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Master's Programme in Finance

Revisiting the determinants of bank capital structure in Europe and the United States

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Abstract

I analyse the determinants of the capital structure of publicly listed European and U.S. banks in the period 2013–2023, using three different definitions of bank leverage and a set of explanatory variables based on the economic characteristics of the individual bank. There are significant similarities between the determinants of the capital structure of banks and non-financial companies. Bank market and book leverage are explained by the bank's size, profitability, the market-to-book ratio and asset risk. The variables otherwise have a negative effect on market leverage, but the effect of bank size is positive. The effects are otherwise identical with respect to book leverage, but the market-to-book ratio has a positive effect. The cross-sectional variables are not reliably significant with respect to regulatory leverage. Regardless of the definition of leverage, fixed effects at the level of the individual bank are the most important determinant of bank capital structure. Banks' capital structures are specific to the individual bank and remain relatively stable over time and the role of the cross-sectional determinants is limited. The results show that in addition to regulatory requirements, bank capital structure is subject to the disciplining pressure of market forces.

Keywords Banking, capital structure, leverage, bank regulation

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Tiivistelmä

Tutkielmassani analysoin listattujen eurooppalaisten ja yhdysvaltalaisten pankkien pääomarakennetta määrittäviä tekijöitä vuosina 2013–2023 käyttäen kolmea erilaista velkaisuusasteen määritelmää sekä joukkoa pankin taloudellisia ominaisuuksia kuvaavia selittäviä muuttujia. Pankkien ja rahoitussektorin ulkopuolisten yritysten pääomarakennetta selittävien tekijöiden välillä on merkittäviä yhtäläisyyksiä. Pankin koko, kannattavuus, markkina- ja kirja-arvon välinen suhde sekä omaisuuserien riskisyys selittävät markkina- ja kirja-arvoin mitattua pankin velkaisuusastetta. Selittävien muuttujien vaikutus velkaisuusasteeseen markkina-arvoin on muutoin negatiivinen, mutta pankin koon vaikutus on positiivinen. Muuttujien vaikutukset velkaisuusasteeseen kirja-arvoin ovat muuten identtiset, mutta markkina- ja kirja-arvon välisellä suhteella on positiivinen vaikutus. Mainitut muuttujat eivät luotettavasti selitä pankkisääntelystä seuraavien määritelmien mukaisesti määritettyä pankin velkaisuusastetta. Riippumatta käytettävästä velkaisuusasteen määritelmästä, pankkikohtaiset kiinteät vaikutukset ovat keskeisin pankin pääomarakennetta selittävä tekijä. Pankkien pääomarakenteet ovat siis yksilöllisiä ja pysyvät melko vakaina yli ajan. Tulokset osoittavat, että lainsäädännöllisten vaatimusten lisäksi pankin pääomarakenteeseen vaikuttaa pääomamarkkinoiden asettama paine.

Avainsanat Pankkitoiminta, pääomarakenne, velkaisuusaste, pankkisääntely

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1. Introduction

1.1. Background and motivation

One of the defining characteristics of banking as a business activity is a high degree of leverage. At the same time, a bank's capital structure is subject to strict regulatory requirements. Banks are crucial as financial intermediators, extending credit to the real economy and monitoring borrowers (Diamond 1984), and for various public policy goals, such as the effective functioning and stability of the financial system and monetary policy transmission. The government commonly provides various guarantees and subsidies to banks and their investors, including deposit insurance and possible implicit guarantees, such as certain banks being "too big to fail". This may mean that depositors and other investors do not have enough incentives to monitor the bank's activities, which creates moral hazard and excessive risk-taking (Bhattacharya et al. 1998). Hence, it is in the public interest to regulate banks, which includes setting limitations on bank leverage. The prudential regulation of banks is coordinated internationally via the Basel Committee on Banking Supervision, consisting of central banks and banking supervisors, among them the Federal Reserve, the European Central Bank (ECB) and the Bank of England.

Capital structure studies, such as the ones by Rajan and Zingales (1995) or Frank and Goyal (2009), commonly exclude financial companies altogether. Indeed, if the capital structure of a bank was fully determined by regulation, further research into its determinants would not be necessary, as significant cross-sectional variation would not exist. Of course, banks must maintain capital buffers above their regulatory requirements, due to the various costs associated with breaching or coming close to breaching the capital ratio set by regulators. The easiest way to do this is by retaining a sufficient share of earnings when profitability is high, as American banks did in the 1990s (Berger et al. 2008). According to the buffer view of bank capital structure, banks that would find it easier to issue equity at short notice would require lower capital buffers, so they would be expected to have higher leverage.

However, the buffer view does not reflect empirical reality. Gropp and Heider (2010) find that standard cross-sectional determinants of non-financial firms' leverage also hold for banks. The signs of several of the determinants also turn out to be opposite to what the buffer view predicts. Furthermore, they find that unobserved time-invariant bank fixed effects are an important determinant of banks' capital structures. While capital requirements are undoubtedly very important, the results suggest that there are also other forces affecting capital structure decisions. To some degree, banks are optimizing their capital structure based on their riskiness and market pressure from investors, much like non-financial companies. At the same time, the analysis of bank capital structure is complicated by the fact that bank leverage can be defined

in many ways, using either book or market values or regulatory capital based on risk-weighted assets. The relationship between different leverage ratios is not straightforward, they are not necessarily determined by the same factors, and it is not clear which form of leverage is the most relevant in practice.

The study of bank capital structure by Gropp and Heider (2010) considers a sample of American and European banks in the period 1991–2004. However, as a reaction to the Global Financial Crisis of 2007–2008, significant changes have been enacted in banking regulation. Among other things, banks' solvency requirements have been strengthened via the standards set by the Basel Committee, leading to increases in capital ratios. According to supervisory statistics provided by the European Central Bank (2025), at the end of 2023, the aggregate Common Equity Tier 1 capital ratio of banks under ECB's supervision was 15.9 % and the aggregate Tier 1 capital ratio was 17.3 %, up from 13.5 % and 14.3 % respectively at the end of 2015. The leverage ratio was 5.8 %, up from 5.0 % at the end of 2016. Similarly, according to statistics provided by the U.S. Federal Reserve System (2025), the Tier 1 capital of U.S. banks was 14.9 % at the end of 2023, up from 13.4 % at the end of 2015. It is conceivable that regulatory changes and increases in the level of equity capital have reduced the scope for cross-sectional variation in bank capital structures and the explanatory power of the determinants of non-financial firms' capital structure with regards to banks. However, research literature has yet to confirm or disconfirm this possibility. My thesis contributes to the bank capital structure literature with an investigation into the matter using the latest available data.

The results are of interest to banking practitioners and serve to inform ongoing discussions on the future course of banking regulation. Among other things, the determinants of bank capital structure are relevant for assessing how banks would react to a rise in capital requirements and what the impact on credit extension would be in different parts of the economic cycle. These questions cannot be answered without being aware of the pertinent empirical facts.

1.2. Research topic and main findings

In this thesis, I analyse the determinants of the capital structure of publicly listed European and U.S. banks in the period 2013–2023. The aim is to examine whether similar cross-sectional determinants as those explaining non-financial firms' capital structure explain the capital structure of banks. I describe bank capital structure with three different definitions of bank leverage, based on the market and book value of the bank's assets as well as regulatory capital and risk-weighted assets. Following the approach of Gropp and Heider (2010), I use a set of explanatory variables based on the economic characteristics of the individual bank. Based on the empirical results, I examine whether bank capital structure can be explained by regulatory

capital requirements and precautionary capital buffers or by the disciplining pressure exerted by market forces.

I find that bank leverage, as measured in market or book values, is explained by the bank's size, profitability, ratio of the market value of the bank's assets to their book value (market-to-book ratio) and the riskiness of its assets. Consistent with earlier empirical evidence, I find size to have a positive effect on market leverage, whereas profitability, the market-to-book ratio and asset risk have a negative effect. The variables produce identical effects with respect to book leverage, except for the market-to-book ratio, which has a positive coefficient. On the other hand, the role of collateral assets and dividend payments is not reliably significant. Overall, the findings are robust to various model specifications, such as considering sub-samples of European and American banks and alternative time periods as well as the inclusion of macroeconomic control variables.

However, the cross-sectional variables that explain bank market and book leverage are not reliably significant with respect to regulatory leverage, as measured using the regulatory capital and risk-weighted assets of the bank. This disconnect is not altogether surprising, as there is not a straightforward relationship between regulatory leverage and the other forms of bank leverage. The results highlight the inherent complexity underlying bank capital structure decisions and the need to consider the different forms of leverage to gain a comprehensive understanding of the factors driving these decisions.

Overall, the results do not support the buffer view of bank capital structure, which predicts that more profitable banks and banks with a higher market-to-book ratio would be more highly leveraged, as they would find it easier to issue equity at short notice. While capital requirements form an important practical consideration for banks, bank capital structure is also subject to the disciplining pressure of market forces. The differences in the results for each of the forms of leverage considered highlight the different perspectives on bank leverage that they provide, based on market expectations, historical economic facts or regulatory requirements.

Regardless of the definition of leverage, fixed effects at the level of the individual bank are ultimately the single most important determinant of bank capital structure, as in the previous study by Gropp and Heider (2010). The result implies that banks' capital structures are specific to the individual bank and remain relatively stable over time and the role of the cross-sectional determinants is limited. Bank capital structure includes both a transitory and a permanent component, with the permanent component having greater importance, even with a contemporaneous decrease in bank leverage.

There are persistent similarities between the determinants of the capital structure of banks and non-financial companies, which is remarkable given all the economic characteristics and regulatory requirements that are specific to banking. Bank market and book leverage are explained by many of the same cross-sectional variables as non-financial companies' leverage with similar effects. Moreover, the importance of bank-level fixed effects corresponds with the findings of Lemmon et al. (2008) regarding non-financial companies.

1.3. Structure

The remainder of the thesis is structured as follows. Section 2 provides a brief overview of bank capital requirements. Section 3 describes the relevant literature on firm capital structure and the specific issue of bank capital structure. Section 4 lays out the general objectives of the thesis as well as the specific research questions. Section 5 describes data collection and sample formation, defines the variables that are used and explains the methodology. Section 6 presents the empirical results on the determinants of bank capital structure and discusses their implications. Market and book leverage are addressed first, including analysis of the sub-samples of European and U.S. banks and the effect of bank fixed effects, before moving on to regulatory leverage. Section 7 presents additional robustness checks based on alternative time periods and the inclusion of macroeconomic control variables. Section 8 concludes the study, starting with a summary of the main findings and conclusions, before discussing the limitations of the study, suggestions for further research and policy implications.

2. Bank capital requirements

To provide background for the various definitions of bank leverage, a brief overview of bank capital requirements is in order. Only a rough outline can be sketched within the scope of this thesis (based on Dill 2020 and BIS 2025). The Basel Committee on Banking Supervision (BCBS) sets international standards for the prudential regulation and supervision of banks with the aim of improving the quality of banking supervision and enhancing financial stability globally. BCBS members include organisations with direct banking supervisory authority and central banks. There are currently 45 members from 28 jurisdictions, including the U.S. Federal Reserve, ECB and the Bank of England. Members are expected to implement the standards in full. The accords on prudential regulation are commonly referred to as the Basel accords, the current framework being referred to as Basel III.

The Basel framework is risk-based, so banks must calculate their risk-weighted assets (RWA) for credit risk, market risk and operational risk. To calculate RWA for credit risk, the Basel

standards include a standardised approach for assigning risk weights to the bank's exposures. For example, the risk weight for exposures to sovereign debt rated AAA to AA– is 0 %, whereas below B– the weight is 150 %. Banks can also use an internal ratings-based approach, conditional on the approval of the supervisor. Internal approaches are subject to an output floor, in other words a minimum percentage of RWA in relation to the standardised approach, which will be 72.5 % when fully phased in.

