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Effects on Capitalization and Lending Decisions of Banks

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Abstract

Unique and confidential Danish data allow us to identify how changes in disclosure requirements and bank-specific time-varying capital requirements affect banks' lending and capital accumulation decisions. We find that banks increase their capital ratios after capital requirements are increased, implying that resilience in the banking system is also increased. The increase in capital ratios is partly due to a modest reduction in lending. Using a policy changes, we show that banks react stronger to changes in capital requirements when these are public. Our results further suggest that the impact of capital requirements differ for small and large banks. Large banks raise their capital ratios more, reduce lending less, and accumulate more new capital compared to small banks.

Keywords: Time-varying capital requirements, bank lending, disclosure rules, Basel requirements, transmission mechanism.

JEL-classification: G21, G28

1. Introduction

Financial crises are often preceded by periods of strong growth in credit (Schularick & Taylor, 2012), and followed by periods of severe recessions (Bordo et. al., 2001; Reinhart and Rogoff, 2014; Laeven and Valencia, 2013). Aiming at reducing the likelihood and severity of future financial crises, supervisory authorities around the world have been equipped with new tools to address risks in the banking system. Two important regulatory tools are capital requirements and disclosure rules. The new banking regulatory regime – Basel 3 – introduces countercyclical capital requirements and enhanced disclosure requirements. Counter-cyclical capital requirements, i.e. time-varying requirements that mandate higher levels of capital during periods of strong credit growth that banks can then rely upon when the tides turn, aim at making banks more resilient during periods of stress in the economy. In addition, if banks view capital as expensive, higher counter-cyclical capital requirements might even restrain credit growth during the boom period. Disclosure requirements aim at providing market participants with a clearer picture of risk taking in banks: If market participants can see risks building up, they can hike funding costs for more risky banks. This should also dampen risk taking.

Despite the importance attached to the new regulatory regime, relatively little systematic evidence exists about the effects of time-varying capital requirements and disclosure rules on bank behavior. This is mainly due to the simple fact that time-varying capital requirements existed in only a few countries before Basel III. In this paper, we analyze the effects on banks' lending and capital accumulation decisions resulting from changes in bank-specific time-varying capital requirements. Using a policy change that tightened disclosure rules by mandating banks to publish their individual capital requirement, we can in addition study how different disclosure rules influence banks' reactions to changes in capital requirements. The setting that allows us to conduct these investigations is the unique Danish implementation of the Basel II framework since 2007.

The Basel II framework specifies a flat 8% capital requirement. On top of this, Danish banks are required to fulfill an additional capital requirement. The interesting features of this bank-specific capital requirement are two-fold. First, it varies over time, i.e. increases

(falls) when risks in a bank increase (fall). Second, it is specific to each individual bank. This is important because it allows us to compare the reaction of banks that see their requirement change to the reaction of banks that do not see their requirements change, while at the same time controlling for time fixed effects that affect all banks, such as the macroeconomic situation that all banks are exposed to. Important for our identification strategy, the individual bank capital requirement has generally been the binding capital requirement in Denmark: Several Danish banks have been closed when breaching their individual capital requirement, even when their level of capital exceeded the 8% hurdle generally applied in Basel II (Danmarks Nationalbank, 2013).

On top of this unique way of implementing Basel II, our sample period includes two exogenous policy-induced changes to the regulatory regime that we can use to test new hypotheses. First, bank-specific time-varying capital requirements were confidential and only known to the FSA (and the individual banks themselves, of course) during the first part of our sample. After 2010, on the other hand, they were published in the open. We can use this time variation in disclosure requirements to examine the effects of more disclosure about capital requirements on banks' risk taking. Second, the severeness of the consequences of breaching the bank-specific capital requirements was changed during our sample period (in 2013). Hence, we can compare banks' reactions to changes in capital requirements during a period where the consequences of breaching the capital requirements were severe (banking licenses were withdrawn) to reactions during periods where the consequences of breaching requirements were less severe (banking license were not withdrawn but different supervisory actions were taken). This is important from a policy perspective also, as the counter-cyclical capital buffer in the Basel III agreement is a "soft" requirement, i.e. banks will face different kinds of supervisory action but the banking license is not withdrawn if breaching the requirement.

The main effect we are interested in identifying is whether a change in a bank-specific capital requirement leads to a change in the capital ratio of the bank. We are interested in this effect because banks have two ways to adopt to higher capital requirements: they can increase their capital ratio or they can reduce the buffer of capital they hold over and above the pre-change

level of required capital. From a theoretical and a regulatory perspective, it is important to know which of the two effects dominate because capital requirements are changed in order to affect the resilience of banks. However, if banks adopt to, e.g., higher capital requirements by merely reducing their capital buffers, capital levels, and hence resilience, in the banking system will not be increased. In fact, the banks in our data have a capital buffer of 8%-points on average (across banks and time). The capital requirements we study have on averaged increased by around 2%-points over our sample period. Hence, banks could on average have fulfilled higher capital requirements solely by reducing their voluntary capital buffers. Subsequently, we are interested in identifying how banks restore their capital ratio when capital requirements are changed, if they do so: by changing their level of capital or by changing their level of lending. If they change lending to comply with new capital requirements, changes in capital requirements can have consequences for the real economy.

We analyze confidential bank-level data for all Danish banks during the 2007-2014 period. Denmark is a small country, but the number of changes in capital-requirements is large and they vary considerably. Our sample contains around one thousand observations on changes in bank-specific capital requirements and these vary between quarter-to-quarter changes in bank-specific capital requirements of 25 basispoints to large changes of up to several % points.

Our main results are as follows. We find that banks raise their capital ratios after capital requirements are increased. Within half a year, banks restore about one third of the capital buffer they initially held over the regulatory minimum. This means that if a bank sees it capital requirement increase by 1%-point, it raises its capital ratio by 0.33%-points, on average. Increases in time-varying capital requirements thus strengthen resilience in the banking system. Next, we find that capital ratios are partly increased via a reduction in lending: a 1%-point increase in capital requirements is associated with a reduction in bank lending of 1%. This is in the lower range of estimates found in the empirical literature and suggests relatively modest costs for society of imposing higher capital requirements on banks. When we compare results across periods where capital requirements are confidential and public, we find that banks react stronger to changes in capital requirements when capital requirements are publicly

known. We find that banks change their capital buffer by up to 50% of the change in capital requirement when requirements are public, compared to the app. 33% found for the total sample period. In contrast, we do not identify clear differences in how banks react to changes in capital requirements across periods where the consequences of breaching capital requirements are different. In other words, we do not find a large difference in banks reactions dependent on whether the consequences of breaching capital requirements were severe or not. In this sense, our results imply market discipline, via publication of capital requirements, seems to have a stronger effect on how banks react to changes in capital requirements than the potential consequences of breaching capital requirements. We hypothesize that this is because banks in any case find it imperative not to breach capital requirements, in particular when they are pubic, no matter whether the direct consequences are severe (the FSA imposing certain restrictions on banks) or very severe (the FSA withdraws the banking license). Finally, our results suggest that the impact of capital requirements differ for small and large (SIFI) banks. Large banks raise their capital ratios more, reduce lending less, and accumulate more new capital than small banks.

The empirical literature on time-varying capital requirements is scarce because of the limited experience with setting these requirements before the Basel III framework. One exception is the dynamic provisions introduced in Spain in 2000. In a comprehensive recent study, Jiménez et al. (2015) conclude that dynamic provisions in Spain helped smooth the Spanish credit cycle, i.e. dampened credit growth in good times and cushioned effects on firm borrowing from banks pulling back in bad times. A main difference to the Jiménez et al. (2015) study is that we can say something about the importance of disclosure rules and "severeness" of capital requirements for how banks react to changing capital requirements. On the other hand, Jiménez et al. (2015) match bank lending data with firm level data to show the impact on individual firms, something we cannot do. The second exception is UK where capital requirements for the past two decades have been set differently over time and across banks, reflecting changes in bank-specific risks. Several papers have used the UK framework to investigate the impact of time-varying capital requirements on bank behavior (see, e.g., Francis and Osborne, 2012; Aiyar et. al., 2014a,b; Bridges et al., 2014). The Danish regime differs from the UK regime in

three important aspects. First, Danish banks have since 2010 been required to disclose their bank-specific capital requirements whereas bank-specific capital requirements are confidential in the UK. This time-variation in disclosure rules allow us to also examine the impact of enhancing disclosure requirements. Second, non-compliance with the bank-specific capital requirement in Denmark meant that the financial supervisory authority (FSA) withdrew the license to operate as a bank (until 2013), unless capital was restored within a short period of time – usually within a weekend. In contrast, non-compliance with the capital requirement in the UK triggers various supervisory actions with the aim to restore banks' capital positions but does not lead the UK FSA to withdraw the banking license. Third, during the later part of our sample period, the Danish capital requirement was changed to a requirement similar to the UK requirement, i.e. noncompliance was followed by supervisory action but not withdrawal of the banking license. This change gives us variation in the degree of "hardship" of capital requirements that we can use to say something about the difference in banks' reaction to breaching "hard" and "soft" capital requirements.

