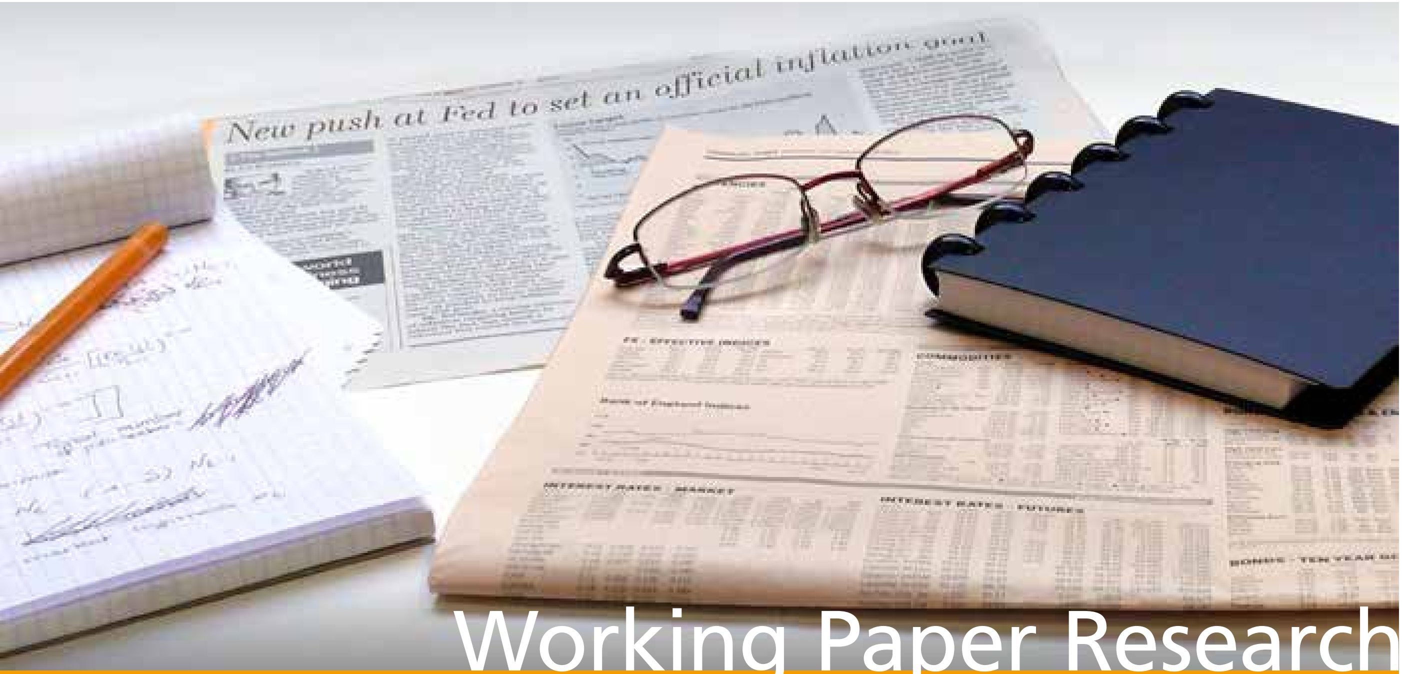
Bank reactions after capital shortfalls



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Abstract

This paper investigates whether European banks have capital targets and how deviations from the target impact their equity composition and activity mix. Using quarterly data for a sample of large European banks between 2004 and 2011, we show that there are notable asymmetries in banks' reactions to deviations from optimal capital levels. Banks prefer to reshuffle risk-weighted assets or increase asset holdings when being above their optimal Tier 1 ratio, whereas they rather try to increase equity levels or reshuffle risk-weighted assets without changing asset holdings when being below target. At the same time, focusing instead on a unweighted equity ratio target, we find evidence of deleveraging and lower loan growth for undercapitalized banks during the recent financial crisis, whereas in the pre-crisis periods banks primarily reacted to deviations from their optimal target by adjusting equity levels.the one observed at the onset of the Great Recession.

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1 Introduction

The recent financial crisis intensified the debate on bank capital regulation. It led to new Basel III capital requirements and formal recommendations by the European Banking Authority (EBA) on recapitalization needs for a group of systemically important EU banks. While the Basel III framework originally was supposed to be introduced in incremental steps, the financial and sovereign debt crises have induced several national authorities as well as market participants to call for a front loading of the requirements. Along with the regulatory debate on higher bank capital standards, some academics and policy makers have called for imposing capital requirements that are even higher than what was agreed in the context of Basel III.[1]

The ideal capital level from a regulatory perspective, however, does not necessarily coincide with the optimal capital level for an individual bank. Whereas the ultimate goal of regulatory capital standards is to contribute to a more stable financial system, an individual bank will have to take into account a broad group of stakeholders when determining optimal capital levels, which implies a number of trade-offs. Shareholders prefer to maximize their return on invested capital through a profit-maximizing allocation of capital across business lines, whereas bond holders and counter parties in derivatives markets are more interested in dealing with a very stable bank. In terms of capital management, the trade-offs between the preferences of these different stakeholders are taken into account when deciding on the level of economic capital, i.e. the level of capital a bank needs to hold given its risk and return structure in order to comply with a chosen default probability over a specific time horizon. From this point of view, the optimal level will thus dependent on the actual risk and return structure of the bank, i.e. its actual business model.

This paper contributes to a better understanding of the potential impact of higher bank capital standards by investigating whether banks have capital targets (both in terms of Tier 1 and common equity) and by analyzing how they move towards them. Assuming that a bank's reaction to higher capital requirements will

[1] See e.g. Admati et al. (2010), Bank of England (2010), Bank for International Settlements (2010), Miles et al. (2011) and Sveriges Riksbank (2011).

be similar to the reaction when it deviates from an internal, optimal capital ratio, the results in this paper could provide insights on the potential implications of the higher capital levels currently being imposed on banks both via new regulatory measures (e.g. Basel III) and via market pressure. More specifically, we analyze how a group of 93 European banks on average adjust their balance sheet when being away from their optimal capital ratio. In addition, we also focus on potential asymmetries in the adjustment behavior. We differentiate between banks that are above and below their optimal capital levels, and we take into account that banks which are far away from their optimal capital ratio will potentially react stronger than banks close to the optimal ratio. We are especially interested in banks that are below their optimal ratio, since their behavior could help in understanding the potential reaction after rising capital requirements or during distressed situations. Furthermore, we make a difference between bank behavior before and during the recent financial crisis, as previous studies showed that economic conditions can have a significant impact on bank capital management (see, e.g., Jokipii and Milne (2008); Francis and Osborne (2012)). Answering these questions should especially help in understanding how banks react to shortfalls in bank capital levels and could help inform decisions of raising bank capital requirements.

Our main findings indicate that banks do have optimal capital ratios, both in terms of Tier 1 capital and in terms of common equity. Furthermore, we find that there are notable asymmetries in bank reactions to deviations from these optimal levels. Overcapitalized banks prefer to reshuffle risk-weighted assets or increase asset holdings when deviating from their optimal Tier 1 ratio, whereas they rather try to increase equity levels or reshuffle risk-weighted assets without changing asset holdings when being below target. When looking at the equity ratio, we also find evidence for deleveraging and lower loan growth for under-capitalised banks during the recent financial crisis, whereas in the pre-crisis period banks primarily reacted to deviations from their optimal target by adjusting equity levels, for example through changes in retained earnings. Our findings also confirm that banks behave differently during crisis times than during ”normal” periods and that especially deleveraging actions due to capital shortfalls might be amplified in periods of crisis where banks' leeway to adjust their balance sheets is more limited.

