The Influence of Regulation on the Capital and Financing Structure of Banks

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II. General Abstract

"European banks are in worse condition than U.S. peers because capital regulation has been looser and banks more leveraged."

Sheila Bair, former chairman of the Federal Deposit Insurance Corporation (FDIC), during a speech in 2011.

Triggered by the financial crisis in 2007, US opinion leaders in particular argued that the banking regulations of other countries were not strict enough to guide banks' to hold sufficient amounts of capital. Motivated by these debates, this dissertation comprises three papers that question whether bank regulation has an effect on the capital ratios or the liquidity ratios of banks. In contrast to the US camp's claims, the dissertation reveals that regulation is not the dominant factor when banks set their capital or liquidity structure. I do not find a measurable effect on the financing structure and only minor evidence of an effect on the capital structure. To conclude, bank regulations aiming for stronger capital and liquidity structures have not achieved the desired results with the old regulatory frameworks. The current discussion regarding the new Basel III framework shows that the topic is still controversial and it will be interesting to see if this new framework alters the results of my thesis.

Keywords: Banks, Capital ratios, Liquidity structure,
Bank regulation, Basel II

JEL Classification: G21, G32, G28, G38, M48

III. Table of Contents

IV. Introduction to the Thesis

IV.1. General Framework, Aim, and Contribution

There is a long-standing economic debate, between the USA and the European political camps in particular, over the correct level of severity of bank regulation. Prompted by this debate, this dissertation comprises three papers that question whether bank regulation has an effect on the capital ratios or the liquidity ratios of banks. The first paper applies a partial adjustment model using the generalised method of moments regression technique in order to find explanatory variables for the capital ratios of banks around the world. These variables include various regulatory factors, which cover different aspects of regulation severity. The second paper applies a difference-in-difference (DiD) approach to investigate whether the announcement of an early-comprehensive introduction of the new Basel II regulatory framework in 2004 for European countries led the capital ratios of these banks developing differently compared to banks from late-partial adopting countries. The third paper uses the same model and similar variables as the first paper, but examines the impact of these variables on the liquidity ratio instead of the capital ratio.

IV.2. The Influence of Regulation on the Capital Ratios of Banks

In my first paper, I find that bank regulation appears to be at best only a partial explanation for the size of banks' capital ratios. Only greater regulatory restrictions on bank activities seem to lead to higher capital ratios and there are indications that stricter private monitoring leads to even lower ratios. On the other hand, I find evidence that capital ratios strongly and persistently depend on their past levels. Additionally, larger banks appear to have lower ratios, whereas dividend payers, systemically relevant banks and banks in countries with systemically relevant bank sectors seem to have higher ratios. Consequently, a larger number of banks sharing the country's risk apparently leads to lower capital ratios. The study also finds evidence that banks in former crisis countries have higher capital ratios than banks in non-crisis countries; this unexpected result might somehow also call into question the accuracy of the disclosure of the capital ratios.

In the second paper, there is evidence of a positive treatment effect. That is, at first glance it seems that the introduction of the new regulation led to higher capital ratios in affected banks. However, going into detail, the study reveals that changes in the accounting standards and not the regulation change might have been the main trigger for this effect. In other words, book values changed and therefore the capital ratios went up because of a change in the measurement method. The "real" effect might have been much smaller than it appears at first. As in the first paper, bank size seems to have a negative effect on banks' capital ratios and the importance of the banking sector appears to have a positive effect. Additionally, there is strong support for the finding that the ratio increases with the profitability of a bank and the economic health of its environment. Further, the study finds some evidence that bank ratios are lower in the case of riskier banks and higher growth rates of the gross domestic product, while the ratios seem to be higher in the presence of higher inflation rates. The only results that contradict those of the first paper relate to the possible influence of dividend payers (I find a negative effect in the second paper).

IV.3. The Influence of Regulation on the Net Stable Funding Ratio of Banks

The third paper reveals that the influence of regulation on liquidity structure also appears to be limited. As stricter capital regulation actually seems to lead to lower (i.e. "worse") liquidity ratios, it would appear that banks only aim to comply with the capital ratio standards and not the liquidity structure ratios (for which binding standards were not yet implemented during the observation horizon). Regarding the other regulatory variables, the paper finds that greater private monitoring appears to cause lower ratios. Further, there is evidence that the importance – and therefore the risk – of a country's banking sector as a whole and higher growth rates of the annual domestic product lead to higher liquidity ratios in the banks of these countries. The results do not reveal any significant bank-specific explanatory factors and the highly significant and robust coefficient on the lagged dependent variable is relatively low. This implies that banks change their liquidity ratios to the desired ratio relatively quickly, but the desired ratio is particular to every single bank.

V. Paper 1: Worldwide Bank Regulation and Capital Adequacy – A Dynamic Panel Data Study

V.1. Abstract

Triggered by the financial crisis in 2007, US opinion leaders in particular argued that the banking regulations of other countries were not strict enough to guide banks' to hold sufficient amounts of capital. Motivated by these debates, I examine explanatory factors for the capital ratio levels of banks from 43 developed countries for the years 2000 to 2011. Besides bank-specific and country-specific factors, my paper includes six time-variant regulatory factors that cover various aspects of regulatory severity. The goal of the paper is to answer the question of whether bank regulation determines capital ratios, that is, whether the US accusations are legitimate. The applied partial adjustment model uses the generalised method of moments regression technique.

In contrast to the US camp's claims, I find that regulation is not the dominant factor when banks set their capital ratios. In fact, only greater regulatory restrictions on bank activities seem to lead to higher capital ratios and there are indications that stricter private monitoring may even lead to lower ratios. Instead, I find evidence that capital ratios strongly and persistently depend on their past levels. Additionally, larger banks appear to have lower ratios, whereas dividend payers, systemically relevant banks and banks in countries with systemically relevant banking sectors seem to have higher ratios. Consequently, a greater number of banks sharing the country risk apparently leads to lower capital ratios. However, my study also finds evidence that banks in former crisis countries had higher capital ratios than banks in non-crisis countries. Although this might not directly cast doubt on regulatory severity, it does cast doubt on the accuracy of the disclosure of capital ratios.

Keywords: Banks, Capital ratios, Bank regulation

JEL Classification: G21, G32, G28

V.2. Introduction and Background

"European banks are in worse condition than US peers because capital regulation has been looser and banks more leveraged" (Onaran, 2011, no pagination). This statement from Sheila Bair (the former chairman of the Federal Deposit Insurance Corporation) made in 2011, highlights a long existing economic discussion between the USA and the European political camp in particular regarding the correct severity of bank regulation. The financial crisis in 2007 rekindled this discussion; although the events in the USA strongly influenced the crisis, the US camp accuses the European camp of enabling banks to hold – from a risk-based view – too little capital because its regulation is not sufficiently tight (e.g. Admati and Hellwig, 2013, Braithwaite and Jenkins, 2011 or Osman, 2010).

Inspired by this intercontinental debate my paper tries empirically to answer the question of whether bank regulation determines bank capital. My assumption is that more severe regulation should lead to higher levels of capital.

My capital measure is based on the framework submitted by the Basel Committee on Banking Supervision (1988), which is known as "Basel I", to regulate the capital adequacy of banks. The idea is that the extent of equity required by a bank depends on the bank's risk, that is, the eligible capital in relation to the risk-weighted assets has to exceed a defined threshold (see formula (V.1)):

$$\frac{\text{Eligible Capital}}{\text{Risk Weighted Assets}} \geq \text{Threshold} \qquad (V.1)$$

The most commonly used measure for eligible capital is Tier 1 capital and, accordingly, the ratio of interest is the Tier 1 ratio (TIER1R)[1]. The Basel 1 framework has been refined and improved several times since its first introduction; however, the general principle has remained the same

[1] The Tier 1 ratio divides shareholder funds plus perpetual non-cumulative preference shares (the Tier 1 capital) by risk-weighted assets and off-balance sheet risks according to the Basel rules. Refer to section V.8.1 for a detailed explanation and the origin of all variables used in the study.

right up to the present day and is the basis for the new Basel III rules (Basel Committee on Banking Supervision, 2011).

Although the Basel regulations give general rules for the capital adequacy of banks, there is room for interpretation by banks. This is caused by the way the regulation bodies of the particular country concerned implemented the rules. The definitions for eligible capital or the risk-weighted assets are not necessarily the same from country to country and this discretion has become a breeding ground for the intercontinental debate.

Shortly after the financial crisis, with the promulgation of the Dodd–Frank Wall Street Reform and Consumer Protection Act,[2] US politicians introduced new rules to further strengthen bank regulation. Politicians from the rest of the world quickly followed suit in attempting to enforce new regulations.[3] By enhancing regulatory power, setting higher activity restrictions and influencing banks' capital structure, most of these regulations directly or indirectly aimed at banks' capital ratios.

However, consistent with previous work (for instance Berger, DeYoung, Flannery, Lee & Öztekin, 2008; Brewer, Kaufman & Wall, 2008; or Barth, Caprio Jr. & Levine, 2006), my study shows that banks have higher average capital ratios than stipulated by the regulation (refer to section V.4). Therefore the question is, does bank regulation really matter? Or do banks set their Tier 1 ratio (only) on the basis of other, bank-specific or country-specific factors? Or is the nature of the Tier 1 ratio-setting process different for every bank?

To answer these questions, I construct six regulatory index variables based on several regulatory surveys from Barth, Caprio Jr. and Levine (2001). Additionally, I implement further bank-specific and country-specific factors as possible explanatory variables. My study applies a partial adjustment model and uses advanced dynamic panel data regression methods based on cross-country bank figures for 43 countries and 12 years (from 2000 to 2011, i.e. covering the period before and after the financial crisis).

2 Refer e.g. to McGrane (2010).

3 Refer e.g. to Clark and Treanor (2010).

Similar to non-banking firms, a lot of empirical work on the banking sector has already been conducted. However, most of the studies are nationally based and therefore do not consider the diverging regulations of various countries. Berger et al. (2008) find explanatory factors for capital ratios by using an adjustment model for the period from 1992 to 2006. Their conclusion is that banks actively manage their capital ratios and set target capital levels substantially above regulatory minimum levels. Moreover, they find that rates adjust rapidly to the target capital levels. Their study only covers US banks and only uses explanatory variables other than regulatory factors.

A cross-country study by Gropp and Heider (2010) investigates the determinants of the capital structure of (large and publicly traded) banks in the years between 1991 and 2004. Among others, Gropp and Heider (2010) also use an adjustment model. However, they apply only rudimentary dynamic panel data regression methods. Although they do not directly implement explanatory regulatory variables, their conclusion is that "[…] capital regulation and buffers may only be of second order importance in determining the capital structure of most banks" (Gropp & Heider, 2010, p. 590). Therefore, most banks seem to set their capital structure in a similar way to non-banking firms. This is an interesting conclusion in relation to the question raised above, that is, whether bank regulation really matters. Similarly, using slightly older data from 1986 to 2001, Flannery and Rangan (2008) conclude that the most important explanation for the capital build-up of the largest US banks during this time is related to market forces. That is, increased capital requirements by the regulator only explain a small part of the build-up. To obtain their results, they also use an adjustment model and implement advanced regression procedures. Again, they do not include bank regulation in the same way as in my study.

In contrast, Brewer et al. (2008) use similar explanatory variables (including variables to measure bank regulation) as my paper and apply a partial adjustment model. However, their model only uses basic regression methods to cover possible biases in dynamic panel data studies. Additionally, it focuses on large banking institutions only, resulting in a much smaller sample size than in my study. The period covered ranges from 1992 to 2005, that is, it does not include the financial crisis. Further, in contrast to my paper, Brewer et al. (2008)

consider the bank regulation variables as time-invariant during the observed period.

The last two facts also apply to Schaeck and Cihák (2009). Their work examines the impact of bank competition on the capital ratio. They use a couple of control variables, including regulatory variables, in their panel data regression. They do not, however, implement target adjustment considerations. Nevertheless, the last two mentioned studies are promising, since they find several significant explanatory bank-specific, country-specific and regulatory variables.

My study extends the previous research by using cross-national data and therefore analyses differences across countries; by considering measures of regulatory severity and contemplating the idea that this regulation severity might change during the observation period; by applying advanced methodological dynamic panel data regressions; and lastly, by also covering a time period that includes the financial crisis.

My paper is of interest for regulators, policy makers, academics and other stakeholders for several reasons: it gives insight in the banks' capital ratio setting and discovers important factors in this setting process; it performs an informative function when analysing banks and their capital ratios; it exposes the extent and direction of regulatory influence on capital ratios; and gives guidance for decision-making when discussing new banking regulations or capital rules.

In contrast to the US camp's claims, I find that regulation is not the dominant factor when banks set their capital ratios.[4] Only greater regulatory restrictions on the activities of banks seem to lead to higher capital ratios and there are indications that stronger private monitoring even leads to lower ratios. Instead, I find evidence that capital ratios strongly and persistently depend on their past levels. Additionally, larger banks appear to hold lower ratios, whereas dividend payers, systemically relevant banks and banks in countries with systemically relevant banking sectors seem to have higher ratios. Consequently, a higher number of banks sharing the country risk apparently leads to lower capital ratios. However, my study also finds evidence that banks in former crisis

[4] Note that robustness checks do not show substantial changes in the results of all other variables when I drop the regulatory components from the calculations (refer to section V.8.4 for details).

countries had higher capital ratios than banks in non-crisis countries. Although this might not directly cast doubt on regulatory severity, it does cast doubt on the accuracy of the disclosure of capital ratios.

The rest of the paper proceeds as follows: section V.3 explains the data and methodology used; section V.4 illustrates descriptive statistics for the dataset before section V.5 reveals the results of the regression, and section V.6 concludes the paper.

V.3. Data and Methodology

V.3.1. Dataset

My study considers only developed countries, since the focus is on countries with expected banking sector importance and with expected regulation influence over banking behaviour. Consequently, the country population consists of all countries belonging to the Organization for Economic Co-operation and Development (OECD)[5], countries with important (i.e. “global”) financial centres according to „The Global Financial Centres Index 10“[6] and the additional European Union (EU) countries not included above[7]. The original total population is therefore 45 countries.

Regulatory data for the paper is based on the bank regulatory survey in Barth et al. (2001). They conducted the survey for the years 2000, 2003, 2008 and 2011. Accordingly, the year population consists of the 12 years from 2000 to 2011 (however, owing to the regression methodology described below, the first year drops out and is just used for lagging and differencing). Missing years between the four survey observation points adopt the value of the nearest observation point (e.g. year 2001 adopts the survey data of 2000 and year 2002 adopts that of 2003). Thus, the paper assumes that changes in the severity of bank regulation occur immediately and not slowly. This appears obvious, since the possible answers to the survey questions are mostly binary (“yes” or “no”).[8] Since my study uses yearly bank data, the financial year-end date is rounded to

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5 These are Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Republic of Korea (KOR), Lithuania (LTU), Luxembourg (LUX), Mexico (MEX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR) and the United States of America (USA).

6 See Yeandle and von Gunten (2013). The additional countries to consider are China (CHN), Hong Kong (HKG), Russian Federation (RUS), Singapore (SGP) and the United Arab Emirates (ARE).

7 These are Bulgaria (BGR), Latvia (LVA), Malta (MLT), Republic of Cyprus (CYP) and Romania (ROU).

8 However, a robustness check which considers slow changes by interpolating the values does not materially change the regression results, except that the dividend dummy (DIV) loses its significance (refer to details in section V.8.4).

the next year-end if a bank does not have 31 December as its financial year-end.[9]

My study includes all banks (regardless of their size) from the Bankscope[10] database with consolidation code C1, C2 and C*.[11] That is, it only considers consolidated figures, since the regulatory requirements usually refer to the consolidated level. I apply the following rules to eliminated bank double entries:

- Entries for which a Tier 1 ratio is available are preferred to other entries.
- If there is equality regarding Tier 1 ratio availability, entries for which more relevant other variables are available are preferred to entries with fewer variables.
- If there is equality regarding the availability of other variables, C1 and C2 consolidation codes are preferred to C*.

The population of a specific year does not include banks with missing data for the variables of interest in that particular year[12], but it does include these banks in the years in which all the necessary data is available (refer to section V.3.2 for a description of the various data). Therefore, the study uses unbalanced panel data according to Wooldridge (2010).

All values (except for ratios) are translated into million USD (United States dollars) using the corresponding year-end foreign exchange rate according to Bankscope.

9 E.g. observations of banks with financial year-end 31 March 2008 are included in the population of 31 December 2008.

10 "Bankscope – World banking information source" from Bureau van Dijk Electronic Publishing BV, Amsterdam, The Netherlands.

11 Refer to section V.8.3 for a detailed explanation of the consolidation codes.

12 However, the banks not included in the population for the regression of a particular year are nevertheless included in the calculation of the country-specific variables of interest for these years (such as e.g. the ratio of banks per one million capita per country).

V.3.2. Model

The paper assumes that bank i (ranging from 1 to N) sets its target Tier 1 ratio ($TIER1R^{*}_{i,t}$)[13] in year t (ranging from 1 to T) according to a number of K+1 (ranging from 0 to K)[14] explanatory variables $D_{k,i,t}$ and their corresponding coefficients β_k to be estimated (see formula (V.2)):[15]

$$TIER1R^{*}_{i,t} = \sum_{k=0}^{K} \beta_k D_{k,i,t} + v_{i,t} \qquad (V.2)$$

Some of the variables $D_{k,i,t}$, presented below are country specific (meaning that they are the same for all banks i in a country j at time t or they are the same for all banks i in a country j for all time periods T). The target Tier 1 ratio is unobservable. However, a partial adjustment model estimates the coefficients by applying the idea that a bank's Tier 1 ratio does not normally equal its target value and that a bank therefore tries to adjust the actual value toward its target.[16] This means that the difference between the ratio for the current year and the ratio for the previous year should equal the difference between the target ratio and the ratio of the previous year times all banks' invariant[17] speed of adjustment λ, as shown in formula (V.3):

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13 Using total capital ratio (TCR) instead of the Tier 1 ratio shows no changes at all compared to the basis set-up (refer to details in section V.8.4).
Further, the new Basel III rules stipulate an additional leverage ratio to be fulfilled, which is said to be less easy for banks to control themselves. To put it simply, it is a ratio that compares book equity to total book assets, without risk weighting the figures (refer to the Basel Committee on Banking Supervision, 2011). Again, using such a ratio instead of the capital ratios mentioned above leads to substantially similar results (with the difference that some additional coefficients become significant and the test diagnostics are not all satisfied possibly because of a changed number of observations).

14 $D_{0,i,t}$ equals 1, which means that k = 0 represents the constant.

15 The formula includes a disturbance term $v_{i,t}$.

16 Refer for example to Lintner (1956), who introduced such as model in the area of dividend-setting decisions or Flannery and Rangan (2006), who used it in to explain a firm's market debt ratio.

17 My model assumes that the speed of adjustment is the same for all banks, since the coefficient on the variable does not substantially change when performing separate regression in regard to various bank categories (e.g. small banks vs large banks, European Banks vs non-European banks, dividend-payers vs non-payers etc.).

$$\text{TIER1R}_{i,t} - \text{TIER1R}_{i,t-1} = \lambda \left(\text{TIER1R}^{*}_{i,t} - \text{TIER1R}_{i,t-1}\right) \quad \text{(V.3)}$$

By substituting formula (V.2) into formula (V.3) and rearranging them, I obtain the dynamic regression model to be estimated according to formula (V.4):[18]

$$\text{TIER1R}_{i,t} = \sum_{k=0}^{K} \lambda\beta_k D_{k,i,t} + (1-\lambda)\,\text{TIER1R}_{i,t-1} + u_{i,t} \quad \text{(V.4)}$$

Note that a speed of adjustment λ converging to 0 means that the adjustment process is persistent, that is, only a small gap between the Tier 1 ratio and the target Tier 1 ratio closes every year and the other explanatory variables are of only minor importance. On the other hand, a speed of adjustment λ converging to 1 means that the adjustment process is immediate, that is, the past ratio is only of minor importance and the other explanatory variables have more influence.

The explanatory variables[19] are divided into regulatory variables, bank-specific variables and further country-specific variables.

I construct six variables, which measure various direct or indirect regulatory components:

- Restriction (REST): This is an index measuring regulatory restrictions on the activities of banks, following the survey explained in Barth et al. (2001). The variable can take a maximum value of 14 and is composed of several questions. These questions deal with the topic of whether banks are allowed to engage in various activities. A higher value of the variable is related to greater restrictions and therefore to more severe regulation and is assumed to be followed by a higher Tier 1 ratio.
- Regulatory body power (RBP): This is an index measuring the direct power of the regulatory body, following the survey explained

18 As in Baltagi (2008), I consider the regression disturbance term as a one-way error component model $\lambda v_{i,t} = u_{i,t} = \mu_i + \varepsilon_{i,t}$, whereas μ_i denotes the unobservable individual specific effect and $\varepsilon_{i,t}$ denotes the remainder disturbance.

19 Refer to section V.8.1 for more detailed definitions of and explanations for the sources of the variables used.

in Barth et al. (2001). The variable can take a maximum value of 13. A higher regulatory power index is related to more severe regulation and is therefore expected to lead to a higher Tier 1 ratio.

- Capital regulation (CAPR): This is an index measuring the regulatory oversight of bank capital, following the survey explained in Barth et al. (2001). The variable can take a maximum value of 5. A higher value is related to stricter capital regulations and therefore to more severe regulation and is assumed to lead to a higher Tier 1 ratio.
- Entry requirements (ERQ): This is an index measuring the difficulty of operating as a bank in a specific country, following the survey explained in Barth et al. (2001). The variable can take a maximum value of 8. A higher value indicates greater difficulties for banks in entering the country's market and is therefore related to more severe regulation that is expected to lead to a higher Tier 1 ratio.
- Private monitoring (PRM): This is an index measuring the degree to which the private sector is empowered, facilitated and encouraged to monitor banks, following the survey explained in Barth et al. (2001). The variable can take a maximum value of 12. The expectation for the influence of this variable is ambiguous. On the one hand, one could assume that a higher private monitoring index is related to more severe regulation and therefore leads to a higher Tier 1 ratio. On the other hand, a higher private monitoring index could be associated with more outside or self-regulation, and therefore less severe bank regulation, and consequently leads to a lower Tier 1 ratio.
- Ownership (OWN): This index measures the degree to which regulations control for ownership in banks, following the survey explained in Barth et al. (2001). The variable can take a maximum value of 3. I expect that a higher ownership index is related to more severe regulation and therefore leads to a higher Tier 1 ratio.

The bank-specific variables for my model are as follows:

- Log of total assets (LTA): This is a measure of the size of the bank calculated as a natural logarithm of the sum of all assets of the bank according to Bankscope.[20] The expectation is that larger banks have lower capital ratios, as shown by Berger et al. (2008). Possible explanations for this could be that bigger banks are more diversified and less risky or have lower cost of raising new capital (i.e. they can adapt quicker to changing circumstances, allowing them to have lower capital cushions) or might even enjoy government guarantees since they are "too big to fail".[21]

- Ratio of loan loss reserves to gross loans (LLRGL): This is a measure of the bank's credit risk calculated as a ratio of the part of the loans for which the bank expects losses (but does not charge off) to the total loan portfolio according to Bankscope. The higher the value, the higher a bank's credit risk. I assume that higher credit risk results in banks having higher Tier 1 ratios, since affected banks need greater capital cushions to absorb higher credit risk.
- Return on average assets (ROAA): This is a measure for the profitability of a bank; it is the ratio of the net income to the total assets (calculated as an average of the previous and the subsequent year-end) of a bank taken from Bankscope. Previous studies have found profitability to have a positive influence on the capital ratio (e.g. Flannery & Rangan, 2008 for banks or Öztekin & Flannery, 2012 for non-banks). This sounds intuitive considering that net income increases the capital and therefore the numerator of the Tier 1 ratio. However, in my study, the prediction of the sign for this coefficient is ambiguous: a more profitable bank could be related to lower riskiness of the bank and therefore to a lower Tier 1 ratio.
- Dividend dummy (DIV): As shown, for example, in some results of Gropp and Heider (2010), dividend-paying banks might have higher

20 Since the Tier 1 ratio and the sum of assets are both balance sheet based figures, I also performed my regression with non-balance sheet based but income statement based variables to measure bank size (the net interest revenue, other operating income and overhead expense) in order to test for a possible correlation bias. My results do not change when I use these variables. Because total assets is the more commonly known variable for measuring firm size, I continue with this variable only in my study.

21 According to Stern and Feldman (2004), the term "too big to fail" was originally associated with a statement by Stewart B. McKinney made during congressional hearings related to the bailout of Continental Illinois (a relatively large bank at that time, which had been declared insolvent). The term is used for banks that have such a large systemic risk that their failure would have substantial negative macroeconomic impacts and therefore have to be supported by the government or another superior body.

capital ratios. Based on data from Bankscope, I therefore include a dummy variable that takes the value of 1 if a bank has paid out a dividend in the specific year and 0 otherwise. The relationship of this variable is also ambiguous: on one hand, the possibility of paying out a dividend might indicate a bank that is already in good financial condition and therefore a higher Tier 1 ratio could be assumed, as found by Gropp and Heider (2010); on the other hand, the pay-out of a dividend directly decreases capital and lowers the Tier 1 ratio. Moreover, dividend-paying banks could have lower cost of raising new capital and therefore have lower Tier 1 ratios.