Finally, we note that the counter-cyclical capital buffer in the Basel III accord specifies system-wide increases in capital requirements when risks are building up in the banking sector, i.e. when the economy is good and there is strong growth in lending. We deal with bank-specific capital requirements during a period (2007-2014) where the Danish economy and overall lending growth has been weak. In spite of this difference, our results have implications for discussions on the counter-cyclical capital buffer, as the fact that we can identify how banks react to changes in time-varying capital requirements at the bank-level provides us with sharp identification. If all banks face the same increase in capital requirements (as in the counter-cyclical buffer of Basel III), the identification of how banks react to such changes becomes more challenging, as one would need to separate the effects on banks' behavior resulting from changes in the macroeconomy and changes in the counter-cyclical buffer. In our setting, we can control for time fixed effects, such as the macroeconomic situation, and study reactions to changes in capital requirements more clearly. In addition, our setting allows us to say something about how banks' reaction to changes in capital requirements are affected by changes in disclosure rules and the severity of breaching time-varying capital requirements.

The remainder of this paper is organized as follows. The next section provides a brief literature review on the impact of capital requirements on bank resilience and bank lending. Section 3 describes the unique Danish implementation of Basel II and explains why it is useful to investigate the impact of changes in disclosure rules and capital requirements on bank behavior. Section 4 describes our data and presents summary statistics. Section 5 outlines the econometric methodology. Section 6 presents our baseline results on how changes in capital requirements impact banks' lending and capital accumulation decisions. Section 7 presents our results on disclosure requirements and "hard" versus "soft" capital requirements. Section 8 concludes.

2. Background and literature review

The benefits and costs of higher capital requirements in banks have been a highly debated topic after the financial crisis of 2007-2009. A key issue in the discussion concerns the transmission of higher capital requirements to banks and the real economy:

- Do higher capital requirements induce banks to hold more capital and thereby increase banks' resilience, or do banks react to higher capital requirements by reducing excess capital buffers?
- Do higher capital requirements imply lower lending from banks to households and firms?

On the one hand, advocates of higher equity levels in banks argue that higher capital requirements entail large social benefits in terms of a safer and more resilient financial system and that this comes with only minimal costs to society (see, e.g., Admati et al. 2010). In contrast, the financial industry, which is affected by the tighter regulation, argues that equity financing is "expensive" and that higher capital requirements will be costly for society because banks will have to reduce lending to the real economy (see also, e.g., Admati et al. 2010).

In the following, we provide a selective review of theoretical and empirical literature that investigates the transmission of changes in capital requirements to banks and the real economy.

2.1. Capital requirements and bank resilience

Bank capital is important because it creates a cushion that banks can use to withstand shocks that create losses on the balance sheet: The more capital a bank has, the longer is the distance to insolvency and the more time managers have to cope with stressful periods (Thakor, 2014). In addition, more capital may improve banks' incentives to behave prudently because managers and shareholders have more skin in the game when managing the bank.

Banks are subject to regulation, not least because bank failures are associated with externalities (Freixas and Rochet, 2008). Failures can 1) cause bank runs due to the risk that customers face looses on deposits, 2) disrupt the flow of credit to the real economy, and 3) cause financial contagion which might threaten financial stability.[1] A key objective in banking regulation is that banks hold sufficient capital to reduce the likelihood of failure most efficiently. When capital influences the distance to default, capital requirements need to ensure that banks exposed to greater risks holder greater amounts of capital.

Banks generally prefer to hold more capital than regulators require, i.e. to have a capital buffer over and above the minimum capital requirement. There are several reasons why banks choose to hold capital in excess of the regulatory minimum. It can be to weather economic downturns and thereby prevent costly supervisory interventions, ranging from the most severe where banking licenses are withdrawn to less severe, such as restriction on dividend policies etc., and/or it can be to reduce financial distress costs (Marcus 1984, Milne and Whalley 2001). Banks may also need to hold excess capital in order to signal soundness to the market, to target an external credit rating, or as financial slack to take advantage of future profitable investment opportunities (BCBS 1999, Berger et. al 1995).

From a regulatory perspective it is important to understand whether capital requirements affect the optimal capital structure in banks, i.e. whether banks raise their own capital ratio when capital requirement are increased, or whether they reduce the voluntary capital buffer they hold in excess of the minimum capital requirement. In the latter case, bank resilience will

[1] Contagion may arise because information about soundness of banks is imperfect so that failure of one bank might contain information about robustness of other banks

not be strengthened as a result of higher capital requirements. Hence, the primary effect we are interested in identifying is whether a change in capital requirements affects banks' capital ratio.

For illustration, we show in Figure 1 how banks can react to higher capital requirements. An increase in capital requirements can either lead to lower capital buffers or banks can increase their capital ratio. If the capital ratio is increased, this can take place in basically two ways: either banks increase their level of capital and/or reduce their assets. Below, we first describe results from the empirical literature that tries to evaluate whether banks increase their capital ratio after increases in capital requirements. In the following subsection, we describe literature investigating whether banks reduce assets if capital requirements are increased.

<Figure 1 - Transmission chart>

2.2. The impact of capital requirements on banks' capitalization

Empirical research has identified substantial heterogeneity on whether capital requirements influence banks' choices of optimal capital structures. For UK banks, several studies have shown that confidential bank-specific and time-varying capital requirements set by the Bank of England and the Financial Supervisory Authority (FSA) since the early 1990's have an impact on banks' choices of capital ratios. Alfon et al. (2005) and Francis and Osborne et al. (2012) find that UK banks rebuild between 0.25–0.50%-point of their initial buffer following a 1%-point change in capital requirements. Bridges et al. (2014) find that UK banks rebuild around 0.40%-point of their initial capital buffer within the first year. This means that banks fulfil higher capital requirements by a combination of increasing their capital ratio, and thus increasing resilience in the banking system, and reducing their capital buffer.

On the other hand, Gropp and Heider (2010) find that capital regulation was of second-order importance in determining the capital structure of large US and European banks during the period from 1991 to 2004. Instead, they find that standard cross-sectional determinants of non-financial firms' leverage carry over to banks. For US banks, Ashcraft (2001) finds little

evidence that capital regulation during the 1980's influenced bank capital ratios and Flannery and Rangan (2008) find that most of the effect during the bank capital build-up of the 1990s in the US can be attributed to market disciplinary forces whereas the effect from higher capital requirements is limited. Lastly, BCBS (1999) finds that banks in the G-10 countries improved their capital ratio after the introduction of the Basel I capital regime in 1988. BCBS, however, states that it is hard to discern whether this increase reflects the effects of the Basel Accord or the fact that market discipline increased during the period. Overall, therefore, results from the UK, based on time-varying and bank-specific capital requirements, find that capital in banks is increased when capital requirements are increased, whereas the findings from studies of changes in a capital requirement regime on bank resilience are more uncertain.

2.3. The impact of capital requirements on banks' lending activity

If banks change their capital ratios when capital requirements are changed, they must either change their level of assets or their level of capital, cf. Figure 1. Higher capital requirements can limit banks opportunities to provide credit to the real economy if equity is a more expensive way of financing bank assets than debt. Whether this is true, has been the subject of a heated debate and is often based on a discussion of whether the Modigliani and Miller (1958) theorem applies to banks. The seminal article by Modigliani and Miller shows that under some rather restrictive assumptions, the value of a firm is unaffected by its capital structure, i.e. its mix of equity and debt. In the context of banks this implies that banks' choice of equity to assets ratio should not affect the amount of loans issued and the interest rate charged to households and firms. There may, however, be various frictions which imply that changes in the funding structure of banks have real effects. These frictions can be divided into short-term flow costs related to the process of raising new external equity, and longer-term stock costs that create a permanent wedge in banks' funding costs when equity levels are increased (Kashyap et al. 2010). Flow costs are factors like transactions costs associated with initiating seasoned equity offerings (SEO) and signaling effects, as in the pecking-order theory of Myers and Majluf (1984) where firms are reluctant to issue new equity because this can be interpreted as a negative signal

by the stock market. These flow costs may – in a transition phase – create a temporary increase in banks' funding costs if capital requirements are increased. Often cited long-term stock costs are the preferential tax treatment of debt, access to formal and informal government guarantees that protect banks' creditors from losses, and agency costs that makes debt a better instrument to discipline bank management to behave prudently (Diamond and Rajan, 2000). These stock costs can imply that equity capital is more expensive than debt financing on an ongoing basis.

There exists a large empirical literature investigating whether the presence of frictions imply that capital requirements matter for banks' lending decisions. When reviewing this literature, it is important to distinguish between an increase in capital requirements and a change in the capital requirements regime that includes not only a change in levels, but also in structure. For example, the various studies examining the introduction of Basel I do not only capture a level effect but also the introduction of more risk sensitive capital requirements and that banks for the first time were required to keep capital against off-balance-sheet exposures. Hence, when interpreting studies on the introduction of a new capital requirements regime one should bear in mind that they do not isolate the effects of capital requirement changes, per se. In our study, where we look at bank-specific time-varying changes in capital requirements, we aim at identifying effects of changes in capital requirements per se.