Regulatory capital consists of Tier 1 and Tier 2 capital. Tier 1 capital is intended to absorb losses on a going concern basis, protecting the bank's ability to continue its credit intermediation function in adverse economic developments. Tier 1 capital consists of Common Equity Tier 1 (CET1) and Additional Tier 1 (AT1) capital. CET1 consists of the bank's core capital, mainly common stock and retained earnings. The criteria for AT1 instruments are stringent. Among other criteria, these instruments must be perpetual and callable at the initiative of the issuer only after a minimum of five years. Tier 2 capital constitutes gone concern capital, absorbing losses in the event of bank failure. The Basel rules set out detailed criteria for Tier 2 instruments, including their subordination to general creditors, maturity, callability and conversion into common equity under certain conditions.

The Basel framework sets minimum requirements for regulatory capital, also called Pillar 1 requirements. CET1 must be at least 4.5 % of RWA, total Tier 1 capital must be at least 6 % of RWA and total capital (Tier 1 + Tier 2) must be at least 8 % of RWA. In addition to the minimum risk-based capital requirements, there is a further capital conservation buffer of 2.5 % of CET1 to ensure an additional layer of capital to absorb losses, and various other buffers, such as a countercyclical capital buffer and additional requirements for globally or otherwise systemically important banks. In addition to risk-based requirements, there is a backstop non-risk-based 3 % leverage ratio requirement based on a total exposure measure. In the United States, to operate without regulatory restrictions, an institution must be "well-capitalized", including a leverage ratio of 5 % and 10 % total capital to RWA. Supplementing the minimum capital requirements is the supervisory review process (Pillar 2), in which the supervisor assesses the overall capital adequacy of the individual bank in relation to its risk profile.

3. Literature

3.1. Firm capital structure: theory and empirical evidence

One of the central questions in corporate finance is how companies choose their capital structure. While a thorough examination of the capital structure literature is beyond the scope and

topic of this thesis, it is useful to present a general overview before moving on to the specific question of bank capital structure (for a detailed review, see Myers 2003). Empirical literature on the cross-sectional determinants of firm capital structure is of particular interest, even though these studies commonly consider non-financial companies only.

Modigliani and Miller (1958) famously stated that the market value of any firm is independent of its capital structure. When real-world frictions that depart from the Modigliani-Miller assumptions are considered, the prominent capital structure theories are the trade-off theory and the pecking order theory (see Myers 1984, and detailed review of the theories by Frank and Goyal 2008). The trade-off theory, in its simplest form, describes the capital structure decision as a trade-off between the tax deductibility of interest payments and financial distress costs. The pecking order theory states that firms prefer internal to external financing and debt financing to equity financing, due to asymmetric information between management and investors. A theoretical model is presented by Myers and Majluf (1984).

Alternatively, from a behavioural perspective, Baker and Wurgler (2002) contend that capital structure is the cumulative outcome of management's past attempts to time the equity market, in other words to issue equity when their market values are high and to repurchase equity when their market values are low. Literature on agency theory, starting with the famous paper by Jensen and Meckling (1976) and focusing on the conflicts of interests between insiders and outsiders, such as management and outside investors, is also relevant for capital structure. While there are agency costs to debt, it can also serve as an important disciplining mechanism on management, counteracting the free cash flow problem as articulated by Jensen (1986). The simple trade-off theory has also been augmented with elements of agency theory in models such as the one presented by Stulz (1990).

Investigations into capital structure necessitate a definition of leverage. The centre of the debate is whether to consider book or market values of debt and equity. According to Barclay et al. (2006), most empirical studies focus on market leverage regressions, mainly using book values as an additional robustness check. However, based on survey evidence, Graham and Harvey (2001) conclude that firms do not rebalance their debt-to-equity in response to fluctuations in the market value of equity and that debt policy overall is not affected by equity market prices. For similar reasons, Welch (2004) advocates for market values, which seems surprising at first, but the rationale is that equity price fluctuations become crucial for determining debt ratios. While book values seem attractive due to their lower volatility and emphasis on the importance of the firm's own activity, ultimately the book value of equity only serves to even out the sides of the balance sheet.

Ultimately, the question is not so much about what the right definition of leverage is, rather about different perspectives. Myers (1977) states that debt ratios based on market values are clearly more informative than those based on book values, but at the same time, book values refer to already existing assets, while market values incorporate future growth opportunities. Barclay et al. (2006) point out that book leverage proxies for the ratio of debt to assets in place. Book leverage should decline with additional growth options generated by the company, as the growth options do not affect the book value of assets, leading to a negative relation between book leverage and growth options. Frank and Goyal (2009) also point out that book values are backward looking. They mainly consider the ratio of total debt to market value of assets, or *market leverage*, but also report results for the ratio of total debt to book value of assets, or *book leverage*. An alternative definition includes long-term debt instead of total debt.

Empirical studies have assessed the different theories' relationship with observable reality. Harris and Raviv (1991) survey early literature, identifying an array of potential determinants of capital structure. However, the results are contradictory in many parts and often statistically insignificant or otherwise unreliable. Rajan and Zingales (1995) find that profitability and the market-to-book ratio negatively affect firm leverage, and conversely, tangible assets and sales have a positive effect. They find firm leverage and the factors correlated with leverage relatively similar across the G7 economies, even though there are institutional differences in, for example, taxation, bankruptcy law and the market for corporate control.

Frank and Goyal (2009) find several factors that have explanatory power on the *market* leverage of non-financial companies, using a sample of listed American firms in the period 1950–2003. Rather than crediting or discrediting certain existing capital structure theories, the focus is on detecting patterns in the empirical data. The authors narrow a large array of potential determinants down into what they call a core model of firm leverage. Market leverage increases in median industry leverage, tangible assets, firm size, as measured by total assets, as well as expected inflation, the only macroeconomic factor included. Conversely, market leverage decreases in the market-to-book ratio and firm profitability. Also, dividend-paying companies are less leveraged. However, only industry leverage, tangible assets and profitability are significant with respect to *book* leverage, and these coefficients retain their signs.

Using a large sample from 37 countries, Öztekin (2015) finds that reliable international cross-sectional determinants of *book* leverage are firm size, tangible assets and industry leverage with a positive effect and profitability and inflation with a negative effect. Furthermore, leverage is affected by the quality of the countries' institutions. Other studies focus specifically on the effect of the institutional differences between countries on capital structure decisions, for example on the differences in legal and tax systems and corruption (see Fan et al. 2012 and the

articles referenced therein), or on whether the institutions are capital market oriented or bank oriented (Antoniou et al. 2008).

Augmenting the findings on significant cross-sectional determinants of firm leverage, Lemmon et al. (2008) find that most of the variation in leverage ratios is driven by an unobserved time-invariant effect, producing stability in capital structures over long periods. They find that these effects are not explained by previously identified determinants, suggesting that variation in capital structures is primarily determined by factors that remain stable for long periods of time. Thus, leverage ratios are characterized by both a transitory and a permanent component.

3.2. Bank capital structure

Some of the central questions in the banking literature include the economic role of financial intermediators (see, for example, Diamond (1984) on the financial intermediary as a vehicle for delegated monitoring and Diamond and Dybvig's (1983) model of the bank as insurance against liquidity shocks), bank runs and the role of deposit insurance and associated moral hazard issues (see, for example, Merton 1977 and for recent evidence, Anginer et al. 2014), as well as the specifics of bank financing, such as the role of demand deposits (see, for example, Calomiris and Kahn (1991) on demand deposits as a disciplining device and Flannery (1994) on the importance of short-term debt for bank financing). Bhattacharya and Thakor (1993) and Bhattacharya et al. (1998) provide surveys of the classic studies on the economics of banking and bank regulation. Ultimately, all these issues are linked to capital structure. Some theoretical approaches to bank capital structure include Myers and Rajan (1998) and Diamond and Rajan (2000).

It has often been assumed that banks wish to minimize their equity capital, as equity is a costly form of financing, so the regulatory capital requirement should in practice form a binding constraint (Allen et al. 2011). However, this view is not supported by empirical evidence. For example, Berger et al. (2008) find that US banks maintained substantial capital buffers on top of regulatory requirements in the period 1992–2006 and actively managed these buffers, particularly via share repurchases. Brewer et al. (2008) state that leverage ratios for large international banking organizations vary depending on their home country, despite them being subject to essentially the same market forces and Basel regulatory requirements. Gropp and Heider (2010) find that capital regulation was only of second-order importance in determining the capital structure of large U.S. and European banks during 1991–2004. Therefore, various alternative explanations for the factors driving banks' capital structure decisions have been proposed in the banking literature.

Firstly, the levels of bank capital above the regulatory minimum can simply be explained by banks holding precautionary capital buffers (see Berger et al. 2008, Gropp and Heider 2010). The aim is to avoid violating the capital requirement and hence the need to issue equity at short notice and at a potentially high cost. Berger et al. (2008) note that US banks were highly profitable during the period 1992–2006, making it easier to accumulate capital buffers even somewhat passively, especially as dividend payments tend to be sticky. The bank must consider that high payouts of retained earnings may lead the market to perceive the bank's growth prospects negatively, lowering equity valuation. From the regulator's point of view, capital buffers make the effects of changes in capital requirements unclear *ex ante* and may exacerbate the procyclicality of credit extension to the economy.

Secondly, banks may be optimizing their capital structure with regards to the riskiness of their assets and pressure from shareholders and debt investors, similarly to non-financial companies. For example, banks with volatile earnings should then hold more equity capital, while larger banks may be perceived as less risky due to diversification or lower cost of new equity issuance (see Berger et al. 2008, Gropp and Heider 2010). The bank's creditors react to an increase in expected distress costs by raising their required interest rates, to which shareholders can react by increasing equity capital. This process effectively creates a "market capital requirement" (see Berger et al. 1995). Flannery and Rangan (2008) analyse the capital build-up of large U.S. banks in the 1990s and conclude that the most important explanation is that changes in the regulatory environment made banks seem riskier and incentivized investors to monitor them more effectively. They find that bank capital ratios are reliably positively related to asset risk from the early 1990s onwards, while passive effects from earnings growth and stock market valuations only have a temporary impact. Decreases in the value of the banking charter, for example due to deregulation and increased competition, may incentivize shareholders to take on additional risk (see Marcus 1984, Keeley 1990). Furthermore, capital buffers may be related to having financing available for potential acquisitions (Berger et al. 2008).

The market pressure exerted on the bank is also affected by public policy and regulation in its various forms, including explicit or implicit safety nets provided by the government. Brewer et al. (2008) contend that international differences in bank capital ratios may be explained by differences in public policy and banking supervision, such as guarantees provided by the government or the degree of supervisory authorities' powers to intervene, for example to take corrective action if capital requirements are breached.

Gropp and Heider (2010) find similarities between the determinants of the capital structure of banks and non-financial firms, using a sample of U.S. and European banks in the period 1991–2004. Specifically, cross-sectional determinants of non-financial firms' capital structure also

explain the capital structure of banks, and the coefficients mostly have the same signs as well. Moreover, banks having characteristics that would conceivably make it easier to issue equity at short notice (profitability, dividend payments, high market-to-book ratio) are in fact less leveraged. The empirical evidence thus goes against the buffer view of capital structure, since such banks should have less need to maintain capital buffers above regulatory requirements. In addition to the cross-sectional variables, unobserved time-invariant bank fixed effects are an important determinant of banks' capital structure, meaning that capital structures are bank-specific and stable over time. The results hold for various definitions of leverage, when controlling for risk and macroeconomic factors, and for sub-samples of U.S. and European banks.

4. Objective and research questions

The objective of this study is to analyse the determinants of the capital structure of banks in Europe and the United States in the period 2013–2023. The framework and methodology are based on the previous research by Gropp and Heider (2010), which itself builds on Frank and Goyal's (2009) analysis of the capital structure of non-financial companies. For the purposes of this study, bank capital structure is described by the leverage ratio, using the market or book value of the bank's assets or the regulatory Tier 1 capital and risk-weighted assets.

Specifically, I aim to answer the following questions:

1) Do similar determinants as those explaining non-financial firms' capital structure explain the capital structure of banks?

2) How does the definition of leverage affect the results to question 1? In other words, are the results different when capital structure is described by book leverage, market leverage or regulatory leverage?

3) Are the results different for sub-samples of European and U.S. banks?

4) How do the results to the previous questions relate to the different views on bank capital structure presented in the literature?