Throughout the paper, we focus on two types of bank capital ratios. From a regulatory perspective, a lot of emphasis is placed on the Tier 1 ratio, i.e. the ratio of Tier 1 capital over risk-weighted assets. The Basel II capital standards included a Tier 1 target. Thus, to analyze the potential reaction of banks to higher capital requirements, focusing on the Tier 1 ratio is the natural choice. However, as Blum (2008) argues, capital measures based on cruder risk-exposure proxies than risk-weighted assets may be more relevant for stock market participants or debt holders, because they may view the risk weights as opaque and uninformative.[2] As funding costs are an important issue for bank managers, it is well possible that banks - just like other firms - also optimize a simple equity ratio. Furthermore, decisions on optimal economic capital have to take into account a range of trade-offs and potentially rely on other risk evaluations of business activities compared to regulatory risk weights. Finally, a recent survey performed by Mckinsey (see Babel et al. (2012)) at more than 25 large European bank shows that more than two-thirds of the banks use both regulatory and standard capital measures when taking strategic capital management decisions. Therefore, we focus both on the Tier 1 ratio and on an unweighted equity ratio (i.e. the ratio of common equity to total assets) throughout this paper, as both could potentially reveal a different story.

2 Literature review

The actual impact of higher capital requirements on a banks‘ balance sheet composition and ultimately on the real economy, remains a highly debated issue. Banks can comply with higher regulatory capital standards or market demands for higher capital ratios by either raising more capital or shrinking their balance sheet (deleveraging). If banks choose the latter option, it can be costly for the real economy through credit crunch effects and fire sales (Hanson et al. (2011)). If banks shrink their assets by reducing lending activities, it

[2] To shed further light on this issue, work is currently being undertaken by the Basel Committee and by the European Banking Authority; see e.g. Basel Committee of Banking Supervision (2013) and European Banking Authority (2013)

will have negative implications for investment and consumption and may generally depress real economic activity. At the same time, if (a large number of) banks decide to sell off parts of their securities portfolio, prices of these securities will drop, potentially inducing a fire-sale spiral.[3] Furthermore, crisis situations make it more likely that banks choose to shrink their balance sheet instead of raising more equity capital. Bolton and Freixas (2006), for example, show that asymmetric information about the net worth of a bank makes equity capital more costly. As asymmetric information is a particularly severe problem during crisis periods, raising equity capital will be more difficult when it is most needed. This comes on top of other costs related to equity issuances. Myers and Majluf (1984) notice that a new equity issue may signal that managers believe that the stock is overvalued, leading to negative stock market responses. Also, given the debt overhang problem (Myers (1977)), bank shareholders will always prefer shrinking assets rather than raising new capital. Thus, from a theoretical point of view, it is very likely that banks resort to shrinking assets when facing capital constraints during crisis periods. This paper contributes to this discussion by empirically analyzing the impact of deviations from optimal capital levels on the composition of a bank's balance sheet.

This paper is thus related to different strands of the existing literature on (bank) capital structure. First, our paper relates to the recently emerging empirical literature that studies the impact of deviations of bank capital relative to a bank-specific capital target on bank characteristics. This approach finds its origin in a study of Hancock et al. (1995) and was recently used in Berrospide and Edge (2010) who examine the impact of capital deviations on bank lending in the U.S., and Francis and Osborne (2012) who focus on the impact of individual bank capital requirements on bank lending and balance sheet composition for a group of UK banks.

Second, this paper relates to the literature on optimal (bank) capital structure (see e.g. Lemmon et al. (2008), Flannery and Rangan (2006), Berger et al. (2008), Gropp and Heider (2010)). These papers mainly

[3] See e.g. Brunnermeier and Pedersen (2009), Geanakoplos (2009) and Diamond and Rajan (2009).

focus on the determinants of optimal (bank) capital levels and how fast firms can adjust towards this optimal level, whereas we are more interested in how banks adjust towards this optimal level, i.e. either by adjusting asset side and/or equity components.

Third, our work is closely related to the extensive literature on the impact of bank capital and capital regulation on real economic growth. A primary focus of this literature has been on the impact of capital regulation on credit supply. A first strand of papers within this category look at the impact of the introduction of the 1988 Basel Capital Accord on the 1990-1991 slowdown in the U.S. Berger and Udell (1994) examine whether the Capital Accord contributed to the 1990-1991 credit crunch in the U.S. and find, among other things, that banks with weaker capital ratios have more substantial credit reallocation effects than others. Peek and Rosengren (1995) show that capital regulations contributed to a slowdown in credit supply during the 1990-1991 recession in the state of New England. Others focused on the indirect role of capital in the monetary transmission process. Kishan and Opiela (2000), for example, focus on U.S. banks between 1980 and 1995 and define undercapitalized banks as banks with a capital ratio under 8%. They find that these banks are more responsive to monetary policy, especially when they are small. Altunbas et al. (2002) and Gambacorta and Mistrulli (2004) find similar results for a sample of respectively European and Italian banks. Berrospide and Edge (2010) study the lending behavior of large bank holding companies in the U.S. and find rather small effects of bank capital on lending. Exploiting the information contained in the Eurosystem Bank Lending Survey a number of recent studies have found a significant impact of capital-related factors on loan supply (see e.g. Hempell and Kok (2010), Del Giovane et al. (2010) and Blaes (2011)) and on economic growth (see e.g. Ciccarelli et al. (2010)). Using a loan level data set on Spanish bank loans, Jimenez et al. (2012) show that banks with low capital grant fewer loans in times of tighter monetary policy and that a decrease in bank capital leads to a positive effect on loan granting.

Only a couple of existing studies have focused on the impact of deviations from optimal capital levels, mainly focusing on the impact on credit growth (Berrospide and Edge (2010) for the US; Francis and Osborne (2012) for a group of UK banks, De Jonghe and Oztekin (2013) for a worldwide sample of banks and Memmel and Raupach (2010) for a group of German banks). Francis and Osborne (2012) focus on other bank characteristics than bank lending within this capital deviation setup.[4] They look at a sample of about 150 UK banks between 1996 and 2007 and study the impact of capital deviations on different balance sheet characteristics, while especially focusing on the impact of bank-specific capital requirements.[5]De Jonghe and Oztekin (2013) use a worldwide sample of banks to analyze how banks adjust their balance sheets in order to evolve towards their optimal capital level, while linking differences in adjustment speed to regulatory and supervisory differences across countries. Finally, Maurin and Toivanen (2012) conduct an analysis on euro area banks where they investigate banks' adjustments to capital targets distinguishing between loans and securities. We contribute to this strand of literature in three ways: i) by focusing on a broader range of balance sheet components that could be affected by capital shortfalls, ii) by allowing for asymmetric reactions for capital surpluses and capital shortfalls and iii) by studying bank reactions during the recent financial crisis and examining whether they differ compared to the pre-crisis period.

3 Data and empirical strategy

3.1 Sample selection

We start with a sample of financial institutions located in EU-27 countries and Norway for which we have quarterly data in either Bloomberg or Worldscope between 2004Q1 and 2011Q3. Next, we rely on Bankscope to identify bank types. We remove all banks which are not commercial banks, saving banks,

[4]Memmel and Raupach (2010) also look at adjustment behavior, but they mainly focus on which type of bank tends to adjust faster than others. In terms of how banks adjust, they only make a difference between asset and liability side adjustments. Furthermore, their empirical framework differs considerably from ours.