BCBS (1999) surveys more than 130 research papers on the response of banks to the introduction of the Basel I capital requirements regime in the G-10 countries. They find that banks' reactions to capital requirements vary according to the stage of the business cycle. Raising new capital or boosting retained earnings are the preferred adjustment channel in booms whereas cutting back loan books are the most effective action in economic troughs. They find some evidence that bank capital pressures after the introduction of Basel I may have restricted bank lending and exacerbated the cyclical downturns in Japan and the US in the early 1990's.

Several empirical studies that investigate the level effect of higher capital requirements use the UK regime with its confidential bank-specific and time-varying capital requirements. Francis and Osborne (2012) use these capital requirements to investigate how loan growth in the UK is impacted by estimated capital deficits in banks from 1996 to 2007. They find that when capital

requirements are changed, banks tend to adjust the risk composition rather than the volume of their loan and asset portfolios. Aiyar et al. (2014a) focus on how capital requirements affect loan supply to firms in the UK, and whether increases in capital requirements 'leak' in the sense that foreign branches can offset reductions in lending by regulated UK banks. They find that regulated UK banks reduce lending to firms by 6-8% in response to a 1%-point increase in capital requirements, but that unregulated foreign banks partly step up by increasing lending instead. In a related study, Bridges et al. (2014) show that capital requirements set at the bank group (consolidated) level have an heterogenous effect on lending to different sectors in the economy. They estimate that a 1%-point increase in capital requirements on average cut - in descending order - loan growth to commercial real estate with 8%, other corporate loans with 4%, household secured lending with 1%, and unsecured household lending with 0.5%.

Aiyar et al. (2014b) shed light on the interaction between monetary policy and time-varying capital requirements by investigating how loan supply responds to monetary policy and bank minimum capital requirements when the two instruments are deployed jointly in the UK. They find that tightening of either capital requirements or monetary policy reduces the supply of lending but that there is little evidence of interaction between the two policy instruments. Lastly, in one of the few studies outside the UK, Messonier and Monks (2015) use the unexpected announcement from the European Banking Authority (EBA) of a core tier 1 capital requirements on 9% to large European banks in 2012. This new and higher capital requirement was introduced in connection with the Capital Exercise of 2011-2012 to restore confidence in the banking sector during the European sovereign debt crisis. Exploiting data on 250 large banks in the Euro area, Messonier and Monks find that banks which were forced to increase their core tier 1 capital ratio by 1% had loan growth that was 1.2% lower than a group of unconstrained banks.

3. Banking regulation in Denmark, 2007-2014

Banks have worldwide been subject to a common set of regulatory capital standards since the introduction of the Basel Accords. The 1988 Basel Accord (Basel I), which applied until

the end of 2006, required banks to comply with a minimum capital requirement of 8% of risk-weighted assets (RWA). Basel I concentrated solely on this minimum capital requirement for banks as the decisive factor to promote safety and soundness in the banking system. Building on Basel I, the introduction of Basel II in 2007 increased the risk-sensitivity of capital requirements and in addition took a broader scope to banking regulation by putting a greater emphasis on banking supervision, disclosure requirements, and market discipline. Basel II is based on three Pillars: (1) minimum capital requirements, (2) supervisory review process, and (3) enhanced disclosure and market discipline. The second and third Pillar are new compared to Basel I.

Denmark has made a unique implementation of the second and third Pillar in Basel II. First, on top of the minimum 8% capital requirement in Pillar 1, Danish banks have been required to comply with an individual capital need, through Pillar 2. This individual capital need has been bank-specific and time-varying, reflecting changes over time in the risk of each bank. Banks are responsible for calculating their own individual capital need, according to guidelines set forward by the FSA. The purpose of the individual capital need is to capture risk dimensions not included in the calculation of the capital requirement in Pillar 1.[2] The individual capital need is required to be at least 8% and must be reported quarterly to the Danish FSA. As part of its task in ensuring compliance with banking regulations, the FSA regularly assess the validity of banks' individual capital need through off-site surveillance and on-site inspections. Second, since 2010 Danish banks have been required to disclose their individual capital need in annual and interim reports as part of the Pillar 3 requirement.

From 2007 to 2012, non-compliance with the individual capital need in Pillar 2 in Denmark implied that the license to operate as a bank was withdraw by the FSA unless capital was restored within a short period of time - usually within a weekend. The Danish FSA has closed several banks during the financial crisis due to non-compliance with the individual capital need, even when the bank's total regulatory capital ratio was higher than the 8% capital requirement in Pillar 1 (Danmarks Nationalbank, 2013). Given that non-compliance with the individual capital need led the Danish FSA to withdraw the banking license, we refer to this way of

[2] This includes bank-specific risks related to e.g. large exposures, credit concentrations, interest rate risk, and also external factors such as e.g. the business cycle.

interpreting the requirement as a "hard" requirement. To our knowledge, Denmark is the only country that on top of the flat 8% capital requirement in Basel II has implemented a "hard" capital requirement that is public (since 2010) and varying over time.

In 2013, the individual capital need was relaxed to a "soft" capital requirement in order to make it more in line with the enforcement of the Pillar 2 requirement in other countries. This "soft" interpretation of the capital requirement implies that non-compliance triggers various supervisory actions, e.g. increased monitoring from the FSA, restrictions on dividend payments etc., but does not imply that the banking license is immediately withdrawn.[3]

In total, we can split our sample period into three subperiods characterized by different degrees of disclosure levels and different degrees of supervisory action following non-compliance with the capital requirements:

Period:	2007-2010	2010-2013	2013-
Disclosure requirement:	Confidential	Public	Public
Supervisory action:	"Hard"	"Hard"	"Soft"

Notes: "Hard" refers to a situation where the banking license is withdrawn if the bank-specific capital need is breached. "Soft" means that supervisory actions are introduced, but banking license is not withdrawn.

The unique capital regime in Denmark makes it possible to test whether there are differences in how banks react to changes in "hard" versus "soft" capital requirements. The previous studies on time-varying capital requirements from the UK have considered a "soft" requirement. Our prior is that a "hard" capital requirement is more binding for banks than a "soft" requirement. In addition, we can investigate whether the disclosure of capital requirements matters for banks' incentive to rebuild capital buffers. Making bank-specific capital requirements public increases the transparency of banks' risk profiles and makes it easier for external market participants to evaluate the adequacy of banks' solvency positions. This enhances the opportunity for

[3] In other countries, banks are required to set a capital target annually as part of the Internal Capital Adequacy Assessment Process (ICAAP) in Pillar 2. This capital target can be viewed as a "soft" capital requirement.

bank creditors to exert market discipline on banks. Our prior is that disclosure requirements strengthen the transmission mechanism of capital requirements as enhanced market discipline increases banks' incentives to rebuild capital buffers after capital requirements are changed.

4. Data

4.1. Data collection

We collect public and confidential data on bank-specific capital requirements, and other bank characteristics from the banks' regulatory reports submitted to the Danish FSA. These reports are at a quarterly frequency and we have data from 2007Q2 to 2014Q2.[4] Our sample period is generally characterized by a period of economic contraction that includes both the financial crisis of 2007-09 and the European sovereign debt crisis.

We restrict our sample to unconsolidated reports because our focus is on individual banking entities which as their main business model provide loans to the real economy. In contrast, banks at the consolidated group level may also include entities that are involved in insurance, pension, and investment activities. Such non-banking entities have a different business model and are covered by another regulatory regime than banks and hence may disturb our results. We also drop small niche banks and banks with loan books smaller than 25% of assets to further restrict our focus on traditional banking entities.

We adjust our raw data as follows. A considerable number of bank mergers and acquisitions have taken place during our 2007-2014 sample period, not least due to the 2007-2009 financial crisis; Rangvid et al. (2013) provide a comprehensive account of the Danish financial crisis and how it affected Danish banks. We account for this by excluding the period of a merger or acquisition for the continuing bank.[5] In addition, some large banks shifted to an internal

[4] We thank the Danish FSA for giving us access to the data and, in particular, to the bank-specific capital requirements that were confidential before 2010. The banks are anonymous in our data set. In our data set, the FSA has identified different types of banks, such as SIFI banks, mortgage institutions, etc.

[5] E.g., if two banks merge at data T, we include both banks up until period $T-1$ and continue with the continuing banks as of period $T+1$. We exclude the bank/banks at period T, as there are discrete extreme jumps in the different variables at time T.

ratings-based approach (IRB) approach to calculate risk-weights in 2008Q1. This created large variation in both capital ratios and capital requirements and we, therefore, exclude the period where they introduced IRB models, for most of them 2008Q1. Lastly we exclude banks with less than $1\frac{1}{2}$ years of data during our sample period. The final sample contains 118 banks, each with an average of 23 quarters of data.

4.2. Descriptive statistics

Table 1 presents summary statistics on the main variables used in our study. In our main tests, we use total regulatory capital that consists of Tier 1 and Tier 2 capital as our measure of capital, as this was the prevalent capital type in Basel II and in the Danish bank-specific capital requirements (until 2013).[6] Loan growth as defined by the Danish FSA consists of growth in standard loans, credit lines, and other loan commitments. Changes in capital requirements and capital ratios are expressed as the quarterly changes in %-points, not the percentage changes. That is, an increase in the capital requirement from 12% to 12.5% is measured as a 0.5%-point increase, rather than a 4.2% increase. We choose this approach because bankers, policymakers, and we are interested in the impact on bank behavior of changing capital requirements by a certain amount of %-point rather than the effect in elasticity terms.