I use the same explanatory variables as Gropp and Heider (2010) in their study of the earlier period 1991–2004. This enables direct comparability with their results and analysis of differences in results for the respective time periods. The variables used are based on the economic characteristics of the individual bank and mostly correspond to or closely resemble the

determinants of non-financial firms' capital structure found by Frank and Goyal (2009) to constitute the core model of capital structure.

If the cross-sectional factors turn out to be statistically significant, it is possible to draw conclusions from the signs of the coefficients with regards to the buffer and market views on bank capital structure. If bank capital structure is determined by regulatory capital requirements and precautionary capital buffers, more profitable banks, dividend-paying banks and banks with a high market-to-book ratio should be more leveraged, since they would find it easier to issue equity if needed. On the other hand, if capital structure is determined by market forces, these variables can be expected to have a negative effect on leverage. The specific predictions offered by the main views of bank capital structure and the effects found in the reference studies are reported in section 5.3.

The previous results of Gropp and Heider (2010) mainly support the market view. However, the results may conceivably be different for the various definitions of leverage. While book leverage describes accounting facts, market leverage is the most relevant measure from an economic point of view, incorporating the market's forward-looking expectations of the bank's prospects. In addition to the leverage ratio, market pressure may also exert an influence on the asset side of the balance sheet, but this effect is not directly captured by this analysis. Moreover, the regulatory capital ratio can specifically be improved by altering the composition and perceived riskiness of the bank's assets, since regulatory requirements are based on risk-weighted assets. This complicates the analysis, as the connection between the different leverage ratios is not obvious. Hence, it is essential to consider each of the various definitions of leverage separately and examine the possible differences in results.

A specificity of the bank's balance sheet is that its liabilities can be decomposed into deposits and non-deposit liabilities. Although determinants of the composition of the bank's liabilities would be an interesting research question, and though Gropp and Heider (2010) also investigate this question, I do not analyse the issue in this thesis.

5. Data and methodology

5.1. Data

I perform the analysis using data for publicly listed banks in European Union member states and the United States during the period 2013–2023. The sample includes banks from the United Kingdom, which ceased to be a member of the European Union on January 31st, 2020,

for the whole period, and excludes banks from Croatia, which became a member state only on July 1st, 2013.

Balance sheet and income statement data and regulatory capital ratios are sourced from LSEG Workspace. Information on dividends paid, equity market capitalization and stock price data are sourced from LSEG Workspace Datastream. If all relevant data points for a given bank in any given year are not available, the observation is deleted from the dataset. The exception to this is the regulatory capital ratio, as this would reduce overall sample size by too much. Company selection is based on S&P's Global Industry Classification Standard (GICS) and its category number 4010 (Banks), as provided by LSEG Workspace. In total, the sample consists of 137 European banks and 602 U.S. banks.

For the final sample that is used for analyses, I select the 100 largest banks from both Europe and the United States separately for each year, for a total of 200 banks per year. However, the sample only includes 97 observations of European banks for the year 2013, so the final sample consists of a total of 2,197 bank-year observations. Bank size is determined by the book value of assets at the end of the previous year. The same sample is used for the separate sub-sample analyses of European and American banks. However, due to the amount of missing data points for the regulatory capital ratio, the sample used for regulatory leverage as the explanatory variable only includes a total of 2,123 bank-year observations, consisting of 1,023 European and 1,100 American observations.

For macroeconomic control variables, annual GDP growth rates and inflation rates for each country, as measured by average consumer prices, are sourced from the International Monetary Fund's World Economic Outlook database. Data on the yields of sovereign bonds and national stock market index figures are sourced from LSEG Workspace Datastream. The specific national stock indices used for the analysis are selected based on representativeness of the national stock market as well as data availability and are listed in the Annex.

5.2. Variables

The following describes the dependent and explanatory variables used for the regressions described in section 5.3. The definition of the variables mainly follows Gropp and Heider (2010), with slight modifications as explained in the text.

I perform the analysis separately for three different dependent variables describing bank capital structure, specifically leverage. Market leverage describes the bank's leverage using the market value for common equity attributable to shareholders as described by market

capitalization at the end of the year in question. For simplicity and for practical reasons, the book and market values of the bank's liabilities are assumed to be equal. Hence, the market value of the bank's assets is proxied by the market value of equity and the book value of liabilities. Market leverage is then given by the following:

$$1 - \frac{Market\ value\ of\ equity}{Market\ value\ of\ equity + Book\ value\ of\ liabilities}$$

where market value of equity is given by adding equity market capitalization and the book value of those items belonging in equity other than common equity attributable to shareholders, such as preferred stock and hybrid instruments included in equity.

Book leverage describes the leverage employed by the bank using values as reported in annual financial reports for the year in question. Book leverage is given by the following:

$$1 - \frac{Book\ value\ of\ equity}{Book\ value\ of\ assets}$$

Finally, regulatory leverage is based on regulatory Tier 1 capital and the bank's risk-weighted assets as determined by applicable capital requirements regulation:

$$1 - \frac{Total\ Tier\ 1\ Capital}{Total\ Risk\ Weighted\ Assets} = 1 - Tier\ 1\ Capital\ Ratio$$

Instead of regulatory leverage, Gropp and Heider (2010) use the Tier 1 capital ratio directly as the explanatory variable. However, I choose a leverage-based definition to make the variable and associated results, including signs of the coefficients, directly comparable with those for market and book leverage.

The explanatory variables are based on the individual economic characteristics of the bank, and, for the most part, they are based on figures included in annual financial reports. Bank size is given by the book value of the bank's total assets. The regressions described in section 5.3 use the logarithm of bank size.

Profitability is calculated using earnings before taxes and interest expenses and the book value of the bank's assets:

$$\frac{Earnings\ before\ taxes + Interest\ expenses}{Book\ value\ of\ assets}$$

The market-to-book ratio describes the ratio of the market value of the bank's assets to their book value. Based on the definition of the market value of assets above, the variable is thus given by the following:

$$\frac{Market\ value\ of\ equity + Book\ value\ of\ liabilities}{Book\ value\ of\ assets}$$

The variable collateral describes the ratio of the bank's assets that can be readily pledged as collateral to its total assets:

$$\frac{Collateral\ assets}{Book\ value\ of\ assets}$$

Collateral assets specifically include investment securities held for trading, available for sale and held to maturity, cash and short-term deposits due from banks and property, plant and equipment. The definition of collateral thus includes financial assets that can be used as collateral when borrowing from the central bank, but it also includes tangible assets. The definition is formulated based on the form in which the data is provided by LSEG Workspace and corresponds with Gropp and Heider's (2010) definition in practical terms.

The dividend variable is a dummy variable which takes the value 1 in year n if the bank made a dividend payment that year, and 0 otherwise.

Asset risk is the volatility (σ) of the bank's stock multiplied by the ratio of the market value of the bank's equity to the market value of the bank's assets, which was defined above, and is thus given by the following:

$$\sigma * \frac{Market\ value\ of\ equity}{Market\ value\ of\ equity + Book\ value\ of\ liabilities}$$

The calculation of volatility is based on the annualized volatility of daily stock returns, which is given by multiplying daily volatility with $\sqrt{250}$.

Table I provides descriptive statistics on variables in the final sample. It is informative to compare the numbers to Gropp and Heider's (2010) sample, which ran from 1991 to 2004. Their corresponding values are presented in parentheses in the text that follows. Looking at bank leverage, mean and median market leverage in the sample are very close to Gropp and Heider's sample, at 88.6 % and 88.5 % (87.3 % and 88.8 %) respectively, whereas mean and median book leverage are both around 3 percentage points lower at 89.6 % and 89.3 % (92.6 % and 92.7 %) respectively. The results suggest that while banks have, on average, substantially

decreased their leverage in book values, their stock market valuations have also come down, conceivably due to weak financial performance in an era characterised by low interest rates. As noted, the earlier period was characterised by high profitability, at least for American banks (Berger et al. 2008). Mean regulatory leverage in the sample is 85.6 %. In other words, banks' average Tier 1 capital ratio in the sample is 14.4 %.

The average bank in the sample has total assets of 154 billion euros (all values converted into euros). However, there is huge dispersion in this regard, with the largest bank having assets worth 3.5 trillion euros and the smallest only around 120 million euros. This dispersion has also increased in comparison to the earlier sample, as the largest bank in my sample is almost 30,000 times the size of the smallest bank, whereas Gropp and Heider reported a difference of only about 3,000 times in this regard. Notably, the average bank is relatively small compared to the largest banks whose total assets are measured in the trillions and the geographical scope of its operations is likely to be somewhat limited, whereas the largest banks operate globally. In 2023, there were 29 Global Systemically Important Banks (G-SIBs), 18 of which were in the scope of the sample used in this thesis (see Financial Stability Board 2023). My sample consists of 200 banks annually with an equal weight assigned to each observation, so G-SIBs ultimately have a relatively small role in the analyses.

The mean and median market-to-book ratios in the sample are only slightly above parity at 101.6 % and 101 % respectively (106.5 % and 103.9 %). The decrease in market-to-book ratios is understandable as banks' profitability has decreased substantially compared to the earlier sample, with average profitability at 1.9 % (5.1 %) and median profitability almost the same at 1.8 % (4.9 %). The maximum market-to-book ratio is also much lower at 142.4 % (180.9 %). Furthermore, banks are much less likely to pay out a dividend, with the share of dividend payers 81.2 % (94.4 %). The mean collateral and asset risk, however, are very close to Gropp and Heider's sample, at 26.3 % (26.6 %) and 3.4 % (3.6 %). Overall, it can be stated that during the sample period, banking was characterized by poor profitability, low market valuations and low volatility.

Table I also reports descriptive statistics separately for the European and U.S. sub-samples. American banks are, on average, less levered in market and book values, but have higher regulatory leverage. They also have higher market-to-book ratios than their European counterparts. Almost all banks in the U.S. sub-sample paid a dividend, while only around two thirds of European banks did. The size of the average bank is larger in the European sample and U.S. banks' average profitability is only marginally higher than in the European sample.

Table I. Descriptive statistics.

The table reports descriptive statistics on the variables defined in section 5.2 calculated from the sample formed by selecting the 100 largest banks separately from Europe and the United States each year in the period 2013–2023. Descriptive statistics are also reported for the European and U.S. sub-samples. Monetary values have been converted into euros.

Sample and variable	Min	Max	Mean	Median	St. dev.
Full sample					
Market leverage	0.598	0.997	0.886	0.885	0.062
Book leverage	0.784	1.018	0.896	0.893	0.031
Regulatory leverage	0.583	1.062	0.856	0.866	0.039
Size (€ bn)	0.12	3,511.61	154.37	16.91	413.21
Profitability	−0.144	0.092	0.019	0.018	0.012
Market-to-book ratio	0.863	1.424	1.016	1.010	0.064
Collateral	0.007	0.837	0.263	0.243	0.123
Dividend	0	1	0.812	1	0.391
Asset risk	0.001	0.306	0.034	0.030	0.026
European banks					
Market leverage	0.648	0.997	0.924	0.940	0.053
Book leverage	0.784	1.018	0.907	0.913	0.035
Regulatory leverage	0.583	1.062	0.837	0.842	0.043
Size (€ bn)	0.12	2,753.44	204.97	25.66	423.28
Profitability	−0.144	0.092	0.017	0.015	0.015
Market-to-book ratio	0.863	1.407	0.985	0.980	0.58
Collateral	0.016	0.837	0.288	0.273	0.131
Dividend	0	1	0.673	1	0.469
Asset risk	0.001	0.306	0.025	0.017	0.029
U.S. banks					
Market leverage	0.598	0.958	0.849	0.854	0.045
Book leverage	0.814	0.946	0.885	0.886	0.022
Regulatory leverage	0.711	0.940	0.872	0.877	0.024
Size (€ bn)	1.58	3,511.61	103.88	12.88	396.73
Profitability	−0.037	0.075	0.020	0.019	0.007
Market-to-book ratio	0.940	1.424	1.045	1.034	0.056
Collateral	0.007	0.759	0.239	0.217	0.108
Dividend	0	1	0.95	1	0.218
Asset risk	0.009	0.187	0.042	0.038	0.019

Table II reports the correlations between the variables. Overall, there are a lot of similarities to the correlations reported by Gropp and Heider (2010). The correlation coefficients mostly have the same sign as in the previous study and in many parts also roughly similar magnitudes. Market and book leverage correlate positively with bank size, and negatively with profitability, the market-to-book ratio and asset riskiness. One notable difference is that I find the correlation between book leverage and the market-to-book ratio, although negative, to be close to zero, whereas in Gropp and Heider's sample it is –0.420.