- Bank's total assets to sum of all banks' total assets of a country (BASA): This is a measure for the relative importance (and therefore the system relevance) of a bank in its country. BASA is the ratio of the bank's total assets to the sum of all banks' total assets of the country for a specific year according to data from Bankscope. As mentioned, an important ("too big to fail") bank could experience different treatment from an unimportant bank, thus affecting its Tier 1 ratio. However, the prediction of the sign for this variable is again ambiguous: higher system relevance might increase a bank's power over the regulator and therefore lower the bank's Tier 1 ratio. Additionally, a bank that is more important in a country could target a lower Tier 1 ratio, since it knows that its country would help out in case of failure. Alternatively, the fact that a bank is system relevant might cause the regulator to be stricter on the bank and therefore lead to a higher Tier 1 ratio (refer e.g. to the arguments of Mishkin, 1999). Apart from the possibility of measuring system relevance as a relative measure, the basis regression additionally includes a more stringent dummy variable "SYS": This dummy variable is 1 if the BASA value of a bank is higher than 10% in its country in a specific year.[22] The argument for the sign prediction is the same as for BASA. Both variables,

[22] There is no exact numeric definition for regulators to rate a bank as system relevant; therefore, the 10% threshold is a discretionary value. The regression results do not materially change when using other thresholds.

BASA and SYS, are simultaneously used in the basis regression measuring "systemic relevance".[23]

The further country-specific variables are as follows:

- Bank concentration (CON): This is a dummy variable taking a value of 1 if the banking industry in a country is highly concentrated and 0 otherwise. An industry is highly concentrated if the sum of total assets of the three largest banks is more than 50% of all banks' total assets of the country for a specific year.[24] The data basis for the calculation is Bankscope. The variable is comparable to the variable SYS above, but it measures the relative importance of several banks together instead of one alone. Therefore, the ambiguous sign prediction is explained in the same way: The more concentrated the banking industry is, the higher the banks' power over the regulator; elevated by the assumption that there might be an implicit survival guarantee, this would lead to lower Tier 1 ratios. On the other hand, a more concentrated banking industry might lead the regulator to be more severe and therefore to stipulate the banks to have more Tier 1 capital.
- Banks per million capita (BMC): This variable measures the size of the banking sector in a country in relation to its population. The calculation of the variable is based on data from the database described in The World Bank (2012). Again, the sign projection is ambiguous: a higher number of banks per population could on the one hand indicate a higher importance of the banking sector (causing similar predictability difficulties as for above variable CON), while on the other hand, it could indicate a better distribution of risk among multiple banks and therefore could lead to lower Tier 1 ratios.
- Bank deposits per gross domestic product (BGDP): This variable measures the importance of the banking system relative to the economy of the country in a specific year. It is calculated as demand, time and saving deposits in deposit money banks as a share

[23] Note that the regression results do not change when using either of the two variables only or both together.

[24] Again, there is no material change in the regression results when using other thresholds.

of GDP from the financial development and structure dataset (as explained in Beck, Demirguc-Kunt & Levine, 2000). The ambiguous sign expectation results from similar explanations as for the above variables CON or BMC.

- Gross domestic product per capita in USD (GDPC): This is a measure of the health of a country’s economy in a specific year, implementing the influence of macroeconomic conditions on bank capital. The variable comes from the database described in The World Bank (2012). Again, the prediction of the sign for this (and the following) coefficient is ambiguous: a healthier economy could be related to banks being less risky and therefore having a lower Tier 1 ratio. Then again, a healthier country could be related to banks being more profitable and, as discussed before, profitability itself has an ambiguous sign prediction.
- Annual gross domestic product growth (GGDP): This variable measures the increase in the health of a country’s economy. The variable is based on the database described in The World Bank (2012).
- Bank z-score (BZS): This variable captures the probability of default of a country's banking system, taken from the financial development and structure dataset (as explained in Beck et al., 2000). It is calculated as the weighted average of the z-scores of a country's individual banks (the weights are based on the individual banks' total assets). The z-score divides a bank’s buffers (capitalisation and returns) by the volatility of those returns, that is, a lower z-score indicates a higher probability of default. At first glance, one expects that a banking system with a higher probability of default should per se be related to a lower Tier 1 ratio, since the ratio measures the capital puffer of banks. This would imply a positive sign for the coefficient. However, one could also argue that banks in a banking system with lower default probability (i.e. being in a more “comfortable” environment) do not need the same amount of regulatory capital or can have more risk-weighted assets than banks in banking systems with higher default probabilities. This argument would lead to a negative sign for the estimated

coefficient. Because of this ambiguity, there is no clear sign prediction for this variable.

- Inflation (INF): This is an additional macroeconomic variable measuring the influence of the price level on the capital ratios. The variable is based on the database described in The World Bank (2012). Hortlund (2005) finds inflation to have a negative impact on the capital ratios of Swedish banks. The explanation is that inflation automatically increases bank debt. Therefore, the prediction for the sign for this coefficient is negative.
- Crisis country (CRC): Since the data period of my study also covers the financial crisis, it might be of interest to implement an ex-post crisis variable. The dummy variable CRC takes the value 1 if a country suffered a bank crisis during the financial crisis and 0 otherwise. Bank crisis countries are the "systemic cases" according to Laeven and Valencia (2010). Presumably, the country experienced such a crisis because the banks were not sufficiently stable, that is, there is an expected negative relation to the Tier 1 ratio.

V.3.3. Regression Methodology

The application of panel data combined with the dynamic form of the regression, as shown in formula (V.4), is known as a dynamic panel data (DPD) model (see e.g. Baum, 2006). In applying such a model, one has to pay special attention to several challenges. Conventional estimation methods might lead to serious biases, as shown e.g. by Nickell (1981), in regard to the standard within-group estimator with fixed effects. These biases arise from various special features of DPD models:

- Problem related to autocorrelation caused by a lagged dependent variable: As formula (V.4) shows, the current Tier 1 ratio ($TIER1R_{i,t}$) is a function of the unobservable and time-invariant individual specific effect μ_i (assuming that $u_{i,t} = \mu_i + \varepsilon_{i,t}$,). μ_i could be correlated with other explanatory variables; in any case it follows that the previous year's Tier 1 ratio ($TIER1R_{i,t-1}$) is a function of μ_i (refer e.g. to Baltagi, 2008). That is, $TIER1R_{i,t-1}$ is correlated with the error term $u_{i,t} = \mu_i + \varepsilon_{i,t}$.[25] Even with the assumption of a non-autocorrelated error process – meaning that the process is i.i.d. (independently, identically distributed) – this might cause serious biases in the coefficient estimates. The problem is even more severe in the case of an autocorrelated process (Baum, 2006). As Hsiao (2007) states, the magnitude of possible biases in particular cannot be ignored in "large N, small T" studies; in other words, studies with a large number of individuals and a small number of time periods like the one used in my paper. For conventional estimation methods such as ordinary least squares (OLS), there are possibilities to correct for possible correlations between the error term and the other regressors (e.g. by eliminating the individual specific effect μ_i when using the within transformation). But, as Bond (2002) demonstrates, the correlation with the lagged dependent variable remains.

- Problem related to not strictly exogenous explanatory variables: I assume that the Tier 1 ratio is set based on various possible influence factors. It is a residual figure that results from various decisions made and circumstances given. From an economic point of view, it does not on the other hand make sense to assume that the ratio impacts vice versa on the explanatory variables. It is, for example, unlikely that the Tier 1 ratio in time t affects bank size in the same or in past periods. Therefore, one of the central assumptions of my paper is the exogeneity of the regressors.[26] Also from a methodological point of view, the use of not strictly exogenous explanatory variables would violate the necessary assumptions of the conventional estimation methods (see e.g. Greene, 2008). However, one could argue that some of the variables are predetermined, that is, shocks in the Tier 1 ratio in time t could have an impact on these variables in time t+1, t+2 etc. I assume that this might be the case for the bank-specific and the regulatory variables. For example, a positive shock to the Tier 1 ratios in a country could lead to less severe regulation in subsequent periods,

25 Note that in terms of this assumption there would also be autocorrelation in formula (V.2), since $v_{i,t} = \frac{\mu_i}{\lambda} + \frac{\varepsilon_{i,t}}{\lambda}$.

26 Apart from the economic logic, the various specification tests as discussed below do not show any evidence of endogeneity problems in my model.

since the higher ratios lead to less risk that has to be regulated. In any case, predetermination does not seem to make sense for the country-specific variables, since they are macroeconomically related – in most countries in the study, the banking sector is not of such importance that one could assume that a bank's Tier 1 ratio influences macroeconomic conditions.

There are two established methods for dealing with DPD models: the first method is the application of the bias-corrected least square dummy variables (LSDVC) presented by Kiviet (1995) for balanced panels and by Bruno (2005a) for unbalanced panels. This method corrects the bias caused by the presence of the explanatory lagged dependent variable. According to, for example, Judson and Owen (1999), the method seems to have some advantages in the case of a small population of individuals N. However, the advantages disappear in the case of a big population (Baltagi, 2008) and in the case of not strictly exogenous regressors (see Bruno, 2005b). Therefore, I found this method to be inadequate for my study, considering my dataset and the assumptions discussed above. The second method for dealing with DPD models is the use of generalised method of moments (GMM) estimators. They exist in the form of the "difference GMM" estimator as introduced by Arellano and Bond (1991), and in form of the "system GMM" estimator presented by Arellano and Bover (1995), as well as Blundell and Bond (1998).

The idea of the GMM estimators is based on the use of instrumental variables (iv, often simply called instruments). As Greene (2008) explains, instruments are variables that correlate with the explanatory variables, but not with the error term. Their appropriate integration into the regression leads to unbiased estimation results, even if the explanatory variables correlate with the error term. Anderson and Hsiao (1981) and Anderson and Hsiao (1982) propose this method for DPD models via a first differencing approach. Applied to my formula (V.4), the following expression (V.5) results:

$$\begin{aligned} \mathrm{TIER1R}_{i,t} - \mathrm{TIER1R}_{i,t-1} = {} & \lambda \sum_{k=0}^{K} \beta_k (D_{k,i,t} - D_{k,i,t-1}) \\ & + (1-\lambda)\,(\mathrm{TIER1R}_{i,t-1} - \mathrm{TIER1R}_{i,t-2}) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \end{aligned} \qquad \text{(V.5)}$$

As formula (V.5) shows, the individual specific effect μ_i in the error term $u_{i,t} = \mu_i + \varepsilon_{i,t}$ disappears and $TIER1R_{i,t-2}$ can be used as an instrument for ($TIER1R_{i,t-1}$ – $TIER1R_{i,t-2}$); the term is highly correlated with ($TIER1R_{i,t-1}$ – $TIER1R_{i,t-2}$) but not correlated with ($\varepsilon_{i,t}$ – $\varepsilon_{i,t-1}$) (see Baltagi, 2008). Briefly stated, differencing opens the possibility for constructing an instrument in the form of the lagged dependent variable, even if the error term process is not i.i.d. This leads to consistent parameter estimates (see Baum, 2006). In order to further increase efficiency, the GMM method uses additional information available by expanding the instrument set to include all the possible time periods (e.g. also using $TIER1R_{i,t-3}$ and further lags as instruments) and all the other endogenous, predetermined or exogenous variables (i.e. also using the various variables $D_{k,i,t}$ as instruments). The difference GMM method uses lagged levels of the explanatory variables as instruments for equations in first differences, while the system GMM also uses lagged differences of the explanatory variables for equations in levels, which again increases the number of possible utilisable instruments (Blundell & Bond, 1998).

My study applies the GMM method, since it allows for handling the potential autocorrelation and predetermination issues discussed above. However, GMM estimators also have limitations and it is important to pay attention to these. As is evident from the explanations above, the instrument count (i.e. the number of instrumental variables used in the regression) relative to the sample size can be quite high when using GMM. This might lead to problems related to the use of too many instruments (refer to the discussion in Roodman, 2009a); in short, GMM estimators could "generate results that at once are invalid and appear valid because of weakened specification tests" (Roodman, 2009a, p. 139). Further, although the residuals of the difference equation might possess first-order serial correlation by construction, GMM methods assume the absence of second-order serial correlation (see the discussion in Flannery & Hankins, 2013).

As discussed above, the GMM method requires a decision as to whether to use the difference GMM or the system GMM. My study uses the latter for its regressions, since it might improve precision and reduce finite sample bias better than to the former (see Wooldridge, 2010). Moreover, in contrast to the system GMM, the difference GMM has the weakness that it increases gaps in unbalanced panels[27] and eliminates time invariant explanatory variables (Roodman, 2009b). Consequently, the system GMM estimator seems to outperform the difference GMM estimator in numerous studies, as for example in Flannery and Hankins (2013). Yet one has to consider the additional constraints explained below when using the system GMM. Whatever the case, it is important to note that the results of the various variables discussed in section V.5 do not change substantially if I use the difference GMM instead of the system GMM; the difference is that, depending on the robustness regression applied, some coefficients become insignificant. This result can be expected, considering that the difference GMM is less precise than the system GMM as discussed above. However, it also indicates (together with the outcome of the specification tests) that there is no evidence that the use of the system GMM is not appropriate in my study.

Finally, GMM methods use either the one-step or the two-step estimator. Generally, the two-step estimator comes with efficiency gains (at least in the robust version according to Bond, 2002). However, my study applies the one-step estimator, as the regressions show no such efficiency gains when switching to the two-step version.

In order to address the various possible issues mentioned above, my study implements several specification tests and robustness checks:

- First, the Hansen tests for over-identification, as explained in Baum, Schaffer and Stillman (2003) and Baum (2006), controls the problem of too many instruments: “The test […] has a null hypothesis of correct model specification and valid overidentifying restrictions. A rejection calls either or both of those hypotheses into question” (Baum, 2006, pp. 200-201). However, as Roodman (2009a) points out, it is important to consider that instrument

[27] As Roodmann (2009b) notes, a further common transformation can avoid the gap problems caused by missing data in some years: the “forward orthogonal deviations” or “orthogonal deviations” as implemented by Arellano and Bover (1995). While the difference transformation subtracts the previous observation of a variable from the current one, the orthogonal deviation subtracts the average of all future observations. When applying this method as a robustness check (refer to section V.8.4), the only difference to the basis regression is that the coefficient on private monitoring (PRM) loses its significance, whereas the coefficient on the USD gross domestic product per capita (GDPC) becomes significantly positive.

proliferation violates the Hansen test.[28] Too many instruments could even lead to implausibly perfect p-values (probability-values) of 1.00. According to Roodman (2009b), there are no clear rules on what is a relatively safe number of instruments and the arbitrary rule of thumb to keep the number of instruments below the number of individuals appears quite generous. Therefore, I apply good practice in reporting and assessing the instrument count compared to the population. Moreover, I perform robustness checks in order to observe the changes in the results and in the test statistics when the instrument count changes. Finally, I use techniques for reducing the instrument count as described in Roodman (2009a).

- To observe the correlation process of the error term, my paper applies the serial correlation test according to Arellano and Bond (1991). The test analyses the first and second-order serial correlation of the residuals ("Arellano-Bond test for AR(1) in first differences" and "Arellano-Bond test for AR(2) in first differences" respectively). The null hypothesis states that there is no serial correlation of first order or second order respectively. The GMM estimator requires that the null hypothesis for second-order serial correlation must not be rejected.
- As mentioned above, the system GMM comes with an additional assumption: Roodman (2009b) describes that changes in the instrumenting variables are required to be uncorrelated with the individual fixed effects. Applied to a simple autoregressive process of order 1 (AR(1) process) in the example of Roodman (2009a), this requirement holds when the coefficient on the lagged dependent variable $(1 - \lambda)$ is smaller than 1 and the dependent variable converges to steady-state levels. Therefore, I will examine the estimated coefficient on the lagged dependent variable regarding its persistence. Additionally, as recommended by Bond (2002), I will examine the validity of the additional moment conditions by means

28 Hansen's (1982) statistic is similar to the Sargan statistic (Sargan, 1958). The latter is not weakened by too many instruments, but it requires homoscedastic errors. Since this cannot necessarily be assumed in the context of my paper, I do not use the Sargan statistic.

of the difference-in-Hansen test.[29] According to Baum (2006), this test allows for subsets of instruments to be checked by taking the differences of two Hansen test statistics: one computed from the fully efficient regression (i.e. using the whole set of over-identifying restrictions) and the other computed from an inefficient but consistent regression (i.e. removing a set of instruments from the list). The null hypothesis states that the specified variables are proper instruments and must therefore not be rejected.

- As suggested by Roodman (2009b), I include time dummies in the regression. They make it more likely that there will be no correlation across individuals in the disturbances, which is assumed by the autocorrelation test and the robust estimates of the coefficients' standard errors.
- Bond (2002) explains that the coefficient on the lagged dependent variable estimated with the GMM method usually lies between the estimated coefficient of the OLS (ordinary least squares) and FE (fixed effects) estimators. I will assess whether the regression results obtained are consistent with these properties.
- Lastly, my regression applies the robust estimator of the covariance matrix of the parameter estimates. This corrects the standard errors in the case of any heteroscedasticity or serial correlation in the errors (see Roodman, 2009b). Moreover, only the application of the robust option allows for the calculation of the Hansen and the difference-in-Hansen test statistic discussed above.

I calculate the regressions with the software STATA[30] using the GMM syntax "XTABOND2" by Roodman (2009b). Formula (V.6) shows the complete regression to estimate the coefficients $\lambda\beta_k$ of the dependent variable $TIER1R_{i,t}$:

[29] Note that equal to the Hansen test a high instrument count also weakens the difference-in-Hansen test (Roodmann, 2009a), underlining again the importance to correctly consider the number of instruments.

[30] "STATA® Data Analysis and Statistical Software" by StataCorp LP, Texas, USA.

$$\begin{aligned}\text{TIER1R}_{i,t} = {} & \lambda\beta_0 + (1-\lambda)\text{TIER1R}_{i,t-1} + \lambda\beta_1\text{REST}_{j,t} + \\ & \lambda\beta_2\text{RBP}_{j,t} + \lambda\beta_3\text{CAPR}_{j,t} + \lambda\beta_4\text{ERQ}_{j,t} + \lambda\beta_5\text{PRM}_{j,t} + \\ & \lambda\beta_6\text{OWN}_{j,t} + \lambda\beta_7\text{LTA}_{i,t} + \lambda\beta_8\text{LLRGL}_{i,t} + \lambda\beta_9\text{ROAA}_{i,t} + \\ & \lambda\beta_{10}\text{DIV}_{i,t} + \lambda\beta_{11}\text{BASA}_{i,t} + \lambda\beta_{12}\text{SYS}_{i,t} + \lambda\beta_{13}\text{CON}_{j,t} + \\ & \lambda\beta_{14}\text{BMC}_{j,} + \lambda\beta_{15}\text{BGDP}_{j,t} + \lambda\beta_{16}\text{GDPC}_{j,t} + \lambda\beta_{17}\text{GGDP}_{j,t} + \\ & \lambda\beta_{18}\text{BZS}_{j,t} + \lambda\beta_{19}\text{INF}_{j,t} + \lambda\beta_{20}\text{CRC}_{j} + \nu_t + u_{i,t}\end{aligned} \qquad \text{(V.6)}$$

As mentioned above, i is the numbering for the individual banks, ranging from 1 to N, t is the numbering for the individual years, ranging from 1 to T and j is the numbering for the various countries, ranging from 1 to J. The regulatory variables for country j in year t are $REST_{j,t}$, $RBP_{j,t}$, $CAPR_{j,t}$, $ERQ_{j,t}$, $PRM_{j,t}$ and $OWN_{j,t}$, the bank-specific control variables for bank i in year t are $LTA_{i,t}$, $LLRGL_{i,t}$, $ROAA_{i,t}$, $DIV_{i,t}$, $BASA_{i,t}$ and $SYS_{i,t}$ and the country-specific control variables for country j in year t are $CON_{j,t}$, $BMC_{j,t}$, $BGDP_{j,t}$, $GDPC_{j,t}$, $GGDP_{j,t}$, $BZS_{j,t}$, $INF_{j,t}$ and CRC_j (the last variable is the same for all years T in a country j). The time dummy ν_t for every year t controls for the unobserved time-fixed effects and $u_{i,t}$ denotes the disturbance term.[31]

Following the wording of Roodman (2009b), the lagged Tier 1 ratio enters the regression as an endogenous variable ("gmm style instrument with two lags"), all country-specific variables except the regulatory variables enter as strictly exogenous ("iv style instruments") and the rest of the variables enter as predetermined ("gmm style instruments with one lag"). The use of the collapse option[32] of XTABOND2 and the limitation to three lag periods aim to reduce the risk of too many instruments. As already mentioned, the addition of the robust option corrects the standard

[31] The paper also uses the term L.TIER1 (L. stands for "lagged") for the lagged Tier 1 ratio $TIER1R_{i,t-1}$.

[32] The collapse option creates only one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance. Together with the lag limitation, this strongly decreases the number of instruments, which otherwise would be quite high and would cause the problems discussed.
Implementing the regression without lag limits or, by contrast, with maximally restricted lags, does not change the regression results significantly, except that in the first case the USD gross domestic product per capita (GDPC) becomes significantly positive (however, as expected at the cost of a weak Hansen test diagnostic).

errors in the case of any heteroscedasticity or serial correlation in the errors.

Before discussing the detailed results of this regression in section V.5, the next section, section V.4, highlights the most important descriptive statistics of the dataset.

V.4. Descriptive Statistics

The original dataset contains 44 141 observations for the years 2000 to 2011. After eliminating the observations with missing variables (including those with no lagged Tier 1 ratio), 15 944 observations remain. All observations for the countries Chile and Romania (233 and 110 respectively) drop completely, since they do not have data for the bank deposits per gross domestic product (BGDP) and for the bank z-score (BZS).

The observations are subdivided into 2 772 banks, each with 1 to 11 useable observations per bank.[33] There is a minimum of 1 037 and a maximum of 1 878 observations per year; therefore the relative frequency ranges from 7 to 12% per year and the observations are quite evenly distributed (refer to Table V.1).

The USA accounts for more than half of the total observations (8 747 observations or approx. 55%) and Japan follows with 1 201 observations (approx. 8%). No other country shows more than 5% of the observations. The United Arab Emirates is the least represented with 17 observations (refer to Table V.1).

[Continued on next page]

[33] Since the regression loses the first observation year (it does not have a lagged Tier 1 ratio), the descriptive statistics only consider the 11 years from 2001 to 2011.

Table V.1: Observations per country and per year

Observations per country						**Observations per year**		
Country	**Observations**	**%**	**Country**	**Observations**	**%**	**Year**	**Observations**	**%**
ARE	17	0%	ITA	600	4%	2001	1'037	7%
AUS	164	1%	JPN	1'201	8%	2002	1'060	7%
AUT	218	1%	KOR	154	1%	2003	1'129	7%
BEL	120	1%	LTU	42	0%	2004	1'063	7%
BGR	49	0%	LUX	53	0%	2005	1'099	7%
CAN	230	1%	LVA	30	0%	2006	1'836	12%
CHE	188	1%	MEX	120	1%	2007	1'797	11%
CHN	105	1%	MLT	22	0%	2008	1'838	12%
CYP	50	0%	NLD	238	1%	2009	1'878	12%
CZE	31	0%	NOR	85	1%	2010	1'615	10%
DEU	332	2%	NZL	58	0%	2011	1'592	10%
DNK	316	2%	POL	66	0%	**Total**	**15'944**	**100%**
ESP	523	3%	PRT	121	1%	**Max:**	**1'878**	
EST	27	0%	RUS	428	3%	**Min:**	**1'037**	
FIN	79	0%	SGP	36	0%			
FRA	306	2%	SVK	37	0%			
GBR	354	2%	SVN	67	0%			
GRC	84	1%	SWE	119	1%			
HKG	165	1%	TUR	61	0%			
HUN	61	0%	USA	8'747	55%			
IRL	95	1%	**Total**	**15'944**	**100%**			
ISL	41	0%	**Max:**	**8'747**				
ISR	104	1%	**Min:**	**17**				

Statistics per country:
ARE (United Arab Emirates), AUS (Australia), AUT (Austria), BEL (Belgium), BGR (Bulgaria), CAN (Canada), CHE (Switzerland), CHN (China), CYP (Republic of Cyprus), CZE (Czech Republic), DEU (Germany), DNK (Denmark), ESP (Spain), EST (Estonia), FIN (Finland), FRA (France), GBR (United Kingdom), GRC (Greece), HKG (Hong Kong), HUN (Hungary), IRL (Ireland), ISL (Iceland), ISR (Israel), ITA (Italy), JPN (Japan), KOR (Republic of Korea), LTU (Lithuania), LUX (Luxembourg), LVA (Latvia), MEX (Mexico), MLT (Malta), NLD (Netherlands), NOR (Norway), NZL (New Zealand), POL (Poland), PRT (Portugal), RUS (Russian Federation), SGP (Singapore), SVK (Slovakia), SVN (Slovenia), SWE (Sweden), TUR (Turkey), USA (United States of America)

Source: Own calculations.

As is evident in Table V.2, almost every variable significantly correlates with the other variables at least at the 10% significance level. However, the correlation coefficients between the various explanatory variables are quite low. Three variable pairs are correlated by just slightly more than 0.5: the regulatory body power index (RBP) with the restriction index (REST), the bank z-score (BZS) with the dummy for crisis countries (CRC) and the dummy for crisis countries with the USD gross domestic product per capita (GDPC). The correlation between the Tier 1 ratio and its lagged value and between the bank's total assets to the sum of all banks' total assets of a country (BASA) and the dummy variable for system relevance (SYS) are the only correlations greater than 0.8.

