Bank reactions after capital shortfalls *

Glenn Schepens[†] Christoffer Kok [‡]

August 3, 2012

PRELIMINARY, PLEASE DO NOT QUOTE

Abstract

This paper investigates whether European banks have capital targets and how deviations from the target have an impact on a banks equity composition and activity mix. Using quarterly data for a sample of large European banks between 2004Q1 and 2011Q3, we show that there are notable asymmetries in banks' reactions to deviations from optimal capital 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. At the same time, focusing instead on a simple leverage 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 react to deviations from their optimal target by adjusting equity levels. Our results could help in understanding the potential reaction of financial institutions to changes in capital requirements, which

*Comments by P. Bologna, S.Biswas, J. Henry, M. Grodzicki and conference participants at the IFABS 2012 conference and the FEBS 2012 conference are gratefully acknowledged. The views expressed in this paper are those of the authors and do not necessarily reflect those of the ECB.

[†]Corresponding author, Department of Financial Economics, Ghent University. glenn.schepens@ugent.be

[‡]European Central Bank.

arguably affect banks' capital targets. Furthermore, by providing evidence on the behavior of banks during the recent financial crisis, we contribute to the debate on how and to what extent banks deleverage their balance sheets during economic downturns.

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 were 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 frontloading of the requirements. At the same time, 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] According to these studies, a "socially optimal" Core Tier 1 (CT1) capital ratio could very well be in the range of 10%-20%. The basic notion behind these claims is that as bank capital constitutes a buffer against unexpected losses more of it, ceteris paribus, would tend to reduce the probability of the occurrence of banking crises. This would in turn yield "social benefits" by limiting the negative repercussions on the real economy normally implied by banking crises and by limiting the size of state interventions and smoothening bank resolutions. Individual banks, it is argued, have few, if any incentives to take into account the potential social costs of operating with too low capital ratios. In addition, it has been argued, that bank equity is not socially costly and that capital requirements would limit banks' ability to exploit the tax advantage of issuing bank debt to the detriment of holding more equity (see, e.g.,

[1] See e.g. Admati, DeMarzo, Hellwig, and Pleiderer (2010), Bank of England (2010), Bank for International Settlements (2010), Miles, Yang, and Marcheggiano (2011) and Sveriges Riksbank (2011).

Admati, DeMarzo, Hellwig, and Pleiderer (2010)).

The actual impact of higher capital requirements on a banks' balance sheet composition and ultimately on the real economy, however, remains a highly debated issue. Banks can comply with higher regulatory capital standards 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, Kashyap, and Stein (2011)). If banks shrink their assets by reducing lending activities, it 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.[2] 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 a banks' net worth 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 mostly 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.

The example in Figure 1, which is inspired by Adrian and Shin (2010), illustrates why optimizing banks will potentially adjust asset and liability positions when being away from their optimal capital ratio. Assume a simplified bank balance sheet with only loans and securities on

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

Figure 1: Bank reaction to capital deviations

Bank (t=1)	
Loans 70	Deposits 60
Securities 30	MMfunding 30
	Equity 10

Bank (t=2)	
Loans 70	Deposits 60
Securities 29	MMfunding 30
	Equity 9

Bank (t=3)	
Loans 70	Deposits 60
Securities 20	MMfunding 21
	Equity 9

the asset side, which is and funded by deposits, money market funding and equity.

The equity ratio of this bank is 10 percent at t=1. Assume that this is the optimal capital target for this bank. If a banks equity is hit by a shock at t=2, for example by a loss of 1 on the securities, the equity ratio falls to 9/99 = 9.09 percent. If the bank wants to get to its optimal capital ratio level, it will have to adjust its balance sheet. It could get back to its optimal equity ratio by increasing its equity with 0.99. This could be done by retaining more earnings or by raising external equity. A deviation from the optimal equity ratio could thus impact the composition and size of equity. However, raising equity is costly and will not always be the preferred funding measure. The pecking order theory, for example, emphasizes that, when external funding is needed, firms will prefer debt to equity (Myers and Majluf (1984)). Furthermore, the market-timing theory on capital structure posits that firms will issue securities depending on the relative cost of debt and equity (see e.g. Baker and Wurgler (2002)). Thus, it is reasonable to expect that banks may choose other alternatives than raising extra capital. In our example, a possible alternative strategy could be to diminish the short-term money market funding with an amount of 9 and at the same time sell off 9 securities, which would bring the capital ratio back to 9/90= 10 percent. Another alternative would be to diminish the amount of loans, by simply decreasing their loan supply or by selling more loans through securitization. This simple example shows that, if banks are actively trying to hold their capital ratio at an optimal level, this can have an impact on various balance sheet items. It also shows the potential multiplier effect on the asset side. While the equity ratio only needs to increase by 0.99 to get back to the optimal ratio, it will take a far stronger effort on the asset side (e.g. a reduction of the loan/securities portfolio by 9 units) to get back to the optimal level, which could have significant real economic repercussions.The same type of reasoning could be made when the bank is hit by a positive capital shock.

In addition to analyzing how banks on average adjust their balance sheet, we also focus on potential asymmetries in the adjustment behavior. More specifically, we are interested in banks that are below their optimal capital levels, 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. Previous studies have showed that economic conditions can have a significant impact on banks‘ capital management (see, e.g., Jokipii and Milne (2008); Francis and Osborne (2012)). There are two possibilities; banks could take a forward looking, over the cycle approach or they could behave more short sighted. If the former is true, then banks will increase bank capital levels during business cycle expansions to build up buffers for bad times. Increased recognition of the build up of risk during economic booms and the potential realization of bad loans in a following stage would thus lead to the build up of excess capital during boom periods (see, e.g. Borio, Furfine, and Lowe (2001)). However, banks could also choose to hold less capital during boom periods, as potential risks are perceived to be less likely to materialize. When risks do materialize, existing capital cushions will not be sufficient to cope with rising losses. Furthermore, markets will potentially require higher buffers during these downturns and banks that want to maintain their credit ratings - in order to prevent higher funding costs - will have to increase their capital levels. As raising external capital or retaining more earnings is hard during crisis periods, banks will have a higher incentive to reduce their lending or securities portfolio during economic downturns. Alternatively, banks will have to take recourse to government capital injections, which however also come with a cost (e.g. higher funding costs, conditionality and loss of independency).