[5]Francis and Osborne (2012) have access to confidential individual bank data on capital requirements for U.K. bank, which are imposed by the banking regulator in the UK (FSA), which allows them to look at the impact of capital regulation on bank capitalization levels.

cooperative banks, real estate banks or bank holding companies. We also exclude banks for which no information is available on bank capital or other variables needed to calculate optimal capital ratios. We focus on two types of capital ratios, being the regulatory Tier 1 ratio (Tier 1 capital over risk weighted assets) and an unweighted equity ratio (common equity over total assets). This leaves us with a sample of 93 banks from 19 European countries.[6] Summary statistics for the equity ratios in the different countries can be found in Table 2. Average Tier 1 ratios range between 7.71 in Portugal and 14.7 in Hungary. Furthermore, none of the banks report Tier 1 ratios below the Basel II threshold, the minimum Tier 1 ratio in our sample is 4.6 in Slovenia. The average country-level equity ratio (common equity over total assets) ranges between 2.43 and 13.43. Macroeconomic indicators are provided by Thomson Datastream. The securitization dummy used in the loan regressions is based on data from Dealogic (DCM Analytics).

To assess the impact of deviations from capital targets, we first need to estimate bank capital targets. Thus, in Section 3.2 we derive the deviations from the capital target by developing a dynamic capital adjustment model, which will also allow us to investigate the adjustment speed towards capital targets, whereas in part 4 we assess the impact of the estimated deviations on bank-specific balance sheet characteristics.

3.2 Dynamic capital adjustment model

We first develop a dynamic capital adjustment model which allows us to estimate bank capital targets and, although not the primary focus of this paper, will also allow for assessing the adjustment speed towards these targets. In line with the existing capital structure literature (see e.g. Flannery and Rangan (2006), Berger et al. (2008), Francis and Osborne (2012)), we model the possibility that target capital ratios might differ across banks and over time as follows:

$$K^*_{i,t} = \beta X_{i,t-1} \tag{1}$$

[6] Austria, Belgium, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hungary, Ireland, Italy, The Netherlands, Norway, Poland, Portugal, Sweden and Slovenia.

Where $K^*_{i,t}$ is the bank-specific, time-varying optimal capital ratio and $X_{i,t}$ is a vector of bank specific characteristics. We focus on two different capital ratios: (i) an optimal regulatory Tier 1 ratio (Tier 1 capital over risk weighted assets) and (ii) an optimal unweighted equity ratio (common equity over total assets). As discussed in the introduction, banks do not only have to comply with regulatory capital standards but also have to decide on optimal economic capital levels, i.e. the level of capital they need to hold given the risk and return structure of their business operations in order to comply with a chosen default probability over a specific time horizon. This optimal economic capital level inherently depends on the business model of the bank, as this will be a key factor in determining its risk and return profile. As such, we determine the optimal capital ratio of a bank based on a broad range of business model characteristics. Following existing literature on the determinants of optimal capital structure (see e.g. Gropp and Heider (2010) Berger et al. (2008), Lemmon et al. (2008)) we include proxies for size (ln(Total Assets), earnings (Return on Equity), bank risk behavior (Loan Loss Provisions) asset composition (Loan ratio), funding mix (Deposit ratio), income diversification (Non-interest income ratio) and cost structure (Cost-income ratio) as bank-specific determinants of the optimal capital level. Size is included as larger banks could potentially face lower risk through diversification benefits or better access to funding; hence lowering required capital. Changes in earnings can have an impact on bank capital levels through retained earnings. When banks are more risky, markets will probably require more capital to be held, which is why we include loan loss provisions. The other indicators included also reveal information on bank riskiness and funding costs, and hence could be of importance for bank capital levels.

Immediate adjustment of the capital ratio towards this target will create substantial adjustment costs, leading to a partial adjustment model which looks as follows:

$$K_{i,t} - K_{i,t-1} = \lambda(K^*_{i,t} - K_{i,t-1}) + \varepsilon_{i,t} \tag{2}$$

Where $K_{i,t}$ is the effective bank capital ratio and where λ can be seen as the adjustment speed towards the target ratio. A low λ would indicate that banks are rather passive in terms of capital management and that they slowly adjust towards their target capital levels, whereas a high λ would point at actively managed capital ratios. The problem with specification (2) is that the target ratio is not directly observable. Therefore, we integrate equation (1) into equation (2) and slightly rearrange the model:

$$K_{i,t} = \lambda(\beta X_{i,t-1}) + (1-\lambda)K_{i,t-1} + \varepsilon_{i,t} \tag{3}$$

Equation (3) can then be estimated using the Blundell and Bond (1998) GMM estimator, which corrects for the biased adjustment speeds caused by the dynamic setup of the panel. Moreover, this will not only give us an estimate of the average adjustment speed of the banks in our sample, but will also allow for calculating the optimal bank capital level by using the estimated coefficients from Equation (3):

$$K^{*}_{i,t} = est(\beta)X_{i,t-1} \tag{4}$$

This estimated optimal capital ratio will then be used in a following step to assess the impact of a deviation from the optimal ratio on bank behavior. For the Tier 1 ratio, we add an extra restriction such that the optimal Tier 1 ratio cannot be below the regulatory minimum of 4 percent.

The dynamic capital adjustment model allows us to check whether banks have a target capital level and how fast they can move towards this optimal level. The model thus gives us information on the reaction of one specific balance sheet characteristic - being the capital ratio itself - to deviations from the target capital level. If we want to know the impact of deviations from the capital target on other balance sheet characteristics, we need some additional steps. First, we can use the optimal capital ratio (see equation (4)) to calculate the deviations ($DEV_{i,t}$) from the target capital level:

$$DEV_{i,t} = est(\beta)X_{i,t-1} - K_{i,t} \tag{5}$$

A negative (positive) value would imply a capital deficit (surplus) relative to the bank-specific capital target. Banks could react to these deviations in a number of ways. For example, when a bank is below its Tier 1 target, it could change the numerator by raising external capital or by retaining a bigger share of its earnings. It might also choose to reshuffle its asset portfolio in such a way that the risk-weighted assets decrease, or by shrinking the securities or loan portfolios, which would increase the Tier 1 ratio.

While checking the impact of deviations from the capital target on any of these different balance sheet items, we explicitly want to control for asymmetric reactions; i.e. the extent to which banks react differently when they are above or below their target and differences between banks that are far away and close to the optimal capital level. Therefore, we regress the change in each equity component on the deviation from the target and a group of control variables, while using interaction terms between dummies and the deviation to control for possible asymmetric effects.