Table V.2: Correlations between variables

	TIER1R	L.TIER1R	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
TIER1R	1.00 ***																					
L.TIER1R	0.83 ***	1.00 ***																				
REST	-0.05 ***	-0.04 ***	1.00 ***																			
RBP	-0.02	-0.01	0.53 ***	1.00 ***																		
CAPR	-0.02 **	-0.02 **	0.05 ***	0.10 ***	1.00 ***																	
ERQ	0.05 ***	0.06 ***	0.13 ***	0.20 ***	0.14 ***	1.00 ***																
PRM	-0.02 ***	-0.03 ***	0.19 ***	0.09 ***	-0.03 ***	-0.06 ***	1.00 ***															
OWN	0.09 ***	0.08 ***	0.18 ***	0.11 ***	0.05 ***	0.16 ***	0.34 ***	1.00 ***														
LTA	-0.20 ***	-0.21 ***	-0.33 ***	-0.33 ***	-0.17 ***	-0.28 ***	0.04 ***	0.00	1.00 ***													
LLRGL	0.02 **	0.01	-0.05 ***	-0.16 ***	0.02 **	-0.06 ***	0.07 ***	0.11 ***	0.03 ***	1.00 ***												
ROAA	0.15 ***	0.15 ***	-0.05 ***	0.00	-0.02 **	0.02 **	-0.01	-0.03 ***	-0.04 ***	-0.15 ***	1.00 ***											
DIV	-0.06 ***	-0.06 ***	0.14 ***	0.22 ***	0.04 ***	0.00	-0.03 ***	-0.15 ***	0.02 ***	-0.15 ***	0.17 ***	1.00 ***										
BASA	-0.05 ***	-0.05 ***	-0.19 ***	-0.15 ***	-0.08 ***	-0.17 ***	-0.02 ***	0.08 ***	0.43 ***	0.08 ***	0.02 ***	-0.01	1.00 ***									
SYS	-0.04 ***	-0.04 ***	-0.16 ***	-0.12 ***	-0.08 ***	-0.12 ***	-0.01	0.08 ***	0.37 ***	0.06 ***	0.02 **	0.02 **	0.84 ***	1.00 ***								
CON	0.02 **	0.01	-0.35 ***	-0.37 ***	-0.08 ***	-0.19 ***	0.00	0.11 ***	0.23 ***	0.15 ***	0.03 ***	-0.19 ***	0.39 ***	0.33 ***	1.00 ***							
BMC	0.01	0.02 **	0.08 ***	0.34 ***	-0.10 ***	0.17 ***	-0.21 ***	-0.03 ***	-0.19 ***	-0.14 ***	0.08 ***	0.10 ***	0.03 ***	0.02 ***	-0.04 ***	1.00 ***						
BGDP	-0.01	-0.03 ***	-0.13 ***	-0.06 ***	-0.19 ***	-0.33 ***	0.11 ***	0.00	0.30 ***	-0.06 ***	-0.12 ***	0.05 ***	0.02 ***	0.02 **	0.04 ***	0.02 ***	1.00 ***					
GDPC	0.01	0.00	0.24 ***	0.37 ***	0.12 ***	0.24 ***	-0.10 ***	0.12 ***	-0.19 ***	-0.29 ***	-0.11 ***	0.09 ***	-0.24 ***	-0.18 ***	-0.27 ***	0.45 ***	0.15 ***	1.00 ***				
GGDP	0.03 ***	0.04 ***	-0.03 ***	-0.01	-0.10 ***	-0.04 ***	0.15 ***	0.22 ***	0.03 ***	-0.04 ***	0.25 ***	0.05 ***	0.10 ***	0.08 ***	0.10 ***	0.05 ***	-0.18 ***	-0.27 ***	1.00 ***			
BZS	0.03 ***	0.04 ***	0.37 ***	0.45 ***	0.21 ***	0.31 ***	-0.06 ***	0.08 ***	-0.41 ***	-0.18 ***	0.04 ***	0.10 ***	-0.26 ***	-0.19 ***	-0.47 ***	0.27 ***	-0.31 ***	0.39 ***	0.01	1.00 ***		
INF	0.04 ***	0.06 ***	-0.15 ***	-0.13 ***	0.16 ***	0.09 ***	0.00	0.05 ***	-0.12 ***	0.17 ***	0.16 ***	-0.05 ***	0.06 ***	0.04 ***	0.17 ***	-0.04 ***	-0.43 ***	-0.36 ***	0.37 ***	-0.09 ***	1.00 ***	
CRC	-0.01	-0.01	0.24 ***	0.50 ***	0.16 ***	0.34 ***	-0.21 ***	-0.09 ***	-0.40 ***	-0.22 ***	-0.03 ***	0.14 ***	-0.28 ***	-0.22 ***	-0.45 ***	0.42 ***	-0.29 ***	0.60 ***	-0.13 ***	0.52 ***	-0.07 ***	1.00 ***

Correlation coefficients between variables for all possible combinations.

**** shows a correlation, which is significant at the 1% level, ** is significant at the 5% level and * is significant at the 10% level.*

The variables are: TIER1R (Tier 1 ratio), L.TIER1R (lagged Tier 1 ratio), REST (restriction), RBP (regulatory body Power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance), CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country).

Source: Own calculations.

According to this analysis, correlations between the variables should not cause serious regression biases.[34]

Table V.3 shows the means and standard deviations (sd) of the various variables classified by country. The mean Tier 1 ratio is 12.9% at a standard deviation of 17.6%. Compared to the other countries, Canada has the highest mean of 50.1% caused by some outliers.[35] Japan shows the lowest mean of 8.1%. Accordingly, the mean Tier 1 ratio is considerably higher than the regulatory minimum ratio of 4% stipulated in the Basel rules. As is evident from Table V.4, differences in the mean Tier 1 ratios between various countries are significant at least at the 10% level for approx. two-thirds (584) of the possible differences.

Comparing the average Tier 1 ratios across the 11 observation years (tables not displayed) reveals that the lowest mean Tier 1 ratio across all banks was 12.00% in 2008 (i.e. at the summit of the financial crisis). This is significantly lower than the means for the years 2011 (14.28%, the highest value for all observation years), 2010 (13.65%) and 2004 (13.51%).[36] The high values in the last two years of the observation period suggest that the crisis resulted in banks having higher Tier 1 ratios. The significant mean differences for the various years confirm that it makes sense to include time dummies in the regressions.[37]

34 Performing six separate basis regressions, each excluding one of the above-mentioned six variables, confirms this expectation; that is, there are no substantial changes in the regression results.

35 A robustness check, which discretionarily eliminates all negative Tier 1 ratios and all Tier 1 ratios above a value of 700%, reveals that outliers do not influence the regression results (refer to section V.8.4).

36 The difference is significant at the 1%, 1% and 5% levels respectively.

37 A regression with just the time dummies on the Tier 1 ratios results in a significant F-test value and additionally supports this statement.

Table V.3: Mean and standard deviation (sd) of variables per country

		TIER1R	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
ARE	Mean	17.6	10.0	10.0	5.0	8.0	10.0	1.0	9.4	5.5	1.4	0.8	5.8	0.2	1.0	2.8	57.8	45 653	4.9	22.5	0.9	0.0
	SD	5.9	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.4	1.0	0.4	6.2	0.4	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
AUS	Mean	10.4	5.6	10.4	2.9	7.6	9.5	1.2	10.2	0.9	0.9	0.7	5.6	0.3	0.9	2.0	81.0	39 319	2.8	11.1	3.0	0.0
	SD	4.3	0.6	1.3	0.8	0.5	1.2	0.4	1.9	1.0	1.2	0.5	7.5	0.4	0.3	0.3	13.5	12 947	0.9	2.6	0.8	0.0
AUT	Mean	13.8	3.1	9.8	2.8	7.7	6.6	0.3	10.1	2.6	0.4	0.4	3.8	0.1	0.1	5.7	91.6	43 017	1.6	27.7	2.1	1.0
	SD	21.7	0.9	1.0	1.7	0.5	0.9	0.5	1.3	2.0	0.9	0.5	5.5	0.4	0.3	0.4	5.7	7 116	2.4	6.9	0.9	0.0
BEL	Mean	17.2	3.8	11.0	3.4	7.7	7.5	0.3	10.8	0.8	0.5	0.6	6.1	0.3	0.9	2.7	98.7	40 254	1.3	5.9	2.2	1.0
	SD	15.2	0.7	0.0	1.3	0.5	1.0	0.5	2.2	1.2	0.8	0.5	7.3	0.4	0.4	0.2	6.3	7 160	1.8	1.5	1.3	0.0
BGR	Mean	13.5	5.3	10.0	3.7	8.0	8.4	0.4	7.5	4.1	1.5	0.3	8.0	0.3	1.0	1.3	50.2	5 527	2.6	16.6	5.2	0.0
	SD	8.2	1.5	0.1	1.0	0.0	0.5	0.5	1.1	2.9	0.9	0.5	8.1	0.4	0.0	0.3	11.3	1 610	4.1	1.4	3.0	0.0
CAN	Mean	50.1	3.9	8.4	2.0	8.0	7.5	1.0	8.1	1.4	1.4	0.4	2.9	0.2	0.2	2.0	136.8	34 335	2.3	21.3	2.2	0.0
	SD	121.5	0.9	1.5	0.0	0.0	1.4	0.0	3.3	4.6	4.4	0.5	5.4	0.4	0.4	0.2	14.0	7 959	0.8	1.6	0.3	0.0
CHE	Mean	17.8	3.3	11.9	3.2	8.0	8.2	0.6	10.4	0.9	0.9	0.6	4.6	0.2	1.0	9.3	130.9	57 615	1.7	7.4	0.8	0.0
	SD	10.2	1.6	2.1	1.1	0.0	0.4	0.5	2.1	1.4	2.2	0.5	9.3	0.4	0.0	0.8	8.9	12 860	1.7	1.5	0.7	0.0
CHN	Mean	10.5	6.0	5.4	2.2	3.8	5.4	0.6	11.3	2.3	1.2	0.6	4.4	0.2	0.2	0.0	47.5	4 242	10.0	19.4	3.5	0.0
	SD	2.9	5.5	5.0	2.0	3.5	5.0	0.6	2.1	0.7	0.3	0.5	6.8	0.4	0.4	0.0	3.6	939	1.3	2.0	2.5	0.0
CYP	Mean	14.3	7.0	10.5	3.1	5.0	8.2	0.5	8.7	7.1	0.7	0.3	15.8	0.6	1.0	8.4	208.6	26 795	2.3	3.8	2.5	0.0
	SD	13.7	0.9	1.3	1.4	2.2	0.6	0.5	1.9	3.6	3.5	0.4	14.8	0.5	0.0	0.8	33.1	4 869	2.3	1.4	1.3	0.0
CZE	Mean	10.8	7.8	8.2	2.5	8.0	8.4	0.1	9.2	4.5	1.2	0.6	17.7	0.6	1.0	1.0	60.7	13 632	3.2	8.7	2.4	0.0
	SD	2.3	0.7	1.2	0.5	0.0	0.8	0.2	1.7	3.5	0.6	0.5	12.4	0.5	0.0	0.1	1.8	4 769	3.8	0.9	1.7	0.0
DEU	Mean	9.6	2.8	9.0	2.1	6.7	7.6	0.0	11.7	2.0	0.2	0.5	2.8	0.0	0.2	1.0	104.7	36 719	1.2	11.3	1.6	1.0
	SD	4.4	0.9	1.0	1.1	1.0	0.6	0.0	1.5	2.1	0.7	0.5	3.7	0.2	0.4	0.1	8.6	6 419	2.7	1.8	0.7	0.0
DNK	Mean	12.2	5.5	9.0	2.2	8.0	7.8	0.2	8.4	3.0	0.6	0.3	3.2	0.1	1.0	6.6	56.3	50 103	0.5	14.7	2.1	1.0
	SD	4.7	0.6	1.1	1.0	0.0	0.8	0.4	2.0	4.4	1.7	0.5	8.0	0.3	0.0	1.0	6.9	10 152	2.5	2.5	0.6	0.0
ESP	Mean	9.5	2.9	9.1	4.8	7.6	8.7	0.2	10.0	2.4	0.7	0.5	1.9	0.0	0.4	1.8	114.3	26 883	1.8	23.7	2.8	0.0
	SD	4.0	0.7	1.0	0.4	0.5	0.5	0.6	1.4	1.0	0.6	0.5	4.5	0.2	0.5	0.2	31.1	6 335	2.5	1.6	1.3	0.0
EST	Mean	13.2	3.1	12.0	2.6	8.0	7.7	0.1	8.4	2.5	1.4	0.1	37.5	0.8	1.0	4.4	40.5	11 420	3.5	7.5	4.1	0.0
	SD	5.3	1.9	0.9	1.2	0.0	0.7	0.4	1.6	2.3	1.6	0.3	30.5	0.4	0.0	0.7	10.6	4 614	7.5	2.3	2.9	0.0
FIN	Mean	12.2	4.0	7.9	1.1	6.6	7.4	0.2	10.0	0.4	0.7	0.5	12.4	0.3	1.0	2.7	53.3	40 172	1.6	17.8	1.7	0.0
	SD	4.8	0.9	1.0	1.2	1.4	1.9	0.4	1.6	0.5	0.6	0.5	17.2	0.5	0.0	0.3	6.9	8 512	4.0	7.1	1.3	0.0
FRA	Mean	12.6	4.3	9.1	3.5	6.7	7.9	0.2	11.1	3.6	0.8	0.6	2.5	0.1	0.0	2.5	70.1	34 687	1.2	16.1	1.7	0.0
	SD	12.3	1.9	1.0	1.4	0.7	0.9	0.4	2.2	6.2	2.1	0.5	3.7	0.3	0.0	0.1	6.6	7 266	1.6	2.9	0.6	0.0
GBR	Mean	12.5	0.1	8.0	3.0	8.0	8.5	0.0	10.6	1.7	0.5	0.5	1.8	0.0	0.0	2.7	129.9	36 254	1.3	10.6	2.0	1.0
	SD	11.0	0.3	1.0	0.0	0.0	0.5	0.0	2.2	4.1	0.8	0.5	3.2	0.2	0.0	0.1	23.6	6 641	2.7	5.0	0.8	0.0

		TIER1R	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
GRC	Mean	9.7	5.0	8.7	2.4	7.0	8.4	0.2	10.1	4.7	-0.7	0.4	9.3	0.4	1.0	1.3	89.3	26 016	0.1	1.8	3.3	0.0
	SD	4.9	0.0	1.7	0.5	0.0	0.8	0.4	1.2	4.5	3.5	0.5	8.6	0.5	0.0	0.1	9.8	3 458	4.0	1.8	1.1	0.0
HKG	Mean	14.0	0.5	4.4	1.4	3.1	4.2	0.3	9.9	0.8	1.0	0.7	4.4	0.1	1.0	5.9	275.8	29 769	4.5	11.5	2.2	0.0
	SD	7.1	0.5	4.7	1.5	3.3	4.5	0.4	1.7	1.0	1.1	0.5	7.9	0.3	0.0	0.4	26.4	2 930	3.4	1.6	1.9	0.0
HUN	Mean	10.8	6.3	11.8	4.4	7.9	8.1	0.2	9.1	3.8	0.9	0.4	12.1	0.5	1.0	1.6	43.0	11 270	1.8	15.7	5.5	0.0
	SD	5.0	1.5	0.4	0.5	0.3	0.8	0.4	0.9	3.4	1.5	0.5	9.2	0.5	0.0	0.2	4.1	2 940	3.3	1.6	1.8	0.0
IRL	Mean	13.5	3.6	10.4	2.6	5.1	8.6	0.2	10.9	2.5	-0.5	0.4	7.3	0.3	0.8	5.1	93.3	48 775	2.0	3.3	2.3	1.0
	SD	11.3	0.5	2.3	0.5	3.9	0.5	0.4	1.2	5.7	4.3	0.5	7.3	0.5	0.4	1.0	14.2	8 159	4.2	1.9	2.8	0.0
ISL	Mean	14.3	5.1	8.4	3.0	7.9	7.5	0.5	8.1	3.4	2.5	0.5	15.2	0.4	1.0	37.7	70.4	47 446	3.6	-0.1	5.5	1.0
	SD	6.9	1.3	1.5	1.0	0.3	0.5	0.5	1.6	4.3	2.9	0.5	16.1	0.5	0.0	12.7	20.5	12 507	4.1	1.2	2.3	0.0
ISR	Mean	9.1	9.3	7.9	3.5	4.1	9.1	0.1	9.1	3.4	0.4	0.3	9.3	0.3	1.0	1.7	86.3	21 830	3.0	24.2	2.2	0.0
	SD	4.1	0.7	1.0	0.9	1.9	0.3	0.3	1.6	2.1	0.7	0.5	10.2	0.5	0.0	0.3	2.8	4 488	2.4	2.3	1.9	0.0
ITA	Mean	11.7	6.4	7.8	2.2	8.0	8.4	0.2	9.4	3.0	0.5	0.2	1.6	0.0	0.5	1.3	63.3	31 327	0.3	13.6	2.2	0.0
	SD	12.2	1.3	2.1	0.4	0.0	0.9	0.4	1.7	2.6	1.3	0.4	4.1	0.2	0.5	0.1	13.8	5 597	2.2	4.8	0.7	0.0
JPN	Mean	8.1	7.8	10.3	2.1	6.9	8.8	0.0	10.1	2.5	0.0	0.8	0.6	0.0	0.1	1.4	194.6	35 063	0.4	9.9	-0.2	0.0
	SD	5.4	0.9	0.7	0.3	0.3	0.6	0.0	1.3	3.9	1.1	0.4	1.7	0.1	0.3	0.0	7.6	2 442	2.3	2.3	0.7	0.0
KOR	Mean	9.1	8.0	9.2	2.3	7.7	10.0	0.7	11.0	2.0	0.8	0.7	5.4	0.1	0.2	0.4	64.9	17 305	4.1	5.9	3.3	0.0
	SD	2.5	2.0	1.5	0.9	0.5	0.8	0.5	0.9	0.8	0.5	0.5	3.8	0.3	0.4	0.1	3.8	3 764	1.9	1.7	0.7	0.0
LTU	Mean	10.5	6.9	11.9	2.4	8.0	8.1	0.5	7.6	3.8	0.1	0.1	13.9	0.5	1.0	2.3	33.3	10 726	3.0	5.3	4.6	0.0
	SD	3.4	1.5	1.3	1.1	0.0	1.0	0.9	1.3	3.2	1.7	0.4	11.4	0.5	0.0	0.2	6.7	3 083	7.9	1.8	3.4	0.0
LUX	Mean	13.1	5.0	11.1	2.5	8.0	8.2	1.2	10.6	1.3	0.4	0.4	10.7	0.5	0.6	33.8	343.5	93 442	2.2	32.4	2.4	1.0
	SD	8.4	2.0	1.0	0.8	0.0	0.4	0.4	0.8	1.3	1.0	0.5	6.9	0.5	0.5	5.6	35.8	23 457	3.5	2.7	0.9	0.0
LVA	Mean	10.9	3.8	10.4	3.3	8.0	7.9	0.3	7.7	5.8	-0.2	0.2	13.5	0.6	1.0	6.5	35.0	10 655	0.5	3.2	5.9	1.0
	SD	3.8	0.4	0.6	1.1	0.0	0.7	0.5	1.0	6.7	2.8	0.4	9.7	0.5	0.0	1.5	6.7	3 455	9.9	0.7	5.4	0.0
MEX	Mean	14.7	4.0	9.5	2.5	8.0	10.0	1.0	9.0	4.9	1.3	0.4	2.8	0.1	0.0	0.4	23.8	9 228	1.7	24.2	4.3	0.0
	SD	4.6	2.0	1.5	0.5	0.0	0.0	1.0	1.5	3.2	1.1	0.5	3.6	0.3	0.0	0.0	1.8	814	4.4	5.2	0.8	0.0
MLT	Mean	15.6	6.6	12.6	2.6	8.0	8.1	0.6	7.8	5.8	1.1	0.7	25.1	0.6	1.0	16.9	138.2	16 163	1.6	16.2	2.4	0.0
	SD	7.0	0.5	0.7	0.5	0.0	0.3	0.5	1.2	6.3	0.8	0.5	18.3	0.5	0.0	4.1	4.9	3 893	2.3	4.7	0.9	0.0
NLD	Mean	13.8	1.7	9.0	3.2	7.6	8.1	0.2	10.1	0.8	0.4	0.4	3.0	0.1	1.0	2.6	114.6	42 075	1.3	8.4	1.9	1.0
	SD	10.8	0.5	1.1	0.5	0.5	0.9	0.4	2.0	1.5	1.1	0.5	6.0	0.3	0.0	0.4	14.8	8 319	2.0	6.5	0.8	0.0
NOR	Mean	11.1	1.5	6.9	3.8	6.1	6.1	0.8	8.6	1.1	1.0	0.6	4.3	0.1	1.0	7.7	49.9	60 996	2.6	24.5	1.6	0.0
	SD	5.8	0.9	3.8	2.1	3.4	3.4	0.4	1.6	0.8	1.5	0.5	8.7	0.3	0.0	1.0	1.1	8 832	1.1	1.8	0.8	0.0
NZL	Mean	8.7	0.6	7.2	0.2	6.6	10.7	0.1	9.3	0.8	1.1	0.5	15.4	0.7	1.0	2.8	81.5	25 763	2.1	19.5	2.6	0.0
	SD	1.6	1.7	0.4	0.6	0.5	0.6	0.3	1.9	0.9	0.6	0.5	10.7	0.5	0.0	0.5	6.9	5 829	2.1	6.5	0.7	0.0

		TIER1R	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
POL	Mean	11.9	6.0	8.8	2.6	7.5	8.0	0.3	9.6	5.3	1.4	0.5	7.9	0.2	0.1	0.5	42.3	11 186	4.3	11.4	3.2	0.0
	SD	3.1	3.4	0.9	0.9	0.5	0.0	0.5	0.7	3.4	0.7	0.5	5.4	0.4	0.2	0.1	4.2	2 453	1.7	0.8	1.2	0.0
PRT	Mean	10.1	7.0	11.9	3.5	7.0	6.5	0.2	9.8	2.4	0.7	0.6	7.4	0.3	1.0	2.3	99.8	19 542	0.4	16.8	2.3	0.0
	SD	6.1	2.0	0.2	0.8	0.0	0.5	0.4	1.5	1.9	0.7	0.5	7.8	0.4	0.0	0.3	16.3	3 626	1.7	4.7	1.4	0.0
RUS	Mean	16.1	3.7	7.3	3.4	7.7	8.5	0.3	8.0	6.8	1.6	0.4	1.3	0.0	0.8	0.6	27.9	8 348	4.5	7.7	11.0	0.0
	SD	9.2	0.4	1.1	0.9	0.4	0.5	0.4	1.5	4.5	3.9	0.5	3.4	0.2	0.4	0.1	7.2	3 286	4.9	1.2	2.9	0.0
SGP	Mean	18.7	6.4	10.7	2.9	8.0	10.3	0.1	10.6	3.6	1.0	0.9	16.5	0.8	1.0	3.6	105.4	29 868	4.5	21.4	1.9	0.0
	SD	17.5	0.9	1.1	0.3	0.0	0.6	0.3	1.9	2.0	0.3	0.3	9.1	0.4	0.0	0.4	8.9	5 762	4.0	5.2	2.2	0.0
SVK	Mean	14.4	7.8	10.9	2.6	8.0	6.5	0.3	8.8	5.8	1.1	0.6	18.9	0.7	1.0	1.7	52.2	14 134	4.4	8.1	3.6	0.0
	SD	6.7	1.4	0.8	0.5	0.0	0.9	0.5	0.8	5.6	0.7	0.5	10.7	0.5	0.0	0.2	2.9	3 854	4.4	0.9	2.1	0.0
SVN	Mean	9.6	6.4	12.3	4.7	7.6	7.9	0.6	8.1	6.5	0.6	0.6	13.8	0.3	1.0	5.6	51.8	19 289	2.5	13.9	3.9	0.0
	SD	2.5	1.2	0.5	0.5	0.5	0.3	0.5	1.0	2.8	1.0	0.5	14.5	0.5	0.0	0.8	3.2	5 283	3.8	1.7	2.4	0.0
SWE	Mean	16.7	4.6	7.0	2.0	7.0	7.0	0.0	10.0	0.7	0.7	0.3	5.8	0.2	1.0	3.2	46.6	43 268	2.0	19.6	1.3	0.0
	SD	25.5	1.5	1.0	1.0	1.0	0.0	0.0	1.8	2.5	0.8	0.5	8.6	0.4	0.0	0.3	5.4	5 559	3.0	2.0	1.2	0.0
TUR	Mean	18.9	4.3	12.3	5.0	7.3	9.0	0.3	8.7	4.0	1.9	0.4	3.6	0.1	0.0	0.5	36.2	7 444	7.9	12.6	12.1	0.0
	SD	12.1	1.9	1.0	0.3	0.5	0.4	0.5	1.6	4.0	1.4	0.5	4.1	0.3	0.0	0.1	7.2	2 263	2.2	9.5	8.2	0.0
USA	Mean	12.8	7.5	11.5	3.3	7.9	8.2	0.2	7.4	1.6	0.6	0.7	0.1	0.0	0.0	5.3	74.1	44 107	1.3	23.5	2.4	1.0
	SD	7.9	0.8	0.5	0.8	0.2	0.4	0.4	1.5	1.1	1.7	0.4	0.4	0.0	0.0	1.9	6.1	3 867	2.1	1.7	1.2	0.0
Total	Mean	**12.9**	**6.3**	**10.4**	**3.1**	**7.6**	**8.2**	**0.3**	**8.5**	**2.1**	**0.6**	**0.6**	**1.9**	**0.1**	**0.2**	**4.3**	**89.1**	**38 680**	**1.5**	**19.0**	**2.5**	**0.8**
	SD	**17.6**	**2.3**	**1.9**	**1.1**	**1.1**	**1.1**	**0.5**	**2.1**	**2.7**	**1.8**	**0.5**	**5.7**	**0.2**	**0.4**	**3.5**	**46.0**	**12 122**	**2.7**	**7.0**	**2.2**	**0.4**

Mean and Standard deviation per country:
ARE (United Arab Emirates), AUS (Australia), AUT (Austria), BEL (Belgium), BGR (Bulgaria), CAN (Canada), CHE (Switzerland), CHN (China), CYP (Republic of Cyprus), CZE (Czech Republic), DEU (Germany), DNK (Denmark), ESP (Spain), EST (Estonia), FIN (Finland), FRA (France), GBR (United Kingdom), GRC (Greece), HKG (Hong Kong), HUN (Hungary), IRL (Ireland), ISL (Iceland), ISR (Israel), ITA (Italy), JPN (Japan), KOR (Republic of Korea), LTU (Lithuania), LUX (Luxembourg), LVA (Latvia), MEX (Mexico), MLT (Malta), NLD (Netherlands), NOR (Norway), NZL (New Zealand), POL (Poland), PRT (Portugal), RUS (Russian Federation), SGP (Singapore), SVK (Slovakia), SVN (Slovenia), SWE (Sweden), TUR (Turkey), USA (United States of America)

and per variable:
TIER1R (Tier 1 ratio), REST (Restriction), RBP (Regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (Private monitoring), OWN (Ownership), LTA (Log of total assets), LLRGL (Ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (Dividend dummy), BASA (Bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance), CON (bank concentration), BMC (Banks per million capita), BGDP (Bank deposits per gross domestic product), GDPC (Gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (Bank Z-score), INF (Inflation), CRC (Crisis country).