Table 1 shows that the average (across banks and periods) actual capital ratio is 17.7%. This is considerable above the average bank-specific capital requirement on 9.9% which in itself is above the 8% Basel II requirement. This is consistent with the literature showing that banks target a capital buffer in excess of the regulatory requirement. Important for our empirical analysis, there is a large cross-sectional variation in capital requirements across banks. The minimum capital requirement is 8%, the maximum is 30%, and the standard deviation is 2%. To give a visual impression of the variation in capital needs, we show in Figure 2 the distribution of bank-specific capital requirements across banks in the last quarter of 2013, as an example. There are three banks for which their bank-specific capital need corresponds to the Basel II

[6] The Basel III framework focuses on raising the requirements to banks' Core Tier 1 capital ratios, which is a higher quality type of bank capital that has better loss-absorbing capacity. In unreported robustness checks, we find that our results are qualitatively similar if we instead of total regulatory capital consider this Core Tier 1 capital in our analyses.

requirement of 8%. For the remaining 76 banks, their capital need is above 8% with the bulk of banks having a bank-specific capital need in the 10%-12% range. One bank has a capital need of 19% in Q4 of 2013.

[Table 1 - Summary statistics]

[Figure 2 - Histogram of capital requirements, 2013Q4]

Capital requirements are reported each quarter to the Danish FSA by the banks themselves, as mentioned in Section 3. Some quarters a bank might report that there is no change in the capital requirement, other quarters banks report a new capital requirement compared with the one from the previous quarter. Table 1 and Figure 3 show that there is large variation in the magnitudes of quarterly changes in capital requirements. The mean change in capital requirements is 0.1%-point, the standard deviation is 0.9%, the lowest change is -5.8%-point, and the maximum change is a 7.2%-point change from one quarter to the next. Most of the changes are within the +/– 1% range, but there are several hundred changes in excess of +/– 1%. Similarly, our sample is overall characterized by a large number of changes in capital requirements; excluding negligible changes (smaller than 0.25 in absolute value), there are in total 1094 changes. This compares with around 130-250 changes in capital requirements for some of the UK studies. Hence, even though Denmark is a small country, the sample we have at our disposal is large and there is considerable variation in our variable of interest.

[Figure 3 - Magnitude of changes in capital requirements]

Figure 4 displays the time-series variation in the minimum capital requirements over the sample period. There are slightly more increases (650) than decreases (444) in our sample. The changes are generally evenly distributed across time meaning that our results are not driven by any particular subperiod.

[Figure 4 - Variation in capital requirements]

4.2.1. Loanbook and capital buffer changes over the sample period

We are interested in evaluating what happens to bank lending and banks' capital decisions following changes in capital requirements. In aggregate, capital requirements have been increased over the sample period and the loanbook (as a fraction of banks' total assets) has been falling. Figure 4 shows this. It plots the loan book (loan/total assets) and capital requirement for the average bank in our sample. Average non-weighted capital requirements have increased from nearly 9% in 2007 to 11% in 2014. At the same time, average non-weighted loan books have fallen from 75% in 2007 to 62% in 2014 meaning that a lower fraction of banks' balance sheets are used to provide loans to the real economy. One goal of this study is to investigate more formally whether changes in capital requirements are associated with banks' lending decisions.

[Figure 5 - Time series of average loan book and capital requirements]

In order to provide further overall insights into what has happened to banks' capital buffers during the total sample period, Figure 6 decomposes the non-weighted change in banks' capital buffers from 2008Q1 to 2014Q2. This sheds light on how banks' balance sheets have adjusted during our sample period. To account for potential bank heterogeneity, Figure 5 shows the change in capital buffers for the average bank (left panel), domestic systemically important (SIFI) banks (middle panel), and non-SIFI banks (right-panel).[7] For the average bank, the size of the capital buffer is nearly unchanged at 8% from 2008Q1 to 2014Q2. Higher capital requirements and larger balance sheets (assets) have lowered banks capital buffers during our sample period, whereas banks have rebuild their capital buffers by accumulating more capital and lowering their average risk weights. However, the figure for the average bank hides important differences between SIFI and non-SIFI banks. For the average SIFI-bank the size of the capital buffer have increased substantially from 9% in 2008Q1 to 13% in 2014Q2 and this improvement have primarily been achieved by accumulating new capital. In contrast, for the average non-SIFI bank the size of the capital buffer is unchanged at 8% from 2008Q1 to 2014Q2, which

[7] See Section 6.2 for the definition of SIFI banks in Denmark

may be attributed to the fact that non-SIFI banks have only been able to accumulate a limited amount of new capital.

[Figure 6 - Change in capital buffer][8]

5. Estimation methodology

In order to investigate the transmission mechanism of capital requirements we focus on how changes in capital requirements impact 1) banks' capital ratios and 2) lending growth and capital accumulation. We estimate the following three panel equations:

$$\Delta K_{i,t} = \sum_{k=0}^{K} \beta_k \Delta CR_{i,t-k} + \gamma X + \alpha_i + \eta_t + \epsilon_{i,t} \tag{1}$$

$$\Delta Log(L_{i,t}) = \sum_{k=0}^{K} \beta_k \Delta CR_{i,t-k} + \gamma X + \alpha_i + \eta_t + \epsilon_{i,t} \tag{2}$$

$$\Delta Log(E_{i,t}) = \sum_{k=0}^{K} \beta_k \Delta CR_{i,t-k} + \gamma X + \alpha_i + \eta_t + \epsilon_{i,t} \tag{3}$$

where $\Delta K_{i,t}$ denotes the %-point change in the capital ratio of bank i, $\Delta Log(L_{i,t})$ is the (log) change in bank lending of bank i, $\Delta Log(E_{i,t})$ is the (log) change in bank i's capital levels, $\Delta CR_{i,t}$ is the %-point change in the bank-specific capital requirements, and X is a vector of bank-specific controls that might affect banks' lending decisions and their ability to accumulate capital. Specifically, we control for changes in asset quality by including loan-loss reserves and charge offs, changes in earnings potential by including return on assets, and changes in balance sheet size by including the log of total assets. We also control for bank and time fixed effects. Bank fixed effects control for unobserved and time-invariant heterogeneity at the bank level, which for example can be difference in business models and management. Quarterly time fixed effects are included to control for macroeconomic and demand-side effects that are common to all banks at a given point in time. We cluster standard errors by time.

To capture that banks gradually adjust to changes in capital requirements we include both

[8] Figure 6 is constructed by using the methodology in Cohen and Scatigna (2014)

the contemporaneous change in capital requirements and lags in our baseline models. The contemporaneous term is included because banks calculate their own bank-specific capital requirement and therefore may initiate their respond to a change in capital requirement contemporaneously.

Due to the lack of a natural experiment our specifications can be subject to endogeneity problems, as a result of reverse causality or omitted variable bias. Reverse causality can arise in the lending equation if lending growth is a key determinant in the calculations of banks' capital requirement. This may create a downward bias in our estimates as higher credit growth can increase bank risk and thereby raise banks' capital requirements. In addition, there could be an omitted variable bias problem due to an unobserved risk variable that influences both banks' risk profile and banks' lending and capital accumulation decisions. For example, a variable causing a deterioration in banks' loan portfolio quality can increase a bank's capital requirements and may also be correlated with the bank's loan supply decisions. In this case, there may be an upward bias in our estimates as our results in addition to the effect from capital requirements also capture a risk management effect. These shortcomings are, however, not unique to our study but are general to studies in the banking capital-requirement literature.

6. Results

6.1. The impact of capital requirements on capital ratios, lending growth, and capital accumulation

Table 2 presents our baseline results on how a change in capital requirements impacts banks' capital ratios (column 1), lending growth (column 2), and capital accumulation (column 3). The simplest specification, which only includes the changes in bank-specific capital requirement (ΔCR), is shown in columns denoted with an (a) while columns denoted with (b) adds a set of bank controls. For our main variable of interest, the change in capital requirements, we report the sum of the coefficients associated with the contemporaneous and two lagged values to capture that banks gradually adjust to changes in capital requirements. The figures in brackets

for this variable are the p-values associated with F-test statistics for the null-hypothesis of no statistical significance. We provide additional information on the speed of the adjustment period by showing how our results depend on the number of lags included in the model below.

We find that banks raise their capital ratios after capital requirements are increased. The sum of coefficients in column (1a) is 0.33 %-point and is statistically significant at the 1% level, suggesting that banks raise their capital ratios by 0.33%-point when capital requirements are increased by 1%-point. Adding bank controls does not alter this result. The result supports the hypothesis that capital requirements impact banks optimal capital structure, rather than being passively absorbed in an equal and offsetting change in the capital buffer held above the regulatory minimum. From a policy perspective this is important because it implies that bank resilience is strengthened when capital requirements are increased, and that in the short term – within half a year – banks' rebuild a third of their initial capital buffer. However, the estimated coefficient is significantly below one. This implies that banks do not fully rebuild their capital buffer after an increase in capital requirements. In total, therefore, banks fulfil higher capital requirements by a combination of reducing their capital buffer and increasing their capital ratio. This finding extends and verifies related findings from UK-studies, such as Alfon et al. (2005), Bridges et al. (2014a,b) and Francis and Osborne (2012).