In addition to the bank-level explanatory variables, I also use macroeconomic control variables for robustness checks. These include annual GDP growth and inflation rate for each country included in the sample. I also use the term spread, as measured by the 10-year minus 2-year benchmark yields of the government bonds of the country in question. Gropp and Heider used the 3-month yield for this variable, whereas I use the 2-year yield for data availability reasons. Furthermore, I use the stock market risk, measured by the volatility of the national stock market index of the country in question. The calculation is based on annualized volatility using daily returns and is calculated in the same way as the volatility of the individual bank's stock for the purpose of calculating the asset risk variable described above.

Table II. Correlations.

The table reports the correlations between the explanatory and dependent variables described in section 5.2.

The names of the variables are abbreviated as follows: ML = Market leverage, BL = Book leverage, RL = Regulatory leverage, Size = Bank size, Profit = Profitability, MTB = Market-to-book ratio, Coll = Collateral, Div = Dividend payment, Risk = Asset risk.

Variable	ML	BL	RL	Size	Profit	MTB	Coll	Div	Risk
ML	1.000								
BL	0.526	1.000							
RL	–0.165	0.074	1.000						
Size	0.256	0.359	–0.016	1.000					
Profit	–0.301	–0.287	–0.043	–0.051	1.000				
MTB	–0.868	–0.050	0.208	–0.093	0.186	1.000			
Coll	0.033	0.247	–0.230	0.273	–0.082	0.102	1.000		
Div	–0.300	–0.208	0.041	0.049	0.222	0.215	–0.133	1.000	
Risk	–0.630	–0.329	0.142	–0.199	0.146	0.554	–0.010	0.043	1.000

5.3. Method

Following the methodology of Gropp and Heider (2010), and using the variables described in section 5.2, I estimate a fixed effects multiple OLS regression of the determinants of bank leverage. The asset risk factor is not included in Frank and Goyal's (2009) core model of firm leverage for non-financial companies, but Gropp and Heider (2010) consistently find it significant with respect to bank leverage. Therefore, I estimate the model with and without the asset risk factor. The full model takes the following form (*Equation 1*):

$$L_{i,c,t} = \alpha + \beta_1 Log(Size_{i,c,t-1}) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1}$$

$$+\beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log(Asset\ risk_{i,c,t-1}) + c_c + c_t + \mu_{i,c,t}$$

where $L_{i,c,t}$ denotes leverage (either book, market or regulatory) for bank i in country c at time t, and c_c and c_t denote fixed effects for country and time, respectively. The explanatory variables are all lagged by one year, except for the dividend dummy, as dividend payment decisions are based on the previous year's earnings.

Furthermore, to analyse the significance of including the fixed effects in the regressions, I estimate specifications of the model where either country fixed effects (c_c) or time fixed effects (c_t) or both are excluded, being otherwise identical to Equation 1.

An alternative specification of the model is otherwise identical to the one in Equation 1 but includes bank fixed effects (c_i) instead of country fixed effects (c_c) to account for unknown time-invariant bank-specific factors.

As part of robustness testing, I also estimate the model presented in Equation 1 augmented with the macroeconomic control variables that were described in the previous section. The regression model is then as follows (*Equation 2*):

$$L_{i,c,t} = \alpha + \beta_1 Log(Size_{i,c,t-1}) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1}$$

$$+\beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log(Asset\ risk_{i,c,t-1}) + \beta_7 GDP\ growth_{c,t}$$

$$+\beta_8 Inflation_{c,t} + \beta_9 Term\ spread_{c,t} + \beta_{10} Log(Stock\ market\ risk_{c,t}) + c_c + c_t + \mu_{i,c,t}$$

To account for heteroscedasticity and serial correlation of errors, all the regressions include clustered standard errors at the bank level. Furthermore, all variables are winsorized at 0.05 % on both tails.

To analyse the results produced by the regressions, I use the predictions offered by the main views of bank capital structure, as well as the effects found empirically in the most important

reference studies. Table III reports the direction of the effect of each explanatory variable as predicted by the buffer view of bank capital structure and the market pressure view of bank capital structure, following Gropp and Heider (2010). The table also reports the effects found in empirical studies reported by Gropp and Heider (2010) with respect to banks' *market* leverage and Frank and Goyal (2009) on non-financial companies' *market* leverage.

The buffer view predicts that banks with high profitability and a high market-to-book-ratio as well as dividend paying banks are more leveraged, for reasons explained earlier. Overall, it can quite comfortably be predicted that banks with riskier assets are less leveraged and that leverage increases with bank size, regardless of which view is chosen. Otherwise, it is not clear what the predictions for the market pressure view of bank capital structure should be. The predicted effects reported by Gropp and Heider (2010) correspond to the empirical literature on non-financial companies' capital structure. If banks' capital structure decisions are subject to similar market discipline as non-financial companies, the factors should in theory have the same effects with respect to banks. However, due to the various specificities of banking, it is not obvious that the effects should necessarily be the same as for non-financials, nor that they should be identical with respect to the different definitions of leverage. At the same time, a

Table III. The effect of the explanatory variables predicted by the buffer and market views of bank capital structure and effects on market leverage found in previous studies.

The effects of the explanatory variables on bank leverage predicted by the buffer view of bank capital structure are reported in column 1. The effects of the explanatory variables on bank leverage predicted by the market pressure view of bank capital structure are reported in column 2. Column 3 reports the effects found by Gropp and Heider (2010) on bank market leverage and column 4 reports the effects in Frank and Goyal's (2009) core model of non-financial companies' market leverage. The asset risk variable is not included in the Frank and Goyal core model and the model also includes variables not reported here (see section 3.1).

Variable	**Buffer view of bank capital structure**	**Market view of bank capital structure**	**Results in Gropp and Heider (2010)**	**Results in Frank and Goyal (2009)**
Size	+	+	+	+
Profitability	+	–	–	–
Market-to-book ratio	+	–	–	–
Collateral	none	+	+	+*
Dividend	+	–	–	–
Asset risk	–	–	–	n.a.

* Instead of collateral, the coefficient for tangible assets is reported here.

unifying theory to explain the determinants of capital structure does not exist, neither for banks nor for non-financial companies. Frank and Goyal (2009) present a summary of the effect of various factors on leverage predicted by the main capital structure theories.

6. Results

6.1. Determinants of bank market and book leverage

I estimate the model presented in section 5.3 separately with market and book leverage as the dependent variable, for the sample of European and U.S. banks described in section 5.1. Market leverage is economically more informative than book leverage, as it incorporates the value of future growth opportunities at prevailing valuation levels. Fluctuations in equity prices thus impact market leverage directly, and it is also subject to possible market inefficiencies, while book leverage merely describes historical accounting facts. Like Gropp and Heider (2010), I first run the regressions without the asset risk factor and subsequently estimate the full model presented in Equation 1 in section 5.3. The results are shown in table IV. Statistical significance is reported at the customary 1 %, 5 % and 10 % levels.

Using *market leverage* as the dependent variable, each factor except collateral is statistically significant at the 1 % level. Including the asset risk variable in the regression does not affect the significance of the other variables but slightly increases adjusted R2. Notably, the coefficient is negative for all explanatory variables except bank size. This means that more profitable banks, banks with a higher market-to-book ratio as well as dividend-paying banks are less leveraged than other banks, holding other things equal. This finding is not in line with the buffer view of bank capital structure, which suggests that such banks would be on average more leveraged. Banks with riskier assets, as measured by their volatility, are also less leveraged. This is predicted by the buffer view but is also easily explained by the market pressure view, as risky banks should hold more equity capital for various contingencies. Conversely, market leverage increases with bank size, which can also support different views of bank capital structure. The positive coefficient for size can be explained by bigger banks being better known and more credible issuers, leading to a lower cost of capital.

The results of the market leverage regressions thus mostly align with the predictions of the market view of bank capital structure. They are also mostly in line with the results of Gropp and Heider (2010, presented in their table V, column 1 and table VII, column 1), though I find the collateral variable only marginally significant. The similarities are notable considering that there are considerable differences in some of the characteristics of the banks in the respective samples, such as the average profitability. The results also align with the analysis of non-

Table IV. Determinants of bank market and book leverage.

The table reports the results for a model of the determinants of bank capital structure. The sample consists of 100 European and 100 U.S. banks each year in the period 2013–2023. The dependent variable is market leverage in columns 1–2 and book leverage in columns 3–4. The model includes country fixed effects (c_c) and time fixed effects (c_t). A detailed description of the sample and variables can be found in sections 5.1 and 5.2.

Columns 1 and 3 show the results for estimating the model without the asset risk factor:

$$L_{i,c,t} = \alpha + \beta_1 Log\left(Size_{i,c,t-1}\right) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1} + \beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + c_c + c_t + \mu_{i,c,t}$$

Columns 2 and 4 show the results for the complete model:

$$L_{i,c,t} = \alpha + \beta_1 Log\left(Size_{i,c,t-1}\right) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1} + \beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log\left(Asset\ risk_{i,c,t-1}\right) + c_c + c_t + \mu_{i,c,t}$$

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by *s.e.*

Dependent variable	Market leverage		Book leverage	
	(1)	(2)	(3)	(4)
Log(Size)	0.006	0.005	0.006	0.005
t-stat	7.26***	7.04***	6.61***	6.17***
s.e.	0.001	0.001	0.001	0.001
Profitability	−1.165	−0.809	−1.241	−0.908
t-stat	−7.40***	−5.51***	−8.55***	−6.84***
s.e.	0.157	0.147	0.145	0.133
Market-to-book	−0.534	−0.453	0.117	0.193
t-stat	−16.33***	−15.18***	4.01***	6.67***
s.e.	0.033	0.030	0.029	0.029
Collateral	−0.022	−0.019	0.008	0.010
t-stat	−1.77*	1.84*	0.65	0.91
s.e.	0.012	0.011	0.013	0.011
Dividend	−0.012	−0.013	−0.010	−0.010
t-stat	−3.24***	−3.86***	−2.89***	−3.47***
s.e.	0.004	0.003	0.003	0.003
Log(Asset risk)		−0.019		−0.018
t-stat		−7.34***		−8.37***
s.e.		0.003		0.002
Constant	1.317	1.168	0.674	0.535
t-stat	34.16***	32.11***	17.60***	13.82***
s.e.	0.039	0.036	0.038	0.039
Observations	2,197	2,197	2,197	2,197
Adjusted R2	0.82	0.84	0.56	0.61

financial companies by Frank and Goyal (2009), who likewise find a negative coefficient for the market-to-book ratio, profitability and dividend payments and a positive coefficient for size. The model fits the data well, as the regressions have adjusted R2 above 0.8, which is close to the R2 reported in Gropp and Heider's study.

When interpreting the results for market leverage, we should keep in mind that market values of equity are irrelevant for capital requirements, but they are typically used to assess investment decisions and determine the bank's cost of capital. Hence, it could be expected that out of the three definitions of bank leverage used, the buffer view would be least relevant with respect to market leverage, and vice versa for the market view. According to Graham and Harvey (2001), firms generally do not rebalance their debt-to-equity ratios in response to changes in their equity prices, while Welch (2004) concludes that equity price fluctuations are crucial for determining firms' debt ratios. This may also be the case for banks, though regulatory requirements form an additional consideration and possible constraint.

A very simple explanation for the negative coefficient of profitability is that more profitable banks end up with lower leverage by virtue of retained earnings accumulating on the balance sheet, considering that dividend payments tend to be sticky (Berger et al. 2008). This is in line with a pecking order approach to capital structure, as retained earnings are the favoured form of financing under this view and there is no target debt ratio. Alternatively, even if the bank has a target, there may be a substantial lag in reaching it due to adjustment costs. This also links to dividend-paying banks being less leveraged, assuming that more profitable banks are more likely to pay out a dividend. Of course, profitability and the information content of dividend payments also affect stock valuation. Holding all other things constant, a higher market-to-book ratio yields a lower market leverage ratio.