Source: Own calculations.

Table V.4: Significance of mean Tier 1 ratio differences between countries

	ARE	AUS	AUT	BEL	BGR	CAN	CHE	CHN	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HKG	HUN	IRL	ISL
ARE		***			*			***		***	***	***	***	**	***	*	*	***	**	***		*
AUS			**	***	***	***	***		***		*	***	**	***	***	**	**		***		***	***
AUT						***	**				***		***					*				
BEL						***		***		**	***	***	***		***	***	***	***	**	***	*	
BGR						**	***	***		*	***	*	***					***		**		
CAN							***	***	**	*	***	***	***		***	***	***	***	***	**	***	*
CHE								***	*	***	***	***	***	**	***	***	***	***	***	***	***	**
CHN									***		*	***	**	***	***	*	*		***		***	***
CYP											***	**	***					***		*		
CZE													*	**					**			***
DEU												***		***	***	***	***		***	*	***	***
DNK													***					***	***	**	*	**
ESP														***	***	***	***		***	**	***	***
EST																		***		**		
FIN																		***	*	*		*
FRA																		**				
GBR																		**				
GRC																			***		***	***
HKG																				***		
HUN																					*	***
IRL																						
ISL																						

	ISR	ITA	JPN	KOR	LTU	LUX	LVA	MEX	MLT	NLD	NOR	NZL	POL	PRT	RUS	SGP	SVK	SVN	SWE	TUR	USA
ARE	***	**	***	***	***	**	***	**			***	***	***	***			*	***			**
AUS	**		***	***		***		***	***	***		***	***		***	***	***		***	***	***
AUT	**	*	***	***								*		*	*					*	*
BEL	***	***	***	***	***	*	**	*		**	***	***	***	***				***			***
BGR	***		***	***	**						**	***		***	*	*		***		***	
CAN	***	***	***	***	**	**	*	***		***	***	**	**	***	***		*	***	***	**	***
CHE	***	***	***	***	***	***	***	***		***	***	***	***	***	**		*	***			***
CHN	***		***	***		***		***	***	***		***	***		***	***	***	*	**	***	***
CYP	***		***	***	*						*	***		***				***		*	
CZE	**		***	***				***	***			***	*		***	**	***	**		***	
DEU		***	***			***		***	***	***	**		***		***	***	***		***	***	***
DNK	***		***	***	**			***	***	**	*	***		***	***	***	**	***	***	***	
ESP		***	***			***	*	***	***	***	***		***		***	***	***		***	***	***
EST	***		***	***	**		*				*	***		**				***		**	
FIN	***		***	***	**			***	**			***		**	***	***	*	***		***	
FRA	***		***	***				*				**		**	***	***		*	**	***	
GBR	***		***	***				**				***		**	***	***		**	**	***	
GRC			***			***		***	***	***			***		***	***	***		**	***	***
HKG	***	**	***	***	***		**				***	***	**	***	***	***		***		***	*
HUN	**		***	***		*		***	***	**		***			***	***	***	*	*	***	**
IRL	***		***	***	*						*	***		***	**	*		***		***	
ISL	***		***	***	***		**				***	***	**	***				***		**	

	ARE	AUS	AUT	BEL	BGR	CAN	CHE	CHN	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HKG	HUN	IRL	ISL	ISR	ITA	JPN	KOR	LTU	LUX	LVA	MEX	MLT	NLD	NOR	NZL	POL	PRT	RUS	SGP	SVK	SVN	SWE	TUR	USA
ISR																								**	*		*	***	**	***	***	***	***		***		***	***	***		***	***	***
ITA																									***	***				***		**		*			***	***			***	***	***
JPN																										**	***	***	***	***	***	***	***		***	***	***	***	***	**	***	***	***
KOR																											***	***	***	***	***	***	***		***	**	***	***	***		***	***	***
LTU																												*		***	***	**		***	**		***	***	***			***	*
LUX																																	*	***		**	**	**		***		***	
LVA																														***	***			***			***	**	**	**		***	
MEX																																	***	***	***	***		**		***		***	***
MLT																																	***	***	***	***				***			*
NLD																																	**	***		***	***	**		***		***	**
NOR																																		***			***	***	***	*	**	***	**
NZL																																			***	*	***	***	***	**	**	***	***
POL																																				**	***	***	**	***		***	
PRT																																					***	***	***		***	***	***
RUS																																								***		**	***
SGP																																								***			***
SVK																																								***		**	
SVN																																									**	***	***
SWE																																											***
TUR																																											***
USA																																											

Significances of differences in the mean Tier 1 ratios between various countries using t-tests for all possible combinations.

**** shows a difference in the mean Tier 1 ratio significant at the 1%-level, ** is significant at the 5%-level and * is significant at the 10%-level.*

The countries are: ARE (United Arab Emirates), AUS (Australia), AUT (Austria), BEL (Belgium), BGR (Bulgaria), CAN (Canada), CHE (Switzerland), CHN (China), CYP (Republic of Cyprus), CZE (Czech Republic), DEU (Germany), DNK (Denmark), ESP (Spain), EST (Estonia), FIN (Finland), FRA (France), GBR (United Kingdom), GRC (Greece), HKG (Hong Kong), HUN (Hungary), IRL (Ireland), ISL (Iceland), ISR (Israel), ITA (Italy), JPN (Japan), KOR (Republic of Korea), LTU (Lithuania), LUX (Luxembourg), LVA (Latvia), MEX (Mexico), MLT (Malta), NLD (Netherlands), NOR (Norway), NZL (New Zealand), POL (Poland), PRT (Portugal), RUS (Russian Federation), SGP (Singapore), SVK (Slovakia), SVN (Slovenia), SWE (Sweden), TUR (Turkey), USA (United States of America)

Source: Own calculations.

Regarding the six regulatory variables (tables not displayed), the calculations show that the means of the variables for the year 2011 (i.e. after the financial crisis) are significantly (at 1% significance levels) higher than the means for the years 2001, 2003 and 2008 (i.e. before or during the financial crisis). The only exception is the mean for the capital regulation (CAPR), which is significantly lower in 2011 than in 2008. This supports the obvious assumption that the regulation became more severe after the financial crisis

A further observation is that the USA has significantly higher means for four of the six regulatory variables compared to all the other countries (the exceptions are the variables private monitoring PRM and ownership OWN).[38] This partially supports the accusations of the US camp, which held that US regulation is more severe than that of other countries.

Considering these observations, the next section, section V.5, aims to give explanations for the significant differences in the Tier 1 ratios.

38 The mean differences are significant at the 1% level.

V.5. Regression Results

Table V.5 shows the results for the basis regression. The diagnostics obtained, which I discussed in section V.3.3, support the model: the Arellano-Bond test for first-order serial correlation rejects the null hypothesis and there is insufficient evidence to reject the null hypothesis related to second-order serial correlation. This implies that there is expected autocorrelation of first order, but none of second order. Further, there is not enough evidence to reject the Hansen test for over-identification, suggesting that the instruments used are valid. The resulting coefficient on the lagged dependent variable is 0.94; as expected, it is therefore higher than the coefficient resulting from a fixed-effect estimation (0.38) and (almost) lower than the coefficient from an OLS estimation (0.89). The value of 0.94 for the coefficient of the lagged dependent variable also satisfies the expectation that this coefficient has a value just less than, but not above, unity. In addition, there is not enough evidence to reject the null hypotheses related to the difference-in-Hansen test.[39] These observations indicate that there are no endogeneity issues and that the steady-state assumption is satisfied so that using the system GMM as method seems to be preferable to the difference GMM.[40] The low number of instruments (71) relative to the number of individuals (2 772) and observations (15 944) implies that the regression is probably not weakened by too many instruments. Since the specification tests support the model, the next passage reveals the results of the regression.

39 In fact, the default of XTABOND2 in STATA separately calculates a test statistic for every instrument subset: one for the exogeneity of the lagged differences of endogenous/predetermined variables in the level equation and one for the exogeneity of the non-endogenous or non-predetermined instrumental variables. The figures listed in my regression tables refer to these two test statistics. However, as explained in Roodman (2009b), XTABOND2 gives the possibility of performing further breakdowns of the difference-in-Hansen test. After all, "[…] researchers should consider applying a difference-in-Hansen test to all the system GMM instruments for the levels equation […]" (Roodman, 2009a, p. 148). Performing separate difference-in-Hansen tests for all instruments separately does not reveal problems in the regression.

40 Further, as already noted in section V.3.3, results do not change in content when using the difference GMM instead of the system GMM.

Table V.5: Basis regression

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.9415	***	(7.65)
REST	+	0.8028	***	(3.19)
RBP	+	-0.2985		(-0.96)
CAPR	+	0.1088		(0.43)
ERQ	+	-0.1463		(-0.25)
PRM	+/-	-1.0698	**	(-2.01)
OWN	+	-0.1032		(-0.06)
LTA	-	-5.6983	***	(-3.27)
LLRGL	+	-0.1848		(-0.53)
ROAA	+/-	-0.0425		(-0.06)
DIV	+/-	1.6312	**	(2.02)
BASA	+/-	0.4671		(1.58)
SYS	+/-	5.0124	*	(1.94)
CON	+/-	0.1968		(0.23)
BMC	+/-	-0.5299	**	(-2.52)
BGDP	+/-	0.0533	***	(3.34)
GDPC	+/-	0.0001		(1.44)
GGDP	+/-	0.0428		(0.35)
BZS	+/-	-0.3376	***	(-2.93)
INF	-	-0.1022		(-0.59)
CRC	-	-4.3658	**	(-2.28)
Observations:		15 944		
Groups:		2 772		
Instruments		71		
Arellano–Bond test for AR(1) in first differences		-2.21	**	
Arellano–Bond test for AR(2) in first differences		0.84		
Hansen test of joint validity of instruments (df = 39)		35.83		
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		9.62		
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		7.94		

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to 4.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (Ratio of loan loss reserves to gross loans), ROAA (Return on average assets), DIV (Dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 3.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank s-score), INF (Inflation), CRC (Crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

As anticipated, the coefficient on the lagged Tier 1 ratio (1 – λ) has a positive sign and is significant at the 1% level. This gives strong evidence that a substantial part of the current Tier 1 ratio is influenced by the past ratio and that banks adjust their Tier 1 ratio based on an adjustment factor. As mentioned, the coefficient is near unity, implying that the change in the Tier 1 ratio is persistent. In other words, the adjustment factor or speed of adjustment λ is quite low at only 0.06 and only a small gap between the Tier 1 ratio and the target Tier 1 ratio closes every year. The significant positive effect is considerably robust against all variations of regressions performed, showing that the lagged Tier 1 ratio is one of the fundamental variables to explain the current Tier 1 ratio.

Regarding the robustness of the various variables, Table V.6 gives an overview of the results of the key checks, which I mention in my study; section V.8.4 explains the checks more in detail; and section V.8.5 shows the regression tables of the robustness checks.

Related to the regulatory variables in the basis regression, the coefficients on restriction (REST) and private monitoring (PRM) show significant results (at the 1%- and 5%-significance level respectively). REST shows the predicted positive sign direction. Considering that this result is robust for all regressions performed, it implies that higher regulatory restrictions on bank activities effectively lead to higher Tier 1 ratios.

The coefficient on private monitoring (PRM) is negative (remember that the sign expectation was ambiguous). That is, a higher dependence on private monitoring and, in return, a lower dependence on direct regulation seem to lead to lower Tier 1 ratios for banks.

Table V.6: Overview of various regression results

	Predicted sign	Basis regression. Dep. variable: TIER1R	Regression without lag limits. Dep. variable: TIER1R	Regression with further restricted lags. Dep. variable: TIER1R	Regression with orthogonal deviation. Dep. variable: TIER1R	Regression without USA. Dep. variable: TIER1R	Regression without outliers. Dep. variable: TIER1R	Regression with TCR. Dep. variable: TCR	Basis regression with intrapolated data. Dep. variable: TIER1R	Basis regression without regulatory variables. Dep. variable: TIER1R
Explanatory variable										
L.TIER1R	+	+	+	+	+	+	+	n/a	+	+
L.TCR	+	n/a	n/a	n/a	n/a	n/a	n/a	+	n/a	n/a
REST	+	+	+	+	+	+	+	+	+	n/a
RBP	+									n/a
CAPR	+									n/a
ERQ	+									n/a
PRM	+/-	-	-	-	( )	( )	-	-	-	n/a
OWN	+									n/a
LTA	-	-	-	-	-	-	-	-	-	-
LLRGL	+									
ROAA	+/-									
DIV	+/-	+	+	+	+	+	+	+	( )	+
BASA	+/-		(+)	(+)	(+)	(+)	(+)		(+)	
SYS	+/-	+	+	+	+	( )	( )	+	+	( )
CON	+/-					(-)				
BMC	+/-	-	-	-	-	-	-	-	-	-
BGDP	+/-	+	+	+	+	+	+	+	+	+
GDPC	+/-		(+)		(+)	(+)				
GGDP	+/-									
BZS	+/-	-	-	-	-	( )	-	-	-	-
INF	-									(-)
CRC	-	-	-	-	-	!+!	-	-	-	-
Test diagnostics:		ok	not ok	ok	ok	not ok	ok	ok	ok	ok

Results of the various regressions. "+" means that the coefficient on the corresponding variable is positive and significant at least at the 10% level. "-" means the same for negative coefficients. Figures in parentheses "( )" mean that there are changes in the significance compared to the basis regression. Figures in exclamation points "! !" mean that there a changes in the signs of significant coefficients compared to the basis regression.

If just one of the test diagnostics discussed is not within the expected result, this is indicated as "not ok" in the lowermost line.

The variables are: TIER1R (Tier 1 ratio), L.TIER1R (lag of TIER1R), TCR (total capital ratio), L.TCR (lag of TCR), REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (Log of total assets), LLRGL (Ratio of loan loss reserves to gross loans), ROAA (Return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance), CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country)

Source: Own calculations.

The impact of PRM is not significant when excluding US banks from the regression.[41] This suggests that the degree of private monitoring is crucial for US banks and not relevant for banks outside the USA.

The coefficients on the other regulatory variables are not significant in the basis regression or in one of the robustness checks. Applied to regulatory body power (RBP), this means that direct regulation has no impact to the level of banks' Tier 1 ratios. The US camp's argument that tighter regulation for European banks would lead to fewer stressed banks is therefore weakened, since direct regulation seems not to matter – not even in the USA.

Likewise, capital regulation (CAPR) does not influence the Tier 1 ratios and therefore similarly challenges the call for more severe capital regulations, which came up after the financial crisis.

The insignificant results for entry requirements (ERQ) and ownership (OWN) further imply that indirect regulation severity through control of the difficulty to operate as a bank in a specific country and the degree to which ownership in banks is controlled does not matter in relation to the Tier 1 ratios.

On the other hand and as shown below, various bank-specific and other country-specific variables seem to have a significant impact on the Tier 1 ratios.

The logarithm of total assets (LTA) is significant at the 1% level with a negative sign as predicted. This result is strongly robust. With regard to

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41 A robustness check, which performs the basis regression without US banks, shows several different results compared to the basis regression. The bank's total assets to the sum of all banks' total assets of a country (BASA) instead of the dummy variable for system relevance (SYS) is now significantly positive, still indicating that systemically relevant banks seem to have higher Tier 1 ratios. Further, the coefficient on the gross domestic product per capita in USD (GDPC) becomes significantly positive and the one for bank concentration (CON) becomes significantly negative. Considering that these variables are not relevant in most other regressions, these changes should not be over-interpreted. More interestingly, some – in other respects –robust variables change their behaviour when excluding US banks: the coefficients on the private monitoring index (PRM) and the bank z-score (BZS) lose their significance and the dummy for crisis country (CRC) remains significant, but the sign changes (i.e. it is positive now). Refer to the text for an interpretation of these results and to section V.8.4 for further regression details.
Note that these changes in the significance of the coefficients when excluding US banks also remain substantially the same for all possible robustness checks. Thus, the robustness check of performing the regression without US banks is itself also robust.

the possible explanations discussed in section V.3.2, larger banks probably have lower Tier 1 ratios because they are more diversified and less risky than smaller ones. Considering the result in respect of the systemic relevance discussed below, larger banks do not seem to have smaller Tier 1 ratios as a result of enjoying government guarantees. Given the results for the dividend dummy analysed below, the argument that larger banks have lower Tier 1 ratios thanks to having a lower cost of raising capital seems not to be relevant either.

The next significant bank-specific variable is the positive coefficient on the dummy variable for system relevance (SYS), significant at the 10% level. Thus, the more systemically important a bank is in its country, the higher its observed Tier 1 ratio seems to be.[42] Consequently, banks appear to somehow already adopt the "risk" topic in their Tier 1 ratios. This raises the question of whether the severity of the bank regulation or third party (e.g. political) pressure causes this result. Acknowledging the outcome from the various regulatory variables, the latter appears more obvious. Note that the result also applies in the regressions without US banks, indicating that the topic also seems to be adopted outside the USA.

The last significant bank-specific variable is the dummy for dividend payers (DIV). The coefficient on this variable is significantly positive at the 5% level in the basis regression and only insignificant in one robustness regression. Following the expectations in section V.3.2, the reason for the positive coefficient could be that a bank that is able to pay a dividend is a bank that is in good financial condition, which assumes a higher Tier 1 ratio.[43] The positive coefficient on the dividend dummy implies that the cost of raising capital does not influence the Tier 1 ratio.

Continuing with the country-specific variables, the coefficient on the bank deposits per gross domestic product (BGDP) is significantly positive at the 1% level and strongly robust.[44] This implies that the more important the banking sector of a country is relative to its economy in a

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42 This outcome is robust, since the coefficient either remains significant in all robustness checks or is confirmed by a significantly positive coefficient on the bank's total assets to the sum of all banks' total assets of a country (BASA).

43 Note that a possible inverse dependency of such a variable is considered by regarding the variable as not strictly exogenous (see explanations in section V.3.3).

44 The significantly positive sign remains in all robustness checks.

specific year, the higher the Tier 1 ratios of the banks in this country. Again, this is possibly explained by the assumption that banks somehow adopt the "risk" topic.

Further, the coefficient on banks per million capita (BMC) is significantly (at the 5% level) negative.[45] That is, the more banks a country has relative to its population in as specific year, the lower the Tier 1 ratio of these banks seems to be. In the light of the outcome of the other variables, a possible interpretation of this result is that a larger number of banks in a country implies that the risk is better distributed between these banks and therefore the Tier 1 ratio tends to be lower.

The next significant variable (at the 10% level) in the basis regression is the dummy for crisis countries (CRC). As predicted, the Tier 1 ratio is lower if a bank is located in a crisis country. However, in the regression without US banks although the coefficient remains significant, it does change sign.[46] That is, for non-US banks, crisis countries seem to cause higher Tier 1 ratios. In some way, this confirms the arguments of the US faction in the intercontinental discussion: non-US countries could have become crisis countries because the disclosed Tier 1 ratios of their banks were too high compared to their real economic situation and this in turn could have been caused by too lenient regulation.[47]

The USA also influences the last significant variable, the aggregated bank z-score (BZS) of a country. In the basis regression the coefficient on this variable is significantly (at the 1% level) negative. That is, a higher z-score (i.e. a lower average probability of default for the banks of this country in a specific year) leads to a lower Tier 1 ratio. This suggests that banks in a banking system with lower default probability (i.e. being in a more "comfortable" environment and having lower risks) do not need the same amount of regulatory capital or can have more risk-weighted assets than banks in banking systems with higher default

45 This result applies in all robustness checks.

46 Apart from the non-US banks regression, the coefficient is significantly negative in in all robustness checks as it is in the basis regression.

47 Note that during the observation period of my study, there has also been another big crisis, the dot-com bubble (refer e.g. to Lowenstein, 2004). This might somehow influence the results of the CRC variable; therefore, interpretations should be made with caution. In any case, the variable is not essential for the rest of the outcome of the study – omitting it does not change the results of the other variables.

probabilities.[48] However, the coefficient on BZS loses its significance in the regression without US banks. The probability of default does therefore not matter for non-US banks or, to put it differently, only US banks have smaller Tier 1 ratios when the average probability of default for the banks in a specific year is low. Therefore, I assume that this variable is not crucial in regard to the banks' capital ratios.

In conclusion, the basis regression and the robustness checks show both expected and surprising results in relation to the regulatory variables of interest, the bank-specific variables and further country-specific variables. The next section, section V.6, summarises these results and concludes the paper.

48 This result is also valid in all robustness check apart from the non-US banks regression.

V.6. Conclusion and Outlook

Debates on the appropriate regulation of banks have been ongoing for a long time, but have become more frequent and more controversial since the financial crisis in 2007. US opinion leaders in particular accuse other countries – primarily European countries – of having regulations that are not sufficiently severe to guide banks to hold adequately high capital.

Motivated by these debates, I examine explanatory factors for the capital ratio levels of banks from 43 developed countries in the time period between 2000 and 2011. Besides bank-specific and country-specific factors, my paper includes six time-variant regulatory factors, which cover various aspects of regulatory severity. The use of the lagged capital ratio as a further explanatory variable completes the applied partial adjustment model, which is calculated using the GMM method.

Even though the US camp arguments that its regulation is stricter than that of other countries, my study reveals the USA is not stricter for all regulatory factors. Nevertheless, consistent with the US argument, the data shows that there are indeed significant differences in banks' Tier 1 ratios between countries. Additionally, it seems that the regulation in general became stricter after the financial crisis and also that the post-crisis average Tier 1 ratios became significantly higher than the ratios before the crisis. At first glance, one could therefore agree with the US camp that stricter regulation steers banks to have higher capital ratios.

However, regarding such positive effects of the regulatory variables on the banks' capital ratios, I find strong evidence only for activity restrictions; greater restrictions seem to educate banks on the need to have higher capital ratios. Thus, actual debates to further restrict bank activities appear to cover an effective instrument that would increase the capital ratios and raise the banks' capital cushions. On the other hand, I find no evidence that countries' power over the regulatory body, ownership restrictions, entry requirements or capital requirements influence banks' capital ratios. These results therefore weaken the (US camp's) votes to further increase the stringency of such instruments. On the contrary, there are indicators related to the USA that stronger private monitoring such as external audits or credit ratings may even lead banks to have lower capital ratios.

While the impact of the regulation on capital ratios therefore seems to be limited, I find strong evidence that the previous year's capital ratio has a persistent impact on the present capital ratio. The yearly adjustment of the target capital ratio is only approximately 6%; that is, the adjustment seems to be considerably slower than some former studies have estimated (for instance, Berger et al. (2008) have obtained a rate between 45 and 57%). I assume that the difference in the applied regression methods causes this discrepancy.

Apart from the variables above, I also find support for a couple of significant explanatory bank-specific and other country-specific factors. There is evidence that banks paying dividends have higher capital ratios. A possible reason for this could be that a bank being able to pay out a dividend is a bank in good financial condition, which leads to a higher capital ratio. Further, larger banks seem to have smaller capital ratios. One could therefore at first glance agree to the regulatory argument that splitting larger banks into several smaller banks leads to higher capital ratios, since it reduces the "too big to fail" issue. However, my results imply that larger banks have lower capital ratios precisely because they are less risky than smaller ones. A bank having a higher (systemic) risk does indeed seem to have a higher capital ratio. This could be an indicator that such banks face greater (e.g. political) pressure to have larger capital cushions. Applied to the country-specific factors, this observation also holds for the banking sector as a whole: the more important the banking sector of a country relative to the rest of the economy, the higher the capital ratios of its banks appear to be. Additionally, the capital ratios seem to fall when the bank risk in an economy is shared among more banks. Overall, the results suggest that the riskiness of banks appears to have already been somehow implemented in the bank capital ratios.

What do these results mean in relation to the future of bank regulation? Evidently, the past regulations across the various countries were not sufficiently accurate to have a direct impact on the capital adequacy of banks; bank-specific and other country-specific factors seem to be more important. It could be interesting for further research to examine whether the availability of more post-crisis data in future years will alter these results. However, merely increasing the regulatory severity as requested by the US camp might also remain ineffective in future. Prospective changes in bank regulation should concentrate on the effective variables such as the activity restrictions or the “risk” topic. Additionally, changes should lead to the ineffective variables becoming powerful; for example, intuitively, capital regulations only matter if they are sufficiently strict and not when banks comply with them anyway.

However, my study does possibly reveal an aspect that might partly confirm the accusations of the US camp. Apart from the USA, it seems that banks in crisis countries had higher capital ratios than banks in non-crisis countries. The circumstances under which countries became crisis countries, despite their banks’ higher capital ratios, might indicate that the disclosed capital ratios of their banks were too high compared to their real economic situation. Therefore, an interesting topic for further work could cover the question of whether banks correctly disclose their Tier 1 ratios and whether there is a measurable relationship between accurate disclosure and the severity of bank regulation.

