The Determinants of Bank Capital Structure:
A European Study

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ABSTRACT

The paper investigates the capital structure determinants of the European Economic Area's listed commercial banks. We include the global financial crisis and the euro sovereign debt crisis and also investigate moral hazard effects derived from too-big-to-fail status and alternative types of risk, including that derived from ESG issues. In line with the extant corporate finance literature, we find that equity capital is negatively associated with size and positively related to profits, market-to-book ratios, and dividends. Our evidence also shows that market risk significantly increases banks' equity capital, which confirms the regulatory view that riskier banks are forced to hold higher equity; while asset quality measured by non-performing loans does not seem to significantly affect banks' capital structure decisions. Moreover, we find a positive relationship between equity capital and banks' reputational risk related to Environmental Social Governance (ESG) issues. Finally, it appears that large systematically important banks hold significantly lower equity capital. The study offers potentially important implications as the debate on optimal capital structures of banks is still ongoing.

Keywords: Bank Capital; Capital Structure; Financial Crisis; TBTF; Reputational Risk.

JEL Classification: G21, G32

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1 Introduction

Banks are among the most regulated financial institutions, and the financial sector is among the most regulated sectors in the economy. That is motivated by the need to protect all consumers and government safety net. Post-crisis the focus of international regulation has been on banks' leverage ratios, liquidity, quantity and quality of their capital due to its importance in sustaining systemic stability highlighted by the financial crisis. As bankers argue that high capital ratio requirements increase banks costs and reduce their profitability and ability to compete, it would be expected that banks want to hold less capital than required by regulators.

But recent studies have shown that banks, especially those located in the US and EU, maintain capital ratios well above the regulatory minimum which motivates the need to further investigate banks' capital structure determinants (Berger et al. 2008 , Brewer et al. 2008 and Flannery and Rangan, 2008). In a study of 200 US and EU banks during the period 1991-2004 Gropp and Heider (2010) show that regulatory capital requirements are not of first-order importance in determining banks' capital structure, and find similarities between banks and non-financial firms in their capital structure decision. The "specialness" of banking firms and their remarkable growth in recent years has highlighted the importance of understanding their capital structure and risk taking especially after the recent experiences of financial instability and bank failures that had a significant negative impact on the economy.

In this paper we extend the study of Gropp and Heider (2010) and address the following questions: What are the main bank-specific determinants of capital structure of European listed commercial banks? What is the impact of stock market risk on banks' capital structure? What other risks are the most likely to be related to capital between traditional banking risk (non-performing loans), liquidity risk and reputational risk related to Environmental Social Governance (ESG) issues?. We also contribute to the literature by examining if and to what

extent banks' and non-financial firms' capital structures are similar using the most recent available bank data. We also extend the sample period to cover the international financial crisis and the euro sovereign debt crisis and assess their effect on banks' capital structure. Finally we investigate the capital structure for systemically important banks and test for the too-big-to fail moral hazard effect.

Our main findings are that capital regulations are not of first-order importance in determining banks' capital structure, thereby confirming Gropp and Heider (2010) results, and providing support for the corporate finance view on the bank-specific factors that affect the capital structure decision. The findings hold over the global financial crisis and the euro area sovereign debt crisis period. We also find that the crisis period negatively affected both book and market equity capital and on the contrary to normal times less profitable banks with lower growth opportunities were perceived by market participants to be in a better position to withstand shocks during the crisis period. Generally, we find that size and market risk variables are the most important factors affecting capital. Investigating additional alternative types of risk, we find that asset quality risk does not seem to affect banks' capital choice. While Banks with higher ESG reputational risk exposure tend to be better capitalized than those with lower risk, we find that well capitalised banks also have higher liquidity. Further, our results indicate that bank equity capital is negatively affected by bank size. Specifically, our results suggest that a bank's book equity ratio is negatively related to its systemic size, measured by the bank's average liabilities-to-GDP ratio.

This paper is structured as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3 discusses the hypotheses and variables selection. Section 4 explains the data and main methodology used in this paper. Section 5 presents and discusses the results. Finally, Section 6 concludes the paper.

2 Literature Review

2.1 Theoretical stand: Bank-specific capital structure theories

Banks are a distinct industry with a special function and features that should be taken in consideration when analysing their capital structure. Banks' capital structure literature is normally separated from that of non-financial firms'. This is due to their 'specialness', their business models and the regulatory and supervisory pressure they operate under imposed minimum capital ratio. Moreover, compared to other industries, banks operate with considerably lower equity levels.

Miller (1995) when asked whether the Modigliani and Miller's (M-M) propositions apply to banks, he replied "Yes and No". On the one hand, he suggests that the (M-M) capital indifference theorem can be extended to banks, even in the presence of market imperfections. He states that it is difficult to consider bank deposits so special to eliminate the applications of M-M propositions to banks. On the other hand, what make banks special are the government repayment guarantees that will affect the banks' cost of capital. Miller argues that the view of banks' equity capital being scarce and expensive is incoherent, and if capital market is left to its devices the M-M propositions cannot be ruled out even in the existence of agency and informational imperfections.

Berger et al. (1995) confirm that capital structure of financial institutions, similarly to other firms, is determined partly by the departure from the perfect world of Modigliani and Miller (1958). The major market imperfections they consider in determining financial institutions' optimal capital ratios are taxes, costs of financial distress, asymmetric information and transactions costs as well as government safety net. According to Berger et al. (1995) banks differ from other firms in two aspects that affect their capital structure: (i) government safety nets that protect the soundness of the financial system and are likely to reduce bank capital as

it protects bank creditors from the penalties of bank risk taking and therefore tends to decrease market capital requirement and (ii) the regulatory capital requirements that aim to increase the capital of banks. As banks have the highest leverage among firms, Berger et al. (1995) argue that this is in contrast with the implications of M-M propositions, which expect capital structure to vary randomly across firms.

The bank-specific capital structure theories developed significantly over the last decades. In particular, Diamond and Rajan (2000) build a model for capital structure where in case of certainty banks use deposits only to fund their projects but under uncertainty conditions the cost of runs motivate the use of other sources of outside capital. Increased bank capital reduces banks' liquidity but enables them to survive and avoid financial distress. The optimal capital structure trades-off banks liquidity, costs of distress and the ease of forcing repayments from borrowers. Allen et al. (2011) discuss the excess capital that banks hold, and how it is expected to support market discipline and system stability. Their model focuses on the assets/lending side and shows that when markets are perfectly competitive, to attract more borrowers and at the same time incentivize monitoring banks choose to use costly capital rather than increase interest on loans.

Admati et al. (2013) examine the arguments that equity is expensive and high capital requirements are costly for large banks. They find this view to be weak and supported by weak arguments from managers and shareholders who have strong incentives to maintain high leverage. Instead, they argue that when banks hold more equity, the risk premium decreases thereby reducing the required return on equity which in turn reduces banks' costs. In their view banks with higher capital face fewer distortions in lending decisions and improve their performance.

Miles et al. (2013) support Admati et al. (2013) and attempt to estimate the optimal equity capital for banks. They find that large increases in equity capital result in small long-term increases in borrowing costs faced by customers. On the other hand, substantially higher capital requirements could result in great benefits by reducing the risk of systemic banking crisis.

More recently Allen et al. (2015) develop an equilibrium general capital structure model with bankruptcy cost. In their model diversification is an alternative to holding equity capital in reducing bankruptcy costs. They argue that it is optimal and more profitable for banks to use costly capital as corporate borrowers prefer dealing with banks that have higher capital and hence have more incentive to monitor them. The authors also highlight the need for more empirical studies on bank capital structure.

Other theories discuss how capital affects banks' liquidity creation, lending and shareholder value. Some argue that higher capital increases banks' efficiency in assets allocation thereby increasing lending and liquidity creation and incentivising more monitoring and consequently higher bank value (Mehran and Thakor, 2011). Others maintain that higher capital decreases liquidity, increases costs and consequently lowers lending and liquidity creation (Diamond and Rajan, 2001). However these theories agree on the effect of banks capital in sustaining systemic stability.

More recently, Thakor (2014) provides a simple model of a bank that provides quality asset transformation and chooses its capital structure. This model is used to explain the relationship between bank capital and stability; it also addresses various theories of bank capital structure. Moreover, the paper reviews the theoretical and empirical debate in the literature on bank capital. The author states that it is empirically proven that higher capital is linked to increased lending, increased creation of liquidity, increased shareholder value in banking and increased

probabilities of survival in crises; while lower capital might lead to systemic instability and increased government debt resulting in bailouts and sovereign crisis. The paper provides extensive discussion of how regulation can enhance banking stability and argues that financial institutions should be required to hold more capital in order to mitigate risks.

2.2 **Empirical stand**

Most empirical studies tend to find similarities in the factors affecting the capital structure of banks and those of non-financial firms. Early studies focus on the US data and on banks' buffer capital. Recent studies include capital as an independent variable to examine other issues such as performance during the crisis (Beltratti and Stulz, 2012), or understand the performance of systemically important banks (Bertay et al., 2013).