Turning to *book leverage* as the dependent variable, the level of statistical significance of the explanatory variables remains identical, except for collateral, which is now clearly insignificant. As previously, the asset risk factor is significant and has no effect on the significance of the other variables. Compared to the market leverage regressions, the coefficients for profitability, dividend payment and asset risk remain negative and largely similar in magnitude, and for bank size, results are essentially identical.

However, the coefficient for the market-to-book ratio turns positive, meaning that banks with a higher market-to-book ratio are more highly leveraged in book values. Conceivably, banks with higher valuations can maintain higher leverage in terms of historical balance sheet values, assuming investors pay more attention to market values and the expectations embedded in them and that regulatory requirements do not form a binding constraint on book leverage. This highlights the forward-looking element of equity markets and the differing perspectives of

market and book leverage. Nevertheless, as the coefficients for profitability and dividend payments remain negative, the evidence in favour of the buffer view of bank capital structure remains limited.

Again, my results are broadly in line with Gropp and Heider's (2010, presented in their table VI, column 1 and table VII, column 3), with most factors being statistically significant in both analyses. However, there are also important differences. In the previous study, the coefficient for the market-to-book ratio was still negative but quite close to zero, and the factor was statistically insignificant. All the other factors were significant at the 1 % level, whereas I find the collateral variable insignificant. Out of similar variables, Frank and Goyal (2009) find only profitability and tangible assets to be significant with respect to non-financial companies' book leverage. I find adjusted R2 is lower for the book leverage regressions than for market leverage. It is still 0.61 when the asset risk factor is included and, again, close to the corresponding R2 of 0.58 reported by Gropp and Heider.

As a first assessment of model specification, I analyse the significance of including the country and time fixed effects in the regressions. Table V shows the results for estimating the model presented in section 5.3 (Equation 1) with either country or time fixed effects or both excluded. The results offer support for including these fixed effects in the regressions, as their inclusion improves adjusted R2, though moderately. Adjusted R2 is highest when both country and time fixed effects are included (Table IV, columns 2 and 4). However, whether the fixed effects are included or not mostly does not affect the explanatory variables' statistical significance. The exception is collateral, which is significant at the 1 % level with respect to book leverage until country fixed effects are added to the model. The fixed effects thus add value, even though they are not crucial for the explanatory power of the model.

Overall, the results of the market and book leverage regressions show that cross-sectional determinants of capital structure, namely bank size, profitability, the market-to-book ratio, dividend payments and asset risk, continue to have explanatory power on European and U.S. banks' market and book leverage in the period 2013–2023. The significance of these variables has not been driven out by changes in the regulatory and economic environment. Conversely, evidence for the significance of the collateral variable is weak. The model of bank capital structure that is used explains most of the variation in banks' market and book leverage.

The results imply that rather than being mainly explained by regulation and precautionary capital buffers, the cross-sectional variation in banks' market and book leverage is also affected by market forces. This is not altogether surprising, especially with respect to market leverage, which incorporates market expectations of the bank's growth prospects. The results are broadly in line with Gropp and Heider (2010) and in many parts align with the results for non-

Table V. Effect of country and time fixed effects.

The table reports the results for a model of the determinants of bank capital structure with either country or time fixed effects or both excluded from the model. The sample consists of 100 European and 100 U.S. banks each year in the period 2013–2023. The dependent variable is market leverage in columns 1–3 and book leverage in columns 4–6. A detailed description on the sample and variables can be found in sections 5.1 and 5.2.

Columns 1 and 4 show the results for estimating a baseline model without fixed effects:

$$L_{i,c,t} = \alpha + \beta_1 Log\left(Size_{i,c,t-1}\right) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1} + \beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log\left(Asset\ risk_{i,c,t-1}\right) + \mu_{i,c,t}$$

In columns 2 and 5, the regressions include time fixed effects (c_t), and in columns 3 and 6, the regressions include country fixed effects (c_c).

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by *s.e.*

Dependent variable	Market leverage			Book leverage		
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Size)	0.007	0.006	0.006	0.006	0.006	0.005
t-stat	8.70***	7.60***	8.22***	8.00***	7.61***	6.34***
s.e.	0.001	0.001	0.001	0.001	0.001	0.001
Profitability	−0.681	−0.646	−0.797	−1.069	−1.012	−0.973
t-stat	−4.91***	−4.37***	−6.35***	−7.85***	−6.78***	−8.60***
s.e.	0.139	0.148	0.126	0.136	0.150	0.113
Market-to-book	−0.477	−0.490	−0.436	0.187	0.230	0.150
t-stat	−18.66***	−16.96***	−16.33***	7.72***	8.39***	5.91***
s.e.	0.026	0.029	0.027	0.024	0.027	0.025
Collateral	0.002	0.002	−0.020	0.032	0.027	0.016
t-stat	0.21	0.27	−1.91*	3.27***	2.86***	1.39
s.e.	0.009	0.009	0.010	0.010	0.010	0.012
Dividend	−0.023	−0.022	−0.014	−0.014	−0.015	−0.010
t-stat	−9.26***	−8.89***	−4.37***	−5.86***	−6.05***	−3.54***
s.e.	0.002	0.002	0.003	0.002	0.002	0.003
Log(Asset risk)	−0.027	−0.028	−0.018	−0.017	−0.020	−0.015
t-stat	−11.54***	−10.18***	−8.56***	−8.95***	−8.83***	−8.32***
s.e.	0.002	0.003	0.002	0.002	0.002	0.002
Constant	1.140	1.149	1.151	0.520	0.475	0.584
t-stat	34.98***	32.06***	34.45***	17.41***	14.78***	15.99***
s.e.	0.033	0.036	0.033	0.030	0.032	0.037
Country fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	Yes	No	No	Yes	No
Observations	2,197	2,197	2,197	2,197	2,197	2,197
Adjusted R2	0.76	0.80	0.80	0.45	0.48	0.58

financial companies studied by Frank and Goyal (2009). There are thus persistent similarities between the determinants of the capital structure of banks and non-financial companies.

6.2. Market and book leverage in European and U.S. sub-samples

The results presented in section 6.1 were based on the combined sample of European and U.S. banks, as described in section 5.1. However, it is possible that the variables considered show different effects with respect to European and American banks. This may be caused by, for example, differences in the structure of capital markets and the economy, local banking culture and practices, or banking supervision practices, as postulated by Brewer et al. (2008). The sub-samples also differ in the characteristics of the banks included, as described in section 5.2, and the low number of European banks for which data is available means that all or almost all European banks will be included in the full sample in any given year. Hence, I estimate the model presented in section 5.3 (Equation 1) separately using sub-samples of European and U.S. banks. Naturally, the U.S. sample does not exhibit variation at the country level, so the regression does not include country fixed effects. The results are reported in table VI.

For the most part, the analysis confirms initial findings, but it also reveals certain distinctions between European and U.S. banks. Overall, all the coefficients have the same sign with respect to European as U.S. banks. Profitability, the market-to-book ratio and asset risk are consistently significant at the 1 % level across all specifications, as in the full sample. The market-to-book ratio again has a negative coefficient with respect to market leverage but turns positive with book leverage as the dependent variable in both sub-samples. I also find the dividend dummy significant across the samples, but only marginally at the 10 % level for U.S. banks' market leverage. There are some differences in the magnitudes of the coefficients between European and U.S. banks. Particularly, the coefficient for asset risk is over three times larger for American banks.

Most importantly, the results show clear differences with respect to bank size. I find that its effect pertains mainly to European banks and the coefficients in the European sub-sample are close to the ones reported for the whole sample. For U.S. banks, size is significant only at the 10 % level with respect to market leverage, and even then, the coefficient is close to zero. Nevertheless, the significance of bank size should not be entirely discarded on this evidence. On the other hand, collateral, which exhibited weak significance in the full sample, is now clearly and consistently insignificant for both European and U.S. banks.

Overall, I find less dispersion between the full sample and sub-sample results than Gropp and Heider (2010, analysis on sub-samples presented in their appendix, table A1, columns 2–3 and 5–6). In their analysis, only asset risk exhibits strong statistical significance consistently across

Table VI. Determinants of bank leverage for sub-samples of European and U.S. banks.

The table reports the results for the following model of the determinants of bank capital structure for sub-samples of European banks (columns 1 and 3) and U.S. banks (columns 2 and 4):

$$L_{i,c,t} = \alpha + \beta_1 Log\left(Size_{i,c,t-1}\right) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1} + \beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log\left(Asset\ risk_{i,c,t-1}\right) + c_c + c_t + \mu_{i,c,t}$$

The sample consists of 100 European or U.S. banks each year in the period 2013–2023. The dependent variable is market leverage in columns 1–2 and book leverage in columns 3–4. The model includes country fixed effects (c_c) and time fixed effects (c_t), except for the U.S. sub-sample, for which country fixed effects are not relevant. A detailed description on the sample and variables can be found in sections 5.1 and 5.2.

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by *s.e.*

Dependent variable	Market leverage		Book leverage	
Sub-sample	Europe	U.S.	Europe	U.S.
	(1)	(2)	(3)	(4)
Log(Size)	0.006	0.002	0.006	0.001
t-stat	5.71***	1.84*	5.61***	0.61
s.e.	0.001	0.001	0.001	0.001
Profitability	−0.968	−0.767	−0.945	−0.577
t-stat	−7.04***	−3.14***	−6.84***	−2.70***
s.e.	0.138	0.244	0.138	0.214
Market-to-book	−0.433	−0.367	0.212	0.284
t-stat	−9.44***	−8.69***	4.34***	8.43***
s.e.	0.046	0.042	0.049	0.034
Collateral	−0.018	−0.018	0.020	0.003
t-stat	−1.31	−1.37	1.16	0.24
s.e.	0.014	0.013	0.017	0.012
Dividend	−0.011	−0.013	−0.007	−0.014
t-stat	−3.63***	−1.85*	−2.40**	−2.97***
s.e.	0.003	0.007	0.003	0.005
Log(Asset risk)	−0.015	−0.051	−0.015	−0.052
t-stat	−4.96***	−9.46***	−6.07***	−10.70***
s.e.	0.003	0.005	0.002	0.005
Constant	1.161	1.027	0.494	0.424
t-stat	24.65***	16.43***	9.29***	8.81***
s.e.	0.047	0.062	0.053	0.048
Observations	1,097	1,100	1,097	1,100
Adjusted R2	0.79	0.72	0.68	0.41

all the sub-samples. For example, they find the market-to-book ratio to be insignificant with respect to book leverage for both European and U.S. banks. Furthermore, they find profitability to be significant only at the 10 % level. However, in line with my results, Gropp and Heider find size to be more significant for European banks.

The adjusted R2 of the models is generally lower than for full samples, particularly with market leverage as the dependent variable. However, the change in the explanatory power of the model goes in opposite directions for the book leverage sub-samples. Adjusted R2 is 0.68 for the European sample, which is higher than for the book leverage regressions presented in section 6.1, whereas for the U.S. sample it is only 0.41. For comparison, in Gropp and Heider's (2010) analysis these figures were 0.53 and 0.27, respectively.

To sum up, the results for the sub-samples of European and U.S. banks thus broadly confirm the initial findings and the explanatory power of the model of bank capital structure. They also reveal that the effect of bank size comes from the European side of the sample and reinforce the finding that collateral is insignificant. Otherwise, there do not seem to be substantial differences in the results for European and U.S. banks. The results add credibility to the conclusions presented in section 6.1 and alleviate some of the concerns regarding sample selection. Again, the findings offer more support for the market view than the buffer view of bank capital structure, as all the coefficients retain their signs.

6.3. The effect of bank fixed effects on market and book leverage

The analyses in sections 6.1 and 6.2 were based on the model including country and time fixed effects in addition to the set of bank-level explanatory variables. The next step is to analyse the effect of unobserved time-invariant bank fixed effects on bank capital structure. Hence, I estimate the model described in section 5.3 (Equation 1) with bank fixed effects instead of country fixed effects, using the full sample as well as the European and U.S. sub-samples, and using market and book leverage separately as dependent variables. Table VII reports the results.