V.7. References

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V.8. Appendices

V.8.1. Detailed Explanations of Variables

Name of variable	Explanation	Source
Tier 1 ratio (TIER1R)	Measure of regulatory capital adequacy, calculating shareholder funds plus perpetual non-cumulative preference shares as a percentage of risk weighted assets and off balance sheet risks according to the Basel rules.	Bankscope[49].
Total capital ratio (TCR)	Broader measure for capital adequacy than the Tier 1 ratio, since it adds the Tier 2 capital (which includes subordinated debt, hybrid capital, loan loss reserves and the valuation reserves) to the Tier 1 capital. As for the Tier 1 ratio, this ratio is calculated as a percentage of risk-weighted assets and off-balance sheet risks according to the Basel rules.	Bankscope.
Restriction (REST)	Measure for regulatory restrictions on the activities of banks following the survey explained in Barth et al. (2001). The variable can take a maximum value of 14 and is composed as follows: It adds 0 each if the answer to the following questions[50]	Own calculation based on Barth et al. (2001).

49 Observations in Bankscope that did only have the value N (i.e. no value) for "common positions" were eliminated if they could not be manually calculated from other available positions. Common positions are those that are expected for every bank (such as total assets or the Tier 1 ratio). Non-common variables (such as e.g. loan loss reserves, i.e. positions that could have no value because the bank does not have any) were considered with value 0.

50 Note that the explanations in relation to the calculation of the variables are based on the question verbalisation and question numbering from the latest update of the survey in 2011, as introduced by Cihak, Demirguc-Kunt, Peria and Mohseni-Cheraghlou (2012).

Name of variable	Explanation	Source
	• 4.1 "What are the conditions under which banks can engage in securities activities?" • 4.2 "What are the conditions under which banks can engage in insurance activities?" • 4.3 "What are the conditions under which banks can engage in real estate activities?" • 4.4 "What are the conditions under which banks can engage in nonfinancial businesses except those businesses that are auxiliary to banking business (e.g. IT company, debt collection company etc.)?" is "A full range of these activities can be conducted directly in banks." It adds 1 point each if the answers to the above questions is "A full range of these activities are offered but all or some of these activities must be conducted in subsidiaries, or in another part of a common holding company or parent." It adds 2 points each if the answer to the above questions is "Less than the full range of activities can be conducted in banks, or subsidiaries, or in another part of a common holding company or parent."	

However, I ensured that my study only included questions that – with regard to contents – also agree to the other three surveys. Note moreover that questions not answered in one of the surveys were considered as "no", if not otherwise derivable.

Name of variable	Explanation	Source
	It adds 3 points each if the answer to the above questions is "None of these activities can be done in either banks or subsidiaries, or in another part of a common holding company or parent." Moreover, it adds 1 if the answer to • question 7.2 "Are there any regulatory rules or supervisory guidelines regarding asset diversification?" is yes, • question 7.2.2 "Are banks prohibited from making loans abroad?" is yes.	
Regulatory body power (RBP)	Measure for the direct power of the regulatory body following the survey explained in Barth et al. (2001). The variable can take a maximum value of 13 and is composed as follows: It adds 1 if the answer to • question 5.9 "Are auditors required to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse?" is yes, • question 5.10 "Does the banking supervisor have the right to meet with the external auditors and discuss their report without the approval of the bank?" is not no, • question 5.12b "In cases where the supervisor identifies that the bank	Own calculation based on Barth et al. (2001).

Name of variable	Explanation	Source
	has received an inadequate audit, does the supervisor have the powers to take actions against the auditor?" is yes, • question 5.7.a "Do supervisors receive a copy of the following: The auditor's report on the financial statements" is yes, • question 10.5.b "Do banks disclose to the supervisors off-balance sheet items?" is yes, • question 12.3.2 "Can the supervisory authority force a bank to change its internal organizational structure?" is yes, • question 11.1.f "Please indicate whether the following enforcement powers are available to the supervisory agency: Require banks to constitute provisions to cover actual or potential losses?" is yes, • question 11.1.j "Please indicate whether the following enforcement powers are available to the supervisory agency: Require banks to reduce or suspend dividends to shareholders?" is yes, • question 11.1.k "Please indicate whether the following enforcement powers are available to the supervisory agency: Require banks to reduce or suspend bonuses and	

Name of variable	Explanation	Source
	other remuneration to bank directors and managers?" is yes, • question 11.5.a "Which authority has the powers to perform the following problem bank resolution activities: Declare insolvency?" is "Bank Supervisor", • question 11.5.b "Which authority has the powers to perform the following problem bank resolution activities: Supersede shareholders' rights" is "Bank Supervisor", • question 11.5.b "Which authority has the powers to perform the following problem bank resolution activities: Remove and replace bank senior management and directors" is "Bank Supervisor", • question 12.20 "How frequently are onsite inspections conducted in large and medium size banks?" is more than yearly.	
Capital regulation (CAPR)	Measure for the regulatory oversight of bank capital following the survey explained in Barth et al. (2001). The variable can take a maximum value of 5 and is composed as follows: It adds 1, if the answer to • question 1.4.2 "Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities?" is yes,	Own calculation based on Barth et al. (2001).

Name of variable	Explanation	Source
	• question 1.4.3 "Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities?" is no, • question 1.5 "Can initial capital contributions by prospective shareholders be in the form of borrowed funds?" is no, • question 3.2.a "Which risks are covered by the current regulatory minimum capital requirements in your jurisdiction: Credit risk?" is yes, • question 3.2.a "Which risks are covered by the current regulatory minimum capital requirements in your jurisdiction: Market risk?" is yes.	
Entry requirements (ERQ)	Measure for the difficulty to operate as a bank in a specific country following the survey explained in Barth et al. (2001). The variable can take a maximum value of 8 and is composed as follows: It adds 1 if the answer to • question 1.6.a "Which of the following are legally required to be submitted before issuance of the banking license: Draft bylaws?" is yes, • question 1.6.b "Which of the following are legally required to be	Own calculation based on Barth et al. (2001).

Name of variable	Explanation	Source
	submitted before issuance of the banking license: Intended organizational chart?" is yes, • question 1.6.d "Which of the following are legally required to be submitted before issuance of the banking license: Market / business strategy?" is yes, • question 1.6.e "Which of the following are legally required to be submitted before issuance of the banking license: Financial projections for first three years?" is yes, • question 1.6.f "Which of the following are legally required to be submitted before issuance of the banking license: Financial information on main potential shareholders?" is yes, • question 1.6.g "Which of the following are legally required to be submitted before issuance of the banking license: Background/experience of future Board directors?" is yes, • question 1.6.h "Which of the following are legally required to be submitted before issuance of the banking license: Background/experience of future senior managers?" is yes,	

Name of variable	Explanation	Source
	• question 1.6.i "Which of the following are legally required to be submitted before issuance of the banking license: Source of funds to be used as capital?" is yes.	
Private monitoring (PRM)	Measure for the degree to which the private sector is empowered, facilitated and encouraged to monitor banks following the survey explained in Barth et al. (2001). The variable can take a maximum value of 12 and is composed as follows: It adds 1 if the answer to • question 5.1 "Is an audit by a professional external auditor required for all commercial banks in your jurisdiction?" is yes, • question 5.1.1.a "Does the external auditor have to obtain a professional certification or pass a specific exam to qualify as such?" is yes, • question 5.1.2 "Are specific requirements for the extent or nature of the audit spelled out?" is yes, • question 8.1 "Is there an explicit deposit insurance protection system for commercial banks?" is no, • question 9.3 "Does accrued, though unpaid, interest/principal enter the bank's income statement while the loan is classified as non-performing?" is no,	Own calculation based on Barth et al. (2001).

Name of variable	Explanation	Source
	• question 9.5 "If a customer has multiple loans and advances and one of them is classified as non-performing, are all the other exposures automatically classified as non-performing as well?" is yes, • question 10.1 "Are banks required to prepare consolidated accounts for accounting purposes?" is yes, • question 10.5.1.b "Do banks disclose to the public: Off-balance sheet items" is yes, • question 10.5.1.c "Do banks disclose to the public: Governance and risk management framework" is yes, • question 10.5.2 "Are bank directors legally liable if information disclosed is erroneous or misleading?" is yes, • question 10.7 "Are commercial banks required by supervisors to have external credit ratings?" is yes, • question 10.8 "How many of the top ten banks (in terms of total domestic assets) are rated by international credit rating agencies (e.g., Moody's, Standard and Poor)?" is 10.	

Name of variable	Explanation	Source
Ownership (OWN)	Measure for the degree to which regulations control for ownership in banks following the survey explained in Barth et al. (2001). The variable can take a maximum value of 3 and is composed as follows: It adds 1 if the answer to • question 2.3 "Is there a maximum percentage of a bank's equity that can be owned by a single owner?" is yes, • question 2.5.1 "Can related parties own capital in a bank?" is yes, • question 2.6.d "2.6 Can nonfinancial firms own voting shares in commercial banks: Nonfinancial firms cannot own any equity investment in a commercial bank?" is yes.	Own calculation based on Barth et al. (2001).
Log of total assets (LTA)	Natural logarithm of the sum of all assets of a bank.	Own calculation based on data from Bankscope.
Ratio of loan loss reserves to gross loans (LLRGL)	The ratio of the part of the loans for which the bank expects losses (but does not charge off) to the total loan portfolio.	Bankscope.
Return on average assets (ROAA)	This is the ratio of the net income to the total assets (calculated as average of the previous and the subsequent year-end) of a bank.	Bankscope.

Name of variable	**Explanation**	**Source**
Dividend dummy (DIV)	Dummy variable, which is 1 in case that the bank has paid out a dividend in the specific year and 0 otherwise.	Own calculation based on data from Bankscope.
Bank's total assets to the sum of all banks' total assets of a country (BASA)	Ratio of a bank's total assets to the sum of all banks' total assets of the country for a specific year.	Own calculation based on data from Bankscope.
Dummy for system relevance (SYS)	Dummy variable, which is 1 in case that the bank's total assets to the sum of all banks' total assets of the country for a specific year is higher than 10% and 0 otherwise.	Own calculation.
Bank concentration (CON)	Dummy variable, which is 1 in case that the total assets of the three biggest banks is more than 50% of all banks' total assets of the country for a specific year, 0 otherwise.	Own calculation.
Banks per million capita (BMC)	Number of banks per country for a specific year divided by total population of this country in millions.	Own calculation based on data from world development indicators (The World Bank, 2012).
Bank deposits per GDP (BGDP)	Demand, time and saving deposits in deposit money banks as a share of GDP.	Financial development and structure dataset (as explained in Beck et al., 2000)

Name of variable	Explanation	Source
Gross domestic product per capita in USD (GDPC)	Explained by variable's name.	World development indicators (The World Bank, 2012).
Annual gross domestic product growth (GGDP)	Explained by variable's name.	World development indicators (The World Bank, 2012).
Bank z-score (BZS)	Captures the probability of default of a country's banking system, calculated as a weighted average of the z-scores of a country's individual banks (the weights are based on the individual banks' total assets). The individual z-score divides a bank's buffers (capitalisation and returns) by the volatility of those returns, according to formula (V.7), i.e. a lower z-score indicates a higher probability of default: $$\frac{\text{ROA} + \frac{\text{Equity}}{\text{Total Assets}}}{\text{Standard deviation of ROA}} \qquad (\text{V.7})$$	Financial development and structure dataset (as explained in Beck et al., 2000)
Inflation (INF)	Explained by variable's name.	World development indicators (The World Bank, 2012).
Crisis country (CRC)	Dummy variable, which is 1 if the country suffered a banking crisis during the financial crisis, 0 otherwise. Banking	Own calculations based on classification

Name of variable	**Explanation**	**Source**
	crisis countries are the ones named as systemic cases according to Laeven and Valencia (2010).	made by Laeven and Valencia (2010).

V.8.2. Table of Abbreviations

approx.	Approximately
AR(1)	Autoregressive process of order 1
AR(2)	Autoregressive process of order 2
ARE	United Arab Emirates
AUS	Australia
AUT	Austria
BEL	Belgium
BGR	Bulgaria
CAN	Canada
CHE	Switzerland
CHL	Chile
CHN	China-People's Rep.
CYP	Cyprus
CZE	Czech Republic
DEU	Germany
df	Degrees of freedom
Dep.	Dependent
DNK	Denmark
DPD	Dynamic panel data
e.g.	Exempli gratia (for example)
ESP	Spain
EST	Estonia
et al.	Et alii (and others)
EU	European Union
FE	Fixed effects
FIN	Finland
FRA	France
GBR	United Kingdom
GMM	Generalized Method of Moments
GRC	Greece
HKG	Hong Kong
HUN	Hungary
i.e.	Id est (that is)
i.i.d.	Independently, identically distributed
IRL	Ireland
ISL	Iceland
ISR	Israel
ITA	Italy
iv	Instrumental variable
JEL	Journal of Economic Literature
JPN	Japan
KOR	Republic of Korea

LSDVC	Least Square Dummy Variable Correction
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MEX	Mexico
MLT	Malta
n/a	Not applicable
NLD	Netherlands
No.	Number
NOR	Norway
NZL	New Zealand
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
POL	Poland
pp.	Pages
PRT	Portugal
ROU	Romania
RUS	Russian Federation
sd	Standard deviation
SGP	Singapore
SVK	Slovakia
SVN	Slovenia
SWE	Sweden
TUR	Turkey
USA	United States
USD	United States Dollar
Vol.	Volume
vs	Versus

V.8.3. Table of Symbols

&	and
β	Coefficient to be estimated
C1	Consolidation code according to Bankscope: Statement of a mother bank integrating the statements of its controlled subsidiaries or branches with no unconsolidated companion
C2	Consolidation code according to Bankscope: Statement of a mother bank integrating the statements of its controlled subsidiaries or branches with an unconsolidated companion
C*	Consolidation code according to Bankscope: additional consolidated statement
D	Explanatory variable
$\varepsilon_{i,t}$	Remainder disturbance for individual bank i at time t; $\varepsilon_{i,t} = u_{i,t} - \mu_i$
i	Numbering for individual bank (ranging from 1 to N)
j	Numbering for country (ranging from 1 to J)
J	Total number of countries
k	Numbering for explanatory variables (ranging from 0 to K)
K	Total number of explanatory variables
L.	Lagged
λ	Speed of adjustment
μ_i	Unobservable specific effect for individual i; $\mu_i = u_{i,t} - \varepsilon_{i,t}$.
ν_t	Unobservable time effect
N	Total population of individual banks
®	Registered Trademark
t	Numbering for time (ranging from 1 to T)
t-test	Student's test
T	Total time periods

$u_{i,t}$ Regression disturbance term for individual i at time t; $\lambda v_{i,t} = u_{i,t} = \mu_i + \varepsilon_{i,t}$

$v_{i,t}$ Disturbance term in estimation of target Tier 1 ratio for individual bank i at time t

% Percentage

* Target

V.8.4. Robustness Checks

Changing Lags and Using Forward Orthogonal Deviations

Section V.3.3 explained that the basis regression limits the lags of the endogenous and predetermined explanatory variables in order to avoid specification problems. However, this might be at the cost of losing information from the higher lagged variables.

Table V.7 shows the regression with no lag limits. This regression does not change the signs of former significant coefficients. As expected, no formerly significant coefficients lose their significance, since the additional lags provide more information. On the contrary, two further coefficients turn out to be significant. The positive sign for the USD gross domestic product per capita (GDPC) indicates that banks in healthier economies have higher Tier 1 ratios. The positive coefficient on the bank's total assets to the sum of all banks' total assets of a country (BASA) underlines the finding that systemically relevant banks seem to have higher Tier 1 ratios.

In the regression without lag limits, the Arellano-Bond test diagnostics and the value of the coefficient on the lagged dependent variable are satisfactory. However, as anticipated, the Hansen test diagnostic shows that the regression without lag limits appears to cause instrument problems (total instruments are now 174, compared to 71 for the basis regression).

Therefore, Table V.8 shows the results of the regression when the instruments are minimised to the lowest possible value of 45 (by using only one lag for GMM-style instruments). The regression diagnostics now support the model again.[51] As for the regression without lag limits and in addition to the basis regression, the coefficient on the bank's total assets to the sum of all banks' total assets of a country (BASA) becomes significantly positive. Apart from this, all remains unchanged from the basis regression.

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[51] Note that the difference-in-Hansen test is obsolete when taking just one lag for the GMM-style instruments; therefore, the value n/a (not applicable) is included in Table V.8.

Therefore, the basis regression results seem to be quite robust against changes in the lag limits. This is also valid when using forward orthogonal deviations instead of differencing (refer to the description in section V.3.3). The results of this regression (see Table V.9) are similar to the ones of the basis regression;[52] the only difference is that the coefficient on private monitoring (PRM) loses its significance, whereas the coefficients on the bank's total assets to the sum of all banks' total assets of a country (BASA) and on the USD gross domestic product per capita (GDPC) are now significantly positive.

Regressions without USA

According to the descriptive statistics in section V.4, more than half of the observations relate to the USA. As discussed in the introduction, this country plays an important role in the intercontinental debate. It might therefore be interesting to see which of the results are driven by the USA itself. Table V.10 shows the results of the basis regression excluding US banks.[53]

In comparison to the basis regression, the coefficients on the bank's total assets to the sum of all banks' total assets of a country (BASA) and on the gross domestic product per capita in USD (GDPC) become significantly positive and the one for bank concentration (CON) becomes significantly negative. Furthermore, the coefficients on the private monitoring index (PRM) and the bank z-score (BZS) lose their significance. However, most interestingly, the dummy for crisis country (CRC) remains significant but changes sign (i.e. it is positive now), indicating that crisis countries outside the USA have higher Tier 1 ratios.

It therefore seems that the USA has a relatively big impact on the regression results by even changing the manner of dependency of the explanatory variables.[54]

52 All the regression diagnostics support the model.

53 The test diagnostics for this regression are fine apart from the difference-in-Hansen test of the GMM style instrument subset, indicating some instrumentation problem. This could be caused by the decreased number of observations (7 197) and individuals (1 251) in this regression relative to its unchanged number of instruments (71).

54 Note that these changes in the significance of the coefficients when excluding US banks remain the same if I re-perform all other mentioned robustness checks without US banks

Elimination of Outliers

As discussed in section V.4, the Tier 1 ratio data contains some outliers. The present section repeats the basis regression, but discretionarily eliminates all negative Tier 1 ratios and all Tier 1 ratios above a value of 700%.[55]

Table V.11 shows that this regression does not change the results of the basis regression[56]: The bank's total assets to the sum of all banks' total assets of a country (BASA) instead of the dummy variable for system relevance (SYS) is now significantly positive, still indicating that systemically relevant banks appear to have higher Tier 1 ratios.

To conclude, the regression is rather robust against the elimination of outliers.

Using Total Capital Ratio instead of Tier 1 Ratio

The Tier 1 ratio is just one of the two actual relevant capital adequacy measurements. The other is the total capital ratio. Compared to the Tier 1 ratio, the total capital ratio adds the Tier 2 capital to the Tier 1 capital in the numerator. Tier 2 capital consists of subordinated debt, hybrid capital, loan loss reserves and the valuation reserves.

(except that in the interpolated regression, the coefficient on the entry requirements [ERQ] becomes significantly negative; I assess this as insignificant, since this is the only regression in which this happens). Thus, the robustness check to perform the regression without US banks is itself also robust.

55 Note that the results do not change substantially when the data for the Tier 1 ratio is winsorised at the 1st and 99th percentile instead of dropping the outliers: compared to the basis regression, the coefficients on the return on average assets (ROAA), the gross domestic product per capita in USD (GDPC) and the inflation (INF) become significantly positive and the dummy for crisis country (CRC) loses its significance. However, the winsorised regression does not satisfy the Hansen and difference-in-Hansen test diagnostics.

56 The test diagnostics for the regression without outliers are satisfied.

Table V.12 reveals the results of the basis regression but using the total capital ratio instead of the Tier 1 ratio.[57] Compared to the basis regression there are no changes.[58]

Using Interpolated Regulatory Survey Data

As defined in section V.3.1, I assume that changes in the severity of bank regulation occur immediately and not slowly. This section checks whether the regression results diverge when the changes in the regulatory severity occur smoothly over the years (i.e. in years with no survey available, the regulatory variables are interpolated).

As is evident from Table V.13,[59] there are only two changes to the results of the base regression: the coefficient on the bank's total assets to the sum of all banks' total assets of a country (BASA) turns out to be significant and positive, whereas the dummy for dividend payers (DIV) is no longer significant.

Thus, it looks as if it does not substantially matter whether the model assumes immediate or smooth changes in the severity of regulation.

Regression without Regulatory Variables

As mentioned in section V.2, most previous studies have not explicitly considered regulatory variables. In order to check the robustness of the

[57] The test diagnostics are as expected.
Note that the total number of observations slightly decreased, since not all observations showing a Tier 1 ratio also show a total capital ratio. Using the "opposite" data (i.e. taking all observations which have a total capital ratio, but which do not necessarily have a Tier 1 ratio; there are 16 893 total observations in this case), does not substantially change the results. The coefficients on the bank's total assets to the sum of all banks' total assets of a country (BASA) and one the dummy variable for system relevance (SYS) change significance and the coefficient on the USD gross domestic product per capita (GDPC) emerges as significant. However, the test diagnostics for this latter regression are less satisfying than for the first.

[58] The new Basel III rules stipulate an additional leverage ratio to be fulfilled. Proponents argue that this ratio is less easy for the banks to control themselves. Simply put, it is a ratio that compares book equity to total book assets without risk weighting the figures (refer to the Basel Committee on Banking Supervision, 2011). Using such a ratio instead of the Tier 1 or the total capital ratio again leads to substantially the same results (with the difference that more coefficients become significant and the test diagnostics are not all satisfied, which might be the result of a changed number of observations).

[59] Again, all test diagnostics support this model.

bank-specific and the other country-specific coefficient results, the regression shown in Table V.14 drops the six regulatory variables.[60] As the table shows, the dummy variable for system relevance (SYS) is no longer significant while, on the other hand, the coefficient on the inflation rate (INF) becomes significantly negative (as expected) at the 10% confidence level. Accordingly, it would seem that this robustness check does not change the interpretation of the basis regression results substantially.

60 This model also demonstrates support by all test diagnostics. Moreover, the results do not substantially change if I drop only separate regulatory variables.