This paper is related to different strands of the existing literature on (bank) capital structure. First of all, 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 it origin in a study of Hancock, Laing, and Wilcox (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, Roberts, and Zender (2008), Flannery and Rangan (2006), Berger, DeYoung, Flannery, Lee, and Oztekin (2008), Gropp and Heider (2010)). These papers mainly 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 capital 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 focussed 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, Fazylov, and Molyneux (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 significant impact of capital-related factors on loan supply (see e.g. Hempell and Kok (2010), Del Giovane, Eramo, and Nobile (2010) and Blaes (2011)) and on economic growth (see e.g. Ciccarelli, Maddaloni, and Peydro (2010)). Using a loan level dataset on Spanish bank loans, Jimenez, Ongena, Peydro, and Saurina (Forthcoming) 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 focussed on the impact of deviations from optimal capital levels, mainly focussing on the impact on credit growth (Berrospide and Edge (2010) for the US; Francis and Osborne (2012) for a group of UK banks and Memmel and Raupach (2010) for a group of German banks). To our knowledge, Francis and Osborne (2012) is the only paper we know of that focusses on other bank characteristics than bank lending within this capital deviation setup.[3] They look at a sample of about 150 UK banks between 1996 and

[3] Memmel and Raupach (2010) also look at adjustment behaviour, 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

2007 and study the impact of capital deviations on different balance sheet characteristics, while especially focusing on the impact of bank-specific capital requirements.[4] We contribute to this strand of literature in three ways: i) by focussing 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. Assuming that a bank's reaction to higher capital requirements will be similar to the reaction when it deviates from an internal, optimal capital ratio, the results in this paper could also provide some insights concerning 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 pressures.[5]

One important question is which concept of capital to focus on. 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, if we want to analyze potential reaction of banks to higher capital requirements, looking at the Tier 1 ratio is the most interesting avenue. 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 highly opaque and uninformative. As funding costs are an important issue for bank managers, it is well possible that

side adjustments. Furthermore, their empirical framework differs considerably from ours.

[4]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.

[5]This assumption is strengthened by the findings of Francis and Osborne (2012), who show that in the UK regulatory capital requirements are positively associated with banks‘ targeted ratios: see also Aiyar, Calomiris, and Wieladek (2012). Furthermore, survey results from Alfon, Argimon, and Bascunana-Ambros (2004) show that higher capital requirements are associated with higher capital ratios.

banks - just like other firms - also optimize a simple leverage ratio. Therefore, we use both the Tier 1 ratio and a simple leverage ratio (i.e. the ratio of common equity to total assets), as both could potentially reveal a different story.

The paper is organized in the following way: Section 2 describes the data and the empirical methodology. Section 3 presents the results, while Section 4 concludes.

2 Data and Empirical strategy

2.1 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, 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. This leaves us with a sample of 93 banks from 22 European countries.[6] Macroeconomic indicators are provided by Thomson Datastream. The securitization dummy used in the loan regressions is based on data coming from Dealogic (DCM Analytics).

To assess the impact of deviations from capital targets, we first need to estimate bank capital targets. Thus, in the first subsection 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 a second part we assess the impact of the estimated deviations on bank-specific balance sheet characteristics.

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

2.2 Dynamic capital adjustment model

In this part, we 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, DeYoung, Flannery, Lee, and Oztekin (2008), Francis and Osborne (2012)), we model the possibility that target capital ratios might differ across banks and over time as follows:

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

Where $K^*_{i,t}$ is the bank-specific, time-varying optimal capital ratio and $X_{i,t}$ is a vector of bank specific characteristics. Following existing literature on the determinants of optimal capital structure (see e.g. Gropp and Heider (2010) Berger, DeYoung, Flannery, Lee, and Oztekin (2008),Lemmon, Roberts, and Zender (2008)) we include proxies for size (ln(Total Assets), earnings (Return on Equity), bank risk behavior (Loan Loss Provisions) and bank business model characteristics (Loan ratio, Deposit ratio, Income diversification, 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 retained earnings, as dividend payments are rarely adjusted for most banks. 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, which is why they 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.

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 of all, we can use the optimal capital ratio (see equation (4)) to calculate the deviations ($DEV_{i,t}$) from the target capital level:

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

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 also want to control for asymmetric reactions; i.e. the extent to which banks react differently when they are above or below their target. Therefore, we regress the change in each equity factor 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.

$$\Delta BS_{i,t} = \alpha_i + \beta_1 * DEV_{i,t-1} + \beta_2 * DEV_{i,t-1} * D_{i,t-1} + \beta_3 * D_{i,t-1} + \delta * CV_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

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 $D_{i,t-1}$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. We study the impact on six balance sheet factors, namely Tier 1 capital, total capital, retained earnings, risk-weighted assets, total assets and bank 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 do believe that combining the different components for which we do have information available already provides interesting insights into how European financial institutions manage their capital ratios.

3 Results

3.1 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 our two capital measures, being the Tier 1 capital ratio (columns 1-3) and a simple equity ratio (columns 4-6). These ratios are regressed on their own one period lagged value and a group 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 sort of robustness check for our 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 coefficient. This is the case for both the Tier 1 as well as the equity 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 Tier1 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 1 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.