The purpose of this analysis is to assess the robustness of initial results on the significance of the explanatory variables. Gropp and Heider (2010) find bank fixed effects an important determinant of bank capital structure, which implies that individual banks' capital structures remain relatively stable over time. The analysis also provides an opportunity to reveal further differences between market and book leverage as well as European and U.S. banks, thus adding detail to the picture formed by initial results.

The first observation is that including bank fixed effects in the model consistently increases the regressions' adjusted R2, justifying this model specification. The model explains most of the

Table VII. Determinants of bank market and book leverage with bank fixed effects.

The table reports the results for the following model of the determinants of bank capital structure, including bank fixed effects (c_i) and time fixed effects (c_t):

$$L_{i,c,t} = \alpha + \beta_1 Log(Size_{i,c,t-1}) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1} + \beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log(Asset\ risk_{i,c,t-1}) + c_i + c_t + \mu_{i,c,t}$$

The sample consists of 100 European and 100 U.S. banks each year in the period 2013–2023 in columns 1 and 4 and the respective European sub-sample in columns 2 and 5 and the U.S. sub-sample in columns 3 and 6. The dependent variable is market leverage in columns 1–3 and book leverage in columns 4–6. A detailed description on the sample and variables can be found in sections 5.1 and 5.2.

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by *s.e.*

Dependent variable	Market leverage			Book leverage		
Sample	Full sample	Europe	U.S.	Full sample	Europe	U.S.
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Size)	0.016	0.015	0.010	0.004	0.013	−0.011
t-stat	5.09***	2.86***	2.09**	1.71*	3.54***	−4.41***
s.e.	0.003	0.005	0.005	0.002	0.004	0.003
Profitability	−0.427	−0.607	−0.500	−0.446	−0.426	−0.431
t-stat	−3.03***	−4.03***	−1.87*	−3.93***	−2.96***	−2.99***
s.e.	0.141	0.150	0.268	0.114	0.144	0.144
Market-to-book	−0.312	−0.375	−0.209	0.052	0.032	0.091
t-stat	−10.39***	−9.27***	−5.40***	2.84***	1.18	4.06***
s.e.	0.030	0.041	0.039	0.018	0.027	0.022
Collateral	−0.005	−0.015	0.025	0.018	0.009	0.048
t-stat	−0.35	−0.89	1.41	1.34	0.47	3.51***
s.e.	0.014	0.017	0.018	0.014	0.020	0.014
Dividend	−0.004	−0.006	0.010	−0.002	−0.001	0.002
t-stat	−1.47	−2.27**	1.07	−1.30	−0.77	0.44
s.e.	0.003	0.003	0.009	0.002	0.002	0.005
Log(Asset risk)	−0.008	−0.005	−0.025	−0.007	−0.008	−0.024
t-stat	−3.53***	−1.92*	−4.24***	−4.65***	−4.22***	−6.72***
s.e.	0.002	0.002	0.006	0.002	0.002	0.004
Constant	0.806	0.920	0.752	0.742	0.525	0.968
t-stat	9.10***	6.75***	5.50***	11.92***	5.14***	14.76***
s.e.	0.089	0.136	0.137	0.062	0.102	0.066
Observations	2,197	1,097	1,100	2,197	1,097	1,100
Adjusted R2	0.90	0.86	0.82	0.85	0.87	0.78

existing variation in bank market and book leverage. Using the full sample, adjusted R2 increases from 0.82 to 0.90 with respect to market leverage and from 0.61 to 0.85 with respect to book leverage. The same finding holds for the geographical sub-samples. Overall, the levels of adjusted R2 are roughly similar for the market and book leverage regressions.

Bank fixed effects turn out to be the single most important determinant of bank capital structure. This can be demonstrated by running simple regressions that only include fixed effects. Regressing market and book leverage on bank fixed effects alone, adjusted R2 is 0.81 for both dependent variables. When time fixed effects are included, these figures go up to 0.86 for market leverage and 0.84 for book leverage, being essentially the same as for the full model. While this does not eliminate the significance of the explanatory variables, it raises questions about how important they ultimately are.

Looking at the individual variables, bank size is consistently significant and has a positive coefficient with respect to market leverage in all samples. With respect to book leverage, however, size is significant at the 1 % level in both geographical sub-samples, but its coefficient is negative in the U.S. sample. In other words, while larger banks are generally more leveraged, U.S. banks' book leverage decreases with size. In the sub-sample regressions in section 6.2, size was altogether insignificant for U.S. banks. Gropp and Heider's (2010, presented in their table X) analysis of the model including bank fixed effects finds bank size to be insignificant with respect to book leverage, which may well be due to the difference between European and American banks in this respect. Unfortunately, Gropp and Heider do not report results for the European and U.S. sub-samples for the model including bank fixed effects, so this remains speculative. While evidence for the explanatory power of bank size remains quite strong overall, its effect is ambiguous as it does not show consistent effects across the different samples.

Moving on, profitability is mostly significant at the 1 % level and the coefficients are negative and roughly similar in magnitude across the various samples. The only exception is the U.S. sub-sample with respect to market leverage, where profitability is only marginally significant. However, the magnitude of the coefficients is much smaller than previously. Likewise, the market-to-book ratio is mostly significant at the 1 % level but is clearly insignificant with respect to European banks' book leverage. In line with initial results, the coefficients are negative for market leverage and positive for book leverage, but smaller in magnitude. Asset risk is also consistently significant at the 1 % level, the only exception being European banks' market leverage. The coefficients, whilst being consistently negative, are again much larger for U.S. banks than European banks.

Collateral and dividend turn out to be mostly insignificant across the different specifications. With regards to collateral, this is in line with initial results. The exception is that collateral is

significant at the 1 % level for U.S. banks' book leverage and has a positive coefficient. Nevertheless, the overwhelming evidence points to this variable not being able to consistently explain bank capital structure. Similarly, while dividend payments initially appeared to be significant with respect to market and book leverage, it turns out that this variable is not robust to including bank fixed effects in the model. Dividend is only significant with respect to European banks' market leverage.

To sum up, the significance of most of the explanatory variables closely resembles that found in sections 6.1 and 6.2. There is strong evidence for the significance of bank size, profitability, the market-to-book ratio and asset risk, even with bank fixed effects included. The results also further reinforce the earlier finding of the insignificance of the collateral variable and reveal that the dividend payment variable has less explanatory power than found initially. The magnitude of the coefficients is also reduced, as some of the variation previously falling under the explanatory variables is subsumed by bank fixed effects. These results are once again in line with Gropp and Heider (2010), who find the market-to-book ratio, profitability and asset risk to be significant and collateral and dividend to be insignificant when bank fixed effects are included. Separate analysis of the European and U.S. sub-samples clearly adds value as it confirms that initial results are generally robust to using the sub-samples, but at the same time it uncovers certain differences between European and U.S. banks.

Ultimately, bank fixed effects continue to be the most important determinant of bank capital structure. Several of the explanatory variables have statistically significant explanatory power, but the added value they provide is somewhat limited, as most of the variation is already captured by fixed effects. The role of bank fixed effects suggests that capital structures are specific to the individual bank and remain relatively stable over time. At first, this may sound puzzling, as statistical data reveals that bank leverage has in fact decreased over time. However, the conclusion is that bank capital structures include both a transitory and a permanent component, with the permanent component having greater importance. This also points to a further similarity between the determinants of the capital structure of banks and non-financial companies, as Lemmon et al. (2008) report an equivalent finding with respect to non-financial companies. The results should not be taken to imply that bank capital requirements are irrelevant, and they might even be compatible with a buffer view of bank capital structure, if the determination of the buffers follows some unknown bank-specific criteria. However, it is up to possible further research to determine what these criteria might be.

6.4. Determinants of bank regulatory leverage

Up to now, I have only considered market and book leverage as the dependent variables in the model of bank capital structure. As discussed earlier, the choice of an appropriate leverage measure for banks is a controversial matter. Berger et al. (2008) specifically criticize the use of market and book leverage for capital structure regressions. Regulatory leverage differs from definitions of leverage based on market or book values, since the bank's supervisor sets capital adequacy requirements which are based on specific definitions of regulatory capital and risk-weighted assets. The relationship between regulatory leverage and book or market leverage is by no means straightforward, as the calculation of the ratios is different for both the numerator and denominator. Keeping the amount of equity capital constant, the regulatory capital ratio can be improved by altering the composition and perceived riskiness of the bank's assets, while such changes would not have any direct effect on book or market leverage. Conversely, the market expectations incorporated in market leverage are altogether irrelevant for regulatory leverage. These differences also show up in the data, as the average regulatory leverage is multiple percentage points lower than market and book leverage (see table I). Therefore, it is not obvious that the effect of the explanatory variables found for market and book leverage should carry over to regulatory leverage. Presumably, if the buffer view is a relevant explanation of bank capital structure, it should carry the highest relevance with respect to regulatory leverage.

I estimate the model of the determinants of bank capital structure described in section 5.3 (Equation 1) using regulatory leverage as the dependent variable and the sample of European and U.S. banks described in section 5.1. Furthermore, I estimate the model with bank fixed effects instead of country fixed effects, using the full sample and the European and U.S. sub-samples separately. Table VIII presents the results. There turn out to be substantial differences compared to the results for market and book leverage. Furthermore, there are hardly any similarities between the European and U.S. sub-samples. The main finding is that none of the explanatory variables used in this study has consistent explanatory power on regulatory leverage. For example, bank size is significant in the full sample regressions, but insignificant in both sub-samples. This constitutes a clear deviation from the findings of Gropp and Heider (2010, presented in their table XII), where bank size, profitability, collateral and asset risk are significant at the 1 % level with respect to the Tier 1 capital ratio, though they only report results for the full sample with country and time fixed effects. It seems that increases in capital ratios have reduced the scope for cross-sectional variation in bank capital structures, at least in the sense that the explanatory variables no longer explain banks' regulatory leverage.

Based on these results, there is a clear disconnect between the determinants of market and book leverage on the one hand, and regulatory leverage on the other. Of course, considering

Table VIII. Determinants of regulatory leverage.

The table reports the results for the following model of the determinants of bank capital structure, where the dependent variable is regulatory leverage:

$$L_{i,c,t} = \alpha + \beta_1 Log\left(Size_{i,c,t-1}\right) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1}$$
$$+\beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log\left(Asset\ risk_{i,c,t-1}\right) + c_n + c_t + \mu_{i,c,t}$$

The sample consists of 100 European and 100 U.S. banks each year in the period 2013–2023 in columns 1–2 and the respective European sub-sample in column 3 and the U.S. sub-sample in column 4. The model includes either country fixed effects (c_c) or bank fixed effects (c_i), denoted by c_n in the equation above, as well as time fixed effects (c_t). A detailed description on the sample and variables can be found in sections 5.1 and 5.2.

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by *s.e.*

Sample	Full sample	Full sample	Europe	U.S.
	(1)	(2)	(3)	(4)
Log(Size)	0.003	0.019	−0.001	0.005
t-stat	2.33**	6.55***	−0.15	1.42
s.e.	0.001	0.003	0.005	0.003
Profitability	−0.100	0.033	−0.261	−0.555
t-stat	−0.52	0.21	−1.33	−3.20***
s.e.	0.193	0.160	0.197	0.174
Market-to-book	−0.021	0.043	−0.004	0.087
t-stat	−0.58	1.66*	−0.09	2.96***
s.e.	0.036	0.026	0.044	0.029
Collateral	−0.059	−0.046	−0.004	−0.061
t-stat	−3.27***	−2.35**	−0.15	−3.51***
s.e.	0.018	0.020	0.024	0.017
Dividend	−0.005	−0.003	−0.001	−0.006
t-stat	−1.86*	−1.32	−0.39	−1.25
s.e.	0.003	0.002	0.003	0.005
Log(Asset risk)	0.003	−0.000	−0.006	−0.011
t-stat	1.14	−0.16	−2.86***	−3.18***
s.e.	0.003	0.002	0.002	0.003
Constant	0.848	0.362	0.881	0.666
t-stat	16.15***	4.47***	6.33**	7.90***
s.e.	0.053	0.081	0.139	0.084
Country fixed effects	Yes	No	No	No
Bank fixed effects	No	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	2,123	2,123	1,023	1,100
Adjusted R2	0.47	0.79	0.76	0.76

the differences between the different definitions of leverage explained earlier, this is not altogether surprising. The results highlight the inherent complexity underlying bank capital structure decisions and the need to consider each of the different forms of leverage to gain a comprehensive understanding of the factors driving these decisions. Focusing only on regulatory leverage, like Berger et al. (2008), gives an altogether too narrow picture of the various dynamics underlying the determination of bank capital structure.