Lindquist (2004) focuses on the relationship between banks' capital buffer and credit risk and investigates whether this buffer acts as insurance against falling below the capital regulatory requirements, whether it is used as a competition signal, a supervisory discipline effect and whether it depends on the growth. A generalized least squares (GLS) random effects model is used to analyse the determinants of capital buffers in 127 savings and 10 commercial Norwegian banks covering the period 1995:Q4-2001:Q1. Explanatory variables include banks' credit risk, price of excess capital using β-coefficients as a risk premium proxy, profitability, size, amount of unspecified loan loss provisions, competitors' average capital buffer, supervisory scrutiny, and growth rate of gross domestic product. For commercial banks the author finds a negative relationship between capital buffer and unspecified loan loss provisions which suggests that the latter is used as an alternative to increasing capital buffer and a significant negative effect of size. In general, the evidence of the study supports the insurance explanation and competition signal explanation. Additionally, the author finds that the buffer capital of Norwegian commercial banks does not vary positively with the

measure of credit risk. The author also concludes that commercial banks make a notable effort to rebuild buffer capital after a period of distress. In a US study, Berger et al. (2008) investigate alternative hypotheses that may help explain the "excess" capital that banks held from the mid-1990s. They first test the "pecking order" theory of capital structure which implies that capital ratio at any point simply reflects the history of retained earnings. Second, they test the economic capital hypothesis which states that banks match their capital ratio to risk exposure, valuable charters that they would like to maintain and asset size. Finally, they test if banks maintain excess capital to be able to take advantage of future investment opportunities. The results of their initial analysis strongly suggest that excess capital reflects more than simple historical accumulation of retained earnings and that banks actively manage their capital ratios. A "variable speed of partial adjustment"[1] model is applied to a sample of publically traded US bank holding companies between 1992 and 2006 to test the determinants of target capital ratios. The variables include two measures of risk; returns volatility and counterparty risk as well as market to book ratio, external growth/business strategies, size and bank fixed effects. Size, market to book ratio and business strategies are found to be statistically significant in explaining the target capital ratios that are set well above the minimum regulatory requirements. The study also includes an estimation of the determinants of banks capital adjustments speed. It provides evidence that merely adequately capitalised banks adjust toward their capital targets faster than well capitalised banks. Nevertheless, troubled banks under supervisory pressure adjust toward their targets more slowly.

In another cross-country study that includes twelve industrial countries' banking sectors, Brewer et al. (2008) attempt to explain the variation in banks' capital structure. They test public and regulatory policies in home countries, bank-specific characteristics and

[1] Partial adjustment models mainly focus on the adjustment speed towards target capital ratios and how this adjustment speed may vary for banks with different characteristics (see Brewer et al. (2008) and Gropp and Heider (2010)).

macroeconomic and financial conditions of the country in explaining these differences. The main hypothesis examined in this study is that public and regulatory policies in home countries are essential in explaining the variations in banks' capital structure. This is examined empirically by testing the relation between changes in the banks' capital ratios and a country's safety net, quality of external governance, the degree of authorities' intervention to maintain safe and sound banking system and other regulatory variables. Other determinants included in the model are bank-specific factors (size, risk exposure and profitability), country-specific macroeconomic factors (growth rate of real gross domestic product, the extent to which the financial system of the country is bank-based). A partial adjustment model is estimated using 78 banking organisations headquartered in 12 industrial economies. The authors find the bank-specific factors and the extent to which the financial system of the country is bank-based to be statistically significant in explaining the capital ratios. Remarkably, they find that changes in capital ratios are higher in countries with better provisions for prompt corrective action, better external governance and more explicit capital regulatory requirements; whereas government safety net (this variable captures features of deposit insurance systems that are associated with moral hazard behaviour by banks) was found to be insignificant in explaining the differences among these countries. In general, banks are found to maintain higher capital ratios in smaller countries that have better corporate governance structures.

Jokipii and Milne (2008) analyse the extent of co-movement between European banks capital buffers and the business cycle. Employing the two-step generalized method of moments (GMM) they examine the impact of the business cycle in addition to other bank-specific factors including return on equity (can be interpreted as a measure of equity cost or revenue), credit risk measured by non-performing loans ratio, banks size, profitability and credit demand on banks' equity capital buffers for a sample of European banks over the period

1997-2004. The authors find a negative co-movement between commercial and large bank buffers and cycle variable, As for other bank-specific variables, they find a significant negative effect of size and return on equity and a significant positive effect of non-performing loans ratio.

Literature on the determinants of banks' capital structure considers two alternative views: on one hand, the corporate finance view, which extends the conventional determinants of capital structure found important for non-financial firms to banks. An alternative view is the buffer/ regulatory view. According to this view banks hold buffer capital above the regulatory minimum requirements in order to avoid the high costs associated with issuing equity capital at short notice in case of any violation of capital requirements. We borrow a set of firm-specific variables that are related to the capital structure from the empirical corporate finance literature that has examined the capital structure of non-financial firms to examine the similarities between banks and these firms. For example, Titman and Wessels (1988) empirically analyse a number of theories of capital structure. They distinguish between different types of debt instruments; short-term, long-term and convertible debt instead of simply using total debt measure. Using factor-analysis technique, the authors examine the relationship between different measures of financial leverage and firm-specific factors including the uniqueness of a line of business, firm's size, non-debt tax shields volatility, collateral value, future growth and past profitability for US non-financial firms over the period 1974-1982. They find a negative relationship between firm's leverage and the uniqueness of a line of business, between short-term debt and firm's size and between past profitability and current debt levels to the market value of equity. However, they find the effect of non-debt tax shields, collateral, volatility and future growth to be insignificant. Additionally, Rajan and Zingales (1995) find similarities between G-7 countries and U.S firms in terms of the factors related to leverage when analysing the determinants of capital

structure for the period 1987-1991. The authors focus on size, tangibility, market-to-book ratio and profitability as determinates of non-financial firms' capital structure choice. They estimate the regression using maximum likelihood and a censored Tobit model and use leverage defined as adjusted debt to capitalization as the dependent variable. They find that tangibility and size are positively correlated with leverage, whereas profitability and market-to-book ratio are negatively correlated with leverage (both book and market values).Another important example is Frank and Goyal (2009) who focus on investigating the most important factors that explain capital structure decisions of listed US non-financial firms from 1950-2003. This study has identified a set of firm-specific variables that are related to the capital structure of non-financial firms. Using an OLS regression, they find that the variation in leverage depends mainly on a set of six variables called "core factors". Specifically, leverage is found to be positively related to median industry leverage, tangibility, assets size and inflation, while negatively related to profits, market to book assets ratio and dividends. Their findings are consistent with several corporate finance trade-off theories on departures from the M-M irrelevance theory. They also find that the importance of these factors in the core model change over-time; for example, profits played an important role in determining the leverage ratio before the 1980s but a less powerful role in later periods.

Gropp and Heider (2010) investigate the determinants of banks' capital structure and contrast the corporate finance view with the buffer view. They examine whether banks' capital determinants are similar to non-financial firms' determinants (market/corporate finance view) as opposed to capital requirements being the most important determinant of capital structure (buffer view). The authors focus on the 200 largest publicly traded commercial banks and bank holding companies in the US and EU for the period 1991-2004. Using a standard capital structure OLS regression, they regress the book/market leverage ratios first on the standard corporate finance determinants used for non-financial firms (i.e., market-to-book ratio, profits,

size, collateral, dividends and risk). All variables are found to be statistically significant in explaining the market leverage ratio and have the same sign as the standard regression for non-financial firms. In order to further identify a potential effect of regulation on capital structure, deposit insurance coverage (moral hazard effect) is added as an additional explanatory variable, but no evidence of its impact on banks' capital structure is found. The evidence suggests that regulation becomes important in determining capital structure for banks that hold capital close to the regulatory minimum. Finally, Gropp and Heider (2010) find that time-invariant and bank-specific fixed effects are the most important in explaining banks' capital structure (unobserved parameters that remain fixed for a long period of time). In general Gropp and Heider (2010) find support for the market/corporate finance view rather than the buffer view of capital structure.

The financial crisis prompted widespread interest in developing a better understanding of banks' book capital, market capital and regulatory capital. Beltratti and Stulz (2012) investigate the significant variation in the large banks' performance across the world during the financial crisis. The authors attempt to determine the factors that caused some banks to perform so poorly during the crisis and others relatively better. The focus of the paper is on a sample of 164 large banks (using a threshold of $50billion in assets as of 2006 for systemic importance) with deposits to assets ratio above 20% and loans to assets ratio above 10% across 32 countries for the period 2007-2008. The authors investigate the importance of factors put forward by academics and policy makers as having contributed to the crisis and expect banks that were more exposed to those factors to perform worse than banks less exposed to them during the crisis. The factors include inadequate capital, lax regulations, poor governance and excessive dependence on short-term financing. The study examines the relationship between banks' performance measured by a bank's buy-and-hold dollar stock returns with bank balance sheet and income statement characteristics (including equity, loans,

deposits, income diversity and risk), regulation measures, bank-level governance and macroeconomic variables. Comparing the worst and best performing banks during the crisis the authors find that banks that performed the worst were in 2006 highly leveraged, had better returns, less deposits, high funding fragility, more shareholder friendly boards, lower ex-ante risk and based in countries with more lax regulation. The authors estimate multiple regressions to investigate the determinants of large banks' performance during the crisis and find strong evidence that short-term funding increased banks' fragility, while Tier 1 ratio is found to be positively related to performance emphasising the role of bank capital. They find that banks from countries more exposed to the US performed worse, which highlights the importance of macroeconomic imbalances and traditional asset contagion channel.

Berger and Bouwman (2013) empirically analyse the impact of capital on bank performance including survival and market share during different types of crisis (banking crisis and market crisis) and normal times. The authors examine a sample of commercial banks in the US for the period from 1984:Q1 to 2010:Q4. For the effect of capital on bank survival, they use logit regressions and find that capital increases the probability of survival for small banks at all times, and for medium and large banks during banking crisis. As for the effect of capital on percentage change in market share they use OLS regression and find that holding higher capital increases the market share for small banks at all times, and only during banking crisis for medium and large banks. Hence the authors provide an empirical support for Allen, Carletti and Marquez (2011) theory that higher capital enables banks to increase their market share.