The improvement in capital ratios is partly due to a reduction in lending. From column (2) it is seen that lending is reduced by around 1%-point when capital requirements are raised by 1%-point and that the effect is highly statistically significant. Our results are in the lower range of estimates found in the empirical literature on the impact of bank capital requirements on lending growth. The Macroeconomic Assessment Group (2010), which was established by the Financial Stability Board and the Basel Committee on Banking Supervision, finds that across several jurisdictions banks reduce lending by between 0.7% to 3.6% when capital requirements are increased by 1%-point. In the papers most closely related to ours, Aiyar et al. (2014a,b) and Bridges et al. (2014) find that UK banks reduce lending by 4 to 8% in response to a 1%-point increase in capital requirements.

Lastly, we do not find a statistical significant effect showing that banks accumulate more

new capital in response to an increase in capital requirements.

Regarding the control variables, we find that loan growth, changes in the capital ratio, and capital accumulation are all positively affected by return on assets, whereas banks with larger changes in loan-loss reserves have lower growth in lending, and larger banks (measured by assets) have higher growth rates of lending. These effect are as expected.

[Table 2 - The impact of capital requirements on capital ratio, loan growth and capital accumulation]

To provide further insight into the adjustment process following a change in capital requirements, we start by first estimating our three panel equations with only the contemporaneous term and then sequentially add a lagged term up until 3 lags. The result of this exercise is summarized in Figure 7.

We see that banks take a large part of the adjustment on loan growth, capital ratio, and capital accumulation immediately as the contemporaneous terms are always significant and sizable in economic magnitude. For loan growth, the effect from a 1% increase in capital requirements peaks after half a year (two lags) where lending growth is reduced by around 1%. Adding additional terms after half a year reduce the cumulative effect as the coefficients on these terms have reversed signs but the additional coefficients are not individually significant. Turning to changes in capital ratios and capital accumulation we see that it is only the contemporaneous terms that are individually statistical significant. In economic terms, however, the effect from adding additional lagged terms are not irrelevant. The cumulative effect on capital ratios peak after 3 quarters at around 0.4%-point and the terms are jointly significant different from zero. The cumulative effect on capital accumulation peaks after 3 quarters with around 1.20%. The effects are, however, not jointly significant.

[Figure 7 - Details on the adjustment period]

6.2. Heterogeneity between SIFI and non-SIFI banks

Recent banking regulation – Basel III – regulates large systemically important banks more stringent than smaller banks. In addition, banks' response to changes in capital requirements might vary depending on the size of the bank. Larger and more international banks may have better access to capital markets and greater flexibility in handling changes in capital requirements compared to small banks. It is possible that, in the short term, small banks' responses to changes in capital requirements may be restricted to mainly altering the asset side of their balance sheet. In order to investigate this, we create a term interacting the change in the capital requirement with a dummy variable for banks that have been designated domestic systemically important financial institutions (SIFI) in Denmark. This concerns the banking groups Danske Bank, Nykredit, Nordea Bank Danmark, Jyske Bank, Sydbank, and DLR Kredit. Because we use individual entity data we treat all entities within a banking group as SIFI-entities if the group has been designated SIFI. This leaves us with 11 SIFI entities in our sample.

Table 3 presents the results from interacting changes in capital requirements by a SIFI dummy. When we look at all SIFI banks together, we find that the change in capital ratio for SIFIs is not different from the change of small banks; this result is altered when looking at different forms of SIFIs in Denmark, as we mention in the next paragraph. On the other hand, SIFI banks reduce lending less than non-SIFI banks when capital requirements are raised. SIFI banks reduce lending by 0.5% compared to 1.1% for non-SIFI banks when capital requirements are increased by 1%-point. The effect is statistically significant at the 10% level. We do not find a statistically significant effect on banks' capital accumulation response.

In Denmark, the are two types of SIFI banks. The first consists of traditional large commercial banks that accept deposits and provide loans to households and firms whereas the second consists of large specialized mortgage banks that only provide secured mortgage financing, i.e. mortgage SIFI banks are not allowed to accept deposits. It is relevant to explicitly consider the two different SIFI types, as they are both important for credit intermediation in Denmark – SIFI mortgage banks provide around 60% of total credit in Denmark – and because their business

model is different. When we differentiate between these two types of banks, we find that large commercial SIFI banks increase their capital ratios significantly more than non-SIFI banks. Large commercial SIFI banks nearly rebuild three quarters of the capital buffer they initially held over the regulatory minimum compared to a third for non-SIFI banks following an increase in capital requirements. Hence, for large commercial SIFIs, increases in capital requirements lead to an almost equally large increase in resilience. Turning to the large specialized mortgage SIFI banks, they reduce lending significantly less than non-SIFI banks. The capital-ratio and capital-accumulation response of large specialized mortgage SIFIs is not statistical significant different from non-SIFI banks. In sum, SIFIs, and in particular large traditional commercial SIFIs, increase resilience more, and reduce lending less, in particular mortgage SIFIs, compared to non-SIFI banks.

[**Table 3 - Heterogeneity between SIFI and non-SIFI banks**]

7. The impact of policy initiatives

In this section we investigate the impact of two unique Danish policy initiatives: 1) the decision to make bank-specific capital requirements public in 2010Q1 and 2) the change in the consequences of breaching the bank-specific capital requirements in 2013 from "hard" consequences to "soft".

7.1. The impact of disclosure requirements

Danish banks have since 2010Q1 been required to disclose their bank-specific capital requirements. This increases the transparency of banks' risk profile and makes it easier for external market participants to evaluate the adequacy of banks' solvency position. This should enhance the opportunity for bank creditors to exert market discipline on banks. Disclosure requirements may, therefore, strengthen the transmission mechanism of capital requirements as it forces banks to rebuild their capital buffers more quickly in order to signal soundness to the market following an increase in capital requirements. We examine the effect of disclosure requirements by

splitting the sample into a confidential period from 2007Q2-2009Q4 and a disclosure period from 2010Q1-2012Q4. We exclude data from 2013 and onwards because capital requirements were relaxed in 2013Q1, as mentioned above. We investigate the impact of this easing in the enforcement of capital requirements in the next subsection.

In Table 4, we find that banks react stronger to changes in capital requirements when capital requirements are disclosed to the market. Banks' capital ratio and loan supply response to changes in capital requirements are larger and more significant in the period where capital requirements are public compared to when they are confidential. These results imply that resilience in the banking sector is strengthened even further when market discipline is allowed to play a significant role in capital-requirement regulations.

One might hypothesize that disclosure requirements impact large and small banks differently. To test this, we interact changes in capital requirements with the SIFI dummy introduced in subsection 6.2. The results are presented in Table 5. We find that SIFI banks do not raise their capital ratios significantly more than non-SIFI banks during the disclosure period. However, SIFI-banks have a significantly smaller lending reduction of only 0.5% compared to 1.8% for non-SIFI banks in the disclosure period.

[Table 4 - The impact of disclosure requirements]

[Table 5 - The impact of disclosure requirements and SIFI status]

7.2. Hard vs. soft capital requirement

Banks' response to changes in capital requirements might depend on the consequences of breaching the capital requirements. In 2013, Denmark relaxed the bank-specific capital requirements from a "hard" capital requirement that closed the bank if the requirement was breached to a "soft" capital requirement that triggers various supervisory actions if breached. This made the bank-specific capital requirement more in line with the Pillar 2 approach used in other countries. In order to investigate whether this easing in capital requirements affected banks' responses to capital requirements, we split the sample into a "hard" requirement period

from 2010Q1 to 2012Q4 and a "soft" requirement period from 2013Q2 to 2014Q2. We only consider the time period where capital requirements are made public because we do not want to confound our results with the impact of disclosure that we have already tested.

Table 6 displays the results of splitting the sample into a "hard" and "soft" capital requirement period. We do not find any conclusive evidence that banks' response to changes in capital requirements are different during the "hard" and the "soft" period. Banks both restored their capital ratios during the "hard" capital requirement period and the "soft" capital requirement period. During the "hard period" they primarily did so via a reduction in lending whereas we do not find any significant effect on loan growth or capital accumulation during the "soft" period. Basically, these results imply that the transmission of changes in capital requirements to resilience in the banking sector does not depend on whether capital requirements are implemented as "hard" or "soft". We interpret this to mean that banks find it damaging to breach capital requirements, no matter the consequences. In particularly, when capital requirements are public, the fact that market participants can observe that a bank's capitalization moves towards its capital requirement will imply that market prices and pressures will change. For fear of this, the bank will change its capital ratio, regardless of whether the consequences of breaching capital requirements are "soft" or "hard".