$$\begin{aligned} \Delta BS_{i,t} = \alpha_i + \beta_1 * DEV_{i,t} + (DEV_{i,t}) * [\beta_2 * Below_{i,t} + \beta_3 * Extreme_{i,t}] \\ +\beta_4 * DEV_{i,t} * Below_{i,t} * Extreme_{i,t} + \beta_5 * Below_{i,t} \\ +\beta_6 * Extreme_{i,t} + \beta_7 * Extreme_{i,t} * Below_{i,t} + \delta * CV_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{6}$$

where $\Delta BS_{i,t}$ is the growth rate for one of the balance sheet variables which could be affected by the deviation of a bank from its optimal capital level. The dummy variable $Below_{i,t}$ equals one when a bank is below its optimal capital level and allows us to differentiate between the impact of capital shortfalls and capital surpluses on a bank 's balance sheet composition. The dummy variable $Extreme_{i,t}$ equals one when a bank is more than one standard deviation away from its optimal capital level and allows us to differentiate between banks close to the optimal ratio and banks more far away. In the results section, we immediately report the impact for the banks in these four groups, which is calculated based on the interaction coefficients in these regressions. The control variables $CV_{i,t-1}$ include both bank-specific balance sheet characteristics, macroeconomic control variables and all possible combinations between the dummies used in the interaction term with the deviation from the optimal capital ratio. When summarizing the results in Section 4, we will discuss the impact of the deviation from the optimal capital ratio - be it the Tier 1 ratio or the equity ratio - for four different groups, based on the dummy interactions. We focus on (i) the group of banks that are more than a standard deviation above the optimal target, (ii) the banks that are above, but close (i.e. less than a standard deviation) to the target ratio, (iii) banks that are below, but close to the target and (iv) banks that are more than one standard deviation below the target. The impact for each group is calculated based on the coefficients of the interaction terms in equation (6). For example, the impact for a bank that is more than one standard deviation above its target equals $\beta_1 + \beta_3$, while the impact for a bank below, but close to the target is $\beta_1 + \beta_2$. We study the impact on six balance sheet factors, namely Tier 1 capital, total capital, retained earnings, risk-weighted assets, total assets and loans. Unfortunately, data availability issues do not allow digging deeper into the banks' asset composition and for example study specific loan or securities portfolio compositions. However, we believe that combining the different components for which information is available already provides interesting insights into how European financial institutions manage their capital ratios.

4 Results

4.1 Speed of adjustment and optimal capital levels

Before we can analyze the impact of capital deviations we need to calculate the optimal capital levels. Table 2 shows the results for the speed of adjustment regressions (see equation 3) for the two capital measures: the Tier 1 capital ratio (columns 1-3) and the simple equity ratio (columns 4-6). These ratios are regressed on their own one-period lagged value and a set of macro-economic and bank-specific control variables, while also taking into account bank- and time fixed effects. For each capital ratio, we run a pooled OLS regression, a panel regression including bank fixed effects and a Blundell-Bond System GMM regression.

We are especially interested in the System GMM results, as the dynamic setup of our panel leads to biased and inconsistent estimates when using the pooled OLS or fixed effects estimators (Nickell (1981)). We include the OLS and fixed effects estimations as a robustness check for the GMM results. More specifically, it can be shown that pooled OLS estimates tend to overestimate the coefficient for the lagged variable while fixed effects estimators underestimate its true value. As a consequence, a good estimate should at least be between the fixed effects and pooled OLS coefficients. This is the case for both the Tier 1 as well as the leverage regression. Furthermore, the J-statistic also confirms the validity of our instruments. Looking at the results, we see that for both capital measures the lagged dependent variable is highly significant and between 0 and 1, indicating that banks do adjust towards an optimal capital level. The speed of adjustment is quite different for the two capital indicators, with the leverage ratio adjusting faster towards the optimal level than the Tier 1 capital ratio. On average, it takes a bank about 3.1 quarters to close half of its Tier 1 capital gap, while half of the leverage ratio gap is on average filled in about half a year. Possible explanations could be that banks are more concerned about their optimal leverage ratios or that it simply is easier to adjust non-risk weighted equity ratios than Tier 1 ratios.

Next, we use these estimation results to calculate time-varying, bank-specific optimal capital ratios and the deviations from this optimal level (see equation 4 and 5). Table 3 shows the summary statistics for the optimal ratios and the corresponding deviations. In a following step, we analyze the impact of the capital deviations on a group of balance sheet characteristics.

4.2 Impact of capital ratio deviations

In what follows, we analyze the impact of the capital deviations on a group of balance sheet characteristics. We divide the balance sheet characteristics in two groups, depending on whether they belong to the numerator (equity or Tier 1 capital) or the denominator (total assets or risk-weighted assets) of the capital ratio. Tables 4 to 8 show the results from this analysis. In each table, we analyze the impact of deviations from optimal Tier 1 or equity levels on either Tier 1 capital, total equity, risk weighted assets, total assets, retained earnings or loans. For each dependent variable, we run 4 regressions. The first two regressions show the results when not taking into account potential asymmetries between being below or above the optimal capital level and between being far away or close to the target ratio. In the last two regressions we examine whether there are differences between capital surpluses and shortfalls by interacting the deviations from the optimal level with a dummy indicating whether a bank is below (dummy=1) or above (dummy=0) the optimal level. Furthermore, we also allow for differences in reaction for banks that are close to or far away from the optimal ratio. As such, we report the impact for four groups of banks in these last two regressions. The impact is calculated based on the interaction coefficients in equation (6). The first coefficient shows the reaction for banks that are more than one standard deviation above the target ratio. The second coefficient shows the impact for banks that are above the target ratio, but with a deviation that is lower than one standard deviation. Similarly, the third and the fourth coefficient show the reaction of banks that are either below, but close the target ratio and for banks that are more than one standard deviation below the target ratio. We expect that banks that are further away from their target react stronger than banks close to their target. We look at two separate periods, being a pre-crisis period running from the first quarter of 2004 until the last quarter of 2007, and a crisis period running from the first quarter of 2008 until the third quarter of 2011. In all regressions, we control for macroeconomic conditions and central bank policy actions by including quarterly GDP growth, quarterly inflation rate and changes in the 3-month EURIBOR (or a country-specific equivalent for non-EMU countries). Following Hancock et al. (1995), Berrospide and Edge (2010) and Francis and Osborne (2012), we include two lags of these macro variables. We also control for bank-specific characteristics that could have an impact on our left-hand side variables. We include bank size (ln(total assets)), a bank efficiency measure (cost-income ratio), a credit risk indicator (loan loss provisions), an income diversification measure (share of non-interest income in total income) and a funding structure measure (ratio of deposits to total assets) as bank-specific control variables. Furthermore, we also take into account the potential impact of bank bailouts on bank behavior by adding a bank bailout dummy which equals one from the moment a bank received a bailout. Finally, when focusing on loan growth, we also control for the impact of bank securitization by including a securitization dummy which equals one if the bank securitized loans in that quarter. We also control for bank-specific unobservable characteristics and seasonal influences by adding bank and time-fixed effects. Standard errors are clustered at the bank level.

4.2.1 Impact of common equity deviations

Capital measures based on cruder risk-exposure proxies than risk-weighted assets may be the most relevant once for stock market participants or debt holders, because they may view the risk weightings as highly opaque and uninformative. Furthermore, decisions on optimal economic capital have to take into account a range of trade-offs and potentially rely on other risk evaluations of business activities compared to regulatory risk weights. Additionally, the results in Table 2 already indicated that banks optimize their equity ratio, and that this happens faster than the adjustments for the Tier 1 ratio. A potential explanation for this is that capital requirements were only of second order importance for banks during the sample period. Consequently, it is of relevance to analyze the impact of deviations from an optimal, unweighted equity ratio, measured as common equity over total assets.