Demirguc-Kunt et al. (2013) focus on banks' capital effect on stock returns during the global financial crisis. They examine whether well-capitalised banks were viewed more positively by the market during the crisis and hence experienced higher stock returns. The authors use

an unbalanced panel sample of 381 listed banks in 12 advanced economies during the period 2005:Q1-2009:Q1 and apply OLS to estimate a basic equation in which a bank's stock return is regressed on a matrix of country/time dummy variables, interaction terms of lagged capital variables and a dummy variable for the crisis period and interaction terms of bank-specific control variables (such as liquidity, asset quality, business model and size) and the crisis period dummy variable (the interaction terms are used to allow the effect of the explanatory variables to differ during the global crisis period). They differentiate among different types of capital variables in addition to estimating the regression for a subsample of large banks only. The results show that capital did not have a significant impact on stock returns before the crisis, but the sensitivity of stock returns to capital measures became stronger during the crisis. The authors find evidence to suggest that better capitalised banks during the crisis were perceived to be in a better position to absorb losses and withstand shocks and hence experienced smaller decline in their stock prices. They also find that the relationship between capital and stock returns is more significant when capital is measured by the leverage ratio. Another interesting finding of this study is that during the crisis the stock return of large banks was more sensitive to leverage ratios than that of smaller banks. Large banks are of greater systemic importance and held less capital before the crisis. The authors support the current focus on strengthening the regulatory capital requirements and recommend more emphasis on minimum leverage ratio as a capital measure to be able to deal with large and complex financial institutions.

Vallascas and Hagendorff (2013) investigate the sensitivity of regulatory capital requirements to risk; in other words, they examine whether minimum capital requirements reflect the risk of banks' portfolio accurately. The authors estimate the link between the change in a bank's risk-weighted assets (which is the regulatory measure of the risk of a bank's portfolio) and the volatility of the bank's assets return (which is the market measure of a bank's portfolio

risk), while controlling for lagged risk-weighted assets and a vector of other bank-specific and country-specific variables. They estimate the regression using a dynamic GMM estimator on a cross-country sample of 246 large listed banking organisations from 41 countries for the period 2000-2010. The results of their study show that there is a positive relation between risk-weighted assets and asset volatility, but significant increases in the market measure of banks' portfolio risk cause a small increase in the regulatory capital requirements. They also provide evidence that Basel II has slightly increased the risk sensitivity of capital requirements.

Distinguin et al. (2013) study the determinants of bank capital buffer focusing on the role of liquidity. They mainly investigate whether banks maintain higher regulatory capital ratios when they face higher illiquidity. Their sample includes US and European listed commercial banks over the period 2000–2006. Using the generalized method of moments (GMM), the authors regress the regulatory capital ratio on illiquidity variables and a set of factors including profitability measured by return on equity, dividends measured by dividends pay-out ratio, risk measured by loan loss provisions to total loans, debt funding structure measured by subordinated debt to total debt, banks' charter value measured by market value of assets to book value of assets, size measured by the natural logarithm total assets, regulatory oversight measured by bank capital regulation index and finally business cycle measured by GDP annual growth rate. Interestingly, results show that higher illiquidity has a negative impact on banks regulatory capital, In other words banks do not strengthen their solvency situation when faced with higher illiquidity. Additionally, they find that banks with higher profitability, lower dividends and higher credit risk tend to have higher capital ratios. Turning to systemic size, Bertay et al. (2013) empirically analyse whether systemically important banks are different in terms of performance (risk and return), business models (activity mixes and funding strategies) and finally whether these banks face a different degree

of market discipline compared to small banks. The authors examine an international sample of banks from 90 countries for the period 1991-2011. On the relationship between absolute and systemic size on the one hand and banks' capital on the other which is the part that is relevant to our work, the authors regress the dependent variable equity ratio (equity divided by assets) on both measures of size; assets as an absolute measure and liabilities over GDP as a proxy for systemic size and a set of bank-level and country-level control variables including country and year fixed effects. Results show a significant negative effect of both absolute and systemic size measures on banks' capital, providing evidence that large and systemically important banks hold significantly lower equity capital than small banks.

In this section we have reviewed briefly empirical literature on the determinants of capital structure, the risk sensitivity of capital and links between bank capital and stability. This brief review has shown that regulatory requirements are not the primary determinants of banks' capital structure decision and shows the importance of bank specific factors and macroeconomic variables in the decision. However, we aim to test if these findings can be extended to the financial crisis and the euro sovereign debt crisis period in addition to testing the sensitivity of equity capital decision to different measures of risk.

3 Hypotheses

The papers most relevant to our study including Titman and Wessels (1988), Rajan and Zingales (1995) and Frank and Goyal (2009), have found a set of firm-specific variables that are reliably related to the capital structure of non-financial firms. Gropp and Heider (2010) confirm the relevance of these variables (i.e., market-to-book ratio, profitability, size, collateral, and risk) for the firms' capital structure decision when applied to large publically traded banks in addition to incorporating a dividend dummy. They find that banks leverage (defined as one minus equity to assets) is positively related to banks size and collateral, and

negatively related to market-to-book ratio, profits and dividends. We use the same set of factors as Gropp and Heider (2010) in our baseline model, but extend the sample period to cover the financial and the euro sovereign crisis. If our results show that these bank-specific variables are the main determinants of banks' capital structure and hold the opposite signs of Gropp and Heider (2010) (as we consider equity ratio instead of leverage ratio), we then can conclude that regulatory requirements are not of first-order importance and provide further evidence for the similarities between banks' and non-financial firms' capital structure.

H1 = similar to non-financial firms, banks' desired equity capital level depends negatively on size and collateral, and positively on the market-to-book ratio, profits and dividends.

The global financial crisis showed fundamental weaknesses in the capital regulation and its role in preventing bankruptcy. Demirguc-Kunt et al. (2013) find that the importance of equity capital becomes evident during the crisis period that pressured the regulatory authorities to alter banks' regulatory environment to reduce their fragility. In this paper we study whether the global crisis and the euro sovereign debt crisis show any significant effect on banks' equity capital and the determinants of capital structure. On the one hand, few studies have found a negative relationship between the position in the cycle and capital buffers (Ayuso et al., 2004; Jokipii and Milne, 2008). On the other hand, the substantial losses banks experienced during this period and the fact that it was harder to raise equity financing than debt financing, motivates us to expect a negative relationship between capital held by banks and the crisis period.

H2 = the relationship between equity capital and crisis period is negative, and not all bank-specific variables affect equity capital with the same sign and magnitude during the crisis.

The regulatory view of capital (buffer view) predicts that equity capital held by banks depend on the probability of falling below the regulatory minimum requirements, hence riskier banks

hold higher equity capital. Similarly, the trade-off theory of corporate finance assumes that firms with higher risk face higher costs of financial distress therefore tend to have more capital. Accordingly, both corporate finance view and buffer view predict a positive impact of risk on banks' equity capital. It has been argued that banks held insufficient capital during the crisis as regulatory requirements were not in line with the riskiness of banks activities (Hellwig, 2010). Therefore, it is important to test the impact of different measures of risk on banks' capital structure.

Our main measure of risk is market risk that is included in Gropp and Heider (2010) model and is expected to have a positive impact on banks' use of equity capital. Riskier banks with higher market return volatility are expected to hold higher capital ratios to decrease the probability of insolvency and the costs of bankruptcy. Vallascas and Hagendorff (2013), show that there is a positive relation between risk-weighted assets as a measure of capital requirements and assets volatility.

H3 = the relationship between equity capital and market risk is positive and significant.

We include additional alternative measures of risk. First, credit risk measured by non-performing loans ratio. Jokipii and Milne (2008), find that banks with relatively risky portfolios generally do hold more capital to hedge against borrowers default risk and meet potential adverse shocks. This is an ex-post measure of the risks associated with the banks' traditional activities and, therefore, its expected sign is positive.

H4 = the relationship between equity capital and credit risk is positive and significant.

As for the second additional measure of risk, we consider liquidity risk. Theoretical and empirical studies suggest a causal relationship from bank capital to liquidity creation, but the relationship is more complex and might be mutual (Distinguin et al. 2013). Banks have an incentive to avoid failure through holding enough capital to hedge against different types of risk and since traditionally banks' main assets are loans that are highly illiquid, we expect

that banks hold higher capital in order to offset liquidity risk, decrease their insolvency risk and strengthen their position in obtaining external financing.

H5 = the relationship between equity capital and liquidity risk is positive and significant.

Finally, we include the reputational risk related to environmental, social and governance issues. Theoretically, Heinkel et al. (2001) argue that socially conscious investors prefer not to invest in low CSR firms, thus fewer investors will be interested in including these firms in their investment portfolios. Additionally, socially irresponsible firms perceived risk particularly litigation risk is higher (Hong and Kacperczyk, 2009). Therefore, we expect banks that are less involved in ESG issues to have lower cost of capital and consequently hold lower capital as they can obtain better price when issuing equity at short notice. To the best of our knowledge, this is the first work that investigates the impact of reputational risk related to ESG issues on banks' capital.

H6 = the relationship between equity capital and reputational risk is positive and significant.