3.2 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 (Tier 1 or Equity Capital) or the denominator (Total Assets or Risk-Weighted Assets) of the capital ratio. Tables 3 to 11 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. The first two columns show the results when not taking into account potential asymmetries between being below or above the optimal capital level. In the last two columns we, in turn, 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. Each column also includes the actual impact for banks that are below their optimal level (*Beta-Shorfall)* and a corresponding t-statistic *(T-statistic)*.[7] For both regressions, 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, Laing, and Wilcox (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 behaviour by adding a bank bailout dummy which equals one from the moment a bank received a bailout. Finally, when focussing 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. All right-hand side variables are standardized, which means that the coefficients show the impact of a one standard deviation change of the independent variable on the dependent variable. We also control for bank-specific unobservable characteristics and seasonal influences by adding bank and time-fixed effects. Furthermore, we also cluster standard errors at the bank level.

[7]This 'beta-shortfall' is calculated as the sum of the coefficient for the capital deviation variable (β_1) and the coefficient of the interaction term between the capital deviation variable and a dummy that equals one when a bank is below its optimal capital level (β_2). The standard deviation of this beta-shortfall is then equal to the square root of the following sum: V(β_1) + V(β_2) + 2*COV($\beta_1\beta_2$), which then allows us to calculate the corresponding t-statistic.

3.2.1 Impact of Tier 1 capital deviations

A natural point to start our analysis is by looking at the impact of capital deviations on actual capital levels. Table 3 shows the impact of deviations from the optimal Tier 1 ratio on the growth in Tier 1 capital the following quarter. 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. However, these 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. 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 (dummy=1) or below (dummy=0) the capital target. 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 capital ratios by increasing Tier 1 capital. In contrast, banks that are above the optimal level have a lower incentive to reduce their capital levels. This is illustrated by the finding that the reaction of banks that are below their optimal capital level is significantly stronger, as the change in capital levels is about five times as strong for undercapitalized banks compared to banks that are equally far above their optimal capital level. 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 capital ratios and perhaps face less outside pressure to revert to their capital target.

Digging one step deeper by looking at the impact of deviations from the Tier 1 ratio on Retained earnings (Table 4) 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 discretely changing capital ratios when they are off targets.

The alternative for these banks is adjusting the denominator of the capital ratio by making changes to their risk-weighted assets (RWA). Table 5 shows 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. Column 3 of Table 5 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, and that there are no significant asymmetries in these reactions. As in Table 3, the size of the reactions is fairly similar for both the pre-crisis and the crisis period. In other words, RWA adjustments (e.g. via reshuffling of portfolio compositions or optimisations) appears to be a flexible tool for banks to adjust their capital ratios; irrespective of the underlying fundamentals.

Changes in RWA can be caused by a change in risk weightings, a real change in total assets or a combination of both. Table 6 provides 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 above their optimal capital 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 below their Tier 1 capital target. This holds for both the crisis and the pre-crisis period.

Finally, in Table 7 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 banks react stronger to capital shortfalls than to capital surplus situations in terms of Tier 1 adjustments, (ii) that there is no such asymmetry when looking at changes in risk weighted assets, (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 recent crisis compared to the years before the crisis.

3.2.2 Impact of common Equity deviations

As mentioned before, 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 weightings as highly opaque and uninformative. It is thus well possible that banks - just like other firms - also optimize a simple leverage ratio. Therefore, we also analyze the impact of deviations from a simple common equity, or leverage, ratio, for which, in contrast to the Tier 1 ratio, the assets are not risk adjusted. Table 2 already indicated that banks optimize their equity ratio. As with the Tier 1 ratio, we again start our analysis 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, Table 8 shows that deviations are negatively correlated with changes in common equity, both before and during the recent crisis. Both banks that are above and banks that are below the target adjust their capital levels; although undercapitalized banks react significantly stronger, which is in line with our previous finding (reported above). Table 9 shows 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. Focussing on the impact of deviations on changes in total assets (Table 10), we find striking differences between the pre-crisis and the crisis period. Whereas during normal periods banks do not appear to react on equity deviations by adjusting their balance sheet size, we find a significant impact during the recent crisis. 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. Table 11 shows that at least a part of this asset side deleveraging is happening via lower loan growth. During the 2008-2011Q3 period, undercapitalized banks had lower loan growth rates than others, while this did not hold during the pre-crisis period. The finding of a significant deleveraging impact, in part affecting also the loan book, when banks are undercapitalised, 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 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. Using a sample of 93 European banks between 2004 Q1 and 2011 Q3, we study (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 below or above the optimal level. We focus both on Tier 1 capital ratios and a simple leverage ratio. We find clear evidence for capital optimisation, both in terms of the Tier 1 ratio and the leverage ratio. Furthermore, we show that there are notable asymmetries in bank reactions to deviations from optimal equity levels. More specifically, overcapitalised 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 a simple leverage ratio, we furthermore 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 occured during the financial crisis and the euro area sovereign debt crisis. Furthermore, our findings highlight the importance of taking into account potential asymmetries when analysing 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.

1

References

Admati, A.R., P.M. DeMarzo, M.F. Hellwig, and P. Pleiderer, 2010, Fallacies, irrelevant facts, and myths in the discussion of capital regulation: Why bank equity is not expensive, *Stanford GSB Research Paper*.

Adrian, T., and H.S. Shin, 2010, Liquidity and leverage, *Journal of Financial Intermediation* 19.

Aiyar, S., C.W. Calomiris, and T. Wieladek, 2012, Does macro-pru leak? evidence from a uk policy experiment, *NBER Working Paper*.

Alfon, I., I. Argimon, and P. Bascunana-Ambros, 2004, What determines how much capital is held by uk banks and building societies?, *FSA Occasional Working Paper Series*.

Altunbas, Y., O. Fazylov, and P. Molyneux, 2002, Evidence on the bank lending channel in europe, *Journal of Banking Finance* 26.

Baker, M., and J. Wurgler, 2002, Market timing and capital structure, *Journal of Finance* 57.

Bank for International Settlements, 2010, An assessment of the long-term economic impact of stronger capital and liquidity requirements, *Basel Committee of Banking Supervision report*.

