EUROPEAN CENTRAL BANK

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THE DETERMINANTS OF BANK CAPITAL STRUCTURE

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by Reint Gropp[2]

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In 2009 all ECB publications feature a motif taken from the €200 banknote.

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Abstract

The paper shows that mispriced deposit insurance and capital regulation were of second order importance in determining the capital structure of large U.S. and European banks during 1991 to 2004. Instead, standard cross-sectional determinants of non-financial firms' leverage carry over to banks, except for banks whose capital ratio is close to the regulatory minimum. Consistent with a reduced role of deposit insurance, we document a shift in banks' liability structure away from deposits towards non-deposit liabilities. We find that unobserved time-invariant bank fixed effects are ultimately the most important determinant of banks' capital structures and that banks' leverage converges to bank specific, time invariant targets.

Key words: bank capital, capital regulation, capital structure, leverage.

JEL-codes: G32, G21

Non-technical summary

The objective of this paper is to examine whether capital requirements are a first-order determinant of banks' capital structure using the cross-section and time-series variation in a sample of large, publicly traded banks spanning 16 countries (the United States and the EU-15) from 1991 until 2004. To answer the question, we borrow extensively from the empirical corporate finance literature that has at length examined the capital structure of non-financial firms. The literature on firms' leverage i) has converged on a number of standard variables that are reliably related to the capital structure of non-financial firms and ii) has examined its transitory and permanent components.

The evidence in this paper documents that the similarities between banks' and non-financial firms' capital structure may be greater than previously thought. Specifically, this paper establishes five novel and interrelated empirical facts.

First, standard cross-sectional determinants of firms' capital structures also apply to large, publicly traded banks in the US and Europe, except for banks close to the minimum capital requirement. The sign and significance of the effect of most variables on bank capital structure are identical to the estimates found for non-financial firms. This is true for both book and market leverage, Tier 1 capital, when controlling for risk and macro factors, for US and EU banks examined separately, as well as when examining a series of cross-sectional regressions over time.

Second, the high levels of banks' discretionary capital observed do not appear to be explained by buffers that banks hold to insure against falling below the minimum capital requirement. Banks that would face a lower cost of raising equity at short notice (profitable, dividend paying banks with high market to book ratios) tend to hold significantly more capital.

Third, the consistency between non-financial firms and banks does not extend to the components of leverage (deposit and non-deposit liabilities). Over time, banks have financed their balance sheet growth entirely with non-deposit liabilities, which implies that the composition of banks' total liabilities has shifted away from deposits.

Fourth, unobserved time-invariant bank fixed-effects are important in explaining the variation of banks' capital structures. Banks appear to have stable capital structures at levels that are specific to each individual bank. Moreover, in a dynamic framework, banks' target leverage is time invariant and bank specific. Both of these findings for banks mirror those found for non-financial firms.

Fifth, controlling for banks' characteristics, we do not find a significant effect of deposit insurance on the capital structure of banks. This is in contrast to the view that banks increase their leverage in order to maximise the subsidy arising from incorrectly priced deposit insurance.

Together, the empirical facts established in this paper suggest that capital regulation and buffers may only be of second order importance in determining the capital structure of most banks.

1. Introduction

This paper borrows from the empirical literature on non-financial firms to explain the capital structure of large, publicly traded banks. It uncovers empirical regularities that are inconsistent with a first order effect of capital regulation on banks' capital structure. Instead, the paper suggests that there are considerable similarities between banks' and non-financial firms' capital structures.

Subsequent to the departures from Modigliani and Miller (1958)'s irrelevance proposition, there is a long tradition in corporate finance to investigate the capital structure decisions of non-financial firms. But what determines banks' capital structures? The standard textbook answer is that there is no need to investigate banks' financing decisions, since capital regulation constitutes the overriding departure from the Modigliani and Miller propositions:

> *"Because of the high costs of holding capital […], bank managers often want to hold less bank capital than is required by the regulatory authorities. In this case, the amount of bank capital is determined by the bank capital requirements (Mishkin, 2000, p.227)."*

Taken literally, this suggests that there should be little cross-sectional variation in the leverage ratio of those banks falling under the Basel I regulatory regime, since it prescribes a uniform capital ratio. Figure 1 shows the distribution of the ratio of book equity to assets for a sample of the 200 largest publicly traded banks in the United States and 15 EU countries from 1991 to 2004 (we describe our data in more detail below). There is a large variation in banks' capital ratios.[1] Figure 1 indicates that bank capital structure deserves further investigation.

Figure 1 (Distribution of book capital ratios)

The objective of this paper is to examine whether capital requirements are indeed a first-order determinant of banks' capital structure using the cross-section and time-series variation in our sample of large, publicly traded banks spanning 16 countries (the United States and the EU-15) from 1991 until 2004. To answer the question, we borrow extensively from the empirical corporate finance literature that has at length examined the capital structure of non-

[1] The ratio of book equity to book assets is an understatement of the regulatory Tier-1 capital ratio since the latter has risk-weighted assets in the denominator. Figure 3 shows that the distribution of regulatory capital exhibits the same shape as for economic capital, but is shifted to the right. Banks' regulatory capital ratios are not uniformly close to the minimum of 4% specified in the Basel Capital Accord (Basel I).

financial firms.[2] The literature on firms' leverage i) has converged on a number of standard variables that are reliably related to the capital structure of non-financial firms (for example Titman and Wessels, 1988, Harris and Raviv, 1991, Rajan and Zingales, 1995, and Frank and Goyal, 2004) and ii) has examined the transitory and permanent components of leverage (for example Flannery and Rangan, 2006, and Lemmon et al., 2008).

The evidence in this paper documents that the similarities between banks' and non-financial firms' capital structure may be greater than previously thought. Specifically, this paper establishes five novel and interrelated empirical facts.

First, standard cross-sectional determinants of firms' capital structures also apply to large, publicly traded banks in the US and Europe, except for banks close to the minimum capital requirement. The sign and significance of the effect of most variables on bank leverage are identical when compared to the results found in Frank and Goyal (2004) for US firms and Rajan and Zingales (1995) for firms in G-7 countries. This is true for both book and market leverage, Tier 1 capital, when controlling for risk and macro factors, for US and EU banks examined separately, as well as when examining a series of cross-sectional regressions over time.

Second, the high levels of banks' discretionary capital observed do not appear to be explained by buffers that banks hold to insure against falling below the minimum capital requirement. Banks that would face a lower cost of raising equity at short notice (profitable, dividend paying banks with high market to book ratios) tend to hold significantly more capital.

Third, the consistency between non-financial firms and banks does not extend to the components of leverage (deposit and non-deposit liabilities). Over time, banks have financed their balance sheet growth entirely with non-deposit liabilities, which implies that the composition of banks' total liabilities has shifted away from deposits.

Fourth, unobserved time-invariant bank fixed-effects are important in explaining the variation of banks' capital structures. Banks appear to have stable capital structures at levels that are specific to each individual bank. Moreover, in a dynamic framework, banks' target leverage is time invariant and bank specific. Both of these findings confirm Lemmon et al.'s

[2] An early investigation of banks' capital structures using a corporate finance approach is Marcus (1983). He examines the decline in capital to asset ratios of US banks in the 1970s.

(2008) results on the transitory and permanent components of non-financial firms' capital structure for banks.

Fifth, controlling for banks' characteristics, we do not find a significant effect of deposit insurance on the capital structure of banks. This is in contrast to the view that banks increase their leverage in order to maximise the subsidy arising from incorrectly priced deposit insurance.

Together, the empirical facts established in this paper suggest that capital regulation and buffers may only be of second order importance in determining the capital structure of most banks. Hence, our paper sheds new light on the debate whether regulation or market forces determine banks' capital structures. Barth et al. (2005), Berger et al. (2008) and Brewer et al. (2008) observe that the levels of bank capital are much higher than the regulatory minimum. This could be explained by banks holding capital buffers in excess of the regulatory minimum. Raising equity on short notice in order to avoid violating the capital requirement is costly. Banks may therefore hold discretionary capital to reduce the probability that they have to incur this cost.[3]

Alternatively, banks may be optimising their capital structure, possibly much like non-financial firms, which would relegate capital requirements to second order importance. Flannery (1994), Myers and Rajan (1998), Diamond and Rajan (2000) and Allen et al. (2009) develop theories of optimal bank capital structure, in which capital requirements are not necessarily binding. Non-binding capital requirements are also explored in the market discipline literature.[4] While the literature on bank market discipline is primarily concerned with banks' risk taking, it also has implications for banks' capital structures. Based on the market view, banks' capital structures are the outcome of pressures emanating from shareholders, debt holders and depositors (Flannery and Sorescu, 1996, Morgan and Stiroh, 2001, Martinez Peria and Schmuckler, 2001, Calomiris and Wilson, 2004, Ashcraft, 2008, and Flannery and Rangan, 2008). Regulatory intervention may then be non-binding and of secondary importance.

[3] Berger et al. (2008) estimate partial adjustment models for a sample of U.S. banks. Their main focus is the adjustment speed towards target capital ratios and how this adjustment speed may differ for banks with different characteristics (see also our section 5). Their paper is less concerned with the question of whether capital regulation is indeed a binding constraint for banks.

[4] See Flannery and Nikolova (2004) and Gropp (2004) for surveys of the literature.

The debate is also reflected in the efforts to reform the regulatory environment in response to the current financial crisis. Brunnermeier et al. (2008) also conceptually distinguish between a regulatory and a market based notion of bank capital. When examining the roots of the crisis, Greenlaw et al. (2008) argue that banks' active management of their capital structures in relation to internal value at risk, rather than regulatory constraints, was a key destabilising factor.

Finally, since the patterns of banks' capital structure line up with those uncovered for firms, our results reflect back on corporate finance findings. Banks generally are excluded from empirical investigations of capital structure. However, large publicly listed banks are a homogenous group of firms operating internationally with a comparable production technology. Hence, they constitute a natural hold-out sample. We thus confirm the robustness of these findings outside the environment in which they were originally uncovered.[5]

The paper is organised as follows. Section 2 describes our sample and explains how we address the survivorship bias in the Bankscope database. Section 3 presents the baseline corporate finance style regressions for our sample of large banks and bank holding companies. Section 4 decomposes banks' liabilities into deposit and non-deposit liabilities. Section 5 examines the permanent and transitory components of banks' leverage. Section 6 analyzes the effect of deposit insurance on banks' capital structures, including the role of deposit insurance coverage in defining banks' leverage targets. The section also considers Tier 1 capital and banks that are close to the regulatory minimum level of capital. In Section 7 we offer a number of conjectures about theories of bank capital structure that are not based on binding capital regulation and that are consistent with our evidence. Section 8 concludes.