V.8.5. Tables for Regression Results of Robustness Checks

Table V.7: Regression without lag limits

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.9348	***	(7.40)
REST	+	0.7069	***	(3.11)
RBP	+	-0.0757		(-0.34)
CAPR	+	-0.0985		(-0.45)
ERQ	+	0.0125		(0.03)
PRM	+/-	-0.8308	*	(-1.92)
OWN	+	0.3472		(0.27)
LTA	-	-4.6340	***	(-3.20)
LLRGL	+	-0.0696		(-0.22)
ROAA	+/-	-0.0446		(-0.07)
DIV	+/-	1.5150	*	(1.93)
BASA	+/-	0.5090	*	(1.86)
SYS	+/-	5.6632	**	(2.50)
CON	+/-	-0.1659		(-0.24)
BMC	+/-	-0.5565	***	(-2.72)
BGDP	+/-	0.0461	***	(3.13)
GDPC	+/-	0.0001	*	(1.91)
GGDP	+/-	-0.0061		(-0.05)
BZS	+/-	-0.2673	***	(-2.86)
INF	-	0.0162		(0.11)
CRC	-	-3.2909	**	(-2.18)
Observations:		15 944		
Groups:		2 772		
Instruments		174		
Arellano–Bond test for AR(1) in first differences		-2.18	**	
Arellano–Bond test for AR(2) in first differences		0.85		
Hansen test of joint validity of instruments (df = 142)		172.48	**	
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		15.00		
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		19.09		

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to "infinity".
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to "infinity".
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

Table V.8: Regression with further restricted lags

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.9572	***	(7.26)
REST	+	1.4875	***	(3.86)
RBP	+	-0.4968		(-0.94)
CAPR	+	0.2051		(0.64)
ERQ	+	0.6686		(0.62)
PRM	+/-	-2.5316	***	(-2.90)
OWN	+	-0.8326		(-0.37)
LTA	-	-6.7380	***	(-3.25)
LLRGL	+	-1.0244		(-1.10)
ROAA	+/-	-0.7191		(-0.73)
DIV	+/-	2.6245	**	(2.26)
BASA	+/-	0.7116	*	(1.73)
SYS	+/-	5.3859	*	(1.74)
CON	+/-	0.1873		(0.16)
BMC	+/-	-0.6667	**	(-2.36)
BGDP	+/-	0.0702	***	(3.40)
GDPC	+/-	0.0000		(0.50)
GGDP	+/-	0.0732		(0.40)
BZS	+/-	-0.4409	***	(-2.97)
INF	-	0.1021		(0.44)
CRC	-	-5.8303	**	(-2.35)
Observations:		15 944		
Groups:		2 772		
Instruments		45		
Arellano–Bond test for AR(1) in first differences		-2.30	**	
Arellano–Bond test for AR(2) in first differences		0.49		
Hansen test of joint validity of instruments (df = 13)		18.89		
Difference-in-Hansen test of exogeneity of GMM style instrument subset		n/a		
Difference-in-Hansen test of exogeneity of IV style instrument subset		n/a		

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (Log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lag 1.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank Z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1cevel, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

Table V.9: Regression with forward orthogonal deviations

Dependent variable: TIER1R			
Explanatory variable	Predicted sign	Coefficient	t-value
L.TIER1R	+	0.9041 ***	(7.02)
REST	+	0.6909 ***	(3.13)
RBP	+	0.0323	(0.16)
CAPR	+	-0.0562	(-0.25)
ERQ	+	0.1484	(0.27)
PRM	+/-	-0.7116	(-1.07)
OWN	+	-0.9924	(-0.56)
LTA	-	-2.9409 ***	(-2.88)
LLRGL	+	0.0738	(0.36)
ROAA	+/-	-0.0753	(-0.11)
DIV	+/-	1.5887 *	(1.94)
BASA	+/-	0.2820	(1.34)
SYS	+/-	5.2106 ***	(2.69)
CON	+/-	0.2946	(0.41)
BMC	+/-	-0.3819 **	(-2.59)
BGDP	+/-	0.0342 ***	(3.27)
GDPC	+/-	0.0001 **	(1.99)
GGDP	+/-	0.0891	(0.96)
BZS	+/-	-0.1832 ***	(-2.71)
INF	-	0.0435	(0.33)
CRC	-	-2.5410 *	(-1.71)
Observations:		15 944	
Groups:		2 772	
Instruments		71	
Arellano–Bond test for AR(1) in first differences		-2.12 **	
Arellano–Bond test for AR(2) in first differences		0.86	
Hansen test of joint validity of instruments (df = 39)		44.73	
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		9.11	
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		19.46	

One-step GMM regression with forward orthogonal deviations with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to 4.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 3.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank Z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

Table V.10: Basis regression without USA

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.9409	***	(8.17)
REST	+	0.7969	**	(2.50)
RBP	+	-0.4104		(-0.81)
CAPR	+	0.2923		(0.43)
ERQ	+	-0.7160		(-1.21)
PRM	+/-	-0.2088		(-0.39)
OWN	+	-1.7065		(-0.72)
LTA	-	-10.9584	***	(-2.65)
LLRGL	+	-0.1934		(-0.51)
ROAA	+/-	-0.9453		(-0.92)
DIV	+/-	1.4819	*	(1.91)
BASA	+/-	0.9845	***	(2.64)
SYS	+/-	4.5677		(1.27)
CON	+/-	-7.2974	***	(-3.27)
BMC	+/-	-1.1607	***	(-3.18)
BGDP	+/-	0.0430	**	(2.34)
GDPC	+/-	0.0003	***	(3.26)
GGDP	+/-	0.2589		(1.52)
BZS	+/-	0.0330		(0.44)
INF	-	-0.2390		(-0.57)
CRC	-	7.0950	**	(2.51)
Observations:		7 197		
Groups:		1 251		
Instruments		71		
Arellano–Bond test for AR(1) in first differences		-2.18	**	
Arellano–Bond test for AR(2) in first differences		0.69		
Hansen test of joint validity of instruments (df = 39)		43.05		
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		19.97	*	
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		15.90		

One-step system GMM-regression with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to 3.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (Return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 2.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

Table V.11: Regression without outliers

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.8233	***	(5.68)
REST	+	1.0431	***	(3.04)
RBP	+	-0.2603		(-0.86)
CAPR	+	0.0504		(0.19)
ERQ	+	-0.8670		(-0.83)
PRM	+/-	-2.0935	**	(-2.34)
OWN	+	-1.6759		(-0.64)
LTA	-	-6.3655	***	(-3.34)
LLRGL	+	-0.4517		(-0.80)
ROAA	+/-	-0.4278		(-0.56)
DIV	+/-	2.3483	***	(2.72)
BASA	+/-	0.5701	*	(1.66)
SYS	+/-	4.5357		(1.51)
CON	+/-	0.0077		(0.01)
BMC	+/-	-0.5590	**	(-2.44)
BGDP	+/-	0.0540	***	(3.61)
GDPC	+/-	0.0001		(1.45)
GGDP	+/-	0.1011		(0.75)
BZS	+/-	-0.3811	***	(-2.66)
INF	-	0.0197		(0.12)
CRC	-	-6.0308	**	(-2.11)
Observations:		15 877		
Groups:		2 769		
Instruments		71		
Arellano–Bond test for AR(1) in first differences		-2.21	**	
Arellano–Bond test for AR(2) in first differences		1.23		
Hansen test of joint validity of instruments (df = 39)		39.08		
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		16.10		
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		10.52		

One-step system GMM-regression with robust standard errors. Negative Tier 1 ratios and those higher than 700% are dropped. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to 3.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 2.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

Table V.12: Basis regression with total capital ratio instead of Tier 1 ratio

Dependent variable: TCR			
Explanatory variable	Predicted sign	Coefficient	t-value
L.TCR	+	0.9566 ***	(7.92)
REST	+	0.7337 ***	(2.62)
RBP	+	-0.4108	(-1.00)
CAPR	+	-0.0916	(-0.36)
ERQ	+	-0.0256	(-0.04)
PRM	+/-	-0.9591 *	(-1.75)
OWN	+	-0.4873	(-0.25)
LTA	-	-5.8325 ***	(-2.94)
LLRGL	+	-0.2850	(-0.55)
ROAA	+/-	-0.1567	(-0.22)
DIV	+/-	1.7566 **	(2.18)
BASA	+/-	0.3944	(1.33)
SYS	+/-	5.1180 *	(1.75)
CON	+/-	0.4740	(0.54)
BMC	+/-	-0.4970 **	(-2.17)
BGDP	+/-	0.0517 ***	(3.34)
GDPC	+/-	0.0001	(1.08)
GGDP	+/-	0.0012	(0.01)
BZS	+/-	-0.3465 ***	(-2.65)
INF	-	-0.1057	(-0.53)
CRC	-	-4.6499 *	(-1.93)
Observations:		15 790	
Groups:		2 742	
Instruments		71	
Arellano–Bond test for AR(1) in first differences		-2.19 **	
Arellano–Bond test for AR(2) in first differences		0.88	
Hansen test of joint validity of instruments (df = 39)		38.79	
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		16.84	
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		8.26	

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

Total capital ratio (TCR) is the dependent variable.
L.TCR (lagged TCR) is an endogenous explanatory variable with instrument lags 2 to 3.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 2.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

***** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.**

Source: Own calculations.

Table V.13: Basis regression with interpolated regulatory data

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.9384	***	(7.42)
REST	+	0.5167	**	(2.15)
RBP	+	-0.3718		(-1.10)
CAPR	+	0.0731		(0.20)
ERQ	+	-0.1845		(-0.32)
PRM	+/-	-1.5291	**	(-2.10)
OWN	+	1.0548		(0.46)
LTA	-	-4.1736	***	(-2.98)
LLRGL	+	-0.3407		(-0.75)
ROAA	+/-	-0.1109		(-0.15)
DIV	+/-	1.1617		(1.51)
BASA	+/-	0.4211	*	(1.69)
SYS	+/-	4.7187	**	(2.36)
CON	+/-	-0.5422		(-0.72)
BMC	+/-	-0.4290	**	(-2.52)
BGDP	+/-	0.0422	***	(3.29)
GDPC	+/-	0.0001		(1.15)
GGDP	+/-	-0.0745		(-0.59)
BZS	+/-	-0.2387	***	(-2.75)
INF	-	0.0024		(0.01)
CRC	-	-3.0441	*	(-1.72)
Observations:		15 670		
Groups:		2 732		
Instruments		71		
Arellano–Bond test for AR(1) in first differences		-2.16	**	
Arellano–Bond test for AR(2) in first differences		0.75		
Hansen test of joint validity of instruments (df = 39)		50.42		
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		9.42		
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		21.98		

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to 3.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 2.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

Table V.14: Basis regression without regulatory variables

Dependent variable: TIER1R				
Explanatory variable	Predicted sign	Coefficient		t-value
L.TIER1R	+	0.9391	***	(7.66)
LTA	-	-6.4248	***	(-3.35)
LLRGL	+	-0.1780		(-0.44)
ROAA	+/-	-0.0526		(-0.08)
DIV	+/-	1.6562	**	(2.06)
BASA	+/-	0.4199		(1.32)
SYS	+/-	3.5386		(1.32)
CON	+/-	-0.0734		(-0.08)
BMC	+/-	-0.4647	**	(-2.34)
BGDP	+/-	0.0470	***	(3.07)
GDPC	+/-	0.0001		(1.24)
GGDP	+/-	0.0114		(0.09)
BZS	+/-	-0.3599	***	(-2.85)
INF	-	-0.3488	*	(-1.75)
CRC	-	-5.6949	***	(-2.71)
Observations:		15 944		
Groups:		2 772		
Instruments		47		
Arellano–Bond test for AR(1) in first differences		-2.21	**	
Arellano–Bond test for AR(2) in first differences		0.85		
Hansen test of joint validity of instruments (df = 21)		23.86		
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 7)		10.61		
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 18)		21.33		

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

TIER1R (Tier 1 ratio) is the dependent variable.
L.TIER1R (lagged Tier 1 ratio) is an endogenous explanatory variable with instrument lags 2 to 4.
LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 3.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (Inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test statistic.*

Source: Own calculations.

VI. Paper 2: The Impact of Basel II on the Capital Ratios of Banks – A Difference-in-Difference Comparison between Early-Comprehensive and Late-Partial Adopters

VI.1. Abstract

This paper examines whether the introduction of the Basel II framework resulted in capital ratios of banks from affected countries developing differently compared to the ratios of banks from countries with a postponed introduction. I apply a difference-in-difference (DiD) approach in which the announced comprehensive introduction of Basel II in Continental Europe in 2004 is the "treatment". To ensure similarity between treatment banks and control banks, I use propensity score matching strategies and construct comparable groups, before applying the DiD computations. Accordingly, I find strong evidence that there is a treatment effect; that is, that after the treatment in 2004, treatment banks had significantly higher capital ratios than control banks. The other control variables included in my calculations support this main result of a positive treatment effect: The outcome of these variables is comparable to other work performed on the subject of bank capital ratios. However, I also find indications that the change in regulation is at best only a partial explanation for the treatment effect, because simultaneous changes in reporting standards might also have caused the capital ratio increase of European banks. In other words, book values changed and the capital ratios went up because of a change in the measurement method. Consequently, the "real" effect might have been much smaller than it appears at first.

Keywords: Banks, Bank regulation, Basel II, Capital ratios

JEL Classification: G21, G32, G28, G38, M48

VI.2. Introduction and Background

In June 2004, the Basel Committee on Banking Supervision (2004) published its new framework for the regulation of capital measurements and capital standards of banks. The framework, known as "Basel II", was the successor to the original "Basel I" regulation issued in 1988 (Basel Committee on Banking Supervision, 1988). Whereas Basel I mainly dealt with minimal capital ratio rules for banks, Basel II was more extensive, being based on three pillars, that is, minimum capital requirements, a supervisory review process and market discipline. The aim of the new framework was to "promote the adoption of stronger risk management practices by the banking industry" (Basel Committee on Banking Supervision, 2004, p. 2) and eventually strengthen the entire banking system. The committee expected its member states to implement the framework as of year-end 2006.

However, early on it emerged that not all the relevant countries planned to introduce the framework at the same rate or with the same rigour. Substantial differences were primarily identified between the Continental European legislators and the United States (US) and Chinese legislators: The European camp supported a quick and comprehensive introduction of the Basel II legislation, which finally resulted in the new directives, Directive 2006/48/EC and Directive 2006/49/EC, being introduced in 2006. The US camp, on the other hand, originally planned the introduction only for larger banks (e.g. Cornford, 2006) and even postponed the introduction timeline (Office of the Comptroller of the Currency, 2005). Similarly, China also distanced itself from its implementation commitments (see e.g. Cornford, 2005).

One major point of concern was the uncertainty as to whether the implementation would have a positive or negative effect on the capital ratios of banks – critics maintained that with the new rules it "[…] became apparent that no one actually knows what regulatory capital requirements will be […]" (Tarullo, 2006, no pagination).

Based on this uncertainty, the aim of my paper is to examine whether the (announced) comprehensive introduction of the Basel II rules in affected countries led the capital ratios of the banks concerned developing differently compared to banks from countries with a postponed or rejected introduction. To do so, I apply a difference-in-difference (DiD) approach, in which the announced comprehensive introduction of the Basel II framework in 2004 is the "treatment". I use the banks from (mainly Continental) Europe EU15 countries as the treatment group and Chinese and US banks as the control group.[61] In order to avoid the results being biased by other factors, the DiD regressions include various other possible explanatory factors. Additionally, to ensure similarity between the treatment banks and the control banks, I use propensity score matching methods and construct comparable groups, before applying the DiD regressions.

Most of the existing work on the capital ratios of banks focuses on the impact of bank-specific and country-specific factors; question related to the regulation are mostly – if at all – only implicitly considered. For example, Gropp and Heider (2010) investigate the determinants of the capital structure of large and publicly traded banks in the years between 1991 and 2004. They conclude that the process by means of which the capital structures of banks are set seems to be similar to non-banking firms and that therefore bank regulation appears to be of only limited importance. Note that they do not explicitly integrate regulation measures in their study. This is also true for Flannery and Rangan (2008). In a study that covers the largest US banks from 1986 to 2001, they conclude that especially market forces are important explanatory factors for the build-up of bank capital. On the other hand, Brewer, Kaufman and Wall (2008), for example, directly include measures for bank regulation. They examine large banks for the period 1992 to 2005 and conclude that there is some evidence that capital requirements have a positive effect on the capital ratios of banks. Similarly, Schaeck and Cihák's (2009) study includes regulatory factors for European banks from 1999 to 2004. According to their findings, stricter capital regulation seems to lead to higher capital ratios. In his study of worldwide banks for the years 2000 to 2011, Lucadamo (2016) also includes regulatory explanatory factors. He finds evidence that the regulation of bank activity increases capital ratios. On the other hand, he discovers evidence

[61] In fact, after the selection of the appropriate comparison countries and banks, a small number of Chinese banks remain as control group observations besides the US bank observations. When I drop Chinese banks completely from my study and consider only US banks as control group observations, my results do not change.

that stronger private regulation leads to lower ratios. He concludes that other factors seem to be more important for banks' capital ratios.

De Jonghe and Öztekin (2015) find comparable results in a similar study, covering the years 1994 to 2004, of various countries around the world. Francis and Osborne (2012) concentrate on UK banks for the years 1996 to 2007. Among other things, they examine the effects of capital requirements on banks' capital ratios and they conclude that banks raise targeted capital ratios in response to increasing capital requirements and vice versa.

To summarise, a lot of work has already been done on the question of whether regulation affects the capital ratios of banks. Some studies conclude that there is no measurable regulation effect. In other studies, there is some evidence to show that regulation has an effect, at least in some way. Either way, in most studies regulation is far from being the main trigger for banks' capital ratios. However, the studies that integrate a measure for regulation do so by including possible explanatory factors as separate variables. The composition of such factors appears to be quite difficult. Considering the findings of these studies, it is difficult to ascertain whether the lack of regulatory influence results from the fact that there is, effectively, only limited impact or if the regulation factors fail to be appropriately created. My paper reduces this complexity regarding the regulation measurement by applying the explained DiD strategy. To my knowledge, this is the first study that applies such an approach in order to measure the impact of bank regulation. Therefore, it is a new variation on the already abundant work conducted on the influence of regulation on the capital ratios of banks and it brings new insights to this topic.

By applying this strategy, my main finding is that there is significant evidence of a treatment effect. This effect is positive in the amount of approximately 100 basis points. That is, I find that after the treatment in 2004, banks from the EU15 treatment group show higher average capital ratios compared to the control group banks. However, it turns out that the regulation change is not necessarily the only factor that led to the treatment effect. There is some evidence to show that simultaneous changes in the bank reporting standards – mainly from cost-based local regulatory standards to fair-value-based International Financial

Reporting Standards (IFRS) – also led to higher capital ratios. In other words, book values changed and therefore the capital ratios went up because of a change in the measurement method. The "real" effect might therefore have been much smaller than it appears at first. The evidence regarding the effect of a reporting standard change is not entirely robust. But considering the results of the other studies in regard to the influence of regulation, it seems apparent that the introduction of Basel II had at best only a partial positive effect on the capital ratios of banks.

The rest of the paper proceeds as follows: Section VI.3 explains the data and methodology, section VI.4 shows the results of the basic model and the robustness checks and section VI.5 concludes the paper.

VI.3. Data and Methodology

VI.3.1. Dataset

As discussed above, in 2004 the Basel Committee on Banking Supervision (2004) published the new standard. Accordingly, 2004 is my treatment year, even though the standard did not become binding on that date (the Basel Committee on Banking Supervision, 2006, presented its final, comprehensive version of the standard two years later; in addition, the EU – as a strong Basel II-supporter – did not introduce binding rules before its publication of the above-mentioned directives in 2006). However, the intensive discussions regarding the grade of implementation severity started in 2004 and, as Münstermann (2005) states, one could therefore expect banks to start restructuring their balance sheets ahead of a binding introduction date (note that in the robustness checks in section VI.4.2, I test changes in my results by considering possible other treatment dates). In order not to cover one pre- and one post-treatment year only, my study includes the seven years from 2001 to 2007, that is, there are three pre-treatment years and four post-treatment years. If I extend my study to, for example, the year 2011 (i.e. also including the years during and after the financial crisis), the significant treatment effect vanishes. This result is most probably biased by the crisis. Regressions based only on crisis countries confirm this assumption,[62] because in some of these regressions the treatment effect turns out to be significant again. Therefore, I do not include years after 2007 in my study.

My treatment group consists of the countries that displayed a clear positive attitude to applying the Basel II rules quickly and comprehensively after their publication. The control group, on the other hand, contains countries with a clear intent to postpone the Basel II introduction or not to introduce it comprehensively. Cho (2013) performed a detailed study regarding Basel II endorsement in various countries. His "early-comprehensive" adopters correspond to my first group mentioned above, while his "late-partial" adopters agree with my latter group. Note that Cho (2013) also included a group of "non-

[62] As crisis countries, I take either the "systemic cases" or the "systemic cases" plus the "borderline cases" defined by Laeven and Valencia (2010). Note that the USA as the important control group country is a crisis country.

implementers". However, the non-implementers are mainly countries from developing nations. I focus on developed countries, since I expect them to be more similar when considering attributes other than Basel II endorsement. Cho's (2013) early comprehensive adopters are the EU countries plus several other smaller countries such as Norway, Hong Kong and Lichtenstein. In the light of the discussion in my introduction, I focus on the EU countries only for this class, since their policy makers were the most insistent lobbyists in the discussions to apply Basel II.[63] I take the 15 countries from the EU15 as my treatment group. The entry of ten further countries into the EU took place in 2004, that is, around the same time as the publication of Basel II. However, in order to avoid biases because of the similar dates of these two events, I do not consider these EU countries.[64] Cho's (2013) late partial adopters are the USA and China (and some other small countries for which there was not enough available data to include them in the population).

The original total population is therefore 17 countries. Since I only take banks that have all data for all observation years (meaning that I use a balanced panel according to Baum, 2006), banks from Sweden and the United Kingdom drop out[65] and the total population is 1 214 banks from 15 countries.[66]

The number of banks per country in Table VI.1 shows that most are US banks (806) and the least represented country is China with seven banks.

63 Note that I also performed my study with different treatment groups that include non-European countries as well: On the one hand, I chose the Basler Committee on Banking Supervision (BCBS) member countries valid as of 2004 (twelve countries without the USA, Grasl, 2012), while on the other, I selected all early-comprehensive countries according to Cho (2013). The results, particularly regarding the positive treatment effect, remain the same for both amendments. However, they are not as robust as if I had only taken EU countries. Considering my discussion regarding the debate between mainly the EU and the USA, my results focus on the regressions with only the EU countries in the treatment group.

64 However, I found that my results do not change if I include all EU countries valid as of today in my treatment group.

65 Note that there is no substantial change in my results if I drop the affected variables and instead include the two countries.

66 The countries are: AUT (Austria), BEL (Belgium), DEU (Germany), DNK (Denmark), ESP (Spain), FIN (Finland), FRA (France), GRC (Greece), IRL (Ireland), ITA (Italy), LUX (Luxembourg), NLD (Netherlands), PRT (Portugal), CHN (China), USA (United States of America).

The banks in the treatment group are quite evenly distributed with no country reaching 10% of the total population.

Table VI.1: Observations per country

	Country	Observations per year	%
Treatment group			
	AUT	31	2.55
	BEL	19	1.57
	DEU	36	2.97
	DNK	24	1.98
	ESP	59	4.86
	FIN	10	0.82
	FRA	101	8.32
	GRC	11	0.91
	IRL	16	1.32
	ITA	38	3.13
	LUX	10	0.82
	NLD	26	2.14
	PRT	20	1.65
		401	
Control group			
	CHN	7	0.58
	USA	806	66.39
		813	
Total		**1 214**	

Absolute and relative amount of observations per country.

The countries are: AUT (Austria), BEL (Belgium), DEU (Germany), DNK (Denmark), ESP (Spain), FIN (Finland), FRA (France), GRC (Greece), IRL (Ireland), ITA (Italy), LUX (Luxembourg), NLD (Netherlands), PRT (Portugal), CHN (China), USA (United States of America)

Source: Own calculations.

My study includes all banks from the Bankscope[67] database with consolidation code C1, C2 and C*.[68] That is, I only consider consolidated figures, since the regulatory requirements usually apply to the consolidated level. In the case of double bank entries, I prefer entries for which more relevant data were available to the entries with less available

[67] "Bankscope – World banking information source" from Bureau van Dijk Electronic Publishing BV, Amsterdam, The Netherlands.

[68] Refer to section V.8.3 for a detailed explanation of the consolidation codes.

data. If there is equality, I favour entries with a C1 consolidation code over C2 and the latter over C*.

I translate all values (except for ratios) into million USD (United States dollars) using the corresponding year-end foreign exchange rate according to Bankscope.

Table VI.2 shows the mean and the standard deviations (sd) of the various variables by year. It turns out that the average capital ratio for all observations increased from 2001 to 2003, it dropped in 2004 and 2005 and then slowly recovered in 2006 and 2007; however, not to the same level as before 2004. Going into detail reveals that the control group accounts for this pattern, since the treatment group shows a different picture: The capital ratios of the treatment group banks also increased from 2001 to 2003, but they did not drop in 2004 and increased slightly up to 2007. The drop in the average capital ratios of the control group after 2003 is significant at the 5% level, whereas the slight increase in the capital ratios of the treatment group is not significant. This observation anticipates the possibility of a treatment effect between the two (unmatched) groups. Before I investigate this finding further in section VI.4, the next two subsections explain the strategy I use to evaluate the treatment effect.

[Continued on next page]

Table VI.2: Means and standard deviations of variables by year

YEAR	ETA	gETA	lnTA	DIV	LLRGL	ROAA	lnGDPC	GGDP	INF	lnBGDP
2001	9.69	4.69	7.66	0.65	1.63	0.96	10.32	1.43	2.79	4.22
	(9.25)	(28.08)	(1.99)	(0.48)	(3.3)	(1.99)	(0.4)	(1.02)	(0.58)	(0.19)
2002	9.99	5.04	7.80	0.66	1.60	0.90	10.37	1.71	1.85	4.24
	(9.23)	(21.54)	(2.01)	(0.47)	(1.79)	(2.74)	(0.38)	(0.97)	(0.64)	(0.19)
2003	10.16	2.51	7.94	0.67	1.64	1.09	10.46	2.28	2.25	4.24
	(9.46)	(22.87)	(2.05)	(0.47)	(1.84)	(1.55)	(0.33)	(1.33)	(0.43)	(0.18)
2004	9.72	-4.24	8.07	0.69	1.59	1.12	10.55	3.46	2.49	4.24
	(9.71)	(22.99)	(2.08)	(0.46)	(1.92)	(1.63)	(0.31)	(0.9)	(0.45)	(0.19)
2005	9.63	0.83	8.15	0.71	1.47	1.19	10.60	2.98	2.98	4.26
	(9.46)	(35.92)	(2.07)	(0.46)	(1.78)	(2.47)	(0.31)	(1.11)	(0.69)	(0.21)
2006	9.86	3.17	8.29	0.71	1.36	1.27	10.65	2.92	2.86	4.29
	(9.6)	(18.94)	(2.1)	(0.45)	(1.47)	(2.16)	(0.3)	(1.01)	(0.7)	(0.22)
2007	9.90	1.18	8.41	0.71	1.41	1.06	10.72	2.27	2.63	4.34
	(9.91)	(47.57)	(2.15)	(0.45)	(1.97)	(2.21)	(0.27)	(1.28)	(0.56)	(0.22)
Total	9.85	1.88	8.05	0.68	1.53	1.08	10.52	2.44	2.55	4.26
	(9.52)	(29.93)	(2.08)	(0.46)	(2.08)	(2.15)	(0.36)	(1.29)	(0.69)	(0.21)

Means and standard deviations (in parentheses) of all variables by year.

The variables are: ETA (ratio total equity to total assets), gETA (growth rate of ETA), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product).

Source: Own calculations.

VI.3.2. Difference-in-Difference Strategy

Wooldridge (2002) explains the general DiD framework, which I apply in my study. The idea is that one observes the outcome variable of interest in two time periods, one before treatment and the other after treatment, and for two different groups, one being the treatment group and the other being the control group. In the context of my study, the treatment is the announced comprehensive introduction of Basel II in 2004 for the EU15 countries (the treatment group). I am interested in the question of whether there is a treatment effect on the capital ratios of banks, i.e. if the treatment group shows different capital ratios after treatment compared to the control group. An ordinary least squares

(OLS) regression based on the following formula (VI.1) answers this question:

$$ETA_{i,t} = \beta_0 + \beta_1 Treatment_i + \beta_2 Post_t + \beta_3 Post\ x\ Treatment_{i,t} + \varepsilon_{i,t} \quad (VI.1)$$

$ETA_{i,t}$ is the capital ratio of bank i at time t. Variable $Treatment_i$ is a dummy variable which takes the value of 1 if bank i is part of the treatment group (0 otherwise). Variable $Post_t$ is a dummy which takes the value of 1 if the time period t of the observation is after the treatment date of 2004 (0 otherwise). Variable Post x $Treatment_{i,t}$ is a dummy variable which takes the value of 1 if the observation is one from a treatment group bank after the treatment date (0 otherwise). $\varepsilon_{i,t}$ is an error term and β_0 to β_4 are the coefficients to be estimated: Whereas β_0 is the constant, β_1 shows the estimated difference in the capital ratios between treated and non-treated banks before the treatment date; β_2 reveals the estimated difference in the capital ratios of control banks before and after treatment; and β_3 exposes the estimated treatment effect and represents the DiD estimator of interest in my study.