Bank of England, 2010, The long-term economic impact of higher capital levels, *Bank of England Financial Stability Report*.

Berger, A.N., R. DeYoung, M.J. Flannery, D. Lee, and O. Oztekin, 2008, How do large banking organizations manage their capital ratios?, *Journal of Financial Services Research* 34.

Berger, A.N., and G.F. Udell, 1994, Did risk-based capital allocate bank credit and cause a credit crunch in the united-states, *Journal of Money Credit and Banking* 26.

Berrospide, J.M., and R.M. Edge, 2010, The effects of bank capital on lending: What do we know, and what does it mean?, *International Journal of Central Banking* 6.

Blaes, B., 2011, Bank-related loan supply factors during the crisis: an analysis based on the german bank lending survey, *Deutsche Bundesbank Discussion Paper Series*.

Blum, J.M., 2008, Why basel ii may need a leverage ratio restriction, *Journal of Banking Finance* 32.

Blundell, R., and S. Bond, 1998, Initial conditions and moment restrictions in dynamic panel data models, *Journal of Econometrics* 87.

Bolton, P., and X. Freixas, 2006, Corporate finance and the monetary transmission mechanism, *Review of Financial Studies* 19.

Borio, C., C. Furfine, and P. Lowe, 2001, Procyclicality of the financial system and financial stability:issues and policy options, *BIS paper*.

Brunnermeier, M.K., and L.H. Pedersen, 2009, Market liquidity and funding liquidity, *Review of Financial Studies* 22.

Ciccarelli, M., A. Maddaloni, and J.-L. Peydro, 2010, Trusting the bankers: A new look at the credit channel of monetary policy, *European Central Bank Working Paper*.

Del Giovane, P., G. Eramo, and A. Nobile, 2010, Disentangling demand and supply effects in credit developments: A survey-based analysis for italy, *Banca d'Italia Discussion Paper*.

Diamond, D.W., and R.G. Rajan, 2009, The credit crisis: Conjectures about causes and remedies, *American Economic Review* 99.

Flannery, M.J., and K.P. Rangan, 2006, Partial adjustment toward target capital structures, *Journal of Financial Economics* 79.

Francis, W.B., and M. Osborne, 2012, Capital requirements and bank behavior in the uk: Are there lessons for international capital standards?, *Journal of Banking Finance* 36.

Gambacorta, L., and P.E. Mistrulli, 2004, Does bank capital affect lending behavior?, *Journal of Financial Intermediation* 13.

Geanakoplos, J., 2009, *The leverage cycle* vol. 24.

Gropp, R., and F. Heider, 2010, The determinants of bank capital structure, *Review of Finance* 14.

Hancock, D., A.J. Laing, and J.A. Wilcox, 1995, Bank capital shocks - dynamic effects on securities, loans, and capital, *Journal of Banking Finance* 19.

Hanson, S.G., A.K. Kashyap, and J.C. Stein, 2011, A macroprudential approach to financial regulation, *Journal of Economic Perspectives* 25.

Hempell, H.S., and C. Kok, 2010, The impact of supply constraints on bank lending in the euro area - credit-induced crunching, *European Central Bank Working Paper*.

Jimenez, G., S. Ongena, J.L. Peydro, and J. Saurina, Forthcoming, Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications, *American Economic Review*.

Jokipii, T., and A. Milne, 2008, The cyclical behaviour of european bank capital buffers, *Journal of Banking Finance* 32.

Kishan, R.P., and T.P. Opiela, 2000, Bank size, bank capital, and the bank lending channel, *Journal of Money Credit and Banking* 32.

Lemmon, M.L., M.R. Roberts, and J.F. Zender, 2008, Back to the beginning: Persistence and the cross-section of corporate capital structure, *Journal of Finance* 63.

Memmel, C., and P. Raupach, 2010, How do banks adjust their capital ratios?, *Journal of Financial Intermediation* 19.

Miles, D., J. Yang, and G. Marcheggiano, 2011, Optimal bank capital, *Bank of England Discussion Paper*.

Myers, S.C., 1977, Determinants of corporate borrowing, *Journal of Financial Economics* 5.

———, and N.S. Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13.

Nickell, S., 1981, Biases in dynamic-models with fixed effects, *Econometrica* 49.

Peek, J., and E. Rosengren, 1995, Bank regulation and the credit crunch, *Journal of Banking Finance* 19.

Sveriges Riksbank, 2011, Appropriate capital ratio in major swedish banks - an economic analysis., .

1

Table 1: 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 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").

	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	OLS	FE	SGMM	OLS	FE	SGMM
Tier1Ratio	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(TotalAssets)	-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)
% LoanLossProvisions	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)
CostIncome 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
System GMM			YES			YES
Twostep			YES			YES
IVlags			two			two
AR2pval			0.138			0.215
Jstatpval			0.541			0.242
Cluster		bank			bank	