We begin by looking at the impact of deviations from the optimal level on the numerator of the target ratio, which in this case is common equity. As expected, the first 2 columns of Table 4 indicate that deviations from the optimal equity ratio are negatively correlated with changes in common equity, both before and during the crisis period. However, the first two columns do not take into account potential differences in adjustment behavior between banks that are below and banks that are above their optimal capital level or between banks that are close to or far away from the optimal ratio. We expect that banks that are far below their optimal ratio will have a higher incentive to increase their equity, for example because they could potentially be penalized - in terms of funding cost - for being too close to the regulatory minimum. Hence, in the last two columns we control for potential asymmetries by interacting the deviation variable with a dummy indicating whether a bank is above or below the capital target and with a dummy indicating whether a bank is more than a standard deviation away from the optimal capital ratio. Interestingly, these regressions show that the results presented in the first two columns are mostly driven by banks that are below their target levels. These banks try to increase their equity ratios by increasing common equity. Furthermore, column 3 and 4 of Table 4 indicate that both banks that are above and banks that are below the target adjust their equity levels; although strongly undercapitalized banks react significantly stronger than banks that are far above the optimal equity ratio. Also, during the crisis period we observe a significantly stronger reaction of banks that are far (i.e. more than one standard deviation) below the target than banks that are below, but close to the target. By contrast, banks that are far above target do not reduce their equity levels during crisis periods, potentially indicating the relatively stronger importance given to being well capitalized during crisis periods. The last four columns of Table 4 show that at least part of the adjustment in equity levels is achieved through changes in retained earnings. This is particularly true for banks that are above their optimal levels, although during the recent crisis undercapitalized banks also tried to shore up equity levels by retaining a bigger part of their earnings. Furthermore, there is no significant difference in the size of the reaction - in terms of changes in retained earnings - for banks far below or far above the target.

Focusing on the impact of deviations on changes in total assets in the first four columns of Table 5, we find striking differences between the pre-crisis and the crisis period. Whereas during normal periods banks do not appear to react to equity deviations by adjusting their balance sheet size, we find a significant impact during the crisis period. This effect is particularly strong for banks that are below their optimal equity level, suggesting the presence of a non-negligible deleveraging effect. In other words, deviations from the optimal capital level lead to significant changes in balance sheet growth for banks that are below their optimal level during the recent crisis period, confirming that banks are lowering asset growth in order to raise their capital ratios. Furthermore, banks that are far above their optimal target do not make significant adjustments to their asset size. This result is similar to the result found for equity growth for this group of banks, which might indicate that, during the crisis, notwithstanding being well above target levels, well capitalized banks have a strong incentive to keep their capital ratios high, as this can have an important signaling function during crisis times. The last four columns of Table 5 indicate that, during the crisis, a part of this asset side deleveraging is happening via lower loan growth, although the impact is rather low. During the 2008-2011 period, undercapitalized banks significantly reduced loan growth, while this did not hold during the pre-crisis period. This indication of a deleveraging impact through the loan book, even when it is small, when banks are undercapitalized, is worth keeping in mind when setting new capital requirements. Such concerns were also behind the decision by the Basel Committee to only introduce the new Basel III-based capital requirements in a gradual fashion spanning a transition period of several years.

4.2.2 Impact of Tier 1 capital deviations

A natural expansion of our analysis is to focus on the impact of (risk-weighted) Tier 1 capital deviations on actual capital levels. The first four columns of Table 7 report the impact of deviations from the optimal Tier 1 ratio on the growth in Tier 1 capital. As expected, deviations from the optimal capital level are negatively correlated with changes in Tier 1 capital growth, both before and during the recent financial crisis, although we only find a significant negative impact in the crisis period. As for the common equity ratio, banks that are below the optimal Tier 1 level react more strongly than banks that are above the target. During the crisis, the change in Tier 1 capital levels is about 2.5 times as strong for banks that are more than a standard deviation below the optimal Tier 1 ratio compared to banks that are equally far above their optimal Tier 1 ratio (the difference between both groups is also statistically different). Furthermore, the results also indicate that within the group of undercapitalized banks, the reaction is stronger for banks that are further away from the target, especially during the pre-crisis period. This does not mean that overcapitalized banks are not interested in getting back to their optimal capital target; it only indicates that they prefer other measures to adjust their Tier 1 ratios and perhaps face less acute outside pressure to revert to their Tier 1 target.

Digging one step deeper by looking at the impact of deviations from the Tier 1 ratio on retained earnings in the last four columns of Table 7 shows that the adjustments do not systematically happen through adjustments in retained earnings. This might suggest that retained earnings - being at least in the short term largely determined by exogenous macroeconomic and financial factors - is not a sufficiently reliable tool to change Tier 1 ratios when they are off target.

The alternative for these banks is adjusting the denominator of the Tier 1 ratio by making changes to their risk-weighted assets (RWA). The first four columns of Table 6 show the impact of deviations from the optimal Tier 1 ratio on the growth in RWA. The first two columns confirm our general expectations; deviations from the optimal level are positively correlated with RWA growth, both before and during the current financial crisis. Columns 3 and 4 of Table 6 shows that both banks that are below and banks that are above the optimal level make adjustments to their RWA to get back to their optimal levels. During the pre-crisis period, however, the coefficient for the banks that are more than one standard deviation away from their optimal Tier 1 ratio is significantly larger than the coefficient for the banks in the three other groups. This indicates that banks that are more than a standard deviation below their optimal target, react significantly stronger than banks that are close to the target and than banks that are far above the target. Thus, making changes to the risk-weighted assets seems to be an important strategy to convert to the optimal Tier 1 ratio, especially for banks that are far below their optimal Tier 1 ratio. During the crisis, the size of the reactions is not significantly different between the different groups. In other words, during crisis periods RWA adjustments (e.g. via reshuffling of portfolio compositions or optimizations) appears to be a flexible tool for banks to adjust their Tier 1 ratios, irrespective of the underlying fundamentals, whereas it is especially preferred by seriously undercapitalized banks during normal times.

Changes in RWA can be caused by a change in risk weightings, a real change in total assets or a combination of both. The last four columns of Table 6 provide more information on this issue. The table shows the impact of deviations from the optimal Tier 1 ratio on the growth in total assets. We only find a significant impact on real asset growth for banks that are more than one standard deviation above their optimal Tier 1 ratio, indicating that banks prefer to fine tune their risk-weighted assets instead of making actual changes to the size of their balance sheet when being close to or far below their Tier 1 capital target. This holds for both the crisis and the pre-crisis period.

Finally, in Table 8 we focus on the impact of deviations from optimal capital levels on loan growth. We do not find any significant effect of Tier 1 deviations on loan growth.

Overall, our results indicate (i) that European banks react stronger to capital shortfalls than to capital surplus situations in terms of Tier 1 adjustments, (ii) that banks further away from the optimal Tier 1 ratio react stronger than banks that are close to the optimal ratio, (iii) that part of the changes in risk-weighted assets is coming from changes in real asset growth when banks are above target, whereas they prefer not to decrease real asset growth when being undercapitalized and (iv) that Tier 1 capital adjustment behavior was not fundamentally different during the 2008-2009 crisis compared to the years before the crisis.

5 Conclusions

In this paper, we contribute to a better understanding of bank deleveraging mechanisms by looking at banks' reactions to deviations from optimal capital levels. We focus on two types of capital ratios, being the regulatory Tier 1 ratio and an unweighted equity ratio. Using a sample of 93 European banks between 2004 Q1 and 2011 Q3, we analyze (i) whether these banks have an internal, optimal capital ratio, (ii) how banks react to a deviation from their optimal capital level, (iii) whether this reaction differs during crisis situations and (iv) whether this reaction is symmetric in terms of being (far) below or (far) above the optimal level. We find clear evidence for capital optimization, both in terms of the Tier 1 ratio and the equity ratio. Furthermore, we show that there are notable asymmetries in bank reactions to deviations from optimal capital levels. More specifically, overcapitalized banks prefer to reshuffle risk-weighted assets or increase asset holdings when deviating from their optimal Tier 1 ratio, whereas they rather try to increase equity levels or reshuffle risk-weighted assets without changing asset holdings when being below target. When looking at the equity ratio, we also find evidence for deleveraging and lower loan growth for undercapitalised banks during the recent financial crisis, whereas in the pre-crisis periods banks primarily reacted to deviations from their optimal target by adjusting equity levels, for example through changes in retained earnings.