Up to the global financial crisis, banking institutions around the world grew in size significantly and expanded their balance sheets. Reasons behind this growth include taking advantage of scale economies, risk reduction through diversification, managerial benefits in addition to the desire to reach Too-big-to-fail position to benefit from higher government protection (Demirgüç-Kunt and Huizinga, 2013). Brewer and Jagtiani (2013), find that banks were willing to pay an added premium for mergers to reach the TBTF status, and capture extended government safety net access which allows these banks to operate at lower capital levels. Bertay et al. (2013) provide evidence that systemically important banks generally operate with higher leverage. Hence, we expect systemically important banks to hold lower equity capital proving a moral hazard effect.

H7 = systemically important banks hold lower equity capital than smaller banks.

4 Methodology and data

4.1 The empirical model

Following Gropp and Heider (2010) we use the baseline model borrowed from the corporate finance literature for non-financial firms to explain banks' capital structure determinants. The model includes asset size, profitability, market-to-book ratio, collateral, dividends and market (stock) risk. At this stage we compare between the buffer view and the corporate finance view of capital structure. The buffer view states that the main reason for banks holding capital buffer is to avoid falling under the regulatory requirements, whereas the corporate finance view relates banks' capital buffer to the standard capital structure variables as with non-financial firms.

Our standard capital structure regression can be presented as follows:

$$C_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Collateral_{ict-1} + \beta_5 Div_{ict} + \beta_6 StockRisk_{ict-1} + c_c + c_t + u_{ict} \quad (1)$$

The dependent variable is capital (both measures will be used book and market equity capital) of bank *i* in country *c* at time *t*; the explanatory variables include the market to book ratio (MTB), natural logarithm of total assets (Size), profitability (Prof) measured by ROA, tangibility (Collateral), dividends dummy (Div) and market risk (StockRisk). All bank-level explanatory variables are lagged by one period to control for endogeneity issues. The model also includes country and time fixed effects (c_c and c_t , respectively) to account for heterogeneity across time and countries which may be correlated with the independent variables. Standard errors are clustered at the bank level to control for serial correlation of errors and heteroscedasticity (Peterson, 2009). The model is estimated using ordinary least squares (OLS).

The second baseline model additionally includes a set of macroeconomic variables (GDP growth and inflation) to control for their potential effect on banks' activity and omitting country fixed effects. That can be presented as follows:

$$\begin{aligned} C_{ict} = {} & \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) \\ & + \beta_4 Collateral_{ict-1} + \beta_5 Div_{ict} + \beta_6 StockRisk_{ict-1} + \beta_7 GDPgrowth_{ct} \\ & + \beta_7 Inflation_{ct} + c_t + u_{ict} \end{aligned} \quad (2)$$

Next we analyse the effect of the international financial crisis and the euro sovereign debt crisis on banks' capital structure. We then test additional alternative risk measures in the baseline model including asset quality risk measured by non-performing loans ratio, liquidity risk measured by liquid assets to deposits and short-term funding, and reputation risk measured by reputation risk index (RRI) which captures and quantifies reputational risk exposure related to ESG issues. Finally, we examine a sub-sample of large systematically important banks to test for the too-big-to-fail or moral hazard effect.

We now provide a description of our variables and the expected relations between the independent variables and the equity capital, in line with the predictions of the corporate finance view and the regulatory view of capital. Table 1 displays the definition of bank-specific and macroeconomic variables as well as the data sources used in the study.

Table 1: Definition of variables

Variables	Definition	Source
Dependent variables		
Book Capital Ratio	Book value of equity / Book value of assets	BankScope
Market Capital Ratio	Market value of equity (=Number of shares * End of year stock price) / Market value of bank (=Market value of equity + Book value of liabilities))	DataStream
Bank-specific independent variables		
Market-to-Book Ratio	Market value of assets / Book value of assets	BankScope/DataStream
Profitability	Return on average assets (ROA)	BankScope
Size	Log(Total book value of assets)	BankScope
Collateral	(Total securities + Cash and due from banks + Fixed assets)/ Book value of assets	BankScope
Dividend Dummy	1 if the bank pays dividends in a given year, 0 otherwise	DataStream
Risk		
Stock Risk	Annualised standard deviation of daily stock price returns * (Market value of equity / Market value of bank)	DataStream
NPLs	Non-performing loans / Gross loans	BankScope
RRI	End-of-year reputation risk index	RepRisk
Liquidity Ratio	Liquid assets / Deposits and short-term funding	BankScope
Macroeconomic independent variables		
GDP Growth	Annual percentage change of gross domestic product	World Bank Development Indicators and Eurostat database
Inflation	Annual percentage change in average consumer price index	World Bank Development Indicators
Crisis Dummy	Dummy for years of the financial and the euro sovereign crisis (2008-2011)	
Systemically Important Banks – Assets	Dummy for banks with total assets equal or above 50% of GDP	BankScope/Eurostat database
Systemically Important Banks - Liabilities	Dummy for banks with total liabilities equal or above 50% of GDP	BankScope/Eurostat database

Our dependent variables are the banks' market equity capital ratio measured as a ratio of the market value of equity to the market value of assets and the book equity capital ratio measured as a ratio of the book value of equity to the book value of assets. Turning to the independent variables, we use a market-to-book ratio as a measure of growth opportunities. It has been found to have a positive relation with the equity capital of financial and non-financial firms (Rajan and Zingales (1995), Frank and Goyal (2009), Gropp and Heider

(2010)), which is in line with the sign predicted by the trade-off theory where higher growth opportunities increase the costs of financial distress and consequently less debt is used. On the other hand, the buffer view predicts that banks with higher growth opportunities tend to hold less equity capital, as these banks are better known to investors and can obtain better price when issuing equity at short notice (Gropp and Heider, 2010). We measure profitability as return on the book value of average assets. The pecking order theory of Myers and Majluf (1984) predicts a positive relationship between profitability and equity capital as profitable firms prefer to use internal financing rather than debt; whereas the agency theory expects firms with higher profitability to rely more on debt financing to discipline managers and decrease free cash-flow (Jensen, 1986). Frank and Goyal (2009) report that most empirical corporate finance studies find a positive relation between profitability and equity capital, which validates the pecking order theory. The buffer view of capital predicts a negative relationship between profitability and equity capital. Based on the same argument given for growth opportunities, profitable banks are better known to investors and can obtain better price when issuing equity at short notice so they do not need to hold higher equity capital. Size calculated as the logarithm of total assets is expected to have a negative impact on equity capital according to the trade-off theory that predicts that larger firms tend to have more leverage capacity. However, according to the buffer view the relation between size and equity capital is ex-ante ambiguous (Gropp and Heider, 2009). Larger banks may hold larger buffers to compensate for higher complexity and asymmetric information; alternatively it is possible that larger banks hold smaller buffers because they are better known to investors and able to issue equity with less cost at a short notice. We include collateral as a measure of tangibility, which is expected to have a negative relation with equity capital as according to the trade-off theory tangibility enhances the lenders' willingness to provide debt financing to firms. Titman and Wessels (1988), Rajan and Zingales (1995) and Frank and Goyal (2009) argue

that tangibility reduces the costs of financial distress and hence motivates higher debt financing. As for the dividend variable we use a dummy that takes the value of 1 if the bank pays dividends in a given year. Corporate finance studies support the pecking order theory that dividend-paying firms with higher profits prefer internal financing rather than debt financing; hence a positive relation is expected. Alternatively, the buffer view expects dividend-paying banks to have lower equity-issuing costs and, consequently, to hold lower equity capital.

We also investigate the effect of the global financial crisis and the euro sovereign debt crisis on banks' equity capital and whether the determinants of capital structure have the same effect during this period. To this end, we use a dummy variable that takes the value of 1 for the years of the international financial crisis and the euro sovereign debt crisis (2008–2011) and zero otherwise. Additionally, we incorporate into the model a set of variables consisting of this dummy variable times selected bank-specific explanatory variable (i.e. crisis dummy * Market-to-Book Ratio, crisis dummy * Profitability, crisis dummy * Size, crisis dummy *StockRisk). We generally expect a negative effect of the crisis period on equity capital due to the recession and distress banks experienced during the period. Additionally, we expect different effects of these key determinants during the crisis period especially with the regulatory pressure on banks to adjust their strategies and improve their stability.

Concerning banks' risk, we employ four different measures. In the baseline model we follow Gropp and Hieder (2010) and use market risk which is stock returns volatility (StockRisk) measured as the annualised standard deviation of daily stock price returns by the market value of equity over the market value of the bank. Additionally, we use asset quality risk measured by non-performing loans over gross loans, liquidity risk measured by liquid assets to deposits and short-term funding, and reputation risk measured by reputation risk index RRI.

The RepRisk Index (RRI) is an algorithm that captures and quantifies reputational risk exposure related to Environmental Social and Governance issues, the Current RRI used in our study denotes the level of media and stakeholder exposure of a company related to ESG issues, we use end of year value. RRI decays to zero over a maximum period of two years if no risk incident has appeared for a company. It ranges from zero (lowest) to 100 (highest), the higher the value, the higher the risk exposure to ESG issues. It is worth mentioning that the RRI data are available from beginning of year 2007 and for 74 banks out of our sample. All measures of risk are expected to have a positive effect on equity capital according to both the buffer view and corporate finance view. Under the trade-off theory assumption that firms with higher risk and higher volatility in cash flows face higher costs of financial distress and therefore tend to have more capital. As for the buffer view, riskier banks are required to have more equity capital as they have higher probability of falling below the minimum regulatory capital. Table 2 is adapted from Gropp and Heider (2010) and reviews the predicted signs of the capital structure determinants for corporate finance view and buffer view.