[Table 6 - Hard vs. soft capital requirement]

7.3. Robustness test: Buffer size

Banks prefer to hold more capital than required, i.e. to hold a buffer of capital over and above the capital requirement, for reasons discussed in Section 2. The size of the buffer may – or may not – influence how banks react to changes in capital requirements. On the one hand, banks with small capital buffers may be particularly sensitive to changes in capital requirements because they are already very capital constrained and have little cushion to absorb unexpected shock. On the other hand, banks with relatively easy access to capital market may endogenously choose to hold small capital buffers whereas banks that find it difficult to access capital markets

may choose to hold larger capital buffers. To investigate the role played by banks' capital buffers we interact the changes in capital requirements with dummy variables for, respectively, banks with capital buffers below the 10th percentile, banks in the lowest quartile of buffer size and banks with capital buffers below the median.[9]

Table 7 presents the results of interacting the changes in capital requirements with these different capital buffer dummies. None of the coefficients on the interactions terms are statistical significant suggesting that banks with small capital buffers do not respond differently to changes in capital requirements than other banks. The (true) size of the capital buffers became known by the market after capital requirements were made public in 2010. One might hypothesize that increased market discipline after 2010 forced banks with low capital buffers to respond more quickly to changes in capital requirements than banks with larger capital buffers. In unreported tests, we split the sample into the three subperiods presented earlier and investigate the impact of banks with very low capital buffers i.e. below the 10th percentile. We find that banks with very low capital buffers increase their capital ratios significantly more than other banks when changes in capital requirements - and thereby buffer size - where public information. The response does not seem to depend on whether capital requirements are "hard" or "soft". These results indicate that increased transparency on banks risk profile force low capitalized banks to increase resilience when capital requirements are changed in order to be able to continue to signal soundness to the market. Hence, they support our earlier result that disclosure requirements and market discipline enforce the impact of capital requirements on bank behavior.

[Table 7 - Heterogeneity by size of the capital buffer]

8. Conclusion

We study how banks react to time-varying changes in capital requirements using unique Danish data. We find that banks increase their capital ratios when capital requirements are increased. This is important because it implies that resilience in the banking sector is increased

[9] The 10th percentile varies between 1 and 4 %-point, the 25 percentile varies between 3 and 6 %-point and the median varies between 5 and 8 %-point.

when capital requirements are increased. Two policy changes allow us to evaluate whether it is important that time-varying capital requirements are "hard" or "soft" and whether disclosure rules help impose market discipline. We find that bank resilience is particularly increased when capital requirements are published.

Our findings have implications for the discussion of the effects of time-varying capital requirements such as the counter-cyclical capital buffer of Basel III. Most importantly, our results imply that time-varying capital requirements influence the resilience of the banking system. This is important because the idea underlying the countercyclical capital buffer of Basel III is that it should affect banking resilience. At the same time, it should be recognized that there is a limit to how far our results can be carried over to implications for the counter-cyclical buffer in the Basel III accord, as the counter-cyclical buffer in Basel III is a macrobased buffer whereas we deal with capital requirements for individual banks. Our finding that banks react to time-varying changes in capital requirements by increasing their capital ratios, particularly large banks and when requirements are public, have bearings for future discussions of time-varying capital requirements.

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Figure 1: Transmission chart