From a policy perspective these results point to the risk of bank balance sheet deleveraging and loan contraction when the banking sector is undercapitalised, which in turn might have negative repercussions on real economic activity. Our findings also confirm that banks behave differently during crisis times than during ”normal” periods and that especially deleveraging actions due to capital shortfalls might be amplified in periods of crisis where banks' leeway to adjust their balance sheets is more limited. This finding is consistent with the extraordinary monetary policy and government support measures provided to the banking sector in recent years; measures which arguably have contributed to limit the negative repercussions of the shocks to bank capital that have occurred during the financial crisis and the euro area sovereign debt crisis. Furthermore, our findings highlight the importance of taking into account potential asymmetries when analyzing banks' reactions to deviations from optimal capital levels and can help in understanding how banks react to a sudden shortfall in bank capital levels and should also help inform decisions of raising bank capital requirements.

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6 Tables and Figures

Table 1: Equity and Tier 1 ratio - summary statistics by country

This table shows the summary statistics for the equity ratio (common equity over total assets) and the Tier 1 ratio (Tier 1 capital over risk weighted assets) for each country in our sample) for the full sample period (2004Q1 - 2011Q3).

	Tier 1 ratio				Equity ratio				
Country	**Mean**	**St. Dev.**	**Min.**	**Max.**	**Mean**	**St. Dev.**	**Min.**	**Max**	**Banks**
Austria	8.56	2.19	5.80	17.20	6.28	1.75	2.14	10.09	5
Belgium	10.87	1.64	7.10	14.50	3.18	1.46	1.64	5.70	2
Czech Republic	10.79	2.12	9.50	13.95	8.34	1.71	6.87	10.71	1
Denmark	11.22	2.74	6.42	17.20	6.36	2.88	2.77	14.32	5
Finland	9.34	1.86	6.90	12.50	6.09	1.08	4.20	7.92	1
France	8.93	0.76	7.70	10.60	2.87	0.23	2.47	3.34	8
Germany	8.55	2.04	5.80	14.13	2.45	0.55	1.64	3.81	4
Great Britain	9.85	1.98	6.30	14.10	4.15	1.49	1.64	7.41	6
Greece	9.43	2.23	5.80	14.90	4.90	1.82	1.64	8.73	10
Hungary	14.70	0.14	14.60	14.80	13.34	0.03	13.32	13.37	1
Ireland	9.65	0.07	9.60	9.70	4.36	0.06	4.32	4.40	2
Italy	8.02	1.71	5.80	15.89	7.74	1.58	4.33	12.55	16
Netherlands	10.39	1.10	9.20	13.18	6.14	0.73	5.18	7.41	3
Norway	8.27	1.29	6.30	11.01	4.08	1.02	2.48	6.64	3
Poland	13.43	2.52	8.95	17.20	12.45	2.52	6.32	15.60	10
Portugal	7.71	1.10	5.80	9.30	5.26	1.35	2.93	7.63	4
Slovenia	10.37	7.27	4.6	6.6	10.25	6.52	10.48	8.62	2
Spain	8.25	1.17	6.32	11.63	5.30	0.83	3.44	7.31	9
Sweden	8.63	2.40	5.80	17.20	4.03	0.53	2.94	5.54	5

Table 2: Bank Capital - Speed of Adjustment

This table shows the results for the speed of adjustment regressions for our two capital measures. The dependent variable in the first three columns is the Tier 1 Capital ratio (Tier1 Capital over Risk Weighted Assets), while the dependent variable in the last three columns is the Common equity ratio (Common Equity over Total Assets). Both capital variables are regressed on their own one-period lagged observation, a group of bank-specific business model characteristics and two macro-economic control variables (GDP growth and Inflation rate). All regressions also include time fixed effects. For each capital variable we use three different regression approaches, being OLS, panel with bank Fixed Effects and System GMM. Since we are dealing with a dynamic panel setup, the System GMM approach is the preferred approach. For the panel regressions, we report robust standard errors, clustered at the bank level. The GMM standard errors are Windmeiijer robust standard errors.We use a two step GMM procedure, using a collapsed instrument set of two lags of the right hand side variables. For each regression, the table also mentions the speed of adjustment of the banks towards their optimal capital level (calculated as one minus the coefficient on the lagged dependent variable) and how many quarters it takes for the average bank to fill half of the difference between the optimal and the current capital level (”half”).

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	OLS	FE	SGMM	OLS	FE	SGMM
Tier 1 Ratio	0.879***	0.637***	0.804***			
	(0.0258)	(0.0553)	(0.0894)			
Equity Ratio				0.965***	0.717***	0.728***
				(0.0106)	(0.0340)	(0.0922)
ln(Total Assets)	-0.0398	-0.710	-0.0906	-0.0236*	-0.155	-0.172
	(0.0247)	(0.451)	(0.295)	(0.0133)	(0.112)	(0.214)
Return on Equity	0.00708**	2.36e-05	0.00106	0.000192	0.000590	0.0125
	(0.00318)	(0.00359)	(0.00946)	(0.00201)	(0.00233)	(0.00825)
Loan to Assets Ratio	-0.977***	-2.388***	-2.187**	-0.0586	-0.955***	0.156
	(0.318)	(0.561)	(0.876)	(0.162)	(0.353)	(0.843)
Deposit Ratio	-0.0841	0.992	1.740	-0.0513	-0.301	-0.466
	(0.265)	(0.672)	(1.171)	(0.167)	(0.508)	(0.686)
% Loan Loss Provisions	0.140	0.253	0.170	-0.0512	-0.230	-0.209
	(0.259)	(0.291)	(0.427)	(0.152)	(0.187)	(0.281)
Income Diversification	-0.370**	-0.141	0.000798	0.00930	-0.0938	-0.156
	(0.178)	(0.231)	(0.291)	(0.119)	(0.132)	(0.200)
Cost Income Ratio	0.00160	0.00182	-0.00611**	0.000554	0.000190	-0.000772
	(0.00291)	(0.00248)	(0.00291)	(0.00115)	(0.00106)	(0.00175)
GDP Growth	0.0371***	0.0340**	0.0279	0.00286	0.00306	0.00599
	(0.0101)	(0.0142)	(0.0504)	(0.00506)	(0.00559)	(0.0281)
Inflation Rate	0.0965**	0.0562	-0.00123	0.0856***	0.0645**	-0.0438
	(0.0477)	(0.0439)	(0.407)	(0.0321)	(0.0311)	(0.117)
Constant	1.972***	11.46**		0.526**	3.984***	
	(0.610)	(5.293)		(0.262)	(1.271)	
Observations	1,399	1,399	1,399	1,823	1,823	1,823
R-squared	0.843	0.712		0.953	0.627	
Speed Of Adjustment	0.121	0.363	0.196	0.0345	0.263	0.272
Half	5.379	1.535	3.185	19.72	2.275	2.180
Number of banks	79	79	79	93	93	93
AR2pval			0.138			0.215
Jstatpval			0.541			0.242

Table 3: Bank Specific Variables - Summary Statistics

This table shows the summary statistics for the bank-specific variables used throughout this paper. Our total sample consists of quarterly data for 93 European banks from 2004Q1 until 2011Q3 The consist of two panel. The first panel shows the summary statistics for the capital ratios and bank business model variables. This data is coming from Bloomberg and Datastream. Based on these variables, we can calculate a banks optimal capital ratio and the deviation from this optimal level (see table 2 for more info). The summary statistics for these optimal levels and deviations are shown in the second part of the table.