Table 2: Predicted effects of explanatory variables on equity capital: corporate finance view vs. buffer view

Variable	**Predicted signs on equity capital**	
	Market/corporate finance	Buffer view
Market-to-book ratio	(+)	(-)
Profits	(+)	(-)
Size	(-)	(+)/(-)
Collateral	(-)	0
Dividends	(+)	(-)
Stock risk	(+)	(+)
Asset quality risk	(+)	(+)
Liquidity risk	(+)	(+)
Reputational risk	(+)	(+)

The table compares the traditional corporate finance view and regulatory buffer view in terms of the predicted signs of determinants of capital structure. Source: adapted from Gropp and Heider (2010).

The study of the systemically important banks or the TBTF moral hazard effect is conducted with a similar framework. We follow Demirgüç-Kunt and Huizinga (2013) and include a dummy variable that is equal to one if a bank's average liabilities to national GDP ratio is equal to or above 0.5 over the bank's lifetime in the sample period. Alternatively, we include a dummy variable that is equal to one if a bank's average assets to national GDP ratio is equal to or above 0.5 over the sample period. We expect a negative relationship between systemic size and equity capital held by banks, as reaching the TBTF status enable these banks to capture extended government protection and allow them to operate with lower level of equity capital (Brewer and Jagtiani, 2013).

Finally, we include macroeconomic variables to control for the anticipated high exposure of banks' activities to the economy of each country. These variables are the GDP growth which is a measure of the annual percentage change of gross domestic product and inflation which is a measure of the annual percentage change in the average consumer price index.

4.2 **Data sources**

The data for the analysis are drawn from the following sources: banks' financial statements data from the BankScope database of the Bureau Van Dijk; market data (stock prices, dividends, number of shares and market value) from Thompson Financial's DataStream database; reputation risk index from RepRisk database; country-level economic data from the World Bank Development Indicators and Eurostat database.

The sample period starts in 2005 and ends in 2014, thereby covering the global financial crisis and the euro sovereign debt crisis. The period also includes different regulatory frameworks that banks have to comply with from Basel I, II and recently Basel III.

To select the sample, we start with listed commercial banks and bank holding companies in the European Economic Area excluding Iceland (to avoid the Icelandic financial crisis) and

Liechtenstein (as there are no listed banking institutions). The focus is on the EU 28 countries, Norway and Switzerland. Estonia and Latvia are dropped from the sample as there are no banks that meet the sample criteria. At this stage the sample consists of 182 banks.

Following Beltratti and Stulz (2012), for a bank to be included in the sample we require it to be a deposit-taking and loan-making bank, therefore two criterions were implemented: first, the bank is required to have the deposit and short-term funding to total assets ratio of at least 20%; and second, the gross loans to assets ratio of at least 10%. As a result, Luxembourg is also excluded from the sample.

The final sample consists of 149 listed commercial banks and bank holding companies in the European Economic Area region (EEA) excluding Iceland. Table 3 shows the number of banks in each country of the sample, the average bank size (total assets in billion euros) and the average bank book equity capital ratio. Some banks do not have complete data over the full period hence the sample is an unbalanced panel of 1490 bank-year observations.

Table 1: Number of unique banks across countries

Country	Number of banks	Average bank size (BillEur)	Average bank book capital ratio%
Austria	6	54.49	7.76
Belgium	2	387.40	3.78
Bulgaria	3	1.31	16.53
Switzerland	10	129.70	11.35
Cyprus	3	22.89	6.97
Czech Republic	1	27.09	10.21
Germany	8	353.20	6.15
Denmark	24	23.36	10.75
Spain	8	347.00	5.90
Finland	2	6.04	4.80
France	4	910.20	3.97
United Kingdom	10	854.60	7.25
Greece	5	58.85	6.75
Croatia	13	2.12	12.23
Hungary	1	32.63	12.39
Ireland	3	144.80	6.05
Italy	11	176.80	8.91
Lithuania	1	0.80	10.99
Malta	2	4.01	9.65
Netherlands	2	607.60	5.77
Norway	2	152.90	8.19
Poland	13	12.00	11.28
Portugal	4	60.88	5.92
Romania	3	5.37	9.91
Sweden	3	337.50	4.12
Slovenia	1	0.97	6.73
Slovakia	4	5.60	7.55
Total	149	171.40	8.90

The sample consists of 149 publically traded commercial banks and bank holding companies in EEA (excluding Iceland and Liechtenstein) and covers a period 2005-2014.

The table reports the countries that have at least one bank that meets the sample selection strategy; Denmark has the highest number of banks in the sample (24 banks) followed by Poland (13 banks) and Switzerland (10 banks). The table also shows that in our sample France has the highest average bank size (910 billion Euros) followed by the United Kingdom (854 billion Euros). As for equity capital ratios, Belgium and France have the lowest average ratios with 3.78% and 3.97% respectively while Bulgaria and Hungary have the highest average ratios with 16.53% and 12.39% respectively.

Greek banks were the most effected by the recent European sovereign crisis, to avoid possible bias, descriptive statistics and correlations were calculated with and without Greece. However we find that the effect of these banks is insignificant due to their relatively low number in the sample (5 banks). Further, to avoid the possibility of outliers driving the results, we follow Beltratti and Stulz (2012) and winsorize all bank-level variables at the 1% level. Table 4 provides descriptive statistics for the main variables used in the study.

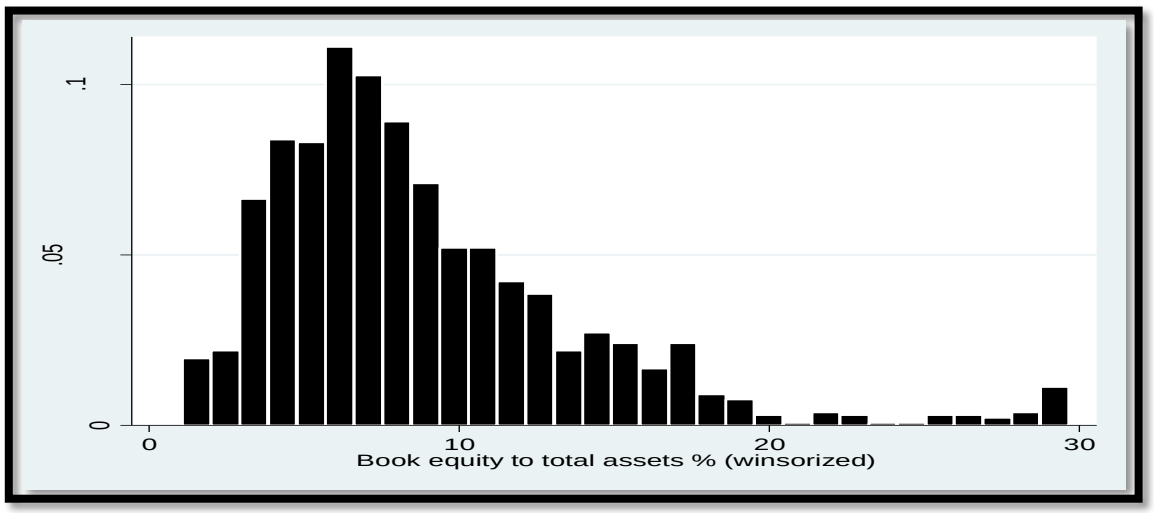
Table 2: Descriptive statistics of main variables

Variable	Mean	Std. Dev.	Min	Median	Max	Observations
Book Capital Ratio	8.898	5.167	1.080	7.620	29.670	1324
Market Capital Ratio	10.151	10.009	0.000	6.955	52.440	1324
Market-to-Book Ratio	102.096	11.230	85.060	99.340	161.750	1324
Profitability	0.461	1.461	-6.560	0.550	4.150	1324
Size (billEur)	171	390	0.045	9.804	1970	1324
Collateral	28.741	14.022	3.280	27.010	68.640	1313
Dividend Dummy	0.559	0.497	0.000	1.000	1.000	1485
StockRisk	3.793	4.526	0.100	2.140	25.630	1251
NPLs	8.006	8.737	0.150	5.350	44.900	1038
RRI	15.171	17.821	-1.000	12.000	71.000	592
Liquidity Ratio	29.230	21.639	3.310	24.395	113.280	1284
GDP Growth	1.147	3.065	-14.810	1.600	11.090	1477
Inflation	2.139	1.606	-4.480	2.120	12.350	1490
Gross loans/total assets%	61.440	15.788	18.810	63.785	91.930	1324
Deposits & short term funding/ total assets%	71.235	14.557	34.060	75.590	93.060	1317

The sample consists of 149 publically traded commercial banks and bank holding companies in EEA (excluding Iceland), data obtained from the BankScope database for 2005-2014. Bank-level variables winsorized at 1% level.