One can assume that the variables explained above are not the only explanatory variables for the banks' capital ratios. Thus, I expand formula (VI.1) using a number of K control variables $D_{k,i,t}$ with their corresponding coefficients α_k. I include a couple of bank-specific control variables, capturing the bank's size, profitability, riskiness and dividend payment ability, which according to existing studies showed significant impacts on banks' capital ratios (refer e.g. to Berger, DeYoung, Flannery, Lee & Öztekin, 2008; Flannery & Rangan, 2008; Gropp & Heider, 2010; or Lucadamo, 2016). Further, I assume that macroeconomic factors such as the health of the economy or the inflation rate could also influence capital ratios, so I include these factors as country-specific control variables.

In detail, my control variables in the base model are bank size calculated as the natural logarithm of the sum of all assets of a bank (LTA)[69]; bank

[69] Since the sum of assets is also the denominator of the left-hand variable in my regression formula and the results show that the coefficient on this variable is significantly negative, one might assume that this could bias the results. Therefore, even if the correlation coefficient of ETA and LTA in my dataset is considerably low (-0.13), I also performed

risk calculated as the ratio of the part of the loans for which the bank expects losses (but does not charge off) to the total loan portfolio (LLRGL); bank profitability calculated as the ratio of the net income to the total assets (as an average of the previous and the current year-end) of a bank (ROAA); a dividend dummy for dividend-paying banks (DIV); the natural logarithm of the gross domestic product per capita in USD (LGDPC); the annual growth of the gross domestic product per capita (GGDP); and the inflation rate (INF).[70]

As explained above, my study is based on pooled panel data from several pre-treatment and several post-treatment years. Greene (2008) shows that in such a model the OLS estimator might result in biased results. To correct for possible biases, I expand my model by including bank-fixed effects a_i and time-fixed effects v_t. Note that the treatment dummy variable becomes redundant when including bank fixed effects. Similarly, the post dummy variable is unnecessary when including time fixed effects.[71] In all my regressions, I follow the proposal of Bertrand, Duflo, and Mullainathan (2004) to use cluster-robust standard errors in many-year-data DiD studies. This should help to correct for a possible serial correlation pattern. If not otherwise stated, the clustering is at bank level.

To conclude, my regression model appears as follows in formula (VI.2):

$$\begin{aligned} ETA_{i,t} &= \beta_0 + a_i + v_t + \\ &\beta_3 \text{Post x Treatment}_{i,t} + \sum_{k=0}^{K} \alpha_k D_{k,i,t} + \varepsilon_{i,t} \end{aligned} \qquad \text{(VI.2)}$$

As Wooldridge (2002) states, the DiD estimator has certain advantages over other estimators. It corrects for errors caused by changes over time

my regression with non-asset based, but income statement based variables to measure bank size: the net interest revenue, other operating income and overhead expenses. If I use these variables, my results do not change. Because total assets is the more commonly known variable for measuring firm size, I therefore continue with this variable in my study.

70 Refer to section V.8.1 for more detailed definitions of and explanations for the sources of the used variables.

71 (Separate) F-tests to check whether the bank or time-fixed effects are jointly significantly different from zero fail to reject the null hypothesis, which indicates that it is advisable to include these fixed effects (see e.g. Murray, 2006). Further, Hausman (1978) tests hypotheses are rejected at the 1% level, indicating that the fixed effects model should be preferred to the random effects model (e.g. Baltagi, 2008).

for reasons unrelated to the treatment. Furthermore, it also corrects for errors resulting from the risk that the treatment group and the control group might have systematic, unmeasured differences not caused by the treatment. “By comparing the time changes in the means for the treatment and control groups, both group-specific and time-specific effects are allowed for.” (Wooldridge, 2002, p. 130). Nevertheless, it is apparent from the idea of the model that one should use a control group that is similar to the treatment group. In other words, the two groups should satisfy the parallel trend assumption, meaning that had the treatment not taken place, their outcome development should have been similar over time. In order to construct an adequate control group, I apply the propensity score matching strategy discussed in the next section.

VI.3.3. Matching Strategy

The model of propensity score matching, which I use in order to assign an adequate control group to the treatment group, was established by Rosenbaum and Rubin (1983). The basis for my matching is the year before treatment, that is 2003 (in the robustness checks in section VI.4.2, I test possible changes in my results in the case of other base years for the matching). The propensity score is the conditional probability for an individual to participate in a treatment based on various covariates. Untreated individuals are allocated to treated individuals according to their calculated propensity scores (i.e. they are matched). In the case of simple nearest neighbour matching (refer e.g. to Abadie & Imbens, 2006), each untreated individual is matched with the treated individual that has the most similar propensity score. However, if the propensity scores are widely spaced, this approach could result in bad matches. To avoid such bad matches, there are various other possibilities for performing the matching. The most important of these include calliper matching (e.g. Cochran & Rubin, 1973) and kernel-based matching (e.g. Heckman, Ichimura & Todd, 1998). The first ensures that untreated individuals only match to treated individuals if their propensity scores lie within a defined range. The second assigns weights to each untreated individual based on how well it matches its corresponding treated individual.

Further, there is the possibility of matching each treated individual to just one or to more than one untreated individuals and there is the option to match the same untreated individual to more than one treated individuals (which is a matching with replacement; according to Smith & Todd, 2005; this method should increase the accuracy of the matching strategy).

As Caliendo and Kopeining (2005) state, any discrete choice model is suitable for calculating the propensity scores, especially in the binary treatment case in my study. I use a probit[72] regression, where the dependent variable is a dummy, which is 1 in the case of an EU15 bank and 0 otherwise. As the most important explanatory variables of the probit regression, I include the lagged capital ratio (L.ETA) and the growth of the equity ratio (gETA). This approach should ensure that the parallel trend assumption is optimally satisfied. As further explanatory variables, I include the natural logarithm of a bank's total assets and the dividend dummy discussed above. Further, I follow Dehejia and Wahba (2002) and Garrido, Kelley, Paris, Roza, Meier, Morrison and Aldridge (2014) to attempt transformations of the explanatory variables in order to balance the result. After various attempts, I obtained the most appropriate results when including a second-order term for the lagged capital ratio, the capital ratio growth rate and the banks' size variable.[73]

Note that the selection of the right covariates is not testable but, according to Rosenbaum and Rubin (1983), the unconfoundedness assumption is key. This states that, conditional on the covariates, the assignment to the treatment has to be independent of the outcome. Therefore, in section VI.4.2, I test whether my results change when using different covariate compositions in my matching strategy. The second key assumption explained by Rosenbaum and Rubin (1983) is overlap, which means that each observation in the population has to have some chance to be in the treatment group or to be in the control group. By applying calliper matching in my base set-up, I ensure that I use only good matches as control group individuals (for the calliper distance measure I take a discretionary value of 0.01). Further, my base set-up matches two untreated individuals to each treated individual and I apply

72 Different approaches, such as using a logit regression, do not change the results of my study.

73 The results do not change without second-order terms but the matching statistics are much better, so it would appear to be more appropriate to include the terms.

a matching with replacement. In section VI.4.2, I change these specifications in my robustness checks.

Before that, however, the next section, VI.4.1, starts by giving the results of the general model.

VI.4. Results

VI.4.1. Results of the Basic Model

As noted in section VI.3.1, the data show that from 2001 to 2007 the capital ratios of the treated banks developed differently from the ratios of the control banks in the original (unmatched) sample. In order to examine a possible general treatment effect, I therefore start by performing a simple DiD regression for this unmatched sample according to formula (VI.2). In the first instance, I did not include any control variable $D_{k,i,t}$. Column 1 of Table VI.3 shows the result of this regression. Coefficient β_3, that is, the treatment effect of interest, has a positive value of 0.72 and is significant at the 1% level. Without considering other influencing factors, this result suggests that the treatment had a positive effect on the capital ratios of banks of the treatment group in contrast to the control group. Otherwise stated, it seems that the announced comprehensive introduction of the Basel II framework resulted in banks from early-comprehensive adopter countries having higher capital ratios compared to banks from late-partial adopter countries. On average, these ratios were higher by 72 basis points.

However, considering the low within R-squared[74] value, it seems that this regression is not a fully explanatory model. Column 2 of Table VI.3 therefore shows the regression with the same data when I include the control variables $D_{k,i,t}$. The within R-squared value is now considerably higher. I still find a significant treatment effect (at the 1% significance level). The value of the estimated coefficient β_3 is 0.99 and is therefore slightly higher than it is without the control variables.

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[74] There are various R-squared measures for assessing the goodness-of-fit of a fixed effects regression. I use the within R-squared according to the discussion in Wooldridge (2013).

Table VI.3: Standard DiD results

Dependent variable: ETA	(1) standard result for unmatched sample (no control variables)	(2) standard result for unmatched sample	(3) standard result for matched sample (no control variables)	(4) standard result for matched sample
Post x Treatment	0.72 ***	0.99 ***	0.60 **	0.96 ***
	(0.25)	(0.31)	(0.28)	(0.30)
lnTA		-4.91 ***		-4.85 ***
		(0.77)		(0.71)
DIV		-0.33 *		0.01
		(0.19)		(0.13)
LLRGL		-0.08		-0.13 *
		(0.05)		(0.08)
ROAA		0.16		0.26 ***
		(0.12)		(0.08)
lnGDPC		4.34 ***		3.90 ***
		(1.53)		(1.24)
GGDP		0.04		0.01
		(0.06)		(0.06)
INF		0.12		0.14
		(0.11)		(0.09)
lnBGDP		1.06		-0.16
		(1.23)		(1.16)
Constant	9.69 ***	-2.16	8.89 ***	12.46
	(0.09)	(11.33)	(0.10)	(9.29)
Observations	8 498	8 498	7 644	7 644
Groups	1 214	1 214	1 092	1 092
Within R-squared	0.009	0.184	0.009	0.217
Control Variables	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Cluster Level	Bank	Bank	Bank	Bank

Results of different regressions of ETA on various independent variables.
t-values included in parentheses.
**** shows significance of the calculated coefficient at the 1% level, ** at the 5% level and * at the 10% level.*

The regression variables are: ETA (ratio total equity to total assets), Post x Treatment (treatment effect of interest), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product) and a constant.

Source: Own calculations.

To summarise, there would seem to be a significant treatment effect when analysing the unmatched, full sample. However, the discussion in section VI.3 raised the question of whether the control group is adequate when using this full sample.

As an analysis of this question, Panel A of Table VI.4 shows the differences between the treatment group and the control group in the variable averages of the full sample for the year 2003. Panel B of the same table shows the pooled averages of the three pre-treatment years 2001 to 2003. The table also shows the standardised percentage bias according to Rosenbaum and Rubin (1985). This bias is the mean difference of the treatment group and the control group as a percentage of the square root of the average sample variances of these two groups. I assume the bank-specific control variables to be of most interest for this analysis.[75]

The average of the biases of these variables for the year 2003 is quite high at 44.5% (the bias is 40.3% for the pooled averages of the years 2001 to 2003). This result suggests that there are noteworthy differences in the characteristics of the treatment group banks compared to the control group banks.

[Continued on next page]

[75] The inclusion of country-specific variables in this analysis (and in the matching procedures discussed below) seems meaningless, considering that there are just two control group countries in the sample. When I nevertheless perform the matching procedures including my country-specific variables, only a small treatment group in the matched sample results (i.e. the other banks do not match). However, I still obtain a positive treatment effect with this approach, which is just slightly not significant at the 10% level (probably due to the small sample size).

Table VI.4: Comparison of variable means for treatment and control group (unmatched sample)

Panel A - only year 2003	Treatment group N	Treatment group Mean	Control group (unmatched) N	Control group (unmatched) Mean	Delta (treatment vs. control group)	Bias in % (treatment vs. control group)
ETA	401	9.80	813	10.34	-0.54	-5.2
gETA	401	3.45	813	2.04	1.41	6.0
lnTA	401	9.18	813	7.33	1.84	97.5
DIV	401	0.36	813	0.82	-0.46	-105.7
LLRGL	401	2.17	813	1.38	0.78	38.3
ROAA	401	0.94	813	1.16	-0.22	-14.1
lnGDPC	401	10.27	813	10.56	-0.29	-98.3
GGDP	401	1.10	813	2.87	-1.77	-149.9
INF	401	2.24	813	2.26	-0.02	-4.0
lnBGDP	401	4.31	813	4.20	0.10	48.3
Average bias of the bank specific variables						44.5

Panel B - years 2001 to 2003	Treated N	Treated Mean	Control Group (unmatched) N	Control Group (unmatched) Mean	Delta (treatment vs. control group)	Bias in % (treatment vs. control group)
ETA	1'203	9.68	2'439	10.08	-0.40	-3.9
gETA	1'203	3.98	2'439	4.13	-0.15	-0.6
lnTA	1'203	8.94	2'439	7.24	1.70	89.9
DIV	1'203	0.36	2'439	0.81	-0.45	-102.7
LLRGL	1'203	2.17	2'439	1.36	0.81	28.6
ROAA	1'203	0.73	2'439	1.11	-0.38	-16.0
lnGDPC	1'203	10.10	2'439	10.52	-0.42	-134.8
GGDP	1'203	1.59	2'439	1.92	-0.33	-26.8
INF	1'203	2.47	2'439	2.21	0.26	36.0
lnBGDP	1'203	4.29	2'439	4.20	0.09	41.4
Average bias of the bank specific variables						40.3

Comparison of variable means for treatment and control group before matching procedures.

The variables are: ETA (ratio total equity to total assets), gETA (growth rate of ETA), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product).

Source: Own calculations.

Because of this concern, I perform the matching approach discussed above before applying the DiD regression again. The basis matching strategy according to section VI.3.3 results in a treatment group of 364 banks. That is, I lose only 37 banks because there was no adequate match for these banks. The corresponding control group is 728 banks (since there are two control banks per treatment bank), therefore the total number of banks is 1 092 and the total number of observations for the seven years is 7 644. Panel A of Table VI.5 reveals the results of the basis matching strategy, showing that the bias of the variables of concern significantly decreases after matching – the average bias of these variables is now 10.2%, compared to 44.5% without matching. Similarly, the pooled average bias for the pre-treatment years 2001 to 2003 drops from 40.3% to 9.8%. Therefore, the basis matching strategy seems to lead to a considerable reduction in the characteristic differences of the banks in the pre-treatment period, even if the matching itself is based only on the year 2003.[76]

Columns 3 to 4 of Table VI.3 show the result of the DiD regression on the matched sample. The regression without control variables visible in column 3 of this table still show a positive estimated coefficient β_3 of 0.99 (the significance is at the 1% level). Including control variables and therefore allowing for possible bank- or country-specific factors does not change this result: The estimated treatment effect remains at approximately the same amount (0.96) and at the same significance level of 1% (see column 4 of Table VI.3).

As an interim conclusion, the results in Table VI.3 indicate that there is a significant positive effect of the announced comprehensive introduction of Basel II on the capital ratios of banks – the effect is a capital ratio increase in the amount of approximately 100 basis points. This finding suggests that the introduction of new extensive bank regulations could in fact have the intended increase in the bank's capital buffers.

Note that, even though I do not consider the results of the control variables as the primary focus of my study, there are also interesting outputs for these. These findings are basically in line with the other studies discussed in section VI.2. I find very strong evidence that bigger banks have lower capital ratios than smaller banks (this finding is valid for every regression and every robustness check performed).

[76] However, I also apply a matching strategy based on the complete pre-treatment period 2001 to 2003 in the robustness checks in section VI.4.2.

Table VI.5: Comparison of variable means for treatment and control group (matched sample)

Panel A - only year 2003	Treatment group N	Treatment group Mean	Control group (matched) N	Control group (matched) Mean	Delta (treatment vs. control group)	Bias in % (treatment vs. control group)	Bias reduction in % (unmatched vs. matched control group)
ETA	364	9.30	728	9.39	-0.09	-0.9	-82.9
gETA	364	3.32	728	2.95	0.37	1.6	-74.1
lnTA	364	9.23	728	9.15	0.08	4.3	-95.6
DIV	364	0.39	728	0.38	0.02	3.8	-103.6
LLRGL	364	2.24	728	1.22	1.03	50.1	30.9
ROAA	364	0.91	728	0.91	-0.01	-0.4	-96.9
lnGDPC	364	10.27	728	10.44	-0.17	-57.4	-41.6
GGDP	364	1.07	728	3.11	-2.05	-173.6	15.8
INF	364	2.23	728	2.22	0.01	2.1	-152.7
lnBGDP	364	4.31	728	4.19	0.12	55.3	14.5
Average bias and reduction respectively of the bank specific variables						10.2	-77.1

Panel B - years 2001 to 2003	Treatment group N	Treatment group Mean	Control group (matched) N	Control group (matched) Mean	Delta (treatment vs. control group)	Bias in % (treatment vs. control group)	Bias reduction in % (unmatched vs. matched control group)
ETA	1 092	9.18	2 184	9.16	0.03	0.3	-107.0
gETA	1 092	4.23	2 184	5.42	-1.19	-4.4	685.6
lnTA	1 092	8.99	2 184	9.06	-0.06	-3.4	-103.7
DIV	1 092	0.39	2 184	0.40	-0.01	-3.2	-96.9
LLRGL	1 092	2.24	2 184	1.17	1.07	37.8	32.2
ROAA	1 092	0.68	2 184	0.90	-0.22	-9.4	-41.2
lnGDPC	1 092	10.11	2 184	10.41	-0.30	-95.6	-29.1
GGDP	1 092	1.57	2 184	2.17	-0.59	-48.0	79.3
INF	1 092	2.47	2 184	2.15	0.32	44.2	22.8
lnBGDP	1 092	4.29	2 184	4.18	0.11	49.1	18.7
Average bias and reduction respectively of the bank specific variables						9.8	-75.8

Comparison of variable means for treatment and control group after matching procedures.

The variables are: ETA (ratio total equity to total assets), gETA (growth rate of ETA), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product).

Source: Own calculations.

There is also strong support for the finding that the ratio increases with the profitability of a bank and the economic health of its environment (i.e. not all, but most regressions confirm these results). Further, I find some evidence that the banks' ratios decrease as the banks' riskiness increases. For a few regressions only I find that dividend payers seem to have lower capital ratios, that the capital ratios appear to be lower in the case of higher growth rates of the gross domestic product and that the ratios seem to be higher in the case of higher inflation rates and the greater importance of the banking sector in a country.

In order to ensure that different specifications of the set-up do not change the result of the base set-up, I perform a couple of robustness checks. I explain these checks and their output in the next section, section VI.4.2.

VI.4.2. Robustness Checks

Table VI.6 and Table VI.7 report the results of the various robustness checks.

First, I perform the standard regression with clustering of the standard errors on country level instead of firm level. As column 1 of Table VI.6 shows, the treatment effect remains at the same amount, while the significance level drops slightly to 5%.

The next two robustness checks deal with the treatment date. In the base set-up, I consider that the treatment took place in 2004, the year in which the Basel II framework was published, as noted in section VI.2. However, at that time the EU had not yet released its official implementation plan – this happened in 2006. My argument for defining the year 2004 as the treatment date is that EU banks had probably already started implementing the Basel II rules at the date of the publication of the rules and not at the date of the announcement of the detailed implementation plan. Nevertheless, I also perform the DiD regression with treatment date 2006 (in this case I do not consider the years 2004 and 2005 to prevent a possible announcement bias). I therefore have only five observation years (three pre-treatment years from 2001 to 2003 and two post-treatment years from 2006 to 2007) for this regression, which decreases the population to 5 460 observations. Column 2 of Table VI.6 reveals that there is still a significant treatment effect (at the 1% level);

the estimated effect of 1.41 is even higher than in the base set-up. Thus, it does not matter if I consider the treatment date to be 2004 or 2006.

Table VI.6: Robustness checks (part 1)

Dependent variable: ETA	(1) clustering at country level	(2) treatment date 2006	(3) treatment date 2002	(4) not considering big US-banks	(5) two periods model with pooled years (no control variables)	(6) two periods model with pooled years
Post x Treatment	0.96 **	1.41 ***	0.16	0.74 **	0.60 **	1.90 ***
	(0.39)	(0.46)	(0.24)	(0.32)	(0.28)	(0.66)
lnTA	-4.85 ***	-4.82 ***	-4.88 ***	-10.31 ***		-4.26 ***
	(0.98)	(0.71)	(0.71)	(0.79)		(0.90)
DIV	0.01	-0.07	-0.04	-0.24		0.06
	(0.19)	(0.16)	(0.14)	(0.19)		(0.25)
LLRGL	-0.13	-0.10	-0.13 *	-0.37 ***		-0.12
	(0.10)	(0.07)	(0.07)	(0.13)		(0.09)
ROAA	0.26 **	0.28 ***	0.26 ***	0.41 ***		0.28 *
	(0.10)	(0.09)	(0.08)	(0.10)		(0.17)
lnGDPC	3.90 **	3.28 ***	5.38 ***	4.63 ***		0.31
	(1.39)	(1.20)	(1.33)	(1.13)		(2.89)
GGDP	0.01	-0.12	0.04	-0.17 **		-0.40 *
	(0.06)	(0.08)	(0.06)	(0.07)		(0.23)
INF	0.14	0.28 **	-0.06	-0.14		0.57 **
	(0.11)	(0.12)	(0.10)	(0.11)		(0.27)
lnBGDP	-0.16	0.30	0.64	0.66		2.91
	(1.89)	(1.51)	(1.10)	(1.31)		(2.69)
Post					-0.30 ***	1.05 ***
					(0.11)	(0.38)
Constant	12.46	0.00 ***	-5.36	50.66 ***	9.17 ***	31.59 *
	(10.13)	(0.00)	(9.22)	(9.59)	(0.06)	(18.45)
Observations	7 644	5 460	7 644	6 699	7 644	2 184
Groups	1 092	1 092	1 092	957	1 092	1 092
Within R-squared	0.217	0.224	0.215	0.462	0.006	0.200
Control Variables	Yes	Yes	Yes	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	No	No
Cluster Level	Country	Firm	Firm	Firm	Firm	Firm

Results of different regressions of ETA on various independent variables.
t-values included in parentheses.
***** shows significance of the calculated coefficient at the 1% level, ** at the 5% level and * at the 10% level.*

The regression variables are: ETA (ratio total equity to total assets), Post x Treatment (treatment effect of interest), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product), Post (post treatment dummy) and a constant.

Source: Own calculations.

On the other hand, I also perform a regression where I consider the treatment date to be 2002 – that is, clearly before the announcement of Basel II. Such a regression, in which one would not expect to obtain a significant treatment effect, is known as a placebo test. It is one of the highly recommended tests when performing DiD studies (refer e.g. to Angrist & Krueger, 1999). Column 3 of Table VI.6 reveals that the treatment effect coefficient loses its significance in this regression, which is the expected outcome. This observation strengthens the result of a positive and significant treatment effect in the regressions with the correct treatment date.

As a further robustness check, I consider that the USA first communicated the quick application of the Basel II rules at least for their big banks, when the framework was announced in 2004 (refer to the discussion in section VI.2). This means that one could expect these banks to show a similar reaction to the announcement as European banks; an effect, which might bias my basis results. Therefore, I also perform a calculation that excludes US banks with total assets higher than USD 25 billion (which was the definition of a big bank according to the implementation idea in the USA). The result is again a positive coefficient of 0.74, significant at the 5% level (see column 4 of Table VI.6). I therefore conclude that the fact that the original US approach planned to treat small to medium-sized banks differently from big banks does not affect my outcome.[77]

The next robustness check deals with possible serial correlation pattern. As already noted above, Bertrand et al. (2006) have concerns about such a pattern in cases in which a DiD regression includes more than two periods. One of their proposed strategies for addressing these concerns is the use of cluster-robust standard errors, as I do in my regressions. Another possibility is to pool the pre- and the post-treatment years in the regression. This involves taking the averages of the variables for the years 2001 to 2003 to obtain just one pre-treatment "year" and the averages of the variables for the years 2004 to 2007 to obtain just one post-treatment "year". Since there are only two years in this regression, it is not necessary to include time-fixed effects, just a dummy "Post" for

[77] Note that it does also not matter whether or not I exclude big non-US banks from the calculation. As a general principle, outliers do not bias my results: There are no changes in the outcome if I winsorise all variables e.g. at the 2% level.

the post-treatment period. Columns 5 and 6 of Table VI.6 show the results of this regression; the first without control variables and the second with control variables included. Again, I find a positive treatment effect (0.60; significant at 5% and 1.90 respectively; significant at 1%). Therefore, it does not seem that serious serial correlation issues affect my results.

The next couple of robustness tests cover different matching approaches. First, I check the outcome of my regression when I use calliper distance measures other than 0.01 in the matching strategy. Column 1 of Table VI.7 reveals the results when I apply no calliper matching at all. This means that for every treated bank there is a matched control bank, even if the match is not good. Accordingly, the number of observations increases (from a total of 7 644 to a total of 8 421) at the cost of a possibly less appropriate matching result (i.e. the decrease of the standardised percentage bias, according to Rosenbaum and Rubin, 1985, is lower than for the calliper matching). The DiD-regression based on this matching strategy still shows a positive treatment effect of 0.96 (significant at the 1% level). The result of the opposite, that is, an unreasonably strict distance measure, appears in column 2 of Table VI.7. The calliper distance measure in this case is only 0.001, decreasing the total observations to only 4 368 (193 treated banks could not be matched with an appropriate control bank and therefore drop out, which means that only 208 treated banks and 416 corresponding control group banks enter the regression). Nevertheless, in this case I also find a positive treatment effect of 0.98, significant at the 5% level.