2. Data and Descriptive Statistics

Our data come from four sources. We obtain information about banks' consolidated balance sheets and income statements form the Bankscope database of the Bureau van Dijk, information about banks' stock prices and dividends from Thompson Financial's Datastream database, information about country level economic data from the World Economic Outlook database of the IMF and data on deposit insurance schemes from the Worldbank. Our sample starts in 1991 and ends in 2004. The starting point of our sample is determined by data

[5] The approach taken in this paper is similar to the one by Barber and Lyon (1997), who confirm that the relationship between size, market-to-book ratios and stock returns uncovered by Fama and French (1992) extends to banks.

availability in Bankscope. We decided on 2004 as the end point in order to avoid the confounding effects of i) banks anticipating the implementation of the Basle II regulatory framework and ii) banks extensive use of off-balance sheet activities in the run-up of the subprime bubble leading to the 2007-09 financial crisis. We focus only on the 100 largest publicly traded commercial banks and bank-holding companies in the United States and the 100 largest publicly traded commercial banks and bank-holding companies in 15 countries of the European Union. Our sample consists of 2,415 bank-year observations.[6] Table I shows the number of unique banks and bank-years across countries in our sample.

Table I (Unique banks and bank-years across countries)

Special care has been taken to eliminate the survivorship bias inherent in the Bankscope database. Bureau van Dijk deletes historical information on banks that no longer exist in the latest release of this database. For example, the 2004 release of Bankscope does not contain information on banks that no longer exist in 2004 but did exist in previous years.[7] We address the survivorship bias in Bankscope by reassembling the panel data set by hand from individual cross-sections using historical, archived releases of the database. Bureau Van Dijk provides monthly releases of the Bankscope database. We used the last release of every year from 1991 to 2004 to provide information about banks in that year only. For example, information about banks in 1999 in our sample comes from the December 1999 release of Bankscope. This procedure also allows us to quantify the magnitude of the survivorship bias: 12% of the banks present in 1994 no longer appear in the 2004 release of the Bankscope dataset.

Table II provides descriptive statistics for the variables we use.[8] Mean total book assets are $65 billion and the median is $14 billion. Even though we selected only the largest publicly traded banks, the sample exhibits considerable heterogeneity in the cross-section. The largest bank in the sample is almost 3,000 times the size of the smallest. In light of the objective of this paper, it is useful to compare the descriptive statistics to those for a typical

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[6] We select the 200 banks anew each year according to their book value of assets. There are less than 100 publicly traded banks in the EU at the beginning of our time period. There are no data for the US in 1991 and 1992. We also replaced the profits of Providian Financial in 2001 with those of 2002, as Providian faced lawsuits that year due to fraudulent mis-reporting of profits.

[7] For example, Banque National de Paris (BNP) acquired Paribas in 2000 to form the current BNP Paribas bank. The 2004 release of Bankscope no longer contains information about Paribas prior to 2000. There is, however, information about BNP prior to 2000 since it was the acquirer.

[8] We describe in detail how we construct these variables in the Appendix.

sample of listed non-financial firms used in the literature. We use Frank and Goyal (2004, Table 3) for this comparison.[9] For both, banks and firms the median market-to-book ratio is close to one. The assets of firms are typically three times as volatile as the assets of banks (12% versus 3.6%). The median profitability of banks is 5.1% of assets, which is a little less than a half of firms' profitability (12% of assets). Banks hold much less collateral than non-financial firms: 27% versus 56% of book assets, respectively. Our definition of collateral for banks includes liquid securities that can be used as collateral when borrowing from central banks. Nearly 95% of publicly traded banks pay dividends, while only 43% of firms do so.

Table II (Descriptive statistics)

Based on these simple descriptive statistics, banking appears to have been a relatively safe and, correspondingly, low return industry during our sample period. This matches the earlier finding by Flannery et al. (2004) that banks may simply be "boring". Banks' leverage is, however, substantially different from that of firms. Banks' median book leverage is 92.6% and median market leverage is 87.3% while median book and market leverage of non-financial companies in Frank and Goyal (2004) is 24% and 23%, respectively. While banking is an industry with on average high leverage, there are also a substantial number of non-financial firms no less levered than banks. Welch (2007) lists the 30 most levered firms in the S&P 500 stock market index. Ten of them are financial firms. The remaining 20 are non-financial firms from various sectors including consumer goods, IT, industrials and utilities. Most of them have investment grade credit ratings and are thus not close to bankruptcy. Moreover, the S&P 500 contains 93 financial firms, which implies that 83 do not make the list of the 30 most levered firms.

Table III presents the correlations among the main variables at the bank level. Larger banks tend to have lower profits and more leverage. A bank's market-to-book ratio correlates positively with asset risk, profits and negatively with leverage. Banks with more asset risk, more profits and less collateral have less leverage. These correlations correspond to those typically found for non-financial firms.

Table III (Correlations)

[9] See also Table 1 in Lemmon et al. (2008) for similar information.

III. Corporate Finance Style Regressions

Beginning with Titman and Wessels (1988), then Rajan and Zingales (1995) and more recently Frank and Goyal (2004), the empirical corporate finance literature has converged to a limited set of variables that are reliably related to the leverage of non-financial firms. Leverage is positively correlated with size and collateral, and is negatively correlated with profits, market-to-book ratio and dividends. The variables and their relation to leverage can be traced to various corporate finance theories on departures from the Modigliani-Miller irrelevance proposition (see Harris and Raviv, 1991, and Frank and Goyal, 2008, for surveys).

Regarding banks' capital structures, the standard view is that capital regulation constitutes an additional, overriding departure from the Modigliani-Miller irrelevance proposition (see for example Berger et al., 1995, Miller, 1995, or Santos, 2001). Commercial banks have deposits that are insured to protect depositors and to ensure financial stability. In order to mitigate the moral-hazard of this insurance, commercial banks must be required to hold a minimum amount of capital. Our sample consists of large, systemically relevant commercial banks in countries with explicit deposit insurance during a period in which the uniform capital regulation of Basle I is in place. In the limit, the standard corporate finance determinants should therefore have little or no explanatory power relative to regulation for the capital structure of the banks in our sample.

An alternative, less stark view of the impact of regulation has banks holding capital buffers, or discretionary capital, above the regulatory minimum in order to avoid the costs associated with having to issue fresh equity at short notice (Ayuso et al., 2004, and Peura and Keppo, 2006). It follows that banks facing higher cost of issuing equity should be less levered. According to the buffer view, the cost of issuing equity is caused by asymmetric information (as in Myers and Majluf, 1984). Dividend paying banks, banks with higher profits or higher market–to-book ratios can therefore be expected to face lower costs of issuing equity because they either are better known to outsiders, have more financial slack or can obtain a better price. The effect of bank size on the extent of buffers is ambiguous ex ante. Larger banks may hold smaller buffers if they are better known to the market. Alternatively, large banks may hold larger buffers if they are more complex and, hence, asymmetric information is more important. The size of buffers should also depend on the probability of falling below the regulatory threshold. If buffers are an important determinant of banks' capital structure, we expect the level of banks' leverage to be positively related to risk. Finally, there is no clear prediction on how collateral affects leverage.

Table IV summarizes the predicted effects of the explanatory variables on leverage for both the market and the buffer view. The signs differ substantially across the two views. To the extent that the estimated coefficients are significantly different from zero, and hence the pure regulatory view of banks' capital structure does not apply, we can exploit the difference in the sign of the estimated coefficients to differentiate between the market and the buffer views of bank capital structure.

Table IV (Predicted effects of explanatory variables on leverage: market/corporate finance view vs. buffer view)

Consider the following standard capital structure regression:

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

The explanatory variables are the market-to-book ratio (*MTB*), profitability (*Prof*), the natural logarithm of size (*Size*), collateral (*Coll*) (all lagged by one year) and a dummy for dividend payers (*Div*) for bank *i* in country *c* in year *t* (see the appendix for the definition of variables). The regression includes time and country fixed effects (c_t and c_c) to account for unobserved heterogeneity at the country level and across time that may be correlated with the explanatory variables. Standard errors are clustered at the bank level to account for heteroscedasticity and serial correlation of errors (Petersen, 2009).

The dependent variable leverage is one minus the ratio of equity over assets in market values. It therefore includes both debt and non-debt liabilities such as deposits. The argument for using leverage rather than debt as the dependent variable is that leverage, unlike debt, is well defined (see Welch, 2007). Leverage is a structure that increases the sensitivity of equity to the underlying performance of the (financial) firm. When referring to theory for an interpretation of the basic capital structure regression (1), the corporate finance literature typically does not explicitly distinguish between debt and non-debt liabilities (exceptions are the theoretical contribution by Diamond, 1993, and empirical work by Barclay and Smith, 1995 and Rauh and Sufi, 2008). Moreover, since leverage is one minus the equity ratio, the dependent variable can be directly linked to the regulatory view of banks' capital structure.[10] But a bank's capital structure is different from non-financial firms' capital structure since it includes deposits. We therefore decompose banks' leverage into deposits and non-deposit liabilities in Section IV.

Table V shows the results of estimating Equation (1). We also report the coefficient elasticities and confront them with the results of comparable regressions for non-financial firms as reported for example in Rajan and Zingales (1995) and Frank and Goyal (2004). When making a comparison to these standard results, it is important to bear in mind that these studies i) use long-term debt as the dependent variable (see the preceding paragraph) and ii) use much more heterogeneous samples (in size, sector and other characteristics, Frank and Goyal 2004, Table 1). In order to further facilitate comparisons with non-financial firms, we also report the result of estimating Equation (1) (using leverage as the dependent variable) in a sample of firms that are comparable in size with the banks in our sample.[11]

Table V (Bank characteristics and market leverage)

All coefficients are statistically significant at the one percent level, except for collateral, which is significant at the 10 percent level. All coefficients have the same sign as in the standard regressions of Rajan and Zingales (1995), Frank and Goyal (2004) and as in our leverage regression using a sample of the largest firms (except the market to book ratio, which is insignificant for the market leverage of those firm). Banks' leverage depends positively on size and collateral, and negatively on the market-to-book ratio, profits and dividends. The model also fits the data very well: the R^2 is 0.72 for banks and 0.55 for the largest non-financial firms.

We find that the elasticity of bank leverage to some explanatory variables (e.g. profits) is larger than the corresponding elasticities for firms reported in Frank and Goyal (2004).[12]

[10] We report the results when using the Tier 1 regulatory capital ratio as the dependent variable in section VI below.