Table 3: Tier 1 Deviation - Impact on Tier 1 Capital

This table shows the impact of deviations from the Tier1 optimal capital level on Tier 1 capital growth. We regress Tier1 capital 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 a group of bank-specific control variables. In the first two columns, 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 Tier1 capital level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). All regressions are run 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. All independent 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 2004-2007	Tier 1 Growth 2008-2011Q3	Tier 1 Growth 2004-2007	Tier 1 Growth 2008-2011Q3
Deviation Tier 1 Ratio	-0.448	-2.299***	-0.653	-2.393***
	(0.783)	(0.559)	(0.785)	(0.550)
Deviation x Shortfall Dummy			-10.69***	-9.586***
			(2.947)	(1.791)
Shortfall Dummy			-1.033	-1.611
			(1.791)	(1.184)
Beta-Shortfall			*-11.34*	*-11.98*
T-statistic			*-3.858*	*-6.034*
GDP growth	-0.00254	0.655	0.0944	0.598
	(0.883)	(0.723)	(0.831)	(0.731)
GDP growth$_{t-1}$	0.680	0.188	1.084**	0.516
	(0.605)	(0.608)	(0.521)	(0.658)
change in interest rate	0.334	0.115	-0.111	0.0903
	(0.897)	(0.159)	(0.854)	(0.154)
inflation rate	-0.286	-0.514	-0.377	-0.521
	(1.031)	(0.538)	(1.020)	(0.550)
change in interest rate$_{t-1}$	0.481	0.364	-0.0384	0.395
	(1.127)	(0.292)	(1.175)	(0.292)
inflation rate$_{t-1}$	-1.577	0.734	-1.150	0.995*
	(1.147)	(0.540)	(1.055)	(0.571)
Size	-2.041	-1.551	-2.529	-1.347
	(2.398)	(1.144)	(2.261)	(1.039)
Cost Income ratio	-0.412	0.197	-0.177	0.412**
	(0.604)	(0.183)	(0.678)	(0.171)
Loan Loss Provisions	0.348	-0.153	-0.0298	-0.0155
	(0.804)	(0.324)	(0.818)	(0.358)
Deposit ratio	-1.890	-0.950	-3.478**	-2.915***
	(1.588)	(1.055)	(1.538)	(1.031)
Income Diversification	0.0867	-0.141	-0.130	-0.258
	(0.507)	(0.233)	(0.492)	(0.242)
bailout		-1.024		-1.523
		(2.919)		(2.803)
Constant	1.259	1.062	-0.166	-2.529
	(2.404)	(1.772)	(2.365)	(1.791)
Observations	452	764	452	764
R-squared	0.152	0.112	0.193	0.153
Number of banks	59	70	59	70
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 4: Tier 1 Deviation - Impact on Retained Earnings

This table shows the impact of deviations from the Tier1 optimal capital level on Retained Earnings growth. We regress 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 the first two columns, we do not differentiate between banks that are below or above the optimal capital level. In column 3 and 4, we 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 Tier1 capital level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). 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. All indepent 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	Ret. Earnings 2004-2007	Ret. Earnings 2008-2011Q3	Ret. Earnings 2004-2007	Ret. Earnings 2008-2011Q3
Deviation Tier 1 Ratio	-0.0559	-0.219	-0.187	-0.191
	(1.307)	(0.370)	(1.308)	(0.368)
Deviation x Shortfall Dummy			-3.271	0.300
			(5.718)	(1.437)
Shortfall Dummy			0.542	0.230
			(3.248)	(0.801)
Beta-Shortfall			*-3.458*	*0.109*
T-statistic			*-0.575*	*0.0726*
GDP growth	-1.391*	0.187	-1.339*	0.186
	(0.784)	(0.335)	(0.734)	(0.335)
GDP growth$_{t-1}$	0.244	1.177**	0.372	1.165**
	(0.812)	(0.511)	(0.818)	(0.502)
change in interest rate	-3.697	0.0543	-3.428	0.0539
	(4.782)	(0.0797)	(4.654)	(0.0790)
inflation rate	1.682	-0.568	1.675	-0.572
	(1.498)	(0.360)	(1.452)	(0.360)
change in interest rate$_{t-1}$	4.085	0.209	5.263	0.208
	(5.653)	(0.278)	(5.598)	(0.278)
inflation rate$_{t-1}$	-0.277	-0.191	-0.0361	-0.196
	(1.122)	(0.381)	(1.162)	(0.383)
Size	-14.51	0.971	-11.98	0.961
	(9.992)	(0.654)	(10.43)	(0.660)
Cost Income ratio	-0.104	0.00973	-0.156	0.00647
	(1.198)	(0.135)	(1.173)	(0.136)
Loan Loss Provisions	0.805	-0.399	0.621	-0.403
	(2.292)	(0.310)	(2.450)	(0.308)
Deposit ratio	-3.982	0.787	-4.920*	0.810
	(2.780)	(0.903)	(2.877)	(0.942)
Income Diversification	-0.676	0.655***	-0.661	0.653***
	(0.673)	(0.228)	(0.677)	(0.229)
bailout		3.130		3.158
		(2.197)		(2.221)
Constant	3.963	2.640***	2.337	2.651***
	(4.665)	(0.818)	(5.145)	(0.976)
Observations	214	799	214	799
R-squared	0.249	0.174	0.256	0.174
Number of banks	63	75	63	75
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 5: Tier 1 Deviation - Impact on Risk Weighted Assets

This table shows the impact of deviations from the Tier1 optimal capital level on growth in Risk Weighted Assets . We regress Risk Weighted Assets 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 the first two columns, 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 Tier1 capital level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). 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. All indepent 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 2004-2007	RWA growth 2008-2011Q3	RWA growth 2004-2007	RWA growth 2008-2011Q3
Deviation Tier 1 Ratio	1.674***	1.651***	1.694***	1.614***
	(0.549)	(0.506)	(0.504)	(0.480)
Deviation x Shortfall Dummy			2.102	1.458
			(1.642)	(1.377)
Shortfall Dummy			-0.560	-0.184
			(0.950)	(0.865)
Beta-Shortfall			*3.796*	*3.073*
T-statistic			*2.254*	*2.135*
GDP growth	0.463	0.469	0.453	0.477
	(0.384)	(0.413)	(0.393)	(0.410)
change in interest rate	3.044***	0.0753	3.097***	0.0829
	(0.856)	(0.0988)	(0.819)	(0.0966)
inflation rate	-0.589	0.475	-0.547	0.471
	(0.641)	(0.366)	(0.634)	(0.360)
GDP growth$_{t-1}$	0.0226	-1.170***	-0.0791	-1.231***
	(0.470)	(0.428)	(0.473)	(0.442)
change in interest rate$_{t-1}$	0.496	0.0713	0.601	0.0696
	(0.835)	(0.320)	(0.852)	(0.318)
inflation rate$_{t-1}$	-1.383*	-0.134	-1.488**	-0.190
	(0.700)	(0.410)	(0.703)	(0.404)
Size	-1.570	-2.139*	-1.472	-2.173**
	(1.364)	(1.116)	(1.391)	(1.081)
Cost Income ratio	0.104	-0.377**	0.0332	-0.417**
	(0.507)	(0.169)	(0.496)	(0.169)
Loan Loss Provisions	0.361	0.173	0.466	0.150
	(0.664)	(0.338)	(0.657)	(0.341)
Income Diversification	-0.0879	-0.375	-0.0279	-0.349
	(0.411)	(0.236)	(0.385)	(0.235)
Deposit Ratio	-2.676	5.635	-0.0770	7.779*
	(6.362)	(4.212)	(6.324)	(4.431)
bailout		4.777**		4.867**
		(2.167)		(2.154)
Constant	-0.221	-2.098	-0.939	-2.385
	(3.282)	(2.024)	(3.239)	(2.026)
Observations	451	763	451	763
R-squared	0.197	0.116	0.204	0.119
Number of banks	59	70	59	70
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 6: Tier 1 Deviation - Impact on Total Assets