Nevertheless, as for market and book leverage, bank fixed effects turn out to be the most important determinant of regulatory leverage. When bank fixed effects are included, the explanatory power of the model is close to the market and book leverage regressions. Adjusted R2 is 0.79 for the full sample and 0.76 for both the European and U.S. sub-samples, even though none of the individual explanatory variables are consistently significant. In fact, as was the case for market and book leverage in section 6.3, similar levels of adjusted R2 are again reached by running the regression that only includes bank and time fixed effects and none of the explanatory variables. Levels of regulatory leverage seem to be bank-specific and not reliably explained by the bank characteristics used as explanatory variables in this study. The conclusions to be drawn from the importance of bank fixed effects were presented in section 6.3.

7. Additional robustness checks

7.1. Alternative time periods

The results presented in section 6, based on data from the period 2013–2023, show that there are a lot of similarities in the determinants of bank capital structure between the periods 1991–2004 and 2013–2023. There are significant differences as well, particularly with respect to the determinants of regulatory leverage. Nevertheless, the similarities that persist are quite remarkable considering that the two periods exhibit significant differences in banks' operating environment, for example the prevailing interest rate environment and the profitability of banking. Furthermore, the global financial system came to the brink of collapse in the interim due to the Global Financial Crisis, which subsequently led to significant regulatory changes, including the more stringent capital requirements of Basel III.

Although the period used in this study is relatively short, it also coincides with various changes and shocks in the economic environment. In 2013, Europe was still suffering the effects of the European sovereign debt crisis. Towards the end of the period, the global economy entered an era of high inflation, and the interest rate environment changed significantly. Therefore, as an additional robustness test, I estimate the model presented in section 5.3 (Equation 1) for two shorter periods, namely 2015–2023 and 2018–2023. The rationale for the first period

specification is that the Basel III capital requirements entered into force in 2015, which causes a discontinuity in the data. Of course, banks can be expected to prepare for regulatory changes well in advance and the various phase-in arrangements associated with the Basel III regulations mean that capital requirements are in constant flux, making any cut-off point somewhat arbitrary by default. Hence, it is useful to consider another alternative period. The shorter period 2018–2023 is simply based on splitting the full period into two halves and considering the latter half. Only market and book leverage are considered, as the explanatory variables used in this study do not have consistent explanatory power on regulatory leverage, as found in section 6.4. Table IX presents the results.

For the period 2015–2023, using the model including country and time fixed effects, the results (table IX, columns 1 and 3) closely resemble those for the full period (table IV, columns 2 and 4). For both market and book leverage, the significance of the explanatory variables is essentially the same and the magnitude of the coefficients is largely similar as well. There are no substantial differences in the adjusted R2 of the respective models either. This also holds when country fixed effects are replaced with bank fixed effects (table IX, columns 2 and 4, compared with table VII, columns 1 and 4), although there are minor differences in the level of significance of the variables, with some variables significant only at the 5 % rather than 1 % level. Furthermore, bank size is insignificant with respect to book leverage. This may be explained by the differences in the effects of bank size between European and U.S. banks, as discussed in sections 6.2 and 6.3. Again, collateral and dividend are clearly insignificant in a model that includes bank fixed effects. The model explains most of the variation in bank leverage, with an adjusted R2 of 0.90 with respect to market leverage and 0.87 for book leverage.

The results are largely similar when the shorter period 2018–2023 is considered (table IX, columns 5–6, results presented only for model including country and time fixed effects). All explanatory variables are significant at the 5 % level, except for collateral with respect to book leverage. The coefficients also retain their signs, including the positive coefficient of the market-to-book ratio with respect to book leverage, and their magnitudes are roughly similar as previously.

Overall, there is nothing to indicate significant differences in the determinants of bank capital structure when analysing the period 2015–2023 or 2018–2023, compared to the full period 2013–2023. Bank size, profitability, the market-to-book ratio and asset risk remain significant, and the importance of bank fixed effects is also reinforced. Thus, the analysis confirms that the results presented in section 6 are robust to changes in the period considered.

Table IX. Determinants of bank market and book leverage with alternative period.

The table reports the results for the following model of the determinants of bank capital structure, for the period 2015–2023 (columns 1-4) and 2018–2023 (columns 5-6):

$$L_{i,c,t} = \alpha + \beta_1 Log(Size_{i,c,t-1}) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1} + \beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log(Asset\ risk_{i,c,t-1}) + c_n + c_t + \mu_{i,c,t}$$

The table reports the results for a model of the determinants of bank capital structure. The sample consists of 100 European and 100 U.S. banks each year. The dependent variable is market leverage in columns 1–2 and 5 and book leverage in columns 3–4 and 6. The models include either country (c_c) or bank (c_i) fixed effects (denoted by c_n) and time fixed effects (c_t). A detailed description on the sample and variables can be found in sections 4.1 and 4.2.

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by s.e.

Period	2015–2023				2018–2023	
Dependent variable	Market	Market	Book	Book	Market	Book
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Size)	0.005	0.018	0.005	0.002	0.005	0.006
t-stat	6.90***	4.66***	6.11***	0.70	6.12***	6.36***
s.e.	0.001	0.004	0.001	0.003	0.001	0.001
Profitability	−0.913	−0.291	−0.974	−0.356	−1.055	−0.948
t-stat	−5.58***	−2.08**	−6.59***	−3.23***	−5.15***	−4.54***
s.e.	0.164	0.140	0.148	0.110	0.205	0.209
Market-to-book	−0.419	−0.243	0.224	0.049	−0.361	0.245
t-stat	−12.47***	−6.50***	7.06***	2.44**	−8.68***	6.45***
s.e.	0.034	0.037	0.032	0.020	0.042	0.038
Collateral	−0.023	−0.004	0.010	0.032	−0.029	0.005
t-stat	−2.14**	−0.24	0.85	2.00**	−2.54**	0.42
s.e.	0.011	0.015	0.012	0.016	0.012	0.012
Dividend	−0.011	−0.003	−0.009	−0.001	−0.010	−0.007
t-stat	−3.35***	−0.89	−2.80***	−0.87	−2.77***	−2.07**
s.e.	0.003	0.003	0.003	0.002	0.004	0.004
Log(Asset risk)	−0.021	−0.007	−0.021	−0.008	−0.026	−0.021
t-stat	−6.52***	−2.28**	−7.89***	−4.33***	−6.86***	−6.06***
s.e.	0.003	0.003	0.003	0.002	0.004	0.003
Constant	1.130	0.691	0.475	0.781	1.065	0.430
t-stat	28.21***	5.85***	11.32***	10.86***	22.20***	8.93***
s.e.	0.040	0.118	0.042	0.072	0.048	0.048
Country fixed effects	Yes	No	Yes	No	Yes	Yes
Bank fixed effects	No	Yes	No	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,800	1,800	1,800	1,800	1,200	1,200
Adjusted R2	0.84	0.90	0.63	0.87	0.84	0.65

7.2. Macroeconomic control variables

All the explanatory variables included in the model presented in section 5.3 describe factors at the level of the individual bank. Conceivably, macroeconomic conditions, such as interest rates, realized or expected inflation and GPD growth, may also affect banks' capital structure decisions. Frank and Goyal's (2009) core model of non-financial firms' leverage includes one macroeconomic factor, expected inflation. Furthermore, Gropp and Heider (2010) state that macroeconomic effects may be more important for banks than for non-financial firms because banks' exposure to business cycle fluctuations may be larger. Hence, I estimate the model that includes the macroeconomic control variables described in section 5.3 (Equation 2) as an additional robustness test of initial results. Comparison is made to results for the full model including country and time fixed effects (presented in table IV, columns 2 and 4). Only market and book leverage are considered. Table X presents the results.

Compared to the results presented in section 6, the main observation is that the inclusion of the macroeconomic variables does not affect the significance of the explanatory variables at all. Thus, each explanatory bank-specific variable, except for collateral, remains significant at the 1 % level. The macroeconomic variables themselves are otherwise significant at the 1 % level with respect to market leverage, but the inflation rate is insignificant. Conversely, only inflation is significant with respect to book leverage. It should be noted that the model considers the historical inflation rate, whereas expectations of future inflation are likely to be more relevant for market valuations. However, I presume the conclusions of the analysis would be the same even if realised inflation was replaced with expected inflation.

Overall, these results reinforce the robustness of the findings presented in section 6, as the significance of the explanatory variables is not affected by the inclusion of the macroeconomic variables. Even though most of the macroeconomic variables are themselves statistically significant with respect to market leverage, their addition does not improve the adjusted R2 of the model. As the number of variables in the model increases, statistical issues such as overfitting become more prominent. Based on these results, I conclude that the effect of macroeconomic variables does not warrant further consideration in this thesis. Similar conclusions can be drawn from the results given by a model with bank fixed effects instead of country fixed effects (results not reported).

Table X. Determinants of bank market and book leverage with macroeconomic variables.

The table reports the results for the following model of the determinants of bank capital structure including macroeconomic control variables:

$$L_{i,c,t} = \alpha + \beta_1 Log\left(Size_{i,c,t-1}\right) + \beta_2 Profitability_{i,c,t-1} + \beta_3 Market\text{-}to\text{-}book_{i,c,t-1}$$
$$+\beta_4 Collateral_{i,c,t-1} + \beta_5 Dividend_{i,c,t} + \beta_6 Log\left(Asset\ risk_{i,c,t-1}\right) + \beta_7 GDP\ growth_{c,t}$$
$$+\beta_8 Inflation_{c,t} + \beta_9 Term\ spread_{c,t} + \beta_{10} Log\left(Stock\ market\ risk_{c,t}\right) + c_c + c_t + \mu_{i,c,t}$$

The sample consists of 100 European and 100 U.S. banks each year in the period 2013–2023. The dependent variable is market leverage in columns 1–3 and book leverage in columns 4–6. The model includes country fixed effects (c_c) and time fixed effects (c_t). A detailed description on the sample and variables can be found in sections 5.1 and 5.2.

The regressions include clustered standard errors at the bank level. All variables are winsorized at 0.05 % on both tails. Statistical significance is denoted by ***, ** and * at the 1 %, 5 % and 10 % levels, respectively. Standard error is denoted by s.e.

Dependent variable	Market leverage			Book leverage		
	Coefficient	t-stat	s.e.	Coefficient	t-stat	s.e.
Log(Size)	0.005	6.80***	0.001	0.005	6.50***	0.001
Profitability	−0.971	−6.79***	0.143	−1.002	−7.41***	0.135
Market-to-book	−0.448	−14.22***	0.032	0.207	6.71***	0.031
Collateral	−0.019	−1.86*	0.010	0.005	0.47	0.012
Dividend	−0.014	−4.17***	0.003	−0.011	−3.72***	0.003
Log(Asset risk)	−0.021	−7.51***	0.003	−0.019	−8.13***	0.002
GDP growth	0.107	2.80***	0.038	−0.029	−1.52	0.019
Inflation	−0.023	−0.45	0.051	0.110	2.82***	0.039
Term spread	−0.392	−3.05***	0.128	−0.029	−0.35	0.083
Stock market risk	0.025	4.63***	0.005	0.006	1.43	0.004
Constant	1.222	32.29***	0.038	0.527	13.06***	0.040
Observations	2,197			2,197		
Adjusted R2	0.84			0.61		

8. Conclusion

8.1. Summary of empirical results

In this thesis, I have analysed the determinants of the capital structure of publicly listed banks in Europe and the United States in the period 2013–2023. The objective was to find out whether similar determinants as those explaining non-financial firms' capital structure continue to explain the capital structure of banks, as found in the previous study by Gropp and Heider (2010). I analysed bank capital structure using three different definitions of bank

leverage, namely market, book and regulatory leverage. I employed a model of bank capital structure with a set of explanatory variables based on the economic characteristics of the individual bank, following the methodology of Gropp and Heider. Furthermore, I assessed the empirical results with regards to the different views on bank capital structure presented in the literature. Specifically, the aim was to examine whether bank capital structure is primarily determined by regulatory capital requirements and precautionary capital buffers and to what extent it is also affected by market pressure.