[11] In order to obtain a sample of non-financial firms that are comparable in size to the banks in our sample, we selected the 200 largest publicly traded firms (by book assets) each year from 1991 to 2004 in both the United States and the EU using the Worldscope database. The median firm size is $7.2 billion. The median market leverage is 47% and the median book leverage is 64%.

[12] We examined whether the difference in the elasticity of collateral is due to differences in measurement across banks and firms. However, we found the results robust to defining collateral including or excluding liquid assets. We attribute the relatively weak result for dividends to the fact that almost all of the banks in the sample (more than 94 percent) pay dividends, suggesting only limited variation in this explanatory variable.

However, when we compare the elasticities of bank leverage to firms that are more comparable in size, we tend to get smaller magnitudes. The elasticity of leverage to profits is -0.018 for banks. This means that a one percent increase in median profits, $7.3m, decreases median liabilities by $2.5m. For the largest non-financial firms the elasticity of leverage to profits is -0.296, which means that an increase of profits of $6.5m (1% at the median) translates into a reduction of leverage by $10m.

The similarity in sign and significance of the estimated coefficients for banks' leverage to the standard corporate finance regression suggests that a pure regulatory view does not apply to banks' capital structure. But can the results be explained by banks holding buffers of discretionary capital in order to avoid violating regulatory thresholds? Recall from Table IV that banks with higher market-to-book ratios, higher profits and that pay dividends should hold less discretionary capital since they can be expected to face lower costs of issuing equity. However, these banks hold *more* discretionary capital. Moreover, collateral matters for the banks in our sample. Only the coefficient on bank size is in line with the regulatory view if one argues that larger banks are better known to the market and find it easier to issue equity.

Leverage can be measured in both book and market values. Both definitions have been used interchangeably in the corporate finance literature and yield similar results.[13] But the difference between book and market values is more important in the case of banks, since capital regulation is imposed on book but not on market values. We therefore re-estimate Equation (1) with book leverage as the dependent variable.

Table VI (Bank characteristics and book leverage)

Table VI shows that the results for book leverage are similar to those for market leverage in Table V, again comparing to the results in Rajan and Zingales (1995), Frank and Goyal (2004) and the sample of the largest non-financial firms. Regressing book leverage on the standard corporate finance determinants of capital structure produces estimated coefficients that are all significant at the 1% level. Again all coefficients have the same sign

[13] Exceptions are Barclay et al. (2006) who focus on book leverage and Welch (2004) who argues for market leverage. Most studies, however, use both.

as in studies of non-financial firms and for the largest non-financial firms reported in the last column.[14]

We are unable to detect significant differences between the results for the book and the market leverage of banks, as in standard corporate finance regressions using firms. This does not support the view that regulatory concerns are the main driver of banks' capital structure since they should create a wedge between the determinants of book and market values. Like for market leverage, we do not find that the signs of the coefficients are consistent with the buffer view of banks' capital structure (see Table IV).

Despite its prominent role in corporate finance theory, risk sometimes fails to show up as a reliable factor in the empirical literature on firms' leverage (as for example in Titman and Wessels, 1988, Rajan and Zingales, 1995, and Frank and Goyal, 2004). In Welch (2004) and Lemmon et al. (2008), risk, however, significantly reduces leverage. We therefore add risk as an explanatory variable to our empirical specification. Columns 1 and 3 of Table VII report the results.

Table VII (Adding risk and explanatory power of bank characteristics)

The negative coefficient of risk on leverage, both in market and book values, is in line with standard corporate finance arguments, but also consistent with the regulatory view. In its pure form, in which regulation constitutes the overriding departure from the Modigliani and Miller irrelevance proposition, a regulator could force riskier banks to hold more book equity. In that regard, omitting risk from the standard leverage regression (1) would result in spurious significance of the remaining variables. The results in Table VII show this is not the case. Risk does not drive out the other variables. An F-test on the joint insignificance of all non-risk coefficients is rejected. All coefficients from Tables IV and V remain significant at the 1% level, except i) the coefficient of the market-to-book ratio on book leverage, which is no longer significant, and ii) the coefficient of collateral on market leverage, which becomes significant at the 5% level (from being marginally significant at the 10% level before).[15]

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[14] We do not find a significant coefficient on collateral and dividend paying status for the largest non-financial firms. While the coefficients have the expected signs, clustering at the firm level increases the standard errors such that the coefficients are no longer significant. We attribute this to the relatively small sample size and the greater heterogeneity in the firm sample.

[15] Risk lowers the coefficient on the market-to-book ratio by two thirds. The reason is that risk strongly commoves positively with the market-to-book ratio (see Table III: the correlation coefficient is 0.85).

Since capital requirements under Basel I, the relevant regulation during our sample period, are generally risk insensitive, riskier banks cannot be formally required to hold more capital. Regulators may, however, discretionally ask banks to do so. In the US for example, regulators have modified Basel I to increase its risk sensitivity and the results could reflect these modifications (FDICIA). However, the coefficient on risk is twice as large for market leverage as for book leverage (Table VII). Since regulation pertains to book and not market capital, it is unlikely that regulation drives the negative relationship between leverage and risk in our sample. There is also complementary evidence in the literature on this point. For example, Flannery and Rangan (2008) conclude that regulatory pressures cannot explain the relationship between risk and capital in the US during the 1990s.[16] Calomiris and Wilson (2004) find a negative relationship between risk and leverage using a sample of large publicly traded US banks in the 1920s and 1930s when there was no capital regulation.

It is instructive to examine the individual contribution of each explanatory variable to the fit of the regression. In columns 2 and 4 of Table VII, we present the increase in R^2 of adding one variable at a time to a baseline specification with time and country fixed effects only. The market-to-book ratio accounts for an extra 45 percentage points of the variation in market leverage but only for an extra 8 percentage points of the variation in book leverage. This is not surprising given that the market-to-book ratio and the market leverage ratio both contain the market value of assets. Risk is the second most important variable for market leverage and the most important variable for book leverage. Risk alone explains an extra 28 percentage points of the variation in market leverage and an extra 12 percentage points of the variation in book leverage. Size and profits together explain an extra 10 percentage points. Collateral and dividend paying status hardly affect the fit of the leverage regressions.[17]

Finally, we ask whether the high R^2 obtained when regressing banks' leverage on the standard set of corporate finance variables (Tables V to VII) is partly due to including time and country fixed effects. The results of dropping either or both fixed effects from the regression are reported in Table VIII. Without either country or time fixed effects, the R^2 drops from 0.80 to 0.74 in market leverage regressions and from 0.58 to 0.46. While country

[16] There is also complementary evidence for earlier periods. Jones and King (1995) show that mandatory actions under FIDICIA are applied only very infrequently. Hovakimian and Kane (2000) argue that innovations in risk-based regulation from 1985 to 1994 were ineffective.

[17] The equivalent marginal R^2 for non-financial firms reported in Frank and Goyal (2004) are for market-to-book ratio 0.07, profits 0.00, size 0.05, collateral 0.06 and risk 0.05. The largest explanatory power for non-financial firms in their regression has average industry leverage with a marginal R^2 of 0.19.

and time fixed effects seem to be useful in controlling for heterogeneity across time and countries, the fit of our regressions is only to a limited extent driven by country or time fixed effects.[18]

Table VIII (Time and country fixed effects)

In Appendix II, we show that the stable relationship between standard determinants of capital structure and bank leverage is robust to including macroeconomic variables, and holds up if we estimate the model separately for U.S. and the EU banks. The consistency of results across the U.S. and the EU is further evidence that regulation is unlikely to be the main driver of the capital structure of banks in our sample. Even in Europe, where regulators have much less discretion to modify the risk insensitivity of Basel I (see also the discussion of Table VII above), we find a significant relationship between risk and leverage.

4. Decomposing Leverage

Banks' capital structure fundamentally differs from the one of non-financial firms, since it includes deposits, a source of financing generally not available to firms.[19] Moreover, much of the empirical research for firms was performed using long term debt divided by assets rather than total liabilities divided by assets. This section therefore decomposes bank liabilities into deposit and non-deposit liabilities. Non-deposit liabilities can be viewed as being closely related to long term debt for firms. They consist of senior long term debt, subordinated debt and other debenture notes. The overall correlation between deposits and non-deposit liabilities is between -0.839 and -0.975 (depending on whether market or book values are used).[20] Figure 2 reports the median composition of banks' liabilities over time and shows that banks have substituted non-deposit debt for deposits during our sample period. The share of non-deposit liabilities in total book assets increases from around 20% in the early 90s to 29% in 2004. The share of deposits declines correspondingly from 73% in the early 90s to 64% in 2004. Book equity remains almost unchanged at around 7% of total assets. There is a slight upward trend in equity until 2001 (to 8.4% of total assets), but the trend reverses in

[18] Time and country fixed effects alone explain about 30% of the variation in banks' leverage.
[19] Miller (1995), however, mentions the case of IBM whose lease financing subsidiary issued a security called "Variable Rate Book Entry Demand Note", which is functionally equivalent to demand deposits.
[20] The correlations within banks and within years are both strongly negative. The negative overall correlation is driven both by variation over time (banks substituting deposits and non-deposit liabilities) and in the cross section (there are banks with different amounts of deposits and non-deposit liabilities).

the later years of the sample. In nominal terms, the balance sheet of the median bank increased by 12 % from 1991 to 2004. Nominal deposits remained unchanged but nominal non-deposit liabilities grew by 60%. Banks seem to have financed their growth entirely via non-deposit liabilities.

Figure 2 (Composition of banks' liabilities over time)

The effective substitution between deposits and non-deposit liabilities is also visible in Table IX, which reports the results of estimating Equation (1) (with risk) separately for deposits and non-deposit liabilities. Whenever an estimated coefficient is significant, it has the opposite sign for deposits and for non-deposit liabilities (except the market-to-book ratio for market leverage).

Table IX (Decomposing leverage)

The signs of the coefficients in the regression using non-deposit liabilities are the same as in the previous leverage regressions, except for profits.[21] Larger banks and banks with more collateral have fewer deposits and more non-deposit liabilities, which is consistent with these banks having better access to debt markets. More profitable banks substituting away from deposits may be an indication of a larger debt capacity as they are less likely to default. Risk and dividend payout status, however, are no longer significant for either deposits or non-deposit liabilities.