This table shows the impact of deviations from the Tier1 optimal capital level on growth in Total Assets. We regress Total Asset 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 the first two columns, 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. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). 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. All indepent 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 2004-2007	Asset Growth 2008-2011Q3	Asset Growth 2004-2007	Asset Growth 2008-2011Q3
Deviation Tier 1 Ratio	0.917***	1.041***	0.922***	1.057***
	(0.305)	(0.302)	(0.308)	(0.315)
Deviation x Shortfall Dummy			-0.267	-0.514
			(1.286)	(0.898)
Shortfall Dummy			0.189	-0.0140
			(1.000)	(0.516)
Beta-Shortfall			*0.655*	*0.544*
T-statistic			*0.481*	*0.564*
GDP growth	0.669*	1.035***	0.670*	1.034***
	(0.391)	(0.220)	(0.391)	(0.221)
change in interest rate	0.822	-0.00508	0.818	-0.00808
	(0.891)	(0.0825)	(0.889)	(0.0833)
inflation rate	0.0105	-0.464*	0.00505	-0.456*
	(0.475)	(0.260)	(0.479)	(0.261)
GDP growth$_{t-1}$	0.239	-0.312	0.255	-0.290
	(0.333)	(0.216)	(0.329)	(0.221)
change in interest rate$_{t-1}$	-0.0698	0.480**	-0.0786	0.478**
	(0.709)	(0.204)	(0.714)	(0.203)
inflation rate$_{t-1}$	-0.222	-0.549*	-0.203	-0.530*
	(0.540)	(0.299)	(0.538)	(0.305)
Size	-1.221	-5.345***	-1.235	-5.341***
	(2.269)	(1.531)	(2.271)	(1.513)
Cost Income ratio	-0.206	-0.0171	-0.190	-0.00470
	(0.326)	(0.120)	(0.335)	(0.124)
Loan Loss Provisions	-1.118**	-0.410**	-1.128**	-0.398*
	(0.435)	(0.203)	(0.433)	(0.203)
Income Diversification	0.184	0.395**	0.179	0.388**
	(0.267)	(0.165)	(0.273)	(0.167)
Deposit Ratio	13.82***	7.704**	13.14**	7.043*
	(4.545)	(3.594)	(5.046)	(3.858)
bailout		2.118		2.085
		(1.533)		(1.527)
Constant	-1.718	2.318	-1.515	2.365
	(2.586)	(1.555)	(2.655)	(1.578)
Observations	515	885	515	885
R-squared	0.184	0.220	0.185	0.221
Number of banks	72	80	72	80
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 7: Tier 1 Deviation - Impact on Loans

This table shows the impact of deviations from the Tier1 optimal capital level on loan growth. We regress 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), loan securitization and bank size (Total assets). In the first two columns, 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. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). All regressions are run 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. All indepent 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 2004-2007	LoanGrowth 2008-2011Q3	LoanGrowth 2004-2007	LoanGrowth 2008-2011Q3
Deviation Tier 1 Ratio	1.544	-0.844	1.437	-0.752
	(1.057)	(0.561)	(1.275)	(0.803)
Deviation x Shortfall Dummy			0.132	0.175
			(2.095)	(1.048)
Shortfall Dummy			-0.240	0.436
			(1.627)	(0.859)
Beta-Shortfall			*1.570*	*-0.578*
T-statistic			*0.898*	*-0.620*
GDP growth	-0.0140	-0.508	-0.00764	-0.504
	(1.292)	(0.475)	(1.302)	(0.475)
change in interest rate	0.426	0.823***	0.448	0.816***
	(1.213)	(0.295)	(1.225)	(0.293)
inflation rate	0.535	-1.963***	0.538	-1.956***
	(1.176)	(0.632)	(1.177)	(0.627)
GDP growth$_{t-1}$	-0.111	-0.0600	-0.105	-0.0607
	(0.866)	(0.445)	(0.855)	(0.458)
change in interest rate$_{t-1}$	0.165	-0.129	0.205	-0.135
	(1.308)	(0.329)	(1.360)	(0.323)
inflation rate$_{t-1}$	1.156	-0.435	1.163	-0.433
	(1.148)	(0.370)	(1.156)	(0.370)
Size	-4.272	-10.12***	-4.245	-10.12***
	(4.028)	(2.005)	(4.020)	(1.965)
Cost Income ratio	-0.110	0.156	-0.119	0.152
	(0.410)	(0.160)	(0.407)	(0.160)
Loan Loss Provisions	0.815	0.0487	0.839	0.0426
	(1.542)	(0.446)	(1.572)	(0.446)
Income Diversification	0.112	-0.00812	0.102	-0.00408
	(0.806)	(0.541)	(0.794)	(0.540)
Deposit Ratio	-5.831	5.763	-5.678	5.832
	(12.95)	(7.068)	(13.09)	(7.188)
bailout		2.225		2.138
		(2.819)		(2.789)
securitization dummy	0.315	1.187	0.336	1.202
	(1.364)	(1.181)	(1.399)	(1.176)
Constant	5.798	-3.586	5.866	-0.905
	(5.454)	(3.752)	(5.327)	(3.941)
Observations	507	822	507	822
R-squared	0.152	0.124	0.152	0.124
Number of banks	70	79	70	79
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 8: Common Equity Deviation - Impact on Capital Growth