A further possibility for ensuring that the results are based on good matches is to ignore banks with propensity scores close to zero and close to unity (because untreated observations often show a distribution close to zero and treated observations close to unity, which might question the assumption that there is common support in the matching results). If I drop banks with propensity scores below 0.1 and above 0.9, I obtain a treatment effect of 0.79 (significant at the 1% level) in my DiD regression (refer to column 3 of Table VI.7).

Table VI.7: Robustness checks (part 2)

Dependent variable: ETA	(1) matching without caliper distance	(2) matching with stricter caliper distance	(3) prospensity scores <0.1 and >0.9 dropped	(4) matching with kernel-based weighting	(5) one to one matching	(6) matching performed with further covariates	(7) matching performed with pooled years	(8) matching performed with further covariates and pooled years
Post x Treatment	0.96 ***	0.98 **	0.79 ***	0.99 ***	1.05 ***	0.90 ***	0.57 **	0.74 **
	(0.29)	(0.45)	(0.23)	(0.31)	(0.34)	(0.31)	(0.27)	(0.29)
lnTA	-4.81 ***	-5.04 ***	-4.42 ***	-4.91 ***	-5.43 ***	-5.21 ***	-5.57 ***	-5.60 ***
	(0.68)	(1.01)	(0.63)	(0.77)	(0.88)	(0.74)	(0.69)	(0.67)
DIV	-0.06	0.04	0.16	-0.33 *	-0.14	-0.08	-0.49 **	0.15
	(0.15)	(0.20)	(0.11)	(0.19)	(0.17)	(0.15)	(0.21)	(0.16)
LLRGL	-0.13 *	-0.13	-0.11 *	-0.08	-0.09	-0.19 **	-0.24 **	-0.49 ***
	(0.07)	(0.10)	(0.07)	(0.05)	(0.06)	(0.09)	(0.11)	(0.06)
ROAA	0.26 ***	0.40 ***	0.24 **	0.16	0.26 ***	0.41 ***	0.27 ***	-0.09 *
	(0.07)	(0.12)	(0.11)	(0.12)	(0.09)	(0.10)	(0.02)	(0.05)
lnGDPC	4.03 ***	4.05 **	3.56 ***	4.34 ***	4.19 ***	-0.23	-0.10	-0.06
	(1.20)	(1.62)	(1.15)	(1.53)	(1.52)	(1.24)	(1.02)	(0.71)
GGDP	0.01	0.09	-0.01	0.04	0.00	-0.15 **	0.08	-0.05
	(0.06)	(0.09)	(0.04)	(0.06)	(0.07)	(0.07)	(0.06)	(0.04)
INF	0.10	0.22 *	0.08	0.12	0.14	-0.04	0.03	0.00
	(0.08)	(0.13)	(0.08)	(0.11)	(0.10)	(0.10)	(0.09)	(0.07)
lnBGDP	0.22	-0.04	0.40	1.06	0.45	1.50	2.23 *	-0.09
	(1.10)	(1.89)	(1.07)	(1.23)	(1.23)	(1.18)	(1.16)	(1.20)
Constant	9.30	11.71	9.91	-2.16	12.10	50.94 ***	50.28 ***	59.77 ***
	(9.07)	(11.99)	(8.65)	(11.33)	(10.80)	(9.69)	(10.41)	(8.26)
Observations	8 421	4 368	8 071	8 498	5 096	7 602	7 938	7 623
Groups	1 203	624	1 153	1 214	728	1 086	1 134	1 089
Within R-squared	0.207	0.246	0.213	0.184	0.253	0.227	0.214	0.287
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Level	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Results of different regressions of ETA on various independent variables.
t-values included in parentheses.
***** shows significance of the calculated coefficient at the 1% level, ** at the 5% level and * at the 10% level.*

The regression variables are: ETA (ratio total equity to total assets), Post x Treatment (treatment effect of interest), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product) and a constant.

Source: Own calculations.

Next, I perform a matching with kernel-based weighting instead of nearest neighbour matching. Note that in this case, every treatment bank and every control bank enters the matching; the former each have a weight of 1 and the latter have individual weights according to the quality of their ability to be used as a match. This matching method results in a treatment group of 401 banks and a control group of 813 banks; that is, a total of 1 214 banks or 8 498 observations enter the DiD regression. Again, the results of this DiD regression show a significant treatment effect of 0.99 (at the 1% level; see column 4 of Table VI.7).

In the last robustness check related to the matching method, I perform one-to-one matching (i.e. a treatment bank matches with one control bank only).[78] Accordingly, the number of control banks drops to 364 (which is the same as the number of treated banks) and the number of observations to 5 096. The resulting treatment effect is 1.05 and significant at the 1% level (see column 5 of Table VI.7).

To conclude, I assume that my results are not sensitive to changes in the matching method. A further arguable point might be the choice of the covariates in the matching strategy. My first alternative strategy in this context is the inclusion of further covariates, that is, the other bank-specific variables used in my study. This strategy leads to a marginally lower number of observations of 7 602. This does not substantially change the matching output (however, the matching statistics are slightly worse than in the base strategy) and does therefore also not influence the subsequent DiD regression – the result is a significant treatment effect of 0.90 (significant at the 1% level; refer to column 6 of Table VI.7 for details).

An additional alternative strategy is to base the matching not only on the year before treatment; column 7 of Table VI.7 shows the regression results I obtain when I perform a "pooled" matching for the years 2001 to 2003 with the original matching covariates. That is, the matching is not only based on the covariates for year 2003, but also takes into consideration their values for 2001 and 2002. The total number of observations in this case is 7 938. The resulting treatment effect is 0.57, significant at the 5% level.

Column 8 of Table VI.7 reveals the results of the same pooled matching strategy that also includes the additional covariates as in the preceding

[78] Note that the opposite is also possible, e.g. the matching of three (or even more) control banks for every treatment bank. In this case the results regarding the treatment effect do not change either. However, considering that in the original population there are only 813 control banks and 401 treatment banks (the ratio of control banks to treatment banks is only slightly above 2), this approach does not seem to make sense.

passage. That is, this strategy includes all the possible information in my dataset to perform good matches, which results in 363 treated banks to be considered and a total number of 7 623 observations. Interestingly, the matching statistics remain quite good, despite the fact that many covariates have to be matched: The average standardised percentage bias of the variables of interest for the years 2001 to 2003 drops to 4.3% after matching (table not displayed) – which is even better than the average bias of 9.8% in the original model. But in the original model the bias for the lagged capital ratio and for the capital ratio growth is lower (i.e. better), which in my opinion is more important than a slightly better average bias. However, it does not matter which strategy is chosen because I find a significant treatment effect of 0.74 (significant at the 5% level) in the full matching model as well.

To conclude, my results seem to be robust regarding various specifications of the matching strategy or the regression model.[79] That is, banks from European countries show significantly higher capital ratios than banks from the control group after the treatment date of 2004. However, even though the announcement of the Basel II introduction in 2004 might be an explaining factor, there is another possible occurrence that could be considered as "treatment" instead of the Basel II subject – the change in bank reporting standards during this time. The next section, VI.4.3, examines this topic in more detail.

VI.4.3. Changed Regulation versus Changed Reporting Standards?

It is worth noting that it was during my observation horizon that the application of the IFRS became mandatory in 2005 for publicly traded EU banks (Regulation [EC] 1606/2002 of the European Parliament and of the Council). Before the use of IFRS, many of the local reporting standards applied by Continental European banks stipulated the cost principle (refer e.g. to Costa & Guzzo, 2013). This is in contrast to the fair value principle imposed by IFRS. Therefore, a change in the reporting standards might also have had an effect on the capital ratios of banks: different measurement methods might have resulted in changes in the banks' accounting book values, which in turn might have led to

[79] Note that I also performed various combinations of the robustness checks and did not find any substantial changes in my results.

changes in the capital ratios. This raises the question of whether my identified treatment effect was caused by the change in bank regulation or by the change in reporting standards. To answer this question, this section reveals a couple of additional robustness checks.

First, I only include the year 2004 in my post-treatment period, since the mandatory application of IFRS did not occur before 2005. In this case, I still find a significant treatment effect of 1.12 (refer to column 1 of Table VI.8), which indicates that the announced introduction of Basel II led to an increase in the capital ratios.

However, one may argue that banks could also have introduced IFRS before it became mandatory in 2005. In the next test, I therefore completely exclude all banks that experienced a change in their reporting standards in any of the years of my observation horizon. This approach should eliminate any possible bias resulting from the reporting standard change. Column 2 of Table VI.8 shows the results of this change when I exclude the affected banks *after* the matching procedures from section VI.4.1. In this case, I still obtain a significant treatment effect of 1.09 (significant at the 1% level). Having eliminated the possible reporting standard change bias, this result means that the announced introduction of Basel II for early-comprehensive adopters did indeed lead to a treatment effect.

But if I exclude affected banks *before* performing the matching procedures, the result changes: There is still a treatment effect, but it is no longer significant at the 10% level (refer to column 3 of Table VI.8).[80] That is, banks with an early-comprehensive announced introduction of Basel II no longer show any significant difference in their capital ratios compared to late-partial adopters after 2004. In other words, the significant treatment effect from earlier regressions might have been partially caused by the reporting standard change and not (only) the Basel II introduction.

80 Note that this result is robust with respect to the matching robustness checks described in section VI.4.2.

Table VI.8: Robustness checks (part 3)

Dependent variable: ETA	(1) only 2004 as post treatment date	(2) excluding banks with changed reporting standards after matching	(3) excluding banks with changed reporting standards before matching	(4) excluding banks with changed reporting standards without matching	(5) Matched Continental Europe banks with and without reporting standards change	(6) Unmatched Continental Europe banks with and without reporting standards change	(7) Continental Europe banks versus matched UK banks	(8) UK banks versus matched control banks
Post x Treatment	1.12 ***	1.09 **	0.16	0.68	0.20	-1.02 *	0.66 *	-0.85
	(0.29)	(0.46)	(0.49)	(0.44)	(0.53)	(0.52)	(0.36)	(1.60)
lnTA	-4.64 ***	-4.83 ***	-5.92 ***	-4.95 ***	-6.17 ***	-6.86 ***	-4.13 ***	-7.11 ***
	(1.00)	(0.82)	(1.17)	(0.91)	(1.12)	(1.18)	(0.54)	(1.11)
DIV	0.29 *	0.15	-0.44	-0.29	-1.14 ***	-0.45 *	-0.53 ***	-0.13
	(0.15)	(0.17)	(0.31)	(0.35)	(0.39)	(0.24)	(0.15)	(0.34)
LLRGL	-0.08	-0.11	-0.05	-0.03	-0.01	-0.05	-0.02	0.01
	(0.07)	(0.07)	(0.05)	(0.05)	(0.01)	(0.04)	(0.03)	(0.09)
ROAA	0.08	0.26 *	0.20 ***	0.13	0.27	0.23 ***	0.82 ***	0.12
	(0.12)	(0.14)	(0.07)	(0.14)	(0.16)	(0.07)	(0.18)	(0.24)
lnGDPC	3.96 **	3.81 **	4.62 *	-2.56	0.65	6.71 *	7.56 ***	3.03
	(1.98)	(1.69)	(2.76)	(4.77)	(6.99)	(3.77)	(2.81)	(2.81)
GGDP	-1.71	-0.21 *	-0.06	5.38 **	-0.30 **	-0.15	-0.12 **	-0.33
	(3.68)	(0.11)	(0.09)	(2.44)	(0.13)	(0.11)	(0.06)	(0.27)
INF	0.08	0.26 **	0.16	-0.13	0.28	0.23 *	0.04	-0.23
	(0.13)	(0.13)	(0.24)	(0.11)	(0.22)	(0.13)	(0.11)	(0.22)
lnBGDP	0.03	-5.42	-0.08	0.32	6.47 **	1.11	n/a	n/a
	(0.10)	(4.24)	(3.87)	(0.23)	(2.47)	(1.48)		
Constant	16.53	33.79	9.21	-0.98	25.22	-2.58	-30.73	40.74
	(17.86)	(22.36)	(31.91)	(29.34)	(61.27)	(32.47)	(27.81)	(28.21)
Observations	4 368	4 928	1 617	5 866	1 470	2 807	7 833	2'331
Groups	1 092	704	231	838	210	401	1 119	333
Within R-squared	0.164	0.240	0.321	0.190	0.291	0.305	0.291	0.224
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Level	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Results of different regressions of ETA on various independent variables.
t-values included in parentheses.
**** shows significance of the calculated coefficient at the 1% level, ** at the 5% level and * at the 10% level.*

The regression variables are: ETA (ratio total equity to total assets), Post x Treatment (treatment effect of interest; the treatment is the announced comprehensive introduction of Basel II in columns (1), (2), (3) and (4); it is the change in reporting standards in columns (5), (6) and (7)), lnTA (log of total assets), DIV (dividend dummy), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), lnGDPC (log of gross domestic product per capita in USD), GGDP (annual gross domestic product growth), INF (inflation), lnBGDP (log of bank deposits per gross domestic product) and a constant.

Source: Own calculations.

Although the relatively small population could cause the loss of significance (there are only 1 617 observations), the treatment effect nevertheless remains insignificant (even if just slightly) if I use the full possible sample; that is, if I perform the procedures on all banks with no reporting standard changes but without limiting them by doing matching procedures (refer to column 4 of Table VI.8). Thus, the preliminary conclusion is that there is in fact some evidence that the treatment effect might somehow be influenced by changed reporting standards.

Column 5 of Table VI.8 shows the results of a further check related to this objection. In this DiD regression I use only European banks. The treatment variable is not the introduction of Basel II (since all European banks underwent this introduction) but the change in reporting standards. This means that the treatment group consists of all banks that did not change their reporting standards during the observation horizon and the control group consists of the banks that did.[81] If the change in reporting standards was the primary influence on the capital ratios of banks, there should be a measurable treatment effect. But, as the results show, the effect is not significant; that is, a change in reporting standards does not reveal any significant effect on the capital ratios. However, the population is relatively small again. Performing the same procedure on an unmatched and therefore bigger sample reveals a significant treatment effect (at the 10% level – refer to column 6 of Table VI.8). This is the suspected result, namely, (European) banks with a change in the reporting standards had significant higher capital ratios after the treatment than banks without a change.

The next test is similar to the one above, but this time I introduce banks from Great Britain into the analysis. As stated in section V.3.1, I initially dropped these banks because data for the variable lnBGDP was not available for all years. Note that if I drop the variable and include Great Britain banks instead, my general result does not change. That is, I still obtain a significant treatment effect for European banks including Great Britain compared to the control group banks. However, comparing Great Britain banks with Continental European banks might be of additional interest: both groups experienced the announced comprehensive introduction of Basel II in 2004. In contrast to Continental Europe, however, Great Britain already knew the use of fair value accounting before the introduction of IFRS (Cairns, Massoudi, Taplin & Tarca,

[81] Since it has more banks that changed their reporting standards than banks that did not, I define the latter as the treatment group. The reason is that is makes more sense for the matching procedures if the treatment group is smaller than the control group. However, taking the inverse approach does not change the result.

2011). Therefore, one could expect that the introduction of IFRS had no effect on the accounting book values and capital ratios of British banks – in contrast to Continental European banks, for which the change from cost-based to fair-value accounting might have resulted in a change in the accounting book values and capital ratios. That is, if the change of capital ratios is only due to Basel II, I should not obtain a treatment effect when comparing these two groups. If I obtain such an effect, it could be caused by the presence of changed financial reporting standards instead of the Basel II introduction. Column 7 of Table VI.8 shows that this is indeed the case: There is a treatment effect of 0.66, which is significant at the 5% level.[82] Taking into account the above considerations, this result is an additional indicator that the treatment effect was not (only) caused by changes in regulation, but also by changes in the accounting standards.

As a last test in this context, I include only Great Britain banks in the treatment group and compare them with the control banks. Both groups already knew the use of fair value accounting before the introduction of IFRS, but only Great Britain banks faced the announced comprehensive introduction of Basel II. The possible bias of a change from cost-based to fair-value accounting should therefore be eliminated in this check and one might interpret a significant treatment effect as the result of the introduction of Basel II. But, as column 8 of Table VI.8 shows, the treatment effect is not significant. This result could be caused by the relatively small number of observations (there are only 333 groups and 2 331 observations).[83] However, it is a further evidence for the conclusion that the introduction of Basel II was not the only reason for the changes of the capital ratios.

Based on these findings, the next section, VI.5, summarises my results and its implications and discusses possibilities for further work.

[82] Note that it does not matter whether I perform this test on a matched or on an unmatched sample.

[83] The treatment effect remains insignificant, regardless of whether I perform this test on a matched or unmatched sample or whether I specifically exclude or include banks with changed reporting standards. The only thing that changes is that some of the control variables such as LLRG, ROAA, LnGDPC and GGDP becomes significant (they are also significant in most of the other regression, but in column 8 of Table VI.8 only lnTA is significant).

VI.5. Conclusion and Outlook

The bank regulation framework Basel II, which was published in 2004, aimed to strengthen the banking system around the world. However, already at the time of publication, critical votes erupted and it became apparent that not all important countries planned to introduce the new rules at the speed and the magnitude stipulated by the Basel Committee on Banking Supervision.

On the one hand, there was the (Continental) European camp, which supported a quick and comprehensive introduction of the new rules, while on the other hand there was the camp dominated by the US and China, which postponed the introduction or aimed for a less extensive approach. One of the most intensively discussed questions was, among others, whether the new rules would change the capital ratios of banks (the originators of the framework had intended an increase in the ratios).

Motivated by these debates and these open questions, in this work I attempt to ascertain whether there is a measurable change in the capital ratios that was caused by the new framework. Accordingly, I perform a DiD approach by comparing early-comprehensive introducers (the treatment group) of Basel II with late-partial adopters (the control group), using 2004 (the publication year of the new rules) as the treatment date. In order to ensure that the various characteristics of treatment group banks and control group banks do not bias my results, I extend my study by applying a matching strategy before applying the DiD regressions. This results in only comparable banks entering the analysis. The matching strategy is based on several covariates. Further, in order to ensure that the DiD analysis as such is not biased by other factors, I also include other possible explanatory control variables in the regressions.

The results regarding these control variables are comparable to other work performed on the subject of banks' capital ratios: I find very strong evidence that bigger banks have lower capital ratios than smaller banks. There is also strong support for the finding that the ratio increases with a bank's profitability and the economic health of its environment. Further, I find some evidence that banks' ratios decrease as the banks' riskiness increases. For a few regressions only, I find that dividend payers seem to have lower capital ratios, that capital ratios appears to be lower in the case of higher growth rates of the gross domestic product and that ratios seem to be higher in the case of higher inflation rates and the greater importance of the banking sector in a country.

However, as this was not my primary investigation focus, the results regarding the treatment effect are of far more interest for my study. I find evidence of such an effect in the amount of roughly 100 basis points. This result is highly robust in terms of variations in both the matching strategy and the DiD strategy, both regarding the effect size and its significance. That is, it seems that the announced comprehensive introduction of Basel II in 2004 led the affected banks to hold higher capital ratios in this amount compared to banks from countries with no introduction. However, it turns out that the regulation change is not necessarily the only factor that led to the treatment effect. There is evidence that simultaneous changes in bank reporting standards – mainly from cost-based local regulatory standards to fair-value-based IFRS – led to higher capital ratios as well. In other words, book values changed and therefore the capital ratios went up because of a change in the measurement method. The "real" effect might have been much smaller than it appears at first, although the evidence regarding the reporting standards change is not entirely robust. Considering the results of other studies relating to the influence of the regulation, it is nevertheless apparent that the introduction of Basel II had at best only a partial positive effect on the capital ratios of banks.

This result is of interest with regard to future changes in bank regulation, especially the introduction of Basel III, which was announced in 2010 (Basel Committee on Banking Supervision, 2011). The increase in capital ratios alone does not necessarily mean that banks or the banking system have become more stable with the introduction of Basel II. It may be that capital ratios are not directly linked to the stability of the system; or that increased capital ratios are merely the result of changes in the reporting standards and not the banks' risk-absorbing ability; or that the capital ratios should in any case be disproportionately higher than required by the framework (refer e.g. to Admati & Hellwig, 2013). Whatever the case, the financial crisis that occurred after my observation horizon revealed that several banks ran into existential problems despite the application of the Basel II rules. Accordingly, a topic for further research could be whether the introduction of Basel III or other future framework developments have a positive effect on the capital ratios of banks; future crises will show whether this effect has the power to prevent such problems from occurring in the banking sector in the future.

VI.6. References

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VI.7. Appendices

VI.7.1. Detailed Explanations of Variables

Name of variable	**Explanation**	**Source**
Treatment	A dummy variable, which takes the value 1, if bank is part of the treatment group (i.e. in the standard regression: if it is an EU15 bank), 0 otherwise.	Own calculation.
Post	A dummy variable, which takes the value 1, if the time period t of the observation is after the treatment date 2004, 0 otherwise.	Own calculation.
Post x Treatment	A dummy variable, which takes the value 1, if the observation is one from a treatment group bank after the treatment date, 0 otherwise. The estimated coefficient on this variable shows the treatment effect of interest.	Own calculation.
Equity-to-assets ratio (ETA)	The ratio of total equity to total assets.	Own calculation based on data from Bankscope[84].
Lagged equity-to-assets ratio (L.ETA)	The previous year figure of the above variable.	Own calculation based on data from Bankscope

84 Observations in Bankscope that only contained the value N (i.e. no value) for "common positions" were eliminated if they could not be manually calculated from other available positions. Common positions are those that are expected for every bank (such as total assets). Non-common variables (such as e.g. loan loss reserves, i.e. positions that could have no value because the bank does not have any) were considered with value 0.

Name of variable	Explanation	Source
Growth rate of the equity-to-assets ratio (gETA)	The growth rate of the ETA-ratio calculated as shown in formula (VI.3): $$\left(\frac{\text{ETA}}{\text{L. ETA}} - 1\right) \text{x}\, 100 \qquad \text{(VI.3)}$$	Own calculation based on data from Bankscope
Log of total assets (LTA)	Natural logarithm of the sum of all assets of a bank. The variable is a measure for the size of the bank.	Own calculation based on data from Bankscope.
Dividend dummy (DIV)	Dummy variable, which is 1 in cases where the bank has paid out a dividend in the specific year and 0 otherwise.	Own calculation based on data from Bankscope.
Ratio of loan loss reserves to gross loans (LLRGL)	The ratio of the part of the loans for which the bank expects losses (but does not charge off) to the total loan portfolio. The variable is a proxy for the bank's (credit) risk; the higher the value, the higher a bank's risk.	Bankscope.
Return on average assets (ROAA)	This is the ratio of the net income to the total assets (calculated as an average of the previous and the current year-end) of a bank and measures the bank's profitability.	Bankscope.
Log of gross domestic product per capita in USD (lnGDPC)	Natural logarithm of the gross domestic product per capita in USD. The variable is a measure of the health of a country's economy in a specific year.	Own calculation based on data from world development indicators (The World Bank, 2012).

Name of variable	Explanation	Source
Annual gross domestic product growth (GGDP)	Explained by the variable's name. As above, the variable is a measure of the health of a country's economy in a specific year.	World development indicators (The World Bank, 2012).
Inflation (INF)	Explained by the variable's name. The variable measures the influence of the price level on the capital ratios.	World development indicators (The World Bank, 2012).
Log of bank deposits per GDP (lnBGDP)	Natural logarithm of the demand, time and saving deposits in deposit money banks as a share of GDP. This variable measures the importance of the banking system relative to the economy of the country in a specific year.	Own calculation based on data from the financial development and structure dataset (as explained in Beck, Demirguc-Kunt & Levine, 2000)

VI.7.2. Table of Abbreviations

AUT	Austria
BCBS	Basler Committee on Banking Supervision
BEL	Belgium
CHN	China – People's Rep.
DEU	Germany
DiD	Difference-in-difference
DNK	Denmark
EC	European Commission
eds.	Editors
e.g.	Exempli gratia (for example)
ESP	Spain
et al.	Et alii (and others)
EU	European Union
EU15	Member countries of the European Union prior to the addition of ten further countries on 1 May 2004
FIN	Finland
FRA	France
GRC	Greece
i.e.	Id est (that is)
IFRS	International Financial Reporting Standards
IRL	Ireland
ITA	Italy
JEL	Journal of Economic Literature
LUX	Luxembourg
n/a	Not applicable
NLD	Netherlands
No.	Number
OLS	Ordinary Least Squares
pp.	Pages
PRT	Portugal
QIS	Quantitative impact study
sd	Standard deviation
USA	United States
USD	United States Dollar
Vol.	Volume

VI.7.3. Table of Symbols

&	and
α	Coefficient to be estimated (relating to control variables)
a	Bank fixed effect
β	Coefficient to be estimated (relating to treatment variables)
C1	Consolidation code according to Bankscope: statement of a mother bank integrating the statements of its controlled subsidiaries or branches with no unconsolidated companion
C2	Consolidation code according to Bankscope: statement of a mother bank integrating the statements of its controlled subsidiaries or branches with an unconsolidated companion
C*	Consolidation code according to Bankscope: additional consolidated statement
D	Explanatory control variable
$\varepsilon_{i,t}$	Disturbance for individual bank i at time t
i	Numbering for individual bank (ranging from 1 to N)
k	Numbering for explanatory control variables (ranging from 0 to K)
K	Total number of explanatory control variables
L.	Lagged
N	Total population of individual banks
t	Numbering for time (ranging from 1 to T)
t-value	Test statistic for Student's test
T	Total time periods
v	Time fixed effect
%	Percentage

VII. Paper 3: Worldwide Bank Regulation and Bank Liquidity Structure – A Dynamic