In sum, the standard corporate finance style regression work less well for the components of leverage than for leverage itself. This is also borne out by a drop in the R^2 from 58% and 80% in book and market leverage regressions, respectively, to around 30-40% in regressions with deposits and non-deposit liabilities as the dependent variables. Except for profits, the signs of the estimated coefficients when the dependent variable is non-deposit liabilities are as before for total leverage. But the signs are the opposite when the dependent variable is deposits. Moreover, risk is no longer a significant explanatory variable for either components of leverage. The failure of the model for deposits is consistent with regulation as a driver of deposits, but standard corporate finance variables retain their importance for non-

[21] The insignificance of the market-to-book ratio in a regression using book values and including risk is as in Table VII.

deposit liabilities, which is consistent with the findings for long term debt for non-financial firms. Moreover, the shift away from deposits towards non-deposit liabilities as a source of financing further supports a much reduced role of regulation as a determinant of banks' capital structure. Since total leverage is not driven by regulation, one must distinguish between the capital and the liability structure of large publicly traded banks (see also the discussion in Section 7).

5. Bank Fixed Effects and the Speed of Adjustment

Recently, Lemmon et al. (2008) show that adding firm fixed effects to the typical corporate finance leverage regression (1) has important consequences for thinking about capital structure. They find that the fixed effects explain most of the variation in leverage. That is, firms' capital structure is mostly driven by an unobserved time-invariant firm specific factor.

We want to know whether this finding also extends to banks. Table X reports the results from estimating equation (1) (with risk) where country fixed effects are replaced by bank fixed effects. The Table shows that as in Lemmon et al. (2008) for firms, most of the variation in banks' leverage is driven by bank fixed effects. The fixed effect accounts for 92% of book leverage and for 76% of market leverage. Comparable figures for non-financial firms are 92% for book leverage and 85% for market leverage (Lemmon et al., 2008, Table III). The coefficients of the explanatory variables keep the same sign as in Table VII (except for the market-to-book ratio when using book leverage) but their magnitude and significance reduces since they are now identified from the time-series variation within banks only.

Table X (Bank fixed effects and the speed of adjustment)

The importance of bank fixed effects casts further doubt on regulation as a main driver of banks' capital structure. The Basel 1 capital requirements and their implementation apply to all relevant banks in the same way and they are of course irrelevant for non-financial firms. Yet, banks' leverage appears to be stable for long periods around levels specific to each individual bank and this stability is comparable to the one documented for non-financial firms.

Next, we examine the speed of adjustment to target capital ratios. The objective is twofold. First, a similarity of the speed of adjustment for non-financial and financial firms would again be evidence that banks' capital structures are driven by forces that are comparable to those driving firms' capital structures. Second, we can further investigate the relative importance of regulatory factors, which are common to all banks, and bank specific factors.

Following Flannery and Rangan (2006) and Lemmon et al. (2008), we estimate a standard partial adjustment model. We limit the analysis to book leverage since the effect of regulation should be most visible there.[22] Table X present results for pooled OLS estimates (Columns 3 and 4) and fixed effects estimates (Columns 5 and 6).[23] Flannery and Rangan (2006) show that pooled OLS estimates understate the speed of adjustment as the model assumes that there is no unobserved heterogeneity at the firm level that affects their target leverage. Adding firm fixed effects therefore increases the speed of adjustment significantly.

This finding applies to banks, too. Using pooled OLS estimates we find a speed of adjustment of 9%, which is low and similar to the 13% for non-financial firms in Flannery and Rangan (2006) and Lemmon et al.'s (2008). Adding bank fixed effects, the speed of adjustment increases to 45% (Flannery and Rangan (2006) and Lemmon et al. (2008): 38% and 36%, respectively). Hence, we confirm that it is important to control for unobserved bank-specific effects on banks' target leverage. This is evidence against the regulatory view of banks' under which banks should converge to a common target, namely the minimum requirement set under Basel I.

Lemmon et al. (2008) add that, as in the case of static regressions, the fixed effects, and not the observed explanatory variables, are the most important factor for identifying firms' target leverage. Adding standard determinants of leverage to firm fixed effects increases the speed of adjustment only by 3 percentage points (i.e. from 36% to 39%, see Lemmon et al. (2008), Table VI). The same holds for banks. Adding the standard determinants of leverage increases the speed of adjustment by 1.8 percentage points to 46.8%. Banks, like non-financial firms, converge to time invariant bank specific targets. The standard time varying corporate finance variables do not help much in determining the target capitals structures of banks. It suggests that buffers are unlikely to be able to explain banks' capital structures.

[22] The results for partial adjustment models with market leverage are available from the authors upon request.

[23] We realise that both the pooled OLS estimates and the fixed effects estimates suffer from potentially severe biases and that one should use GMM (Blundell and Bond, 1998) instead (see also the discussion in Lemmon et al., 2008). Our objective here is not to estimate the true speed of adjustment, but rather to produce comparable results to the corporate finance literature. Caballero and Engel (2004) show that if adjustment is lumpy, partial adjustment models generally bias the speed of adjustment downwards.

Contrary to what is usually argued, these buffers would have to be independent of the cost of issuing equity on short notice since the estimated speed of adjustment is invariant to banks' market to book ratios, profitability or dividend paying status.

The implications of these results are twofold. First, it suggests that capital regulation and deposit insurance are not the overriding departures from the Modigliani/Miller irrelevance proposition for banks. Second, our results, obtained in a hold-out sample of banks, reflect back on the findings for non-financial firms. It narrows down the list of candidate explanations of what drives capital structure. For example, confirming the finding of Lemmon et al. (2008) on the transitory and permanent components of firms' leverage in our hold-out sample makes it unlikely that unobserved heterogeneity across industries can explain why capital structures tend to be stable for long periods. The banks in our sample form a fairly homogenous, global single industry that operates under different institutional and technological circumstances than non-financial firms.

6. Regulation and Bank Capital Structure

This section exploits the cross-country nature of our dataset to explicitly identify a potential effect of regulation on capital structure. The argument that capital regulation constitutes the overriding departure for banks from the Modigliani-Miller benchmark depends on (incorrectly priced) deposits insurance providing banks with incentives to maximise leverage up to the regulatory minimum.[24] We therefore exploit the variation in deposit insurance schemes across time and countries in our sample and include deposit insurance coverage in the country of residence of the bank in our regressions.[25] This section also seeks to uncover an effect of regulation by considering regulatory Tier 1 capital as an alternative dependent variable and by examining the situation of banks that are close to violating their capital requirement.

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[24] Keeley (1990) and many others since then emphasise the role of charter values in mitigating this incentive. The usual proxy for charter values used in the literature is the market to book ratio. Recall that we estimate a negative relationship between the leverage of banks and the market to book ratio, even though for book leverage ratios this relationship is weak once risk is included.

[25] The information on deposit insurance schemes is from the Worldbank (see Demirguc-Kunt et al., 2008). We use alternatively the coverage of deposit insurance divided by per capita GDP or the coverage of deposit insurance divided by average per capita deposits. Deposit insurance in Finland was unlimited during our sample period. We therefore set the coverage ratios to the maximum for Finnish banks. Any additional effects of unlimited coverage are subsumed in the country fixed effect.

First consider the effect of deposit insurance coverage by itself, without other bank level controls, but with time and country fixed effects (Table XI, Columns 1,2,5 and 6). Higher deposit insurance coverage is associated with higher market leverage, which is consistent with an effect of regulation on capital structure. However, the effect on book leverage is weak (insignificant for the coverage per capita GDP and significant at the 10% level for coverage per average capita deposits). The effects disappear once we control for bank characteristics. This is true for book leverage as well as market leverage, irrespective of which coverage variable is used. The estimated coefficients on bank characteristics in turn are unaffected by adding deposit insurance coverage to the regression (see Table VII). We fail to find evidence that deposit insurance coverage has an impact on banks' capital structure.[26]

Table XI (Deposit insurance coverage)

Next, we estimate a partial adjustment model to check whether the extent of deposit insurance influences the capital structure target of banks. The model is the same as in Section 5, except that we add deposit insurance as an additional explanatory variable. Since we are interested in whether deposit insurance coverage helps to define a common target for banks, we only report pooled OLS estimates. To save space, we also report only results for deposit insurance coverage measured as a percentage of average per capita deposits.[27]

Adding the extent of deposit insurance does not affect the speed of adjustment. Comparing column 3 of Table VIII to column 9 of Table XI, we find that the speed of adjustment remains unchanged at 9%. The same holds when controlling for bank characteristics. The speed of adjustment only changes slightly from 12.4% to 13%. The extent of deposit insurance does not seem to help in defining the capital structure target of banks, which is contrary to what the regulatory view of banks' capital structure would suggest.

Our next approach to identify the effects of regulation on leverage is to examine Tier 1 capital ratios. We define the Tier 1 capital ratio in line with Basel I as Tier 1 capital divided

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[26] We also find no evidence that deposit insurance coverage affects the liability structure of banks. We also estimated the model without country fixed effects (all results are available from the authors upon request). We expected that the omission of country dummies would strengthen the effect of deposit insurance coverage on leverage. This was not the case. The coefficient on both coverage variables turned negative. This highlights the importance of including country fixed effects into the regression in order to correctly identify the effect of deposit insurance.

[27] The results for the partial adjustment model with fixed effects and the results for coverage defined as a percentage of GDP (which yields equivalent results) are available from the authors upon request.

by risk weighted assets (Basel Committee, 1992). The distribution of Tier 1 capital ratios is shown in Figure 3. The distribution of Tier 1 capital is shifted to the right relative to the distribution of book capital ratios reported in Figure 1. There are no banks that fell below the regulatory minimum in any year during our sample period. At the same time, most banks hold significant discretionary Tier 1 capital in the period 1991 to 2004. The shift to the right of the distribution of Tier 1 capital relative to book capital is due to the fact that risk weighted assets are below total assets for all banks as some risk weights are than 100% (Basel Committee, 1992).

Figure 3 (Distribution of Tier 1 capital ratios)

Column 1 of Table XII shows considerable consistency between the regressions with Tier 1 capital as the dependent variable and the leverage regressions reported in Table VII. The only exception is that banks with more collateral hold more Tier 1 capital (significant at the 1 percent level) and are also more levered (from Table VII). The two results imply that banks with a lot of collateral also are invested disproportionately in assets with a low Basel I risk weight. Given that we, inter alia, defined collateral as the sum of Treasury bills, government bonds and cash, all of which receive low risk weights under Basel I, this positive correlation is not surprising.

Even if we are unable to show a first order effect of regulation for banks' capital structure at large, regulation may matter for banks that come close to their capital requirement. We therefore examine the leverage of banks that have little discretionary regulatory capital. Table XII reports the results of estimating a model in which we interact all explanatory variables with a dummy (*Close*) that is equal to one if a bank is close to the regulatory minimum. We use two definition of the *Close* dummy: less than 5% or less than 6% of Tier 1 capital in the previous year.