This table shows the impact of deviations from the optimal equity ratio on changes in total equity. We regress common equity 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 control variables (Total assets, cost income ratio, loan loss provisions, deposit ratio and income diversification). In the first two columns, we do not differentiate between banks that are below or above the optimal equity 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 total equity level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). 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. All indepent 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 2004-2007	Equity Growth 2008-2011Q3	Equity Growth 2004-2007	Equity Growth 2008-2011Q3
Deviation Capital Ratio	-5.161***	-1.999***	-4.363***	-1.577**
	(0.822)	(0.729)	(0.817)	(0.726)
Deviation ETA x Shortfall Dummy			-7.194***	-7.191***
			(1.896)	(1.883)
Shortfall Dummy			-1.361	-1.813*
			(1.034)	(0.956)
Beta-Shortfall			*-11.56*	*-8.768*
T-statistic			*-6.161*	*-3.878*
GDP growth	0.00304	0.742*	-0.00229	0.806**
	(0.512)	(0.380)	(0.513)	(0.376)
GDP growth$_{t-1}$	0.0276	-0.568	-0.144	-0.767*
	(0.516)	(0.372)	(0.505)	(0.401)
change in interest rate	1.348*	0.350**	1.754***	0.402**
	(0.679)	(0.157)	(0.662)	(0.160)
inflation rate	0.569	-1.464***	0.471	-1.232***
	(0.591)	(0.440)	(0.587)	(0.437)
change in interest rate$_{t-1}$	-1.194	0.397	-1.463	0.645*
	(1.028)	(0.350)	(1.038)	(0.370)
inflation rate$_{t-1}$	0.395	-0.340	0.209	-0.361
	(0.748)	(0.421)	(0.764)	(0.409)
Size	-2.023**	-0.218	-3.513***	-0.0138
	(0.964)	(3.137)	(0.745)	(3.561)
Cost Income ratio	-0.281	-0.0425	-0.113	0.00352
	(0.285)	(0.167)	(0.271)	(0.159)
Loan Loss Provisions	-0.946**	-0.571**	-0.936**	-0.697**
	(0.474)	(0.238)	(0.422)	(0.268)
Deposit ratio	1.321	-0.116	1.677**	0.580
	(0.815)	(0.696)	(0.760)	(0.768)
Income Diversification	0.618	-0.107	0.725*	0.0596
	(0.433)	(0.267)	(0.426)	(0.274)
bailout		-0.176		-4.37e-05
		(2.761)		(2.560)
Constant	5.063***	-1.212	3.370**	-2.492*
	(1.376)	(1.312)	(1.434)	(1.428)
Observations	743	1,104	743	1,104
R-squared	0.229	0.154	0.256	0.179
Number of banks	83	95	83	95
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 9: Common Equity Deviation - Impact on Retained Earnings

This table shows the impact of deviations from the optimal equity ratio on Retained Earnings. We regress 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 control variables (Total assets, cost income ratio, loan loss provisions, deposit ratio and income diversification). In the first two columns, we do not differentiate between banks that are below or above the optimal equity 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 common equity level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target (‘Beta-Shortfall‘), and the corresponding t-statistic (‘T-statistic‘) 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. All indepent 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	Ret. Earnings 2004-2007	Ret. Earnings 2008-2011Q3	Ret. Earnings 2004-2007	Ret. Earnings 2008-2011Q3
Deviation Capital Ratio	-5.568***	-1.757***	-5.149***	-1.782***
	(1.406)	(0.440)	(1.446)	(0.446)
Deviation ETA x Shortfall Dummy			7.551**	-1.860
			(3.101)	(1.576)
Shortfall Dummy			4.489***	-0.445
			(1.625)	(0.841)
Beta-Shortfall			2.402	-3.642
T-statistic			0.652	-2.043
GDP growth	-1.107**	-0.153	-1.106**	-0.137
	(0.467)	(0.266)	(0.454)	(0.269)
GDP growth$_{t-1}$	-1.619**	0.733	-1.485**	0.659
	(0.671)	(0.443)	(0.721)	(0.448)
change in interest rate	-3.511	0.0412	-3.881	0.0556
	(3.187)	(0.0585)	(2.935)	(0.0603)
inflation rate	1.020	-0.780***	1.025	-0.733**
	(0.936)	(0.291)	(0.932)	(0.288)
change in interest rate$_{t-1}$e	1.146	0.274	-0.929	0.335
	(3.625)	(0.236)	(3.685)	(0.250)
inflation rate$_{t-1}$	0.819	-0.392	0.833	-0.392
	(0.625)	(0.323)	(0.614)	(0.325)
Size	-2.893	1.390**	-1.562	1.433*
	(7.877)	(0.682)	(7.552)	(0.757)
Cost Income ratio	-0.946	-0.0609	-0.982	-0.0545
	(0.745)	(0.167)	(0.705)	(0.167)
Loan Loss Provisions	1.269	-0.440	1.186	-0.440
	(2.091)	(0.286)	(2.012)	(0.287)
Deposit ratio	-1.570	1.672**	-1.808	1.841**
	(2.057)	(0.721)	(2.150)	(0.753)
Income Diversification	-0.706	0.572***	-0.860*	0.615***
	(0.530)	(0.210)	(0.489)	(0.203)
bailout		2.917		2.932
		(2.039)		(2.055)
Constant	5.272*	-2.977***	5.437*	-3.276***
	(3.000)	(0.835)	(3.198)	(0.906)
Observations	251	1,004	251	1,004
R-squared	0.288	0.145	0.319	0.147
Number of banks	73	90	73	90
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 10: Common Equity Deviation - Impact on Asset Growth