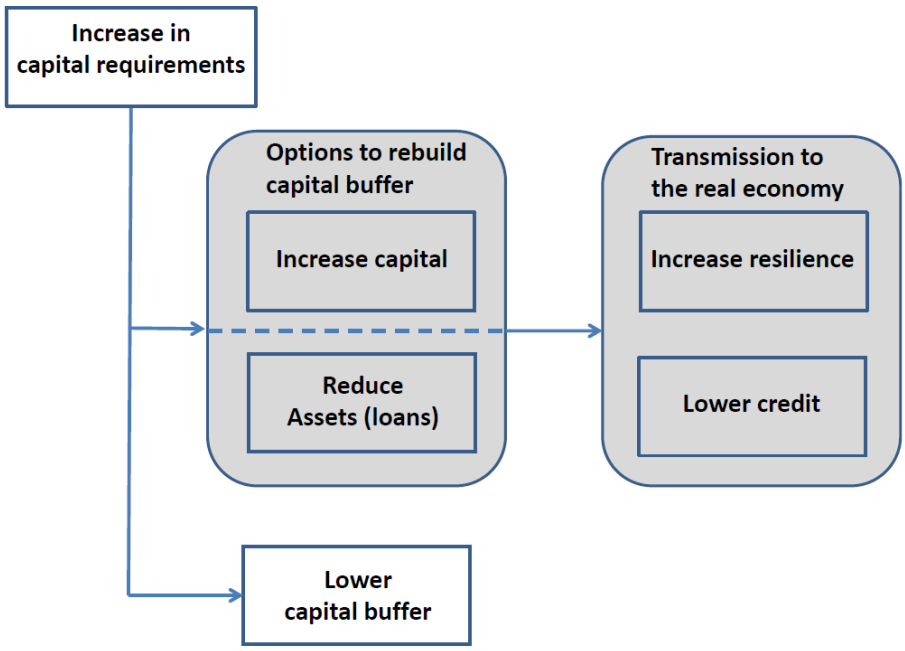

Figure 2 - Histogram of capital requirements, 2013Q4

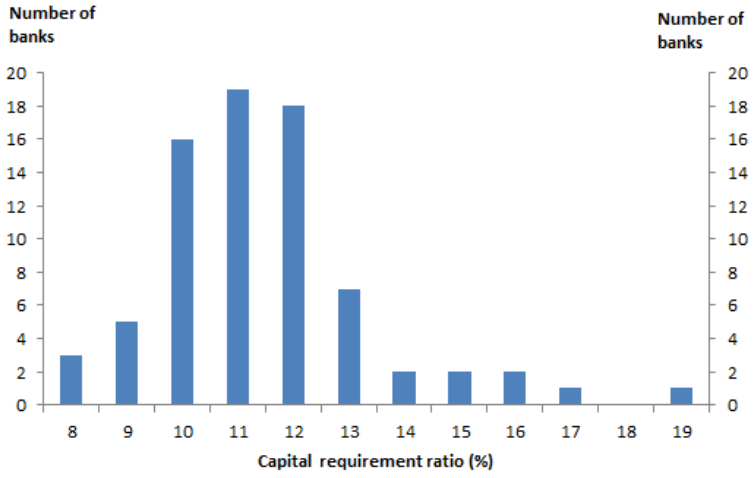

Figure 3 - Magnitude of changes in capital requirements

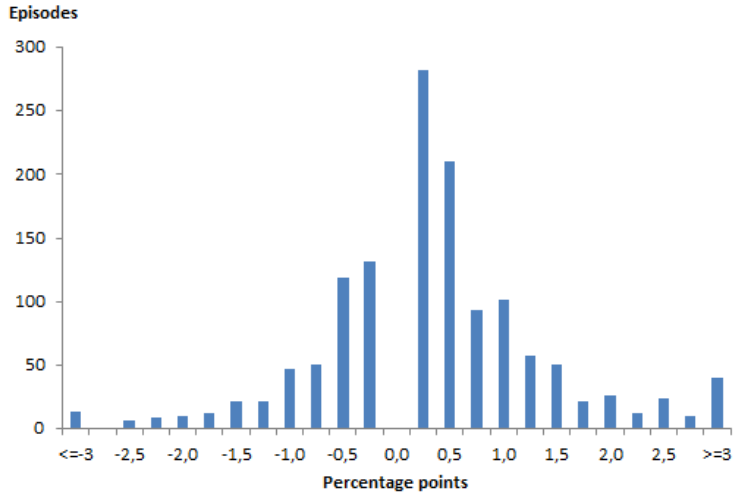

Figure 4 - Time-series variation in capital requirements

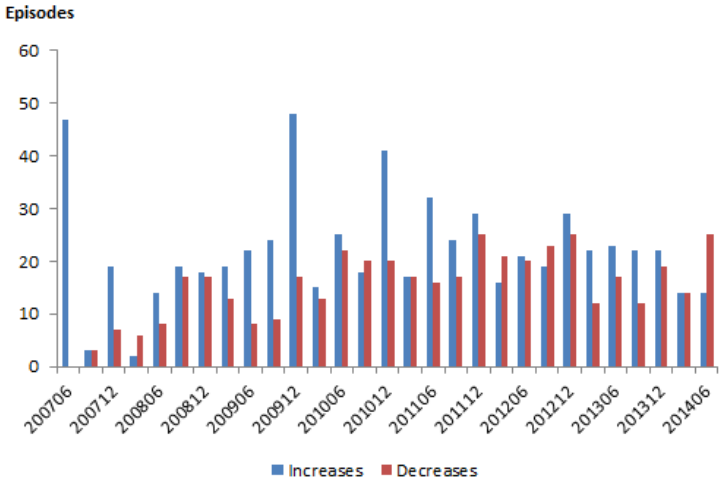

Figure 5 - Time series of average loanbook and capital requirements

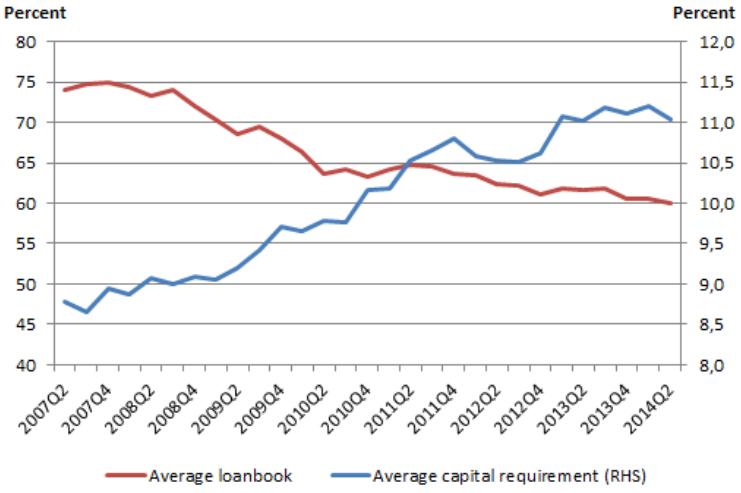

Figure 6 - Change in capital buffer

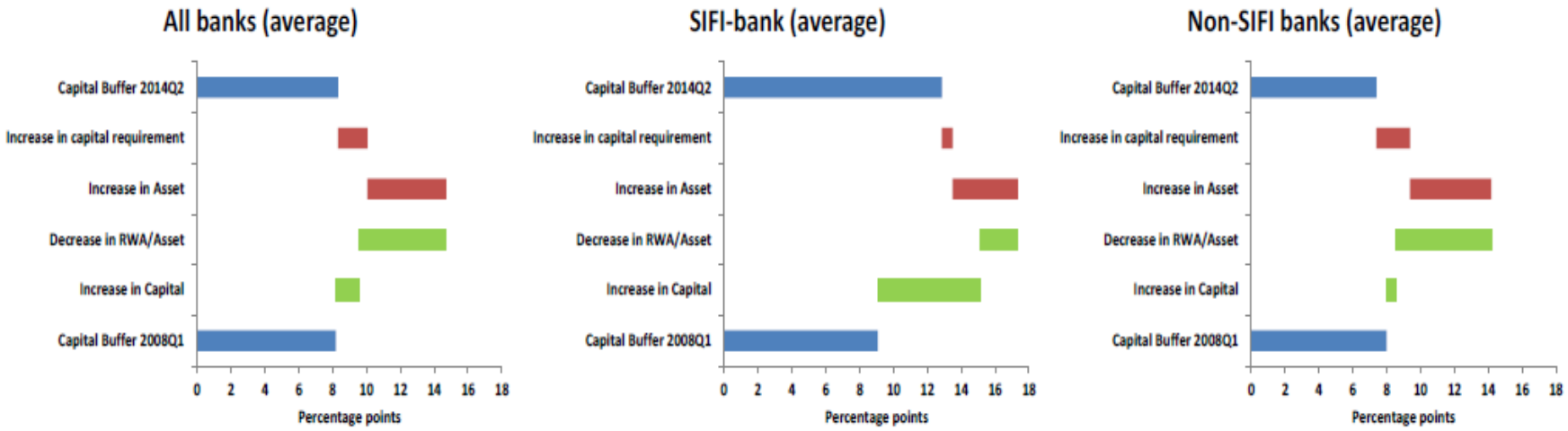

Figure 7 - Details on the adjustment period

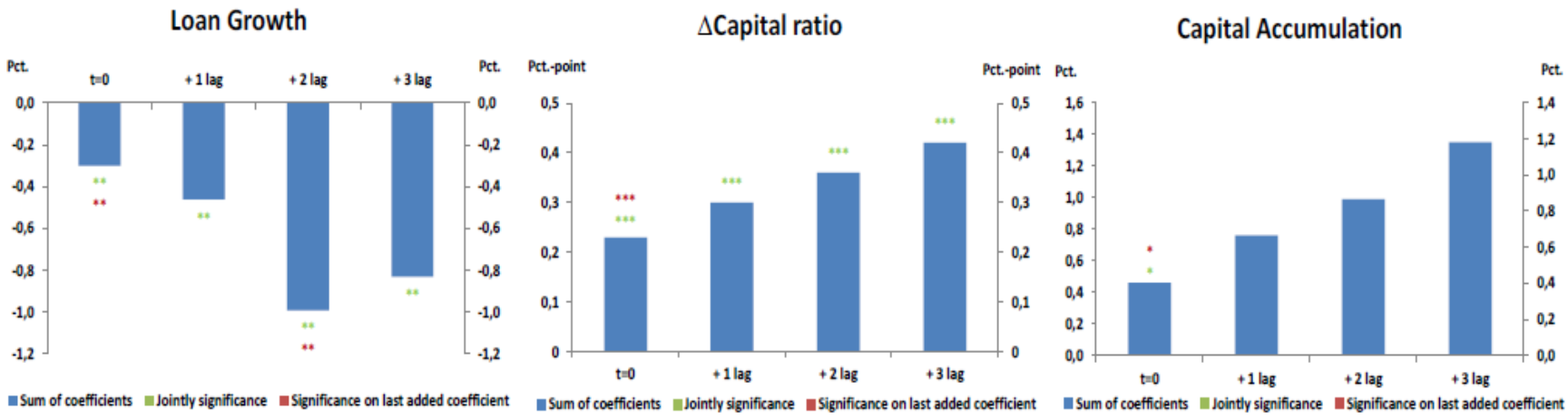

Table 1 : Summary Statistics

Variable	Units	Mean	SD	Min	Max	Obs
Capital requirement ratio	%	9.9	2.1	8	29.9	2735
ΔCapital requirement	%-point	0.1	0.9	-5.8	7.2	2670
Capital ratio	%	17.7	5.4	8.1	64.9	2735
ΔCapital ratio	%-point	0.1	1.9	-28.3	22.2	2670
Lending growth	%	0.1	6.8	-64.4	54.5	2670
Capital accumulation	%	0.6	9.3	-95.0	74.1	2670

Table 2 - The impact of capital requirements on capital ratio, loan growth, and capital accumulation

	ΔCapital ratio		**Loan growth**		**Capital accumulation**	
	1(a)	1(b)	2(a)	2(b)	3(a)	3(b)
ΔCR(sum)	0.33***	0.36***	-1.12***	-0.99**	0.68	0.99
(Prob > F)	(0.00)	(0.00)	(0.01)	(0.02)	(0.46)	(0.16)
Return on assets		0.40***		0.72***		3.78***
(SE)		(0.10)		(0.24)		(0.82)
Loan loss reserves		0.01		-0.31**		-0.21
(SE)		(0.03)		(0.12)		(0.17)
Charge off		0.00		-0.34		-0.40
(SE)		(0.07)		(0.35)		(0.44)
Assets		-1.03**		4.18*		-0.43
(SE)		(0.45)		(2.04)		(2.31)
Adjusted R^2	0.01	0.03	0.17	0.20	0.07	0.17
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,539	2,539	2,539	2,539	2,539	2,539

Note: For the bank-specific capital requirement (CR), we report the sum of coefficents and p-values from F-statistics in italics and parenthesis. For the remaining variables we report the estimated coefficients and standard errors in parenthesis. Standard errors are robust and clustered by time. For statistical significance, we use the following convention: *** p<0.01, ** p<0.05, * p<0.10.

Table 3 - Heterogeneity between SIFI and non-SIFI banks

	ΔCapital ratio			**Loan growth**			**Capital accumulation**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ΔCR(sum)	0.35***	0.34***	0.36***	-1.05**	-0.98**	-1.05**	0.93	0.87	1.05
(Prob > F)	(0.00)	(0.01)	(0.00)	(0.01)	(0.02)	(0.01)	(0.17)	(0.20)	(0.14)
ΔCR x SIFI	0.07			0.45*			0.36		
(Prob > F)	(0.81)			(0.10)			(0.24)		
ΔCR x SIFIBANK		0.38**			-0.53			5.66	
(Prob > F)		(0.05)			(0.72)			(0.23)	
ΔCR x SIFIMORTGAGE			-0.04			0.56**			-0.93
(Prob > F)			(0.95)			(0.03)			(0.20)
Return on assets	0.40***	0.40***	0.40***	0.72***	0.72***	0.72***	3.78***	3.78***	3.78***
(SE)	(0.10)	(0.10)	(0.10)	(0.24)	(0.24)	(0.24)	(0.82)	(0.83)	(0.83)
Loan loss reserves	0.00	0.01	0.01	-0.31**	-0.32**	-0.32**	-0.21	-0.21	-0.21
(SE)	(0.03)	(0.03)	(0.03)	(0.12)	(0.12)	(0.12)	(0.17)	(0.17)	(0.17)
Charge offs	0.00	0.00	0.00	-0.34	-0.34	-0.34	-0.40	-0.39	-0.40
(SE)	(0.07)	(0.07)	(0.07)	(0.35)	(0.35)	(0.35)	(0.44)	(0.44)	(0.44)
Assets	-1.04**	-1.05**	-1.03**	4.17*	4.17*	4.17*	-0.45	-0.47	-0.43
(SE)	(0.45)	(0.45)	(0.45)	(2.04)	(2.04)	(2.04)	(2.32)	(2.32)	(2.31)
Adjusted R^2	0.03	0.04	0.03	0.20	0.20	0.20	0.17	0.17	0.17
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,539	2,539	2,539	2,539	2,539	2,539	2,539	2,539	2,539

Note: The SIFI dummy takes the value 1 for banks that have been designated domestic systemically important financial institutions (SIFI) in Denmark and zero otherwise. SIFIBANK and SIFIMORTAGE are respectively large commercial banks and large specialized mortgate institutions. For the bank-specific capital requirement (CR), we report the sum of coefficents and p-values from F-statistics in italics and parenthesis. For the remaining variables we report the estimated coefficients and standard errors in parenthesis. Standard errors are robust and clustered by time. For statistical significance, we use the following convention: *** p<0.01, ** p<0.05, * p<0.10.