Table XII (Tier 1 capital and banks close to the regulatory minimum)

For banks below 5% Tier 1 capital, all coefficients are zero, except the dividend dummy, which is significantly negative.[28] For banks below 5% Tier 1 capital dividend paying

[28] This is the outcome of joint-significance tests of the sum of the coefficient on the explanatory variable and the interaction term of the explanatory variable with the respective *Close* dummy.

status is negatively associated with leverage. This is consistent with regulators limiting dividend payments for banks close to the regulatory minimum.

Given the low number of banks and observations that at some point fell below 5% Tier 1 capital (23 bank-year observations, 15 different banks), we also consider the results for the banks below 6% Tier 1 capital (137 bank-year observations, 49 different banks). For banks below 6%, the market-to-book ratio, profits and risk are not significantly different from zero. However, we can no longer reject that the coefficients on size (at the 1% level) and collateral (at the 5% significance level) are equal to zero. This is in addition to dividends having a significant effect. Hence, bank characteristics matter again for banks that have slightly more discretionary capital. It is noteworthy that the link between risk and leverage *weakens* for banks close to the regulatory minimum. Riskier banks that are close to the regulatory minimum do not adjust their capital structure towards more equity, as the buffer view would predict.

Overall, we conclude that capital requirements do introduce a non-linearity in the behaviour of banks when capital falls to levels very close to the regulatory minimum.

7. Discussion and Future Research

The evidence presented in this paper is inconsistent with regulation as the primary explanations for the capital structure of large, publicly traded banks. This raises two questions: First, why are banks are so leveraged if the moral hazard effect associated with deposit insurance is unimportant? And second, can the results presented in this paper narrow down the scope for future research with regards to differentiating between different theories of bank capital structure, in which regulation is non-binding? This section seeks to give first tentative answers to both of these questions.

Within the standard corporate finance theories, the high leverage of banks suggests either (i) that the tax benefits for banks are larger than for non-financial firms, (ii) that bankruptcy costs for banks are smaller, (iii) that agency problems in banks push them into the direction of more leverage, or (iv) that asymmetric information is more important for banks raising the cost of issuing equity. All these factors may interact, but for simplicity we address each of them separately.

First, we are not aware of any evidence that the tax benefits of debt should be larger for banks than for non-financial firms. Second, while to our knowledge there is also no systematic comparison of the bankruptcy costs for firms and banks, Mason's (2005) results do suggest that bankruptcy costs for banks are not systematically lower than for firms. Due to the opacity of banks' assets and other factors, the bankruptcy costs may in fact be significantly higher. Recent anecdotal evidence in connection with failed banks during the financial crisis of 2008/2009 also suggests that the bankruptcy costs of banks are substantial, at least to society as a whole (although it is not clear whether bank management takes this externality into account).

Third, agency costs may be a promising avenue to explain the higher leverage of banks relative to non-financial firms. Flannery (1994) argues that because banks invest in assets that are opaque, difficult for outsiders to verify, and permit ample opportunities for asset substitution, there may be a large role for short term debt even for uninsured banks. Short term debt can discipline the managers of banks through liquidity risk and mismatched maturities.[29] Fourth, and related, if banks are more difficult to understand for outside investors (Morgan, 2002) than non-financial firms, it is possible that the costs of issuing equity may be higher (as in Myers and Majluf, 1984). Our paper shows that profitable, dividend paying banks with high market to book ratios issue more equity, which supports this explanation for banks' capital structures.

Further, the stability of capital structures over time implies that the factors driving the cross-sectional variation in leverage ratios within the banking sector are stable over long horizons as well. Static pooled OLS regressions appear inadequate for dealing with the unobserved heterogeneity present in banks' capital structures. The presence of a significant unobserved permanent component requires alternative identification strategies. For non-financial firms, Bertrand and Schoar (2003) and Frank and Goyal (2007) have progressed in this direction using data for non-financial firms. For example, Bertrand and Schoar (2003) construct a data set, in which they are able to differentiate firm fixed effects from manager fixed effects by tracking managers across different firms. In Bertrand and Schoar (2003) the capital structure of firms depends on the managers preferences (for example her risk aversion). In addition, they find that firms with stronger governance structures tend to hire better managers. This suggests that it may be possible to trace differences in capital structure of banks back to differences in the quality of corporate governance in the banks. Frank and

[29] There are other interesting differences in the governance of banks relative to non-financial firms, which are documented in Adams and Mehran (2003), including the absence of hostile take-overs in banking, differences in board sizes and CEO stakes. All of these factors may be related to differences in leverage.

Goyal (2007) find that the preferences of the entire management team and not just that of the CEO may matter and further emphasise the difficulty in separating firm fixed effects from CEO, CFO and "management team" fixed effects.

In the banking literature, there are also a number of theoretical contributions consistent with non-binding regulation and stable capital structures over time. For example, Diamond and Rajan (2000) argue that the capital structure of a bank trades off the ability to create liquidity and credit against stability. This suggests that banks' capital structure is a function of the degree to which the banks' customers rely on liquidity and credit. Hence, the stable cross-sectional variation in capital structures documented in this paper may reflect that banks catering to different clienteles, a factor that tends to vary little over time.[30] Allen et al. (2009) show that under some circumstances borrowers may demand banks to commit some of their own capital when extending credit. Since borrowers do not fully internalize the cost of raising capital, the level of capital demanded by market participants may be above the one chosen by a regulator, even when capital is a relatively costly source of funds. As in Diamond and Rajan (2000), the capital structure of banks is then largely determined by the asset side of their balance sheet and may indeed exhibit the stability that we document in this paper.

The managerial preference approach (Bertrand and Schoar, 2003; Frank and Goyal, 2007) and the explanations based on the interaction between assets and liabilities (Diamond and Rajan, 2000; Allen et al., 2009) differ in two dimensions, which may help to differentiate them empirically. First, in Bertrand and Schoar (2003) and Frank and Goyal (2007), managers' preferences have a direct impact on capital structure: Less risk averse managers chose a more aggressive strategy and higher leverage. In contrast, in Diamond and Rajan (2000) and Allen et al. (2009), stable capital structures arise from stable asset structures. Banks chose an optimal capital structure given a customer-determined structure of their assets. This difference may be a promising avenue for disentangling the different theories. Second, attributing differences in leverage directly to managerial preferences suggests that the capital structures of financial and non-financial firms are ultimately determined by the same drivers. In contrast, Diamond and Rajan (2000) or Allen et al. (2009) suggest that banks are different and that we should be looking for bank specific factors to explain bank leverage.

[30] In Diamond and Rajan (2000) banks are all deposit financed if there is no uncertainty. The introduction of uncertainty into the model results in a situation, in which it may be optimal for banks to finance assets partially with capital. This is consistent with our negative relationship between risk and leverage.

8. Conclusion

Motivated by substantial cross-sectional variation in banks' leverage, this paper examines the capital structure of banks building on central results from the empirical capital structure literature for non-financial firms. Our sample includes commercial banks and bank-holding companies from 16 different countries (US and 15 EU members) from 1991 to 2004. We focus on the largest listed banks and have taken great care to reduce survivorship bias.

We document five empirical facts that appear to be inconsistent with regulation being the overriding departure for banks from the Modigliani and Miller irrelevance proposition. Our evidence does not support the view that buffers in excess of the regulatory minimum are an explanation for the variation of bank capital. We also do not find a significant effect of deposit insurance coverage on banks' capital structure. Most banks seem to be optimising their capital structure in much the same way as firms do, except when their capital comes close to the regulatory minimum.

We also examine the composition of banks' liabilities. Banks have financed balance sheet growth on aggregate with non-deposit liabilities during our sample period. This has resulted in a substantial shift in the structure of banks' total liabilities away from deposits. At the same time, the share of equity remained constant. As the shift is not associated with a contemporaneous decline in deposit insurance coverage, this can be taken as further evidence against banks' attempting to maximise the subsidy from incorrectly priced deposit insurance schemes.

Moreover, the variation of banks' leverage appears to be driven by an unobserved time-invariant bank fixed effect. Like non-financial firms, banks have stable capital structure targets at levels that are specific to each individual bank. These targets do not seem to be determined by standard corporate finance variables or by regulation, but rather by deeper, so far unobserved parameters that remain fixed during long periods of time for each institution.

Our paper supports the market view on banks' capital structure. At the same time, it extends current capital structure findings from corporate finance to the largest publicly traded banks in an international sample, and thus confirms them outside the environment they were initially obtained from. We think our findings may have important implications for future work on capital structure for both banks and firms.

Figure 1: Distribution of book capital ratios

The figure shows the distribution of banks' book capital ratio (book equity divided by book assets) for the 2,415 bank-year observations in our sample of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004.

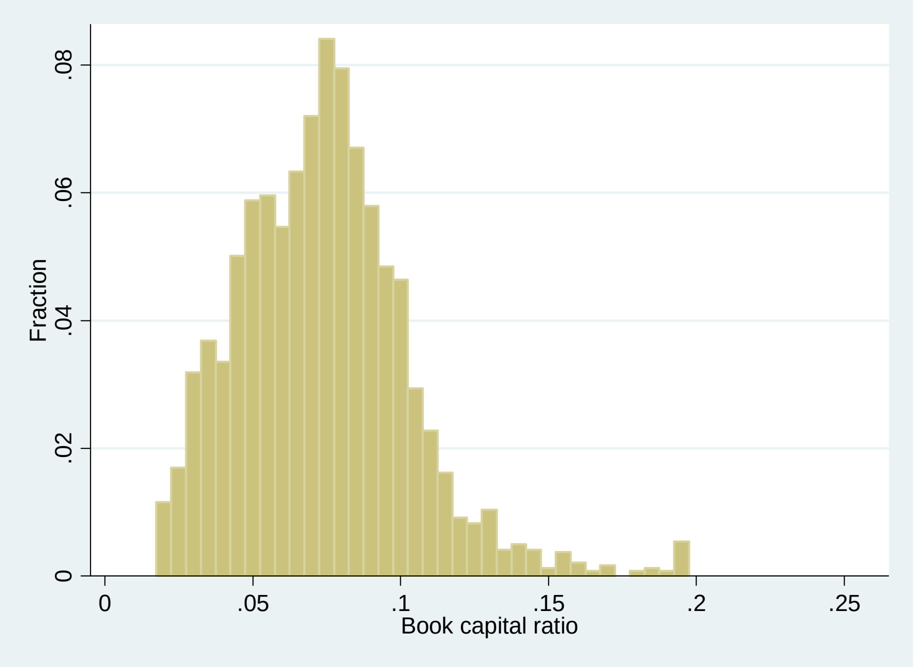

Figure 2: Composition of banks' liabilities over time

The figure shows the evolution of banks' median deposit and non-deposit liabilities (in book values), as well as book equity as a percentage of the book value of banks for 2,408 bank-year observations in our sample of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004.