This table shows the impact of deviations from the optimal equity ratio on Total Assets. We regress Total Assets 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 bank control variables (Total assets, cost income ratio, loan loss provisions, deposit ratio and income diversification). In the first two columns, 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 Total Capital level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). 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. All indepent 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 2004-2007	Asset Growth 2008-2011Q3	Asset Growth 2004-2007	Asset Growth 2008-2011Q3
Deviation Capital Ratio	0.123	1.155**	0.0334	0.958*
	(0.481)	(0.476)	(0.501)	(0.485)
Deviation x Shortfall Dummy			0.633	1.929**
			(1.172)	(0.806)
Shortfall Dummy			0.0433	0.0276
			(0.733)	(0.492)
Beta-Shortfall			*0.667*	*2.887*
T-statistic			*0.542*	*3.454*
GDP growth	0.279	0.928***	0.281	0.908***
	(0.254)	(0.202)	(0.255)	(0.204)
change in interest rate	1.343**	0.0324	1.303**	0.0230
	(0.636)	(0.0820)	(0.649)	(0.0847)
inflation rate	-0.304	-0.371*	-0.293	-0.440**
	(0.283)	(0.205)	(0.283)	(0.203)
GDP growth$_{t-1}$	0.451	0.150	0.470	0.218
	(0.275)	(0.187)	(0.283)	(0.181)
change in interest rate$_{t-1}$	0.107	0.476**	0.137	0.409**
	(0.731)	(0.193)	(0.737)	(0.193)
inflation rate$_{t-1}$	-0.102	-0.570***	-0.0835	-0.552***
	(0.301)	(0.205)	(0.302)	(0.202)
Size	-0.906	-5.602***	-0.783	-5.651***
	(0.914)	(1.688)	(0.974)	(1.575)
Cost Income ratio	-0.166	-0.0295	-0.183	-0.0450
	(0.203)	(0.112)	(0.201)	(0.110)
Loan Loss Provisions	-0.431	-0.411**	-0.433	-0.378**
	(0.347)	(0.186)	(0.340)	(0.182)
Income Diversification	-0.00737	0.231	-0.0180	0.183
	(0.216)	(0.161)	(0.212)	(0.165)
Deposit Ratio	4.545	7.338**	4.367	5.957**
	(3.405)	(3.075)	(3.456)	(2.985)
bailout		2.417		2.457
		(1.500)		(1.546)
Constant	1.959	-3.090*	2.229	-1.845
	(1.747)	(1.640)	(1.825)	(1.685)
Observations	743	1,104	743	1,104
R-squared	0.133	0.224	0.134	0.229
Number of banks	83	95	83	95
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES

Table 11: Common Equity Deviation - Impact on Loan Growth

This table shows the impact of deviations from the optimal Total Capital ratio on Loans. We regress Loan growth on the deviation from the optimal Total Capital ratio, a group of macro-economic control variables (GDP growth, interest rate changes and the inflation rate), loan securitization and bank size (Total assets). In the first two columns, 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 Total Capital level. For these two regressions, we also calculate the actual coefficient for the banks that are below their target ('Beta-Shortfall'), and the corresponding t-statistic ('T-statistic'). 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. All indepent 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 2004-2007	LoanGrowth 2008-2011Q3	LoanGrowth 2004-2007	LoanGrowth 2008-2011Q3
Deviation Capital Ratio	0.236	1.241**	0.474	1.362***
	(0.661)	(0.510)	(0.693)	(0.475)
Deviation x Shortfall Dummy			-0.922	0.243
			(1.418)	(1.009)
Shortfall Dummy			0.309	0.814
			(0.743)	(0.617)
Beta-Shortfall			*-0.448*	*1.605*
T-statistic			*-0.292*	*1.671*
GDP growth	0.240	1.258***	0.225	1.265***
	(0.313)	(0.240)	(0.315)	(0.241)
change in interest rate	1.047	0.168*	1.114	0.159*
	(0.844)	(0.0874)	(0.853)	(0.0877)
inflation rate	0.0256	-0.574**	0.0178	-0.568**
	(0.349)	(0.279)	(0.349)	(0.277)
GDP growth$_{t-1}$	0.377	0.402	0.340	0.385
	(0.392)	(0.265)	(0.396)	(0.277)
change in interest rate$_{t-1}$	1.090	0.675**	0.992	0.666**
	(0.678)	(0.329)	(0.710)	(0.328)
inflation rate$_{t-1}$	-0.110	-1.114***	-0.134	-1.130***
	(0.414)	(0.235)	(0.418)	(0.234)
Size	-1.111	-4.065***	-1.239	-4.134***
	(0.916)	(1.115)	(0.954)	(1.106)
Cost Income ratio	0.426	-0.195	0.457	-0.195
	(0.392)	(0.162)	(0.399)	(0.163)
Loan Loss Provisions	-0.742**	-0.658***	-0.733**	-0.650**
	(0.339)	(0.240)	(0.337)	(0.250)
Income Diversification	0.124	0.114	0.146	0.119
	(0.300)	(0.316)	(0.296)	(0.320)
Deposit Ratio	-1.207	-5.435	-1.091	-5.033
	(6.990)	(3.879)	(6.925)	(3.958)
bailout		2.622		2.439
		(2.000)		(2.040)
secdum	1.150	1.279*	1.166	1.299*
	(0.873)	(0.701)	(0.872)	(0.700)
Constant	4.522	2.863	4.060	2.377
	(3.225)	(2.093)	(3.194)	(2.199)
Observations	583	955	583	955
R-squared	0.172	0.210	0.173	0.211
Number of banks	67	82	67	82
BANK_FE	YES	YES	YES	YES
TIME_FE	YES	YES	YES	YES