Variable	**Mean**	**Std. Dev.**	**N**
Tier 1 Ratio	9.13	2.44	1454
Equity over Total Assets	6.05	2.9	1823
ln(Total Assets)	10.93	1.74	1823
Return on Equity	10.81	12.54	1823
Loan to Assets Ratio	0.70	0.15	1823
Deposit Ratio	0.47	0.16	1823
% LoanLossProvisions	0.14	0.15	1823
Income diversification	0.29	0.15	1823
CostIncome Ratio	2.34	8.37	1823
GDP growth	0.11	5.67	1823
Inflation rate	0.58	0.78	1823
Variable	**Mean**	**Std. Dev.**	**N**
Tier 1 ratio - deviation	0.01	0.29	1454
Equity over Total Assets - deviation	0.12	0.49	1823
Tier 1 ratio - optimal	9.43	2.43	1454
Equity over Total Assets - optimal	5.5	1.4	1823

Table 4: Common equity deviation - Impact on equity and retained earnings growth

This table shows the impact of deviations from the optimal equity ratio on equity growth and growth in retained earnings. We regress equity growth (retained earnings growth) on the deviation from the optimal equity ratio, a group of macro-economic control variables (GDP growth, interest rate changes and the inflation rate) and bank-specific control variables. In column 1 and 2 (5 and 6), we do not differentiate between banks that are below or above the optimal capital level.In column 3 and 4 (7 and 8), we do take into account potential asymmetric reactions by interacting the deviation variable with a dummy which is equal to one when a bank is below its optimal equity ratio level and a dummy equal to one when a bank is more than one standard deviation above or below the target ratio. We report four coefficients. The first coefficient indicates the impact for banks that are more than one standard deviation above target. The second coefficient refers to banks that are between the target and the target plus one standard deviation. The third coefficient shows the reaction for banks that are less than a standard deviation below target, while the fourth coefficient refers to banks that are more than one standard deviation below target. All regressions are done for a pre-crisis (2004Q1-2007Q4) and a crisis period (2008Q1-2011Q3). All regressions include bank and time fixed effects. Standard errors are robust and clustered at the bank level. The variables are normalized around their sample mean, which means that the coefficients show the impact of a one standard deviation change on the dependent variable.

VARIABLES	Equity Growth pre-crisis	Equity Growth crisis	Equity Growth pre-crisis	Equity Growth crisis	Ret. Earnings pre-crisis	Ret. Earnings crisis	Ret. Earnings pre-crisis	Ret. Earnings crisis
Deviation Equity Ratio	-5.161***	-1.999***			-5.568***	-1.757***		
	(0.822)	(0.729)			(1.406)	(0.440)		
Deviation Equity Ratio -			-4.312***	-1.519**			-5.665***	-1.740***
$\geq$ 1 standard deviation above target			(0.806)	(0.742)			(1.524)	(0.442)
Deviation Equity Ratio -			-4.480***	-1.882			-7.969***	-1.627*
Above target			(1.453)	(1.274)			(2.335)	(0.969)
Deviation Equity Ratio -			-9.549***	-5.139***			-4.741	-2.913**
Below target			(1.437)	(1.867)			(3.239)	(1.306)
Deviation Equity Ratio -			-10.55***	-8.070***			-3.885	-3.380**
$\geq$ 1 standard deviation below target			(1.652)	(1.950)			(3.703)	(1.306)
Constant	5.063***	-1.212	3.372**	-2.484*	5.272*	-2.977***	5.631	-3.337***
	(1.376)	(1.312)	(1.481)	(1.482)	(3.000)	(0.835)	(3.413)	(0.935)
Observations	743	1,104	743	1,104	251	1,004	251	1,004
R-squared	0.229	0.154	0.255	0.183	0.288	0.145	0.300	0.147
Number of banks	83	95	83	95	73	90	73	90
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Common equity deviation - Impact on asset and loan growth

This table shows the impact of deviations from the optimal equity level on total asset and loan growth. We regress total asset growth (loan growth) on the deviation from the optimal equity ratio, a group of macro-economic control variables (GDP growth, interest rate changes and the inflation rate) and bank-specific control variables. In column 1 and 2 (5 and 6), we do not differentiate between banks that are below or above the optimal capital level.In column 3 and 4 (7 and 8), we do take into account potential asymmetric reactions by interacting the deviation variable with a dummy which is equal to one when a bank is below its optimal equity ratio and a dummy equal to one when a bank is more than one standard deviation above or below the target ratio. We report four coefficients. The first coefficient indicates the impact for banks that are more than one standard deviation above target. The second coefficient refers to banks that are between the target and the target plus one standard deviation. The third coefficient shows the reaction for banks that are less than a standard deviation below target, while the fourth coefficient refers to banks that are more than one standard deviation below target. All regressions are done for a pre-crisis (2004Q1-2007Q4) and a crisis period (2008Q1-2011Q3). All regressions include bank and time fixed effects. Standard errors are clustered at the bank level. The variables are normalized around their sample mean, which means that the coefficients show the impact of a one standard deviation change on the dependent variable.

VARIABLES	Asset Growth pre-crisis	Asset Growth crisis	Asset Growth pre-crisis	Asset Growth crisis	LoanGrowth pre-crisis	LoanGrowth crisis	LoanGrowth pre-crisis	LoanGrowth crisis
Deviation Equity Ratio	0.123	1.155**			0.347	1.104*		
	(0.481)	(0.476)			(0.696)	(0.606)		
Deviation Equity Ratio -			0.0338	0.987**			0.692	1.363**
≥ 1 standard deviation above target			(0.511)	(0.492)			(0.719)	(0.610)
Deviation Equity Ratio -			0.336	1.352			-0.326	2.560**
Above target			(0.835)	(0.818)			(1.090)	(1.175)
Deviation Equity Ratio -			0.598	2.890***			-1.562	-0.364
Below target			(0.974)	(0.922)			(1.126)	(1.244)
Deviation Equity Ratio -			0.571	2.802***			-0.759	-0.0982
≥ 1 standard deviation below target			(0.963)	(0.756)			(1.357)	(1.163)
Constant	1.959	-3.090*	2.142	-1.829	7.162*	3.188	6.697	2.308
	(1.747)	(1.640)	(1.842)	(1.688)	(4.178)	(2.515)	(4.135)	(2.600)
Observations	743	1,104	743	1,104	742	1,104	742	1,104
R-squared	0.133	0.224	0.134	0.230	0.122	0.186	0.127	0.190
Number of banks	83	95	83	95	83	95	83	95
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6: Tier 1 Deviation - Impact on total assets and risk weighted assets

This table shows the impact of deviations from the optimal Tier1 capital ratio on total asset growth and growth in risk weighted assets (RWA). We regress total asset growth (RWA growth) on the deviation from the optimal Tier 1 ratio, a group of macro-economic control variables (GDP growth, interest rate changes and the inflation rate) and bank-specific control variables. In column 1 and 2 (5 and 6), we do not differentiate between banks that are below or above the optimal capital level.In column 3 and 4 (7 and 8), we do take into account potential asymmetric reactions by interacting the deviation variable with a dummy which is equal to one when a bank is below its optimal Tier 1 capital level and a dummy equal to one when a bank is more than one standard deviation above or below the target ratio. We report four coefficients. The first coefficient indicates the impact for banks that are more than one standard deviation above target. The second coefficient refers to banks that are between the target and the target plus one standard deviation. The third coefficient shows the reaction for banks that are less than a standard deviation below target, while the fourth coefficient refers to banks that are more than one standard deviation below target. All regressions are done for a pre-crisis (2004Q1-2007Q4) and a crisis period (2008Q1-2011Q3). All regressions include bank and time fixed effects. Standard errors are clustered at the bank level. The variables are normalized around their sample mean, which means that the coefficients show the impact of a one standard deviation change on the dependent variable.