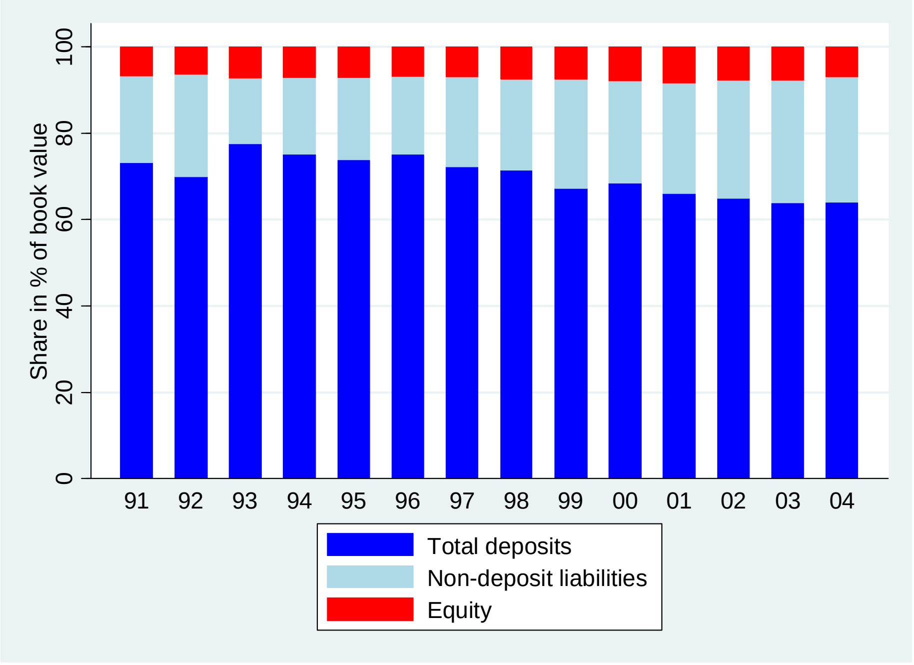

Figure 3: Distribution of Tier 1 capital ratios

The figure shows the distribution of banks' regulatory Tier 1 capital ratio (equity over risk weighted assets as defined in the Basle I regulatory framework) for 2007 bank-year observations in our sample of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004.

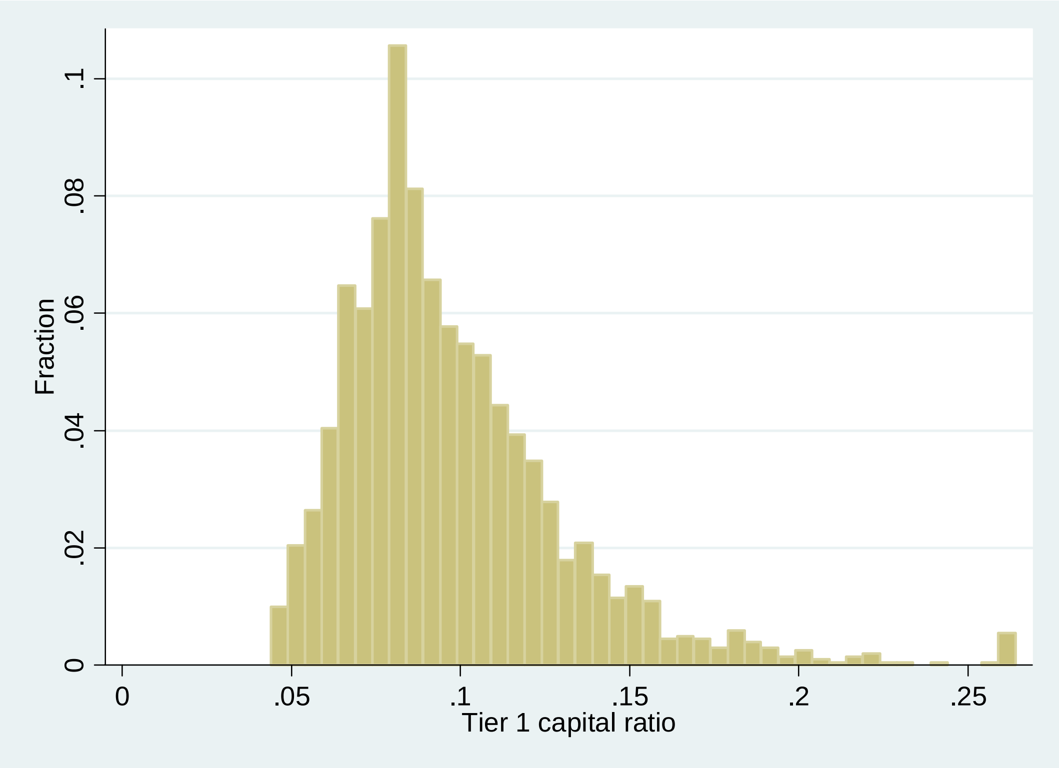

Table I: Unique banks and bank-years across countries

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004.

Country	Unique banks	Bank-years
AT	8	44
BE	5	29
DE	12	123
DK	11	77
ES	13	133
FI	3	30
FR	29	168
GB	17	121
GR	8	53
IE	5	43
IT	30	223
LU	4	34
NL	4	35
PT	5	62
SE	4	40
US	169	1,200
Total	327	2,415

Table II: Descriptive statistics

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables.

	Mean	Median	St.Dev.	Max	Min
Book assets (m$)	64,100	14,900	126,000	795,000	288
Market-to-book	1.065	1.039	0.105	1.809	0.942
Asset risk	0.036	0.028	0.034	0.245	0.002
Profits	0.051	0.049	0.019	0.145	0.011
Collateral	0.266	0.260	0.130	0.782	0.015
Dividend payer	0.944	1	0.231	1	0
Book leverage	0.926	0.927	0.029	0.983	0.806
Market leverage	0.873	0.888	0.083	0.988	0.412
Deposits (Book)	0.685	0.706	0.153	0.922	0.073
Deposit (Mkt.)	0.646	0.654	0.155	0.921	0.062
Non-deposit liab. (Book)	0.241	0.218	0.156	0.819	0.019
Non-deposit liab. (Mkt.)	0.227	0.200	0.150	0.786	0.016
Coverage/GDP(pc)	2.76	2.89	1.44	0.34	11.50
Coverage/Deposits(pc)	7.08	8.50	4.29	27.42	0.11

Table III: Correlations

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. Numbers in italics indicate p- values.

	Book leverage	Market leverage	Book assets	Market-to-book	Asset risk	Profits	Collateral	Dividend payer
Book leverage	1.000							
Market leverage	0.690	1.000						
	0.000							
Book assets	0.298	0.183	1.000					
	0.000	*0.000*						
Market-to-book	-0.420	-0.819	-0.085	1.000				
	0.000	*0.000*	*0.000*					
Asset risk	-0.527	-0.744	-0.083	0.848	1.000			
	0.000	*0.000*	*0.000*	*0.000*				
Profits	-0.083	-0.112	-0.117	0.158	0.157	1.000		
	0.000	*0.000*	*0.000*	*0.000*	*0.000*			
Collateral	-0.070	-0.144	-0.019	0.081	0.128	-0.163	1.000	
	0.001	*0.000*	*0.363*	*0.000*	*0.000*	*0.000*		
Dividend payer	-0.082	-0.126	0.041	0.089	0.035	0.024	0.031	1.000
	0.000	*0.000*	*0.042*	*0.000*	*0.083*	*0.240*	*0.128*	

Table IV: Predicted effects of explanatory variables on leverage: market/corporate finance view vs. buffer view

	Predicted effects	
	market/corporate finance	Buffers
Market-to-book ratio	-	+
Profits	-	+
Log (Size)	+	+/-
Collateral	+	0
Dividends	-	+
Risk	-	-

Table V: Bank characteristics and market leverage

For the first column, the sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. Column 4 reports results for the 400 largest (by total book assets) EU and U.S. manufacturing firms in the Worldscope database. See Appendix I for the definition of variables. The first column shows the result of estimating:

$$L_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + c_c + c_t + u_{ict}$$

The dependent variable is market leverage. The second column reproduces estimates from Table 8, column 7 of Frank and Goyal (2004) and the third column reproduces estimates from Table 9, panel B, first column of Rajan and Zingales (1995) for comparison. Note that the definition of leverage differs across the papers, and that Frank and Goyal (2004) and Rajan and Zingales (1995) do not use country or time fixed-effects. Standard errors are adjusted for clustering at the bank/firm level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

Dependent variable Market leverage	Large Banks	Frank and Goyal (2004) Table 8, Column 7	Rajan and Zingales (1995) Table 9, Panel B (United States)	Largest Firms
Market-to-book ratio	-0.560***	-0.022***	-0.08***	0.002
se	*0.034*	*0.000*	*0.01*	*0.003*
elasticity	*-0.683*	*-0.170*		*0.008*
Profits	-0.298***	-0.104***	-0.60***	-1.483***
se	*0.097*	*0.003*	*0.07*	*0.115*
elasticity	*-0.018*	*-0.008*		*-0.296*
Log(Size)	0.006***	0.021***	0.03***	0.032***
se	*0.001*	*0.000*	*0.00*	*0.006*
elasticity	*0.007*	*0.082*		*0.070*
Collateral	0.020*	0.175***	0.33***	0.102***
se	*0.012*	*0.004*	*0.03*	*0.031*
elasticity	*0.006*	*0.314*		*0.083*
Dividends	-0.019***	-0.092***		-0.045***
se	*0.004*	*0.002*		*0.016*
elasticity	*-0.020*	*-0.106*		*-0.081*
Industry leverage		0.618***		0.568***
se		*0.007*		*0.088*
elasticity		*0.529*		*0.552*
constant	1.360***	-0.037***		-0.146
se	*0.039*	*0.004*		*0.101*
Number of observations	2415	63144	2207	4369
R^2	0.79	0.29	0.19	0.55

Table VI: Bank characteristics and book leverage

For the first column, the sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. Column 4 reports results for the 400 largest (by total book assets) EU and U.S. manufacturing firms in the Worldscope database. See Appendix I for the definition of variables. The first column shows the result of estimating:

$$L_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + c_c + c_t + u_{ict}$$

The dependent variable is book leverage. The second column reproduces estimates from Table 9, column 7 of Frank and Goyal (2004) and the third column reproduces estimates from Table 9, panel A, first column of Rajan and Zingales (1995) for comparison. Note that the definition of leverage differs across the papers, and that Frank and Goyal (2004) and Rajan and Zingales (1995) do not use country or time fixed-effects. Standard errors are adjusted for clustering at the bank/firm level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