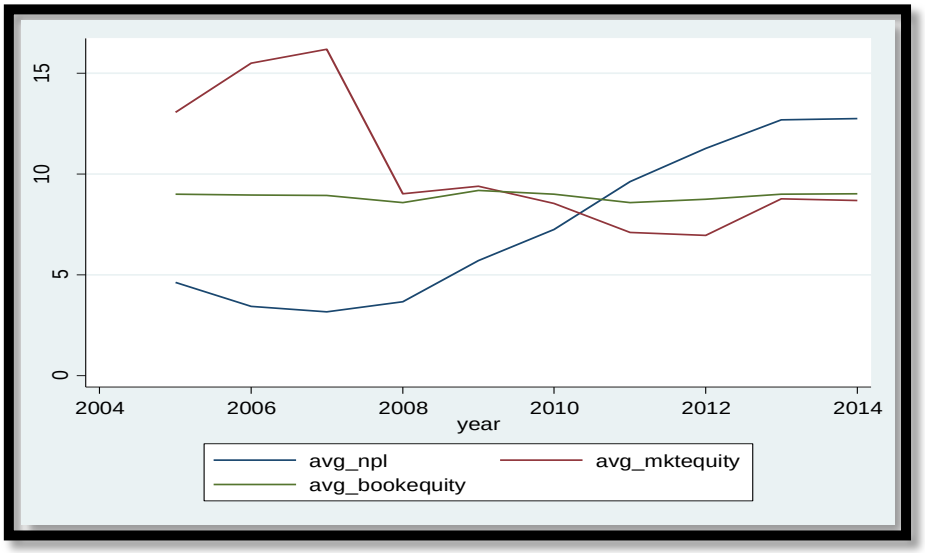
The data show that the mean of book capital ratio for EEA banks is approximately 9% illustrating a high leverage of the sample banks. The results also show high variation in banks' book capital ratio, this applies to market capital ratio as well, which contradicts the traditional view that the amount of capital held by banks is determined by regulatory requirements suggesting low capital dispersion among banks falling under the same regulatory regimes. Figure 1 illustrates the distribution of the book equity to assets ratio varying from 1% to 30% for a sample of 149 listed commercial banks and bank holding companies in the EEA after winsorizing. Figure 2 shows the significant decrease in average market equity capital ratio for European banks included in the sample over the period 2005–2014. Since the financial crisis hit the global economy in 2007-2008 the average credit quality of the banks' loan portfolios decreased severely as a result of the global economic recession (Beck et al., 2013). Figure 2 also shows the significant increase in average non-performing loans ratio for the sample banks over the period 2005–2014.

Figure 1: Distribution of banks book capital ratios



The figure shows the distribution of book capital ratio for the sample.

Figure 2: Change in average equity capital and NPLs ratios over the sample period

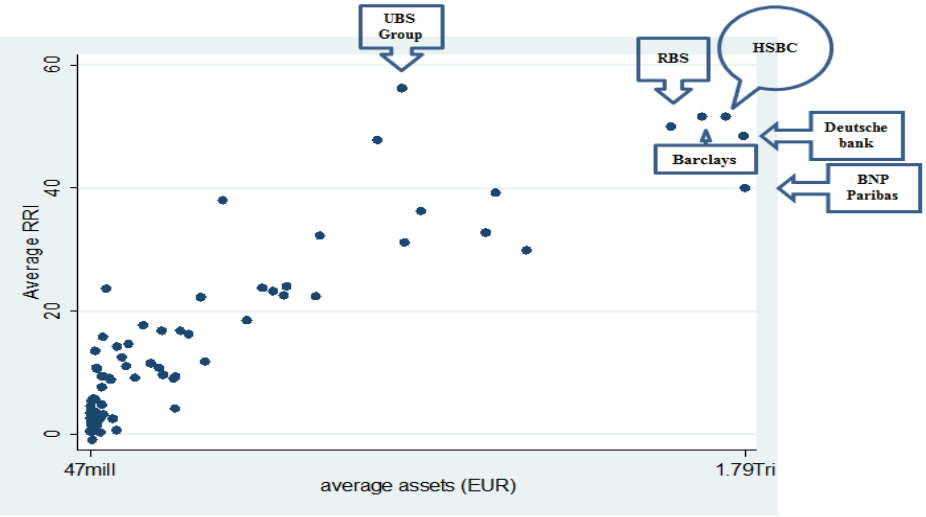


The figure shows the change in average book equity ratio (avg_bookequity), average market equity ratio (avg_mktequity) and average NPLs of listed commercial banks and bank holding companies in the EEA region from BankScope database from 2005 to 2014.

The mean of total book assets is 171 billion euros; the smallest bank in the sample has an asset value of 45 million euros which exhibits significant heterogeneity in the sample. Banks on average appear to earn low return during the sample period as suggested by the mean return on assets of about 0.5%; the negative figure in ROA minimum value illustrates a period of significant losses for some banks.

Banks that have the highest average end-of-year reputational risk exposure over the period seem to be the largest banks in terms of average assets (e.g. Barclays Plc, Royal Bank of Scotland Group Plc (The), BNP Paribas SA, Credit Suisse Group AG, HSBC Holdings Plc, UBS Group AG, Deutsche Bank AG and Societe Generale SA). Figure 3 illustrates the relationship between banks average assets and average RRI for the period 2007-2014.

Figure 3: The relationship between Banks average assets and average RRI



The figure shows the relationship between banks average assets and average RRI for the period 2007-2014.

Before proceeding to the regression results, we examine the correlation between the main bank-specific variables reported in Table 5. The data show that banks with higher asset risk, higher profitability and higher growth opportunities tend to have higher book and market capital ratios, while larger banks and banks with high collateral tend to have more leverage.

The correlations are in line with those found in the empirical literature with the exception of dividend dummy that is found to be negatively correlated with the book capital ratio, but positively and significantly correlated with the market capital ratio.

Table 3: Correlation matrix for selected bank variables

	Book Capital Ratio	Market Capital Ratio	Market-to-Book Ratio	Profitability	Size	Dividend Dummy	Stock Risk	Collateral
Book Capital Ratio	1.0000							
Market Capital Ratio	0.6421	1.0000						
	0.0000							
Market-to-Book Ratio	0.2504	0.8821	1.0000					
	0.0000	*0.0000*						
Profitability	0.2933	0.4122	0.3474	1.0000				
	0.0000	*0.0000*	*0.0000*					
Size	-0.3427	-0.2455	-0.1066	-0.0519	1.0000			
	0.0000	*0.0000*	*0.0001*	*0.0590*				
Dividend Dummy	-0.0544	0.1332	0.1676	0.3192	0.1668	1.0000		
	0.0478	*0.0000*	*0.0000*	*0.0000*	*0.0000*			
Stock Risk	0.5950	0.8392	0.7365	0.2145	-0.2218	-0.0643	1.0000	
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0230*		
Collateral	-0.1805	-0.0988	-0.0103	-0.0266	0.5007	0.0615	-0.1009	1.0000
	0.0000	*0.0003*	*0.7085*	*0.3363*	*0.0000*	*0.0257*	*0.0004*	

The table reports correlation for selected bank variables. *P*-values are reported under the correlation coefficients.

5 Empirical Results

5.1 The determinants of banks' equity capital: The corporate finance view versus the buffer view

In this section we analyse the results derived from estimating Equations (1) and (2) based on the full sample. The results for the equity capital model are reported in Table 6.

We consider two measures of equity capital, namely, the market equity capital (Columns (1) and (2)) and the book equity capital (Columns (3) and (4)) ratios. In order to decide whether to apply a random or a fixed effects estimator we use the Hausman (1978) test. The test suggests that the random effect assumption is not true; hence we use the fixed effects estimator. The model is estimated with macro variables and time fixed effects (Columns (1) and (3)), and with country and time fixed effects without macro-variables (Columns (2) and (4)).

Table 4: Market and book equity capital ratio models

	(1)	(2)	(3)	(4)
Dependent variable	Market Capital Ratio		Book Capital Ratio	
Market-to-Book Ratio	0.474***	0.457***	0.007	0.003
	(0.040)	(0.046)	(0.028)	(0.027)
Profitability	0.373	0.336	0.683***	0.693***
	(0.254)	(0.249)	(0.210)	(0.199)
Size	-0.739***	-0.755***	-0.831***	-0.815***
	(0.097)	(0.167)	(0.100)	(0.194)
Dividend Dummy	1.189**	1.384***	0.720*	0.622
	(0.480)	(0.519)	(0.425)	(0.391)
StockRisk	2.382***	2.198***	1.660***	1.689***
	(0.413)	(0.487)	(0.373)	(0.479)
Collateral	0.008	0.011	-0.002	0.003
	(0.016)	(0.018)	(0.018)	(0.021)
Inflation	-0.457**		-0.120	
	(0.191)		(0.207)	
GDP Growth	0.249**		-0.009	
	(0.104)		(0.096)	
Constant	-26.29***	-24.18***	19.10***	19.63***
	(4.716)	(6.389)	(3.016)	(4.427)
Time fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	No	Yes	No	Yes
Clustering (bank)	Yes	Yes	Yes	Yes
R-squared	0.744	0.757	0.510	0.556
Number of observations	1090	1101	1090	1101

The table reports the regression results of estimating the relation between capital ratios and a set of bank-specific and country macro factors. The dependent variable is (i) market capital ratio (Columns (1)-(2)) and (ii) book capital ratio (Columns (3)-(4)). The independent variables include the bank-specific variables: (i)Market-to-Book Ratio (ii)Profitability (iii)Size (iv) Collateral(v) StockRisk (all lagged by one year) and (vi) Dividend Dummy. And the country macro variables include: (i) Inflation (ii) GDP Growth. The regressions are run on the full sample of 149 publicly traded commercial banks and bank holding companies in EEA (excluding Iceland) covering the period of 2005-2014. Standard errors are reported in parentheses. *, **,*** indicate significance at 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at bank level.

In models (1) (2), where the dependent variable is the market capital ratio, and in models (3) (4) where the dependent variable is the book capital ratio we find that the coefficients on the bank-specific variables are mostly consistent with the predictions of the corporate finance literature (Frank and Goyal (2009); Rajan and Zingales (1995)), which provides evidence that the equity capital held by banks is determined by the same set of factors that determines the capital structure of non-financial firms. This suggests that the regulatory (buffer) view does

not explain the determinants of banks' capital structure. In particular, the buffer view predicts negative relationship between market-to-book ratio, profits, dividends and equity capital (as shown in Table 1). As banks with higher growth opportunities, higher profits and higher frequency of dividend payment would hold less equity capital, since they can issue equity at lower costs and at a short notice; however, results suggest that these banks hold more equity capital providing evidence to our first hypothesis H1.