First, I analysed the determinants of bank market and book leverage with country and time fixed effects included in the model. I showed that bank size, profitability, the market-to-book ratio, dividend payments and asset risk are statistically significant with respect to both market and book leverage. Conversely, I only found weak evidence for the significance of collateral assets. I found the model has strong explanatory power, particularly so with respect to market leverage, and initial model specification tests supported the inclusion of country and time fixed effects in the regressions.

Using market leverage as the dependent variable, all the explanatory variables had a negative effect on leverage, except for bank size. For bank size and asset risk, the effects were as expected. On the other hand, the results indicated that more profitable banks, banks with a higher market-to-book ratio as well as dividend-paying banks are less leveraged than other banks. This follows the findings of Gropp and Heider's (2010) previous study on bank capital structure and Frank and Goyal's (2009) study on non-financial companies' capital structure, offering stronger evidence for the market view of bank capital structure than the buffer view. With book leverage, the variables showed otherwise identical effects, but the effect of the market-to-book ratio was positive.

I performed extensive robustness testing of the initial results, considering various alternative specifications. Firstly, considering differences between European and U.S. banks in general as well as in the characteristics of the banks included in the respective sub-samples, I analysed the sub-samples of European and U.S. banks separately. The results broadly confirmed initial findings, particularly on the statistical significance of the variables. Overall, I found the variables to have the same effect on European as U.S. banks, but the effect of bank size was revealed to belong to the European side of the sample. There were also differences in the magnitudes of some of the coefficients between European and U.S. banks. Otherwise, the analysis did not uncover substantial differences in the results for European and U.S. banks. The insignificance of the collateral variable was further reinforced.

Subsequently, I estimated the model of bank capital structure replacing country fixed effects with individual bank fixed effects, which the previous study by Gropp and Heider (2010) found

to be an important determinant of bank capital structure. This analysis covered the full sample and the European and U.S. sub-samples for market and book leverage. As previously, I found strong evidence for the significance of the bank size, profitability, market-to-book ratio and asset risk variables, these variables being statistically significant across most of the different specifications. There was ambiguity regarding the direction of the effect of bank size, as I found U.S. banks' book leverage to decrease with size. The results also further reinforced the collateral variable's insignificance and revealed that the dividend payment variable is not robust to including bank fixed effects in the model.

The inclusion of bank fixed effects increased the regressions' explanatory power for both market and book leverage, with adjusted R2 roughly in the range of 0.8 to 0.9. Ultimately, bank fixed effects turned out to be the single most important determinant of bank capital structure. This was evident from the fact that essentially the same level of explanatory power was achieved by regressing market and book leverage on bank and time fixed effects alone. This raised questions about the value added by the explanatory variables, even if most of them were statistically significant. Banks' capital structures thus seem to be specific to the individual bank and remain relatively stable over time.

Finally, I estimated the model using regulatory leverage as the dependent variable and found substantial differences compared to the results for market and book leverage as well as between the European and American sub-samples. There was a disconnect between the determinants of market and book leverage on the one hand, and regulatory leverage on the other, as none of the explanatory variables had consistent explanatory power on regulatory leverage. This also constituted a clear deviation from Gropp and Heider's (2010) results, who found most of the variables significant with respect to the Tier 1 capital ratio. Again, bank fixed effects turned out to be the most important determinant of regulatory leverage, as a high level of explanatory power was achieved by regressing regulatory leverage on bank and time fixed effects alone.

Furthermore, I performed additional robustness tests with regards to the period considered as well as using macroeconomic control variables. Only market and book leverage were considered, as the explanatory variables were already found to not have consistent explanatory power on regulatory leverage. The analyses on alternative periods confirmed that the findings of this study are robust to changes in the period considered, as results were essentially the same when analysing the period 2015–2023 or 2018–2023 instead of the full period 2013–2023. The findings also proved robust to the inclusion of macroeconomic variables in the model of bank capital structure. Their addition did not improve the model's explanatory power, and the significance of the explanatory variables was not affected.

8.2. Discussion and suggestions for further research

In this study, I show that there are persistent similarities between the determinants of the capital structure of banks and non-financial companies. Bank market and book leverage are consistently explained by the bank's size, profitability, the market-to-book ratio and asset risk, whereas collateral assets and dividend payments are not reliably significant. The findings are broadly in line with the previous study of the period 1991–2004 by Gropp and Heider (2010) and in many parts align with the results for non-financial companies by Frank and Goyal (2009). Hence, bank market and book leverage are explained by many of the same cross-sectional variables as non-financial companies' leverage with similar effects. The results do not support the buffer view of bank capital structure. While regulatory capital requirements form an important practical consideration for banks, bank capital structure decisions are also subject to the disciplining pressure of market forces. Given all the economic characteristics and regulatory requirements that are specific to banking, this finding is remarkable.

However, the cross-sectional variables that explain bank market and book leverage are not reliably significant with respect to regulatory leverage. Thus, there is a disconnect between the determinants of market and book leverage on the one hand, and regulatory leverage on the other. This is not altogether surprising, as there is not a straightforward relationship between regulatory leverage and the other forms of bank leverage. The loss of explanatory power of the cross-sectional variables may be due to increases in regulatory capital requirements over the past decade, but this effect mostly has not carried over to market and book leverage. It should be recalled that the bank may react to higher capital requirements by altering the composition of its assets, rather than raising new equity capital. The results highlight the inherent complexity underlying bank capital structure decisions.

Regardless of the definition of leverage, fixed effects at the level of the individual bank are ultimately the single most important determinant of bank capital structure. This is line with the previous study by Gropp and Heider (2010) and corresponds with the findings of Lemmon et al. (2008) regarding non-financial companies. The result implies that banks' capital structures are specific to the individual bank and remain relatively stable over time and the role of the cross-sectional determinants is limited. This should not be taken to imply that capital requirements are irrelevant. Rather, bank capital structures include both a transitory and a permanent component, with the permanent component having greater importance, even with a contemporaneous decrease in bank leverage. The bank-specific criteria to determine capital structure remain unknown.

Admittedly, there are limitations to the approach employed in this study, which is based on the methodology of Gropp and Heider (2010). Firstly, the sample that is used for the analyses is based on selecting the 100 largest banks separately from Europe and the United States each year. However, it is well known that there are economic, regulatory and institutional differences between the European Union and the United States, and the European and U.S. subsamples also differ in the characteristics of the banks included. The original study does not further explain the rationale behind the sample formation. Hence, I tested the robustness of full sample results by analysing the sub-samples separately. While these results broadly confirmed full sample findings, there were also differences, particularly in the effect of bank size. The approach employed in this study does not shed light on the possible reasons behind these differences.

Furthermore, Berger et al. (2008) specifically present three main criticisms of the methodology employed in this study. Firstly, the regressions are static and assume that capital structure is chosen at the end of each period. This disregards an ongoing, dynamic process of capital structure adjustment as well as the associated costs. Secondly, the authors point out that Gropp and Heider's (2010) focus is on equity ratios, whereas they study regulatory capital ratios. Finally, they criticize the use of explanatory variables which are typically related to non-financial firms' capital structure instead of banking-specific variables. However, the analysis presented in this study specifically shows that it is necessary to consider each of the different forms of leverage, as opposed to just regulatory leverage. Regulatory capital requirements are imposed by banking supervisors, but from an economic point of view, an investor cares about the bank's actual leverage and whether it is at a sustainable level.

Even though the empirical findings offer more support for the market view than the buffer view of bank capital structure, the evidence is not altogether consistent nor conclusive. The predictions of the buffer view are based on bank characteristics that would conceivably make it easier to issue equity at short notice and hence enable the bank to maintain lower capital buffers. In contrast, the market view is based on the disciplining pressure that market forces exert on capital structure decisions. However, it is not clear what the specific predictions of the market view should be. Gropp and Heider (2010) state rather vaguely that the "variables and their relation to leverage can be traced to various corporate finance theories on departures from the Modigliani-Miller irrelevance proposition". In practice, the predictions are based on the empirical literature on non-financial companies' capital structure. Theoretically, it is not obvious that the effects should necessarily be the same with respect to banks as non-financial companies, nor that they should be identical with respect to the different definitions of leverage.

Moreover, the interpretation of the results is complicated by the finding on the importance of bank-level fixed effects. Even with ever-changing regulatory requirements and an observable decrease in bank leverage over time, bank capital structures seem to include an important time-invariant component, regardless of which definition of leverage is considered. This finding is difficult to analyse in the framework of the buffer and market views of bank capital structure and the bank-specific criteria driving capital structure remain unknown. As a result, the practical implications of the results inevitably remain somewhat unclear. While answering some existing questions, the study seems to open several new ones.

The practical limits to the answers that can be provided with this study leave ample scope for further research. Further analysis would be needed to explain the differences in results and the economic connections between the different forms of bank leverage. Practical insights on how banks decide on their capital structure would also be valuable. There are many ways to examine this issue, including methods with a more qualitative emphasis, such as surveys or interviews. Relevant questions include, for example, what is the relative importance of market, book and regulatory leverage and how banks react to fluctuations in equity market valuations. It would also be useful to examine how banks react to changes in capital requirements. Pertinent questions include, for example, to what extent do banks draw down their capital buffers rather than improve capital ratios and what effects there are on the composition of the bank's assets. Considering all the changes in regulatory requirements occurring over the last decades and the various phase-in arrangements related to the Basel rules, there should be good opportunities to investigate these issues.

Finally, the determinants of bank capital structure have important implications for bank regulation and supervision. The findings on the cross-sectional determinants of bank capital structure presented in this thesis show that while capital structures are largely bank-specific, market pressure also has a noticeable disciplining effect on banks. Regulators should be mindful of increasing capital requirements too much, as this could have negative effects on the ability of the banking system to extend credit to the real economy. At some point, higher capital requirements mean that the bank will cut back on lending or lower the overall riskiness of its loan book rather than increase the amount of equity capital. While this makes the bank safer from the supervisor's point of view, it may not be socially desirable. Moreover, already existing regulatory tools, such as countercyclical capital buffers and the bank-specific supervisory review process, enable supervisors to temper fluctuations in the credit cycle or counter various bank-specific risks without permanent increases in minimum levels of capital.

These observations should not be construed as a call to deregulate banks. Rather, bank regulation in all its forms should be calibrated to provide the necessary conditions and incentives

for effective market discipline. This way, a balance can be struck between the bank's financial intermediation function and financial stability concerns. The required elements already exist in the regulatory framework, but their effective application should be reinforced. Banks are subject to various requirements on governance arrangements, risk management and disclosure of information, among other things. Furthermore, the competent authorities must have all the necessary powers, expertise and information to be able to enact sufficiently onerous intervention measures if the bank's financial situation deteriorates, effectively taking over the bank's management and prohibiting the distribution of funds. Deposit insurance caps ensure that large depositors also have incentives to monitor bank risk-taking. Ultimately, the most important tool may be a credible bank crisis management framework (see Financial Stability Board 2024), whereby the burden of losses in the event of the bank's failure falls on its shareholders and creditors rather than taxpayers, mitigating the moral hazard risks related to implicit government guarantees.

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Appendix

The national stock indices used to calculate the stock market risk variable described in section 5.2

Country	Index
Austria	ATX
Belgium	BEL 20
Bulgaria	SOFIX
Cyprus	CSE General Index
Czech Republic	PX
Denmark	OMXC 25
Estonia	OMX Tallinn
Finland	OMXH 25
France	CAC 40
Germany	DAX
Greece	ATHEX Composite
Hungary	BUX
Ireland	ISEQ 20
Italy	FTSE MIB
Lithuania	LITEX 30
Malta	MSE
Netherlands	AEX
Poland	WIG 20
Portugal	PSI 20
Romania	BET
Slovak Republic	SAX
Slovenia	SBI TOP
Spain	IBEX 35
Sweden	OMXS 30
United Kingdom	FTSE 100
United States	S&P500