Dependent variable Book leverage	Large Banks	Frank and Goyal (2004) Table 9, Column 7	Rajan and Zingales (1995) Table 9, Panel A (United States)	Largest Firms
Market-to-book ratio	-0.066***	-0.002***	-0.17***	-0.007**
se	*0.016*	*0.001*	*0.01*	*0.003*
elasticity	*-0.076*	*-0.012*		*-0.019*
Profits	-0.210***	-0.214***	-0.41***	-0.425***
se	*0.063*	*0.004*	*0.10*	*0.116*
elasticity	*-0.012*	*-0.013*		*-0.062*
Log(Size)	0.006***	0.013***	0.06***	0.030***
se	*0.001*	*0.001*	*0.01*	*0.006*
elasticity	*0.006*	*0.050*		*0.048*
Collateral	0.032***	0.157***	0.50***	0.023
se	*0.009*	*0.005*	*0.04*	*0.030*
elasticity	*0.009*	*0.270*		*0.013*
Dividends	-0.009***	-0.078***		-0.029
se	*0.003*	*0.003*		*0.020*
elasticity	*-0.009*	*-0.086*		*-0.038*
Industry leverage		0.649***		0.718***
se		*0.009*		*0.145*
elasticity		*0.532*		*0.715*
constant	0.886***	0.038***		-0.206*
se	*0.022*	*0.005*		*0.120*
Number of observations	2415	64057	2079	4369
R^2	0.54	0.16	0.21	0.21

Table VII: Adding risk and examining explanatory power of bank characteristics

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. The table shows the result of estimating:

$$L_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + \beta_6 Ln(Risk_{ict-1}) + c_c + c_t + u_{ict}$$

The dependent variable is market leverage (column 1) or book leverage (column 2). Columns 2 and 4 present the increase in R^2 of adding each explanatory variable at a time to a baseline specification with time and country fixed effects only. Standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

Dependent variable	Market leverage		Book leverage	
		inc. in R^2		inc. in R^2
Market-to-book ratio	-0.472***	0.45	-0.020	0.08
se	*0.036*		*0.015*	
elasticity	*-0.576*		*-0.023*	
Profits	-0.262***	0.09	-0.192***	0.04
se	*0.087*		*0.058*	
elasticity	*-0.015*		*-0.011*	
Log(Size)	0.005***	0.03	0.006***	0.09
se	*0.001*		*0.001*	
elasticity	*0.105*		*0.102*	
Collateral	0.020**	0.01	0.032***	0.04
se	*0.010*		*0.008*	
elasticity	*0.006*		*0.009*	
Dividends	-0.019***	0.01	-0.009***	0.00
se	*0.004*		*0.003*	
elasticity	*-0.021*		*-0.009*	
Log(Risk)	-0.024***	0.28	-0.013***	0.12
se	*0.004*		*0.002*	
elasticity	*-0.028*		*-0.014*	
constant	1.195***		0.799***	
se	*0.047*		*0.022*	
Number of observations	2415	2415	2415	2415
R^2	0.80		0.58	

Table VIII: Time and country fixed effects

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. The table shows the results from estimating the model below without country and/or time fixed effects:

$$L_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + \beta_6 Ln(Risk_{ict-1}) + c_c + c_t + u_{ict}$$

The dependent variable is market leverage (columns 1 to 3) or book leverage (columns 4 to 6). Standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively

Dependent variable	Market leverage			Book leverage		
Market-to-book ratio	-0.486***	-0.504***	-0.463***	-0.014	-0.026*	-0.011
se	*0.035*	*0.037*	*0.034*	*0.016*	*0.016*	*0.015*
Profits	0.004	-0.072	-0.141*	-0.041	-0.089*	-0.118*
se	*0.074*	*0.075*	*0.083*	*0.053*	*0.049*	*0.062*
Log(Size)	0.007***	0.006***	0.006***	0.007***	0.005***	0.007***
se	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Collateral	-0.009	0.027**	-0.003	0.020**	0.036***	0.020**
se	*0.011*	*0.010*	*0.010*	*0.009*	*0.008*	*0.008*
Dividends	-0.021***	-0.019***	-0.021***	-0.008**	-0.008**	-0.008***
se	*0.003*	*0.004*	*0.004*	*0.003*	*0.003*	*0.003*
Log(Risk)	-0.027***	-0.015***	-0.033***	-0.016***	-0.010***	-0.018***
se	*0.002*	*0.003*	*0.003*	*0.001*	*0.002*	*0.002*
constant	1.197***	1.260***	1.151***	0.775***	0.820***	0.760***
se	*0.044*	*0.047*	*0.044*	*0.022*	*0.023*	*0.022*
Time Fixed Effects	No	No	Yes	No	No	Yes
Country Fixed Effects	No	Yes	No	No	Yes	No
Number of observations	2415	2415	2415	2415	2415	2415
R^2	0.74	0.76	0.79	0.46	0.54	0.50

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Table IX: Decomposing bank leverage

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. The table shows the result of estimating:

$$Liab_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + \beta_6 Ln(Risk_{ict-1}) + c_c + c_t + u_{ict}$$

The dependent variable (*Liability*) is either deposits divided by the market or book value of assets (columns 2 ans4) or 1 minus deposits divided by the market or book value of assets (columns 1 and 3). Standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

Dependent variable		Non-deposit liab.	Deposits	Non-deposit liab.	Deposits
		(over market value of assets)		(over book value of assets)	
Market-to-book ratio		-0.137**	-0.369***	-0.011	-0.049
	se	*0.066*	*0.075*	*0.077*	*0.090*
Profits		1.629***	-1.924***	1.772***	-2.099***
	se	*0.517*	*0.537*	*0.553*	*0.584*
Log(Size)		0.034***	-0.028***	0.035***	-0.028***
	se	*0.004*	*0.004*	*0.005*	*0.005*
Collateral		0.118*	-0.099*	0.125*	-0.100
	se	*0.061*	*0.059*	*0.065*	*0.064*
Dividends		-0.009	-0.009	-0.005	-0.005
	se	*0.027*	*0.027*	*0.028*	*0.026*
Log(Risk)		-0.013	-0.011	-0.009	-0.005
	se	*0.010*	*0.010*	*0.010*	*0.010*
constant		-0.313***	1.536***	-0.447***	1.274***
	se	*0.103*	*0.108*	*0.115*	*0.120*
Number of observations		2408	2408	2408	2408
	R^2	0.37	0.40	0.35	0.32

Table X: Bank fixed effects and the speed of adjustment

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. Columns 1 and 2 show the result of estimating:

$$L_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + \beta_6 Ln(Risk_{ict-1}) + c_i + c_t + u_{ict}$$

The dependent variable is either market (Column 1) or book (Column 2) leverage. Columns 3 to 6 show the result of estimating a partial adjustment model:

$$L_{ict} = \beta_0 + \lambda \mathbf{B}\mathbf{X}_{ict-1} + (1-\lambda) L_{ict-1} + c_i + u_{ict}$$

$\mathbf{X}_{ict-1}$ collects the same set of variables as before (market-to-book ratio, profits, size, collateral, dividends and risk). The parameter λ represents the speed of adjustment. It measures the fraction of the gap between last period's leverage and this period's target that firms close each period. The reported coefficients λ and **B** and their standard errors are obtained using the Delta method since they are non-linear transformations of the originally estimated coefficients (see Flannery and Rangan (2006) for a derivation of the model). For the Pooled OLS estimation (Columns 3 and 4), $c_i=0$. Columns 3 and 5 have $\mathbf{X}_{ict-1}=\mathbf{0}$. All standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

		Fixed effects		Pooled OLS		Fixed effects	
Dependent variable		Market leverage	Book leverage	Book leverage			
Speed of adjustment				0.090***	0.124***	0.450***	0.468***
	se			*0.020*	*0.026*	*0.045*	*0.045*
Market-to-book ratio		-0.118***	0.017***		-0.023		0.032**
	se	*0.039*	*0.006*		*0.040*		*0.015*
Profits		-0.392***	-0.244***		-0.008		-0.096**
	se	*0.079*	*0.042*		*0.123*		*0.045*
Log(Size)		0.013**	0.003		0.006***		-0.005***
	se	*0.006*	*0.002*		*0.001*		*0.002*
Collateral		0.006	0.001		0.084***		0.007
	se	*0.013*	*0.007*		*0.020*		*0.012*
Dividends		-0.010	0.000		0.018		0.004
	se	*0.007*	*0.002*		*0.013*		*0.003*
Log(Risk)		-0.016***	-0.005***		-0.004		-0.003
	se	*0.003*	*0.001*		*0.004*		*0.002*
constant		0.717***	0.845***	0.086***	0.103***	0.417***	0.454***
	se	*0.146*	*0.035*	*0.019*	*0.027*	*0.042*	*0.041*
Number of observations		2415	2415	2059	2059	2059	2059
Frac. of variance due to bank FE		0.76	0.92			0.70	0.78
R^2		0.88	0.92	0.88	0.88	0.91	0.92

Table XI: Deposit insurance coverage

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. Columns 1 to 8 show the result of estimating:

$$L_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + \beta_6 Ln(Risk_{ict-1}) + \delta Dep_{ct} + c_c + c_t + u_{ict}$$

The dependent variable is either market (Column 1-4) or book (Column 5-8) leverage. Columns 1,2,5 and 6 drop the bank-level variables ((market-to-book ratio, profits, size, collateral, dividends and risk). *Dep* is given by per capital deposit insurance divided by per capita GDP (Columns 1,3,5 and 7) or divided by average deposits per depositor (Columns 2,4,6 and 8-10). Columns 9 and 10 show the result of estimating a partial adjustment model:

$$L_{ict} = \beta_0 + \lambda(\mathbf{BX}_{ict-1} + \delta Dep_{ct}) + (1-\lambda)L_{ict-1} + u_{ict}$$

$\mathbf{X}_{ict-1}$ collects the same variables as before (market-to-book ratio, profits, size, collateral, dividends and risk). The parameter λ represents the speed of adjustment. It measures the fraction of the gap between last period's leverage and this period's target that firms close each period. The reported coefficients λ, δ and **B** and their standard errors are obtained using the Delta method since they are non-linear transformations of the originally estimated coefficients (see Flannery and Rangan (2006) for a derivation of the model). Column 9 has $\mathbf{X}_{ict-1}=\mathbf{0}$. All standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