Coefficients of risk and size variables support both the buffer view and the corporate finance view of capital. The buffer view suggests that riskier banks hold higher equity to avoid falling below the regulatory minimum while larger banks take advantage of being known to the public so they can issue equity at a lower cost and at a short notice. Stock risk (market risk) sign and significance provide evidence of our third hypothesis H3.

The findings of the book equity models (3) (4) are generally consistent with the results of the market equity model as the signs of the coefficients remain unchanged. However, the statistical significance of some coefficients varies as for example in the case of the market-to-book ratio, the dividend dummy and profitability measured as ROA. The estimated coefficient of the collateral variable turns out to be insignificant in all models.

Risk and size variables are highly significant in all models estimated. Consequently, we can say that the most important factors affecting capital appear to be size and risk.

As for the macroeconomic variables, we find that the market equity capital tends to be associated with higher GDP growth and lower inflation; but these results turn insignificant in the book equity capital regression. It is worth mentioning that both using country fixed effects or substituting it with macroeconomic variables provide similar results for the explanatory variables.

Overall, our results are consistent with Gropp and Heider (2010) in that regulation does not appear to be of first order importance in determining banks' capital structure and that there are similarities between banks and non-financial firms regarding the determinants of their capital structure decision although in a period of different regulatory frameworks and crises. Thereby, confirming our first hypothesis H1.

5.2 International financial crisis and euro sovereign debt crisis effect

In this section we investigate the effect of the international financial crisis and the euro sovereign debt crisis on banks' equity capital and whether the determinants of capital structure have the same effect during this period. We expect a negative effect of the crisis period on the equity capital as banks experienced substantial losses and it was harder to raise equity financing than debt financing. Table 7 presents the estimation results of the equity capital model incorporating a dummy variable for the international financial crisis and the euro sovereign debt crisis years (2008-2011) and interaction terms between selected bank-specific variables and the crisis dummy.

Model (1) shows that banks' market equity capital was significantly lower during the crisis period, this result is expected as the global financial crisis and euro sovereign crisis period witnessed a great recession and many banks experienced distress. Incorporating the interaction variables in model (2) we find that the market-to-book and profitability variables exhibit an opposite effect on the market capital ratio during the years of the financial crisis and the European sovereign crisis; in other words less profitable banks with lower growth opportunities were perceived by market participants to be in a better position to withstand shocks. In model (3), where the dependent variable is the book equity capital, we find evidence that banks had less equity capital during the years of the international financial crisis and the European sovereign crisis probably due to the substantial losses banks

experienced during this period, in addition to the difficulty in obtaining equity financing. The interaction terms in model (4) show no significant effects of bank level variables for these years.

As shown in our estimations in Table 7, we find support for our hypothesis H2, as the relationship between capital and crisis period is negative, and some bank-specific variables such as market-to-book ratio and profitability appear to significantly affect equity capital differently during the crisis.

Table 7: Equity capital ratios and crisis effect

	1	2	3	4
Dependent variable	Market Capital Ratio		Book Capital Ratio	
Market-to-Book Ratio	0.454***	0.552***	-0.020	-0.032
	-0.040	-0.031	-0.027	-0.035
Profitability	0.489*	0.734***	0.603***	0.716***
	-0.255	-0.185	-0.213	-0.192
Size	-0.725***	-0.719***	-0.835***	-0.789***
	-0.097	-0.111	-0.100	-0.105
Dividend Dummy	0.759	0.810*	0.447	0.399
	-0.464	-0.436	-0.422	-0.403
StockRisk	2.496***	2.364***	1.732***	1.530***
	-0.408	-0.388	-0.357	-0.373
Collateral	0.003	0.003	0.005	0.004
	-0.017	-0.018	-0.018	-0.018
Inflation	-0.708***	-0.489***	-0.183	-0.214
	-0.128	-0.145	-0.140	-0.137
GDP Growth	0.203***	0.150**	-0.0665	-0.0608
	-0.0755	-0.0645	-0.0596	-0.0595
Crisis Dummy	-2.670***	23.17***	-0.664***	-2.628
	-0.342	-8.151	-0.214	-4.577
crisis dummy * Market-to-Book Ratio		-0.245***		0.032
		-0.081		-0.045
Crisis Dummy * Profitability		-0.977**		-0.270
		-0.449		-0.350
Crisis Dummy * Size		-0.041		-0.091
		-0.120		-0.067
Crisis Dummy *StockRisk		0.232		0.436
		-0.516		-0.345
Constant	-25.29***	-35.82***	22.95***	23.53***
	-4.323	-3.868	-2.745	-3.580
Time fixed effects	No	No	No	No
Country fixed effects	No	No	No	No
Clustering (bank)	Yes	Yes	Yes	Yes
R-squared	0.71	0.736	0.489	0.495
Number of observations	1085	1085	1085	1085

The table reports the regression results of estimating the relation between capital ratios and a set of bank-specific and country macro factors. The dependent variable is (i) market capital ratio (Columns (1)-(2)) and (ii) book capital ratio (Columns (3)-(4)). The independent variables include the bank-specific variables: (i)Market-to-Book Ratio (ii)Profitability (iii)Size (iv) Collateral(v) StockRisk (all lagged by one year) and (vi) Dividend Dummy. And the country macro variables include: (i) Inflation (ii) GDP Growth. Additionally, we incorporate the crisis dummy (columns (1) and (3)) and interaction terms between the crisis dummy and selected bank-specific variables (columns (2) and (4)).The regressions are run on the full sample of 149 publicly traded commercial banks and bank holding companies in EEA (excluding Iceland) covering the period of 2005-2014. Standard errors are reported in parentheses. *, **,*** indicate significance at 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at bank level.

5.3 **Additional measures of risk**

In this section we investigate alternative measures of risk in addition to our main measure which is market risk (StockRisk) to investigate which types of risk have significant effect on banks' capital structure decision. In particular, we first examine the asset quality risk measured by banks' non-performing loans to gross loans ratio. As in Jokipii and Milne (2008), banks are expected to hold higher equity capital to hedge against borrowers' default risk. Table 8 presents the estimation results of the equity capital model with the addition of lagged non-performing loans to gross loans ratio.

The estimated coefficient of the NPLs variable, although positive as expected, is insignificant in both the market capital and book capital regressions (Columns (1) and (2), respectively). This result suggests that asset quality risk on average does not seem to affect banks' capital choice significantly although the recent financial crisis proved the core capital to be insufficient to cover loan losses. Despite the fact that there is a significant increase in average non-performing loans for the sample banks over the period 2005-2014, the relationship between capital choice and asset quality is weak and we fail to find support for our hypothesis that banks with higher credit risk hold higher equity capital H4.

Table 8: Equity capital ratios and NPLs

	(1)	(2)
Dependent variable	Market Capital Ratio	Book Capital Ratio
Market-to-Book Ratio	0.473***	-0.0426*
	(0.052)	(0.024)
Profitability	0.336	0.497*
	(0.341)	(0.271)
Size	-0.685***	-0.771***
	(0.116)	(0.125)
Dividend Dummy	1.299***	1.067**
	(0.450)	(0.447)
StockRisk	2.256***	1.692***
	(0.440)	(0.407)
NPLs	0.024	0.031
	(0.050)	(0.064)
Collateral	0.002	-0.02
	(0.015)	(0.017)
Inflation	-0.290*	0.102
	(0.151)	(0.158)
GDP growth	0.227**	0.082
	(0.100)	(0.077)
Constant	-27.63***	22.55***
	(6.115)	(3.642)
Time fixed effects	Yes	Yes
Country fixed effects	No	No
Clustering (bank)	Yes	Yes
R-squared	0.730	0.527
Number of observations	832	832

The table reports the regression results of estimating the relation between capital ratios and a set of bank-specific and country macro factors. The dependent variable is (i) market capital ratio (Column (1)) and (ii) book capital ratio (Column (2)). The independent variables include the bank-specific variables: (i)Market-to-Book Ratio (ii)Profitability (iii)Size (iv) Collateral (v) StockRisk (vi)NPLs (all lagged by one year) and (vii) Dividend Dummy. And the country macro variables include: (i) Inflation (ii) GDP Growth. The regressions are run on the full sample of 149 publicly traded commercial banks and bank holding companies in EEA (excluding Iceland) covering the period of 2005-2014. Standard errors are reported in parentheses. *, **, *** indicate significance at 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at bank level.

Second, we examine the effect of liquidity risk on banks' capital. Table 9 presents the estimation results of the equity capital model with the addition of a lagged liquid assets to deposits and short-term funding ratio. Consistent with Distinguin et al. (2013), we find that banks with lower liquidity seem to hold lower equity capital and thus are not hedging for this

type of risk through increased capital. Distinguin et al. (2013) find that banks reduce their equity capital when faced with higher illiquidity, in other words banks that face high illiquidity do not strengthen their solvency standards. They explain this finding by the idea that certain liquid liabilities are considered stable by managers and thus might be substituting the capital. The estimated coefficient of the liquidity variable is higher in magnitude and significance in model (2); the positive effect of liquidity on the book value of equity is more pronounced. In both model (1) and (2) we reject our hypothesis H5 that banks hold higher capital to offset liquidity risk and find that well capitalised banks also have higher liquidity.