VARIABLES	RWA growth pre-crisis	RWA growth crisis	RWA growth pre-crisis	RWA growth crisis	Asset growth pre-crisis	Asset growth crisis	Asset growth pre-crisis	Asset growth crisis
Deviation Tier 1 Ratio	1.674***	1.651***			0.917***	1.041***		
	(0.549)	(0.506)			(0.305)	(0.302)		
Deviation Tier 1 Ratio -			1.894***	1.588***			0.968***	1.052***
$\geq$ standard deviation above target			(0.495)	(0.496)			(0.324)	(0.316)
Deviation Tier 1 Ratio -			4.521***	1.205			1.723	0.473
Above target			(1.254)	(1.156)			(1.079)	(0.814)
Deviation Tier 1 Ratio -			4.043**	3.451**			0.298	0.479
Below target			(1.597)	(1.357)			(1.264)	(0.839)
Deviation Tier 1 Ratio			6.527***	2.913**			0.875	0.647
$\geq$ standard deviation below target			(1.660)	(1.164)			(1.441)	(0.903)
Constant	-0.221	-2.098	-1.955	-3.077	-1.718	2.318	-1.828	-2.011
	(3.282)	(2.024)	(3.146)	(2.164)	(2.586)	(1.555)	(2.763)	(1.948)
Observations	451	763	451	763	515	885	515	885
R-squared	0.197	0.116	0.216	0.120	0.184	0.220	0.186	0.221
Number of banks	59	70	59	70	72	80	72	80
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7: Tier 1 deviation - Impact on Tier 1 capital and retained earnings growth

This table reports the impact of deviations from the optimal Tier 1 capital ratio on Tier 1 equity growth and growth in retained earnings. We regress Tier 1 equity growth (retained earnings growth) on the deviation from the optimal Tier 1 ratio, a group of macro-economic control variables (GDP growth, interest rate changes and the inflation rate) and bank-specific control variables. In column 1 and 2 (5 and 6), we do not differentiate between banks that are below or above the optimal capital level.In column 3 and 4 (7 and 8), we do take into account potential asymmetric reactions by interacting the deviation variable with a dummy which is equal to one when a bank is below its optimal Tier 1 capital level and a dummy equal to one when a bank is more than one standard deviation above or below the target ratio. We report four coefficients. The first coefficient indicates the impact for banks that are more than one standard deviation above target. The second coefficient refers to banks that are between the target and the target plus one standard deviation. The third coefficient shows the reaction for banks that are less than a standard deviation below target, while the fourth coefficient refers to banks that are more than one standard deviation below target. All regressions are done for a pre-crisis (2004Q1-2007Q4) and a crisis period (2008Q1-2011Q3). All regressions include bank and time fixed effects. Standard errors clustered at the bank level. The variables are normalized around their sample mean, which means that the coefficients show the impact of a one standard deviation change on the dependent variable.

VARIABLES	Tier 1 Growth pre-crisis	Tier 1 Growth crisis	Tier 1 Growth pre-crisis	Tier 1 Growth crisis	Ret. Earnings pre-crisis	Ret. Earnings crisis	Ret. Earnings pre-crisis	Ret. Earnings crisis
Deviation Tier 1 Ratio	-0.448	-2.299***			-0.0559	-0.219		
	(0.783)	(0.559)			(1.307)	(0.370)		
Deviation Tier 1 Ratio -			-0.810	-2.393***			-0.669	-0.124
$\geq$ 1 standard deviation above target			(0.808)	(0.565)			(1.273)	(0.364)
Deviation Tier 1 Ratio -			-1.830	-4.433***			1.128	1.377
Above target			(1.986)	(1.335)			(2.287)	(1.020)
Deviation Tier 1 Ratio -			-9.398***	-9.554***			-4.114	-0.524
Below target			(2.103)	(1.643)			(4.793)	(1.144)
Deviation Tier 1 Ratio -			-15.23***	-11.29***			-23.20***	0.739
$\geq$ 1 standard deviation below target			(3.595)	(1.714)			(6.456)	(1.431)
Constant	1.259	1.062	-0.361	0.114	3.963	2.640***	2.928	-3.158***
	(2.404)	(1.772)	(2.419)	(1.383)	(4.665)	(0.818)	(4.775)	(1.133)
Observations	452	764	452	764	214	799	214	799
R-squared	0.152	0.112	0.203	0.157	0.249	0.174	0.318	0.180
Number of banks	59	70	59	70	63	75	63	75
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Tier 1 deviation - Impact on loans

This table shows the impact of deviations from the optimal Tier 1 capital ratio on loan growth. We regress total loan growth on the deviation from the optimal Tier 1 ratio, a group of macro-economic control variables (GDP growth, interest rate changes and the inflation rate) and bank-specific control variables. In column 1 and 2, we do not differentiate between banks that are below or above the optimal capital level.In column 3 and 4, we do take into account potential asymmetric reactions by interacting the deviation variable with a dummy which is equal to one when a bank is below its optimal Tier 1 capital level and a dummy equal to one when a bank is more than one standard deviation above or below the target ratio. We report four coefficients. The first coefficient indicates the impact for banks that are more than one standard deviation above target. The second coefficient refers to banks that are between the target and the target plus one standard deviation. The third coefficient shows the reaction for banks that are less than a standard deviation below target, while the fourth coefficient refers to banks that are more than one standard deviation below target. All regressions are done for a pre-crisis (2004Q1-2007Q4) and a crisis period (2008Q1-2011Q3). All regressions include bank and time fixed effects. Standard errors are clustered at the bank level. The variables are normalized around their sample mean, which means that the coefficients show the impact of a one standard deviation change on the dependent variable.

VARIABLES	LoanGrowth pre-crisis	LoanGrowth crisis	LoanGrowth pre-crisis	LoanGrowth crisis
Deviation Tier 1 Ratio	-0.249	-1.430		
	(0.967)	(1.174)		
Deviation Tier 1 Ratio -			-0.338	-1.902
≥ 1 standard deviation above target			(0.886)	(1.387)
Deviation Tier 1 Ratio -			2.179	-6.136
Above target			(4.330)	(4.549)
Deviation Tier 1 Ratio -			-1.153	3.461
Below target			(4.068)	(3.270)
Deviation Tier 1 Ratio -			-6.450	-0.473
≥ 1 standard deviation below target			(7.326)	(3.688)
Constant	9.002	9.480	9.642	8.623
	(7.887)	(6.479)	(8.992)	(6.957)
Observations	515	885	515	885
R-squared	0.102	0.029	0.106	0.033
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Cluster	Bank	Bank	Bank	Bank
Control variables	Yes	Yes	Yes	Yes
Number of banks	72	80	72	80

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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