Table 4 - The impact of disclosure requirements

	ΔCapital ratio		**Loan growth**		**Capital accumulation**	
	(1)	(2)	(3)	(4)	(5)	(6)
Sample period	2007-2009	2010-2012	2007-2009	2010-2012	2007-2009	2010-2012
ΔCR(sum)	0.20	0.29**	-0.85	-1.73***	0.36	-0.55
(Prob > F)	(0.13)	(0.01)	(0.25)	(0.01)	(0.19)	(0.66)
Return on assets	0.49***	0.43**	-0.41	0.18	4.12**	3.57***
(SE)	(0.12)	(0.17)	(0.58)	(0.42)	(1.30)	(0.74)
Loan loss reserves	0.41***	-0.05	-1.08**	-0.49*	1.39	-1.00
(SE)	(0.12)	(0.09)	(0.41)	(0.27)	(1.07)	(0.60)
Charge offs	-0.06	-0.02	0.00	-0.43	-1.26	-0.37
(SE)	(0.28)	(0.09)	(0.83)	(0.51)	(1.29)	(0.48)
Assets	-1.60	-2.23	7.22	9.14**	-10.99	–0.68
(SE)	(1.28)	(1.40)	(8.76)	(4.00)	(7.18)	(7.20)
Adjusted R^2	0.00	0.05	0.19	0.19	0.15	0.12
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,071	1,047	1,071	1,047	1,071	1,047

Note: The bank-specific capital requirement was confidential from 2007Q2-2009Q4 and public from 2010Q1 and onwards. For the bank-specific capital requirement (CR), we report the sum of coefficents and p-values from F-statistics in italics and parenthesis. For the remaining variables we report the estimated coefficients and standard errors in parenthesis. Standard errors are robust and clustered by time. For statistical significance, we use the following convention: *** p<0.01, ** p<0.05, * p<0.10.

Table 5 - The impact of disclosure requirements and SIFI status

	ΔCapital ratio		**Loan growth**		**Capital accumulation**	
	(1)	(2)	(3)	(4)	(5)	(6)
Sample period	2007-2009	2010-2012	2007-2009	2010-2012	2007-2009	2010-2012
ΔCR(sum)	0.21*	0.25*	-0.94	-1.84***	0.30	-0.58
(Prob > F)	(0.08)	(0.06)	(0.11)	(0.01)	(0.15)	(0.68)
ΔCR x SIFI	0.19	0.47	-1.58	1.32**	0.23	0.39
(Prob > F)	(0.75)	(0.31)	(0.25)	(0.04)	(0.11)	(0.87)
Return on assets	0.49***	0.43**	0.38	0.19	4.10**	3.57***
(SE)	(0.13)	(0.17)	(0.56)	(0.42)	(1.29)	(0.75)
Loan loss reserves	0.41***	-0.05	-1.08**	-0.49*	1.39	-1.00
(SE)	(0.12)	(0.09)	(0.41)	(0.27)	(1.06)	(0.60)
Charge offs	-0.07	-0.02	0.02	-0.43	-1.24	-0.37
(SE)	(0.28)	(0.09)	(0.82)	(0.51)	(1.29)	(0.48)
Assets	-1.58	-2.26	7.14	9.08**	-10.96	–0.72
(SE)	(1.27)	(1.42)	(8.78)	(4.00)	(7.19)	(7.22)
Adjusted R^2	0.00	0.05	0.19	0.19	0.15	0.12
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,071	1,047	1,071	1,047	1,071	1,047

Note: The bank-specific capital requirement was confidential from 2007Q2-2009Q4 and public from 2010Q1 and onwards. For the bank-specific capital requirement (CR), we report the sum of coefficents and p-values from F-statistics in italics and parenthesis. For the remaining variables we report the estimated coefficients and standard errors in parenthesis. Standard errors are robust and clustered by time. For statistical significance, we use the following convention: *** p<0.01, ** p<0.05, * p<0.10.

Table 6 - Hard vs. soft capital requirements

	ΔCapital ratio		**Loan growth**		**Capital accumulation**	
	(1)	(2)	(3)	(4)	(5)	(6)
Sample period	2010-2012	2013-2014	2010-2012	2013-2014	2010-2012	2013-2014
ΔCR(sum)	0.29**	0.50**	-1.73***	-0.75	-0.55	3.07
(Prob > F)	(0.01)	(0.01)	(0.01)	(0.12)	(0.66)	(0.14)
Return on assets	0.43**	0.76**	0.18	1.08***	3.57***	6.04***
(SE)	(0.17)	(0.19)	(0.42)	(0.19)	(0.74)	(1.08)
Loan loss reserves	-0.05	-0.01	-0.49*	-0.15	-1.00**	-0.06
(SE)	(0.09)	(0.07)	(0.27)	(0.27)	(0.60)	(0.34)
Charge offs	-0.02	0.19	-0.43	0.25	-0.37	1.37
(SE)	(0.09)	(0.10)	(0.51)	(0.34)	(0.48)	(0.81)
Assets	-2.23	2.99	9.14*	8.10	–0.68	19.67**
(SE)	(1.40)	(1.32)	(4.00)	(6.25)	(7.20)	(7.07)
Adjusted R^2	0.05	0.03	0.19	0.30	0.12	0.24
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,047	421	1,047	421	1,047	421

Note: The bank-specific capital requirement was "hard" from from 2010Q2-2012Q4 and "soft" from 2013Q1 and onwards. For the bank-specific capital requirement (CR), we report the sum of coefficents and p-values from F-statistics in italics and parenthesis. For the remaining variables we report the estimated coefficients and standard errors in parenthesis. Standard errors are robust and clustered by time. For statistical significance, we use the following convention: *** p<0.01, ** p<0.05, * p<0.10.

Table 7 - Heterogeneity by size of the capital buffer

	ΔCapital ratio			Loan growth			Capital accumulation		
	1	2	3	4	5	6	7	8	9
ΔCR(sum)	0.31***	0.28***	0.40***	-0.98**	-1.11**	-0.61	0.58	0.31	1.33
(Prob > F)	(0.00)	(0.00)	(0.01)	(0.02)	(0.03)	(0.54)	(0.40)	(0.41)	(0.33)
ΔCR(sum) x Buffer_P10	0.35			0.03			2.64		
(Prob > F)	(0.23)			(0.78)			(0.14)		
ΔCR(sum) x Buffer_P25		0.30			0.42			2.42	
(Prob > F)		(0.43)			(0.93)			(0.21)	
ΔCR(sum) x Buffer_P50			-0.05			-0.67			-0.55
(Prob > F)			(0.63)			(0.55)			(0.41)
Return on assets	0.39***	0.39***	0.39***	0.72***	0.72***	0.71***	3.76***	3.75***	3.76***
(SE)	(0.10)	(0.10)	(0.10)	(0.25)	(0.25)	(0.25)	(0.82)	(0.83)	(0.83)
Loan loss reserves	0.00	0.00	0.00	-0.32**	-0.32**	-0.33**	-0.24	-0.25	-0.23
(SE)	(0.03)	(0.03)	(0.03)	(0.12)	(0.13)	(0.13)	(0.17)	(0.17)	(0.17)
Charge offs	0.00	0.00	0.01	-0.34	-0.34	-0.33	-0.38	-0.37	0.38
(SE)	(0.07)	(0.07)	(0.07)	(0.35)	(0.35)	(0.35)	(0.44)	(0.44)	(0.44)
Assets	-1.05**	-1.07**	-1.05**	4.18*	4.12*	4.06*	-0.56	-0.76	-0.58
(SE)	(0.45)	(0.45)	(0.46)	(2.05)	(2.09)	(2.08)	(2.29)	(2.24)	(2.30)
Adjusted R^2	0.03	0.03	0.03	0.20	0.20	0.20	0.17	0.17	0.17
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,539	2,539	2,539	2,539	2,539	2,539	2,539	2,539	2,539

Note: P10, P25 and P50 denotes respectively banks with capital buffers below the the 10th, 25th and the 50th percentile. For the bank-specific capital requirement (CR), we report the sum of coefficents and p-values from F-statistics in italics and parenthesis. For the remaining variables we report the estimated coefficients and standard errors in parenthesis. Standard errors are robust and clustered by time. For statistical significance, we use the following convention: *** p<0.01, ** p<0.05, * p<0.10.