Table 9: Equity capital ratios and liquidity

	(1)	(2)
Dependent variable	Market Capital Ratio	Book Capital Ratio
Market-to-Book Ratio	0.460***	-0.01
	(0.043)	(0.030)
Profitability	0.398	0.753***
	(0.261)	(0.180)
Size	-0.712***	-0.827***
	(0.103)	(0.100)
Dividend Dummy	1.170**	0.627
	(0.469)	(0.385)
StockRisk	2.563***	1.835***
	(0.427)	(0.348)
Liquidity Ratio	0.0374*	0.0555**
	(0.020)	(0.021)
Collateral	-0.03	-0.0514**
	(0.024)	(0.026)
Inflation	-0.355**	-0.01
	(0.162)	(0.146)
GDP growth	0.251**	-0.01
	(0.101)	(0.087)
Constant	-25.83***	19.53***
	(4.865)	(3.149)
Time fixed effects	Yes	Yes
Country fixed effects	No	No
Clustering (bank)	Yes	Yes
R-squared	0.743	0.561
Number of observations	1061	1061

The table reports the regression results of estimating the relation between capital ratios and a set of bank-specific and country macro factors. The dependent variable is (i) market capital ratio (Column (1)) and (ii) book capital ratio (Column (2)). The independent variables include the bank-specific variables: (i)Market-to-Book Ratio (ii)Profitability (iii)Size (iv) Collateral(v) StockRisk (vi) Liquidity Ratio (all lagged by one year) and (vii) Dividend Dummy. And the country macro variables include: (i) Inflation (ii) GDP Growth. The regressions are run on the full sample of 149 publicly traded commercial banks and bank holding companies in EEA (excluding Iceland) covering the period of 2005-2014. Standard errors are reported in parentheses. *, **, *** indicate significance at 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at bank level.

Finally, we investigate potential effects of reputation risk on the book and market equity capital. We use a reputation risk index (RRI) that measures the current reputational risk exposure of the bank related to Environmental, Social and Governance issues. Since the RRI data are available from beginning of year 2007 and for 74 banks out of our sample, we run

the regression on a subsample of these banks. Table 10 presents the estimation results of the equity capital model with the addition of a lagged end-of-year RepRisk Index for a sub-sample of banks with available RRI data.

Table 10: Equity capital ratios and reputational risk

	(1)	**(2)**
Dependent variable	Market Capital Ratio	Book Capital Ratio
Market-to-Book Ratio	0.492***	-0.0569**
	(0.077)	(0.024)
Profitability	-0.010	0.354*
	(0.451)	(0.204)
Size	-0.698***	-0.666***
	(0.141)	(0.100)
Dividend Dummy	0.868***	0.280
	(0.303)	(0.255)
StockRisk	1.938***	1.595***
	(0.302)	(0.220)
RRI	0.0278**	0.0213**
	(0.014)	(0.009)
Collateral	-0.004	-0.011
	(0.015)	(0.013)
Inflation	-0.075	0.159*
	(0.162)	(0.084)
GDP growth	0.084	0.034
	(0.156)	(0.079)
Constant	-36.66***	21.47***
	(7.921)	(3.392)
Time fixed effects	Yes	Yes
Country fixed effects	No	No
Clustering (bank)	Yes	Yes
R-squared	0.741	0.582
Number of observations	470	470

The table reports the regression results of estimating the relation between capital ratios and a set of bank-specific and country macro factors. The dependent variable is (i) market capital ratio (Column (1)) and (ii) book capital ratio (Column (2)). The independent variables include the bank-specific variables: (i)Market-to-Book Ratio (ii)Profitability (iii)Size (iv) Collateral (v) StockRisk (vi) RRI (all lagged by one year) and (vii) Dividend Dummy. And the country macro variables include: (i) Inflation (ii) GDP Growth. The regressions are run on a subsample of 74 publicly traded commercial banks and bank holding companies in EEA (excluding Iceland) covering the period of 2007-2014. Standard errors are reported in parentheses. *, **, *** indicate significance at 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at bank level.

The results show that the estimated coefficients of reputation risk index are positive and statistically significant at 5% level in both the market equity and book equity models. This suggests that well-capitalised banks have higher engagement in activities related to ESG issues. The results also suggest that market equity capital does not seem to reflect the value of risks associated with banks' ESG activities. In other words, the market does not seem to realise the banks' higher exposure to reputational risk. The regressions in table 10 enable us to accept the sixth hypothesis H6 that the relationship between capital and reputational risk is positive and significant.

5.4 **Systemically important banks**

In this section we try to capture the "too-big-to-fail" effect on banks' capital structure. Access to safety net allows large institutions to operate with lower capital and thus lower their costs compared to smaller institutions (Brewer and Jagtiani, 2013). To capture banks' systemic importance, we follow Demirgüç-Kunt and Huizinga (2013) and include a dummy variable that is equal to one if a bank's average liabilities to national GDP ratio is equal to or above 0.5 over the sample period. Alternatively, we include a dummy variable that is equal to one if a bank's average assets to national GDP ratio is equal to or above 0.5 over the sample period. We have identified 24 banks in our sample that meet the liabilities criterion and 26 banks that meet the assets criterion.

Table 11 presents the estimation results of the equity capital model incorporating the dummy variables for the systemically important banks. The estimated coefficients for the dummy variables are negative and highly significant which confirms that these systemically important banks hold significantly lower equity capital ratios. That confirms our last hypothesis H7. This result shows that banks' growth may have been driven by their desire to exploit the too-big-to-fail status and benefit from lower financing cost and higher government

protection. Our results are in line with Bertay et al. (2013) who find that systemically important banks operate with higher leverage.

Table 5: Equity capital ratios - systematically important banks

	(1)	(2)	(3)	(4)
Dependent variable	Market Capital Ratio		Book Capital Ratio	
Market-to-Book Ratio	0.460***	0.460***	-0.004	-0.003
	(0.043)	(0.043)	(0.033)	(0.033)
Profitability	0.238	0.239	0.547***	0.551***
	(0.246)	(0.246)	(0.201)	(0.201)
Dividend Dummy	0.582	0.536	0.007	-0.048
	(0.520)	(0.518)	(0.452)	(0.451)
StockRisk	2.853***	2.855***	2.196***	2.203***
	(0.487)	(0.490)	(0.466)	(0.470)
Collateral	-0.023	-0.022	-0.0360*	-0.0359*
	(0.019)	(0.020)	(0.021)	(0.021)
Inflation	-0.375*	-0.375*	-0.039	-0.037
	(0.194)	(0.195)	(0.225)	(0.225)
GDP Growth	0.251**	0.258**	-0.011	-0.004
	(0.113)	(0.113)	(0.120)	(0.120)
Systemically Important Banks – Assets dummy	-2.596***		-2.663***	
	(0.465)		(0.455)	
Systemically Important Banks – Liabilities dummy		-2.590***		-2.568***
		(0.483)		(0.473)
Constant	-35.15***	-35.28***	8.627**	8.490**
	(4.538)	(4.542)	(3.313)	(3.329)
Time fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	No	No	No	No
Clustering (bank)	Yes	Yes	Yes	Yes
R-squared	0.710	0.709	0.383	0.377
Number of observations	1085	1085	1085	1085

The table reports the regression results of estimating the relation between capital ratios and a set of bank-specific and country macro factors. The dependent variable is (i) market capital ratio (Columns (1)-(2)) and (ii) book capital ratio (Columns (3)-(4)). The independent variables include the bank-specific variables: (i)Market-to-Book Ratio (ii)Profitability (iii)Size (iv) Collateral(v) StockRisk (all lagged by one year) and (vi) Dividend Dummy. And the country macro variables include: (i) Inflation (ii) GDP Growth. Additionally, we incorporate the Systemically Important Banks – Assets dummy (columns (1) and (3)) and the Systemically Important Banks – Liabilities dummy (columns (2) and (4)).The regressions are run on a subsample of 26 (model (1) and (3)) and 26 (model (2) and (4)) publicly traded commercial banks and bank holding companies in EEA (excluding Iceland) covering the period of 2005-2014. Standard errors are reported in parentheses. *, **,*** indicate significance at 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at bank level.

6 Conclusion

In this paper we extend the work of Gropp and Heider (2010) to identify the main capital structure determinants of the European Economic Area's listed commercial banks and bank holding companies. We contribute to the literature by extending the sample period to cover the international financial crisis and the euro sovereign debt crisis and assess their effect on banks' capital structure. Further, we investigate the capital structure for systemically important banks and test for the too-big-to fail moral hazard effect. Finally, we examine different measures of risk including non-performing loans, liquidity risk and reputational risk exposure related to ESG issues. We use a sample of 149 commercial banks for the period 2005-2014. Our main hypotheses are: First, banks are similar to non-financial firms in terms of the factors determining capital structure. Second, the international financial crisis and the euro sovereign debt crisis had a significant impact on equity capital and on the factors determining the capital structure decision. Third, banks hold higher equity capital to hedge against different types of risk. Finally, systemically important banks generally operate with lower capital.

We find that banks' capital structure is not solely determined by capital regulations and provide support for the corporate finance view regarding the bank-specific factors that affect the capital structure decision. The most important factors affecting capital structure decision are size and market risk. We also find a significant negative effect of the international financial crisis and euro sovereign debt crisis on equity capital held by banks. We confirm that systemically important banks hold significantly lower capital which provides support for the too-big-to-fail moral hazard hypothesis. Finally, we find that banks with higher ESG reputational risk exposure tend to be better capitalized than those with lower risk. The study offers potentially important implications as the debate on optimal capital structures of banks is still ongoing.

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