Table XI: Deposit insurance coverage (continued)

Dependent variable	Market leverage				Book leverage					
Speed of adjustment									0.090***	0.130***
se									0.023	0.029
Market-to-book ratio			-0.466***	-0.466***			-0.021	-0.021		-0.036
se			*0.037*	*0.037*			*0.016*	*0.016*		*0.038*
Profits			-0.276***	-0.273***			-0.187***	-0.190***		0.033
se			*0.091*	*0.090*			*0.056*	*0.056*		*0.129*
Log(Size)			0.005***	0.005***			0.006***	0.006***		0.006***
se			*0.001*	*0.001*			*0.001*	*0.001*		*0.001*
Collateral			0.020*	0.021*			0.033***	0.033***		0.075***
se			*0.011*	*0.011*			*0.008*	*0.008*		*0.020*
Dividends			-0.021***	-0.021***			-0.010***	-0.010***		0.008
se			*0.005*	*0.005*			*0.003*	*0.003*		*0.010*
Log(Risk)			-0.025***	-0.025***			-0.013***	-0.013***		-0.004
se			*0.004*	*0.004*			*0.002*	*0.002*		*0.004*
Coverage(GDP)	0.014**		0.002		0.002		-0.002			
se	*0.006*		*0.002*		*0.002*		*0.002*			
Coverage(Deposits)		0.010***		0.000		0.002*		-0.001	0.004*	0.002
se		*0.003*		*0.001*		*0.001*		*0.001*	*0.002*	*0.002*
constant	0.959***	0.956***	1.247***	1.249***	0.956***	0.954***	0.839***	0.839***	0.086***	0.110***
se	0.015	0.015	0.049	0.049	0.005	0.005	0.022	0.022	0.022	0.029
Number of observations	2204	2204	2204	2204	2204	2204	2204	2204	1867	1867
R^2	0.315	0.317	0.801	0.801	0.335	0.337	0.596	0.596	0.88	0.88

Table XII: Tier 1 capital and banks close to the regulatory minimum

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. Column 1 shows the result of estimating:

$$K_{ict} = \beta_0 + \beta_1 MTB_{ict-1} + \beta_2 Prof_{ict-1} + \beta_3 Ln(Size_{ict-1}) + \beta_4 Coll_{ict-1} + \beta_5 Div_{ict} + \beta_6 Ln(Risk_{ict-1}) + c_c + c_t + u_{ict}$$

The dependent variable is the regulatory Tier 1 capital ratio. Columns 2 and 3 show the result of estimating:

$$L_{ict} = \beta_0 + \mathbf{BX}_{ict-1} + \mathbf{CX}_{ict-1} * Close_{ict-1} + c_c + c_t + u_{ict}$$

$\mathbf{X}_{ict-1}$ collects the bank level variables (market-to-book ratio, profits, size, collateral, dividends and risk). The dependent variable is book leverage. The interaction dummy *Close* is equal to 1 if a bank's Tier 1 capital ratio is below 5% (column 2) or below 6% (column 3) in the previous year. Standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

	Dependent variable		
	Tier 1 capital ratio	Book leverage	
		Close is <5%	Close is <6%
Market-to-book ratio	-0.019	-0.006	-0.004
se	*0.020*	*0.019*	*0.019*
Market-to-book ratio*Close		0.064**	0.033*
se		*0.030*	*0.019*
Profits	0.423***	-0.220***	-0.230***
se	*0.090*	*0.076*	*0.078*
Profits*Close		0.273**	0.356*
se		*0.129*	*0.190*
Log(Size)	-0.009***	0.004***	0.004***
se	*0.001*	*0.001*	*0.001*
Log(Size)*Close		-0.001	-0.001
se		*0.002*	*0.001*
Collateral	0.097***	0.025***	0.024***
se	*0.012*	*0.008*	*0.008*
Collateral*Close		-0.000	0.015
se		*0.037*	*0.020*
Dividends	0.004	-0.006***	-0.007**
se	*0.004*	*0.002*	*0.003*
Dividends*Close		-0.011	-0.004
se		*0.010*	*0.005*
Log(Risk)	0.010***	-0.010***	-0.011***
se	*0.002*	*0.002*	*0.002*
Log(Risk)*Close		0.009***	0.008*
se		*0.003*	0.004
constant	0.265***	0.827***	0.824***
se	*0.028*	*0.026*	0.026
Number of observations	2007	1731	1731
R^2	0.51	0.65	0.65

Appendix I: Definition of variables

We follow Frank and Goyal (2004) in our definition of variables. All data have been winsorized at 0.05% on both the left and right tail as in Lemmon et al. (2008).

Book leverage = 1- (book value of equity / book value of assets)

Market leverage = 1- (market value of equity (=number of shares * end of year stock price) / market value of bank (=market value of equity + book value of liabilities))

Size = book value of assets

Profits = (pre-tax profit + interest expenses) / book value of assets

Market-to-book ratio = market value of assets / Book value of assets

Collateral = (total securities + treasury bills + other bills + bonds + CDs + cash and due from banks + land and buildings + other tangible assets) / book value of assets

Dividend dummy = one if the bank pays a dividend in a given year

Asset risk = annualised standard deviation of daily stock price returns * (market value of equity / market value of bank).

Deposits (Book) = total deposits / book value of assets

Deposits (Market) = total deposits / market value of asset (see above)

Non-deposit liabilities (Book) = book leverage – deposits (Book)

Non-deposit liabilities (Market) = market leverage – deposits (Market)

GDP growth = annual percentage change of gross domestic product

Stock market risk = annualised standard deviation of daily national stock market index return

Term structure spread = 10 year interest rate – 3 month interest rate on government bonds

Inflation = annual percentage change in average consumer price index

Regulatory Tier 1 capital = Tier 1 capital divided by risk weighted assets

Close = one if the bank has a Tier 1 capital ratio of less than 5% (6%) in the previous year

Coverage(GDP) = Coverage of the deposit insurance scheme in a country per depositor divided by per capita GDP

Coverage(Deposits) = Coverage of the deposit insurance scheme in a country per depositor divided by average deposits per depositor

Appendix II. Macroeconomic controls and U.S.-EU differences

Macroeconomic effects may be more important for banks than for firms, because banks' exposure to business cycle fluctuations may be larger than for firms. Columns 1 and 4 of Table A1 report the results from adding GDP growth, stock market volatility, inflation and the term structure of interest rates as explanatory variables to book and market leverage regressions.

The volatility of the stock market is the only macro-variable that is significant (at the 10% level) in both market and book leverage regressions. Similar to banks' individual risk, a riskier environment is associated with less leverage. A larger term structure spread and lower inflation are associated with significantly higher market but not book leverage. GDP growth is not significant.[31] Similar to results obtained for non-financial firms, controlling for macro-economic factors does not increase the fit of the leverage regressions. The sign, magnitude and significance of the bank-level variables remain unchanged except for profits in the market leverage regression. Some of the negative link between profits and market leverage is subsumed in the positive coefficient on the term structure of interest rates (the correlation between the term spread and profits is -0.43).

The results for estimating the model separately for U.S. and EU banks are reported in columns 2 and 3 (book leverage) and 5 and 6 (market leverage) of Table A1. We present the results for the two economic areas separately in order to examine whether the results are driven by US bank or EU banks alone. We find that this is not the case. All coefficients have the same sign and comparable magnitude as in Table VII where we restrict all coefficients to be the same for US and EU banks. The coefficients are statistically significant except for size and collateral in the US market leverage regression and for dividends in the US book leverage regression.[32]

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[31] Note that the regressions include country fixed-effects. Without them, GDP growth becomes positively significant.

[32] The loss of significance on size is linked to US banks being much smaller than EU banks. Accordingly, the standard deviation of the size of US banks is roughly half of the standard deviation of the size of EU banks.

Table A1: Macro-variables and US vs, EU separately

The sample consists of the 200 largest publicly traded banks in the U.S. and the EU from the Bankscope database from 1991 to 2004. See Appendix I for the definition of variables. Columns 1 and 4 show the result of estimating:

$$L_{ict} = \beta_0 + \mathbf{BX}_{ict-1} + \gamma_1 GDPGR + \gamma_2 Term + \gamma_3 Infl + \gamma_4 Ln(StMktRisk) + c_c + c_t + u_{ict}$$

$\mathbf{X}_{ict-1}$ collects the bank level variables (market-to-book ratio, profits, size, collateral, dividends and risk). Columns 2,3,5 and 6 have γ_j=0. Columns 2 (3) and 6 (7) use EU (US) banks only. The dependent variable is book leverage (column 1-3) or market leverage (column 4-6). Standard errors are adjusted for clustering at the bank level. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level respectively.

Dependent variable		Book leverage			Market leverage		
			EU only	US only		EU only	US only
Market-to-book ratio		-0.022	-0.033	0.024	-0.472***	-0.523***	-0.412***
	se	*0.016*	*0.024*	*0.016*	*0.037*	*0.039*	*0.058*
Profits		-0.171**	-0.134*	-0.260*	-0.172*	-0.156*	-0.427*
	se	*0.067*	*0.083*	*0.140*	*0.101*	*0.091*	*0.236*
Log(Size)		0.006***	0.009***	0.001**	0.005***	0.009***	0.001
	se	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Collateral		0.034***	0.039***	0.020*	0.020*	0.022*	0.001
	se	*0.008*	*0.011*	*0.010*	*0.010*	*0.013*	*0.014*
Dividends		-0.009***	-0.006*	-0.007	-0.020***	-0.009**	-0.033***
	se	*0.003*	*0.004*	*0.005*	*0.004*	*0.004*	*0.008*
Log(Risk)		-0.013***	-0.012***	-0.020***	-0.025***	-0.022***	-0.031***
	se	*0.002*	*0.002*	*0.003*	*0.004*	*0.003*	*0.007*
GDP growth		0.007			-0.049		
	se	*0.022*			*0.044*		
Term structure spread		-0.000			0.004***		
	se	*0.001*			*0.001*		
Inflation		0.001			-0.001***		
	se	*0.000*			*0.000*		
Log(Stock market risk)		-0.006*			-0.012*		
	se	*0.003*			*0.006*		
constant		0.725***	0.767***	0.803***	1.297***	1.214***	1.206***
	se	*0.045*	*0.032*	*0.028*	*0.061*	*0.053*	*0.072*
Number of observations		2415	1215	1200	2415	1215	1200
R^2		0.58	0.53	0.27	0.81	0.81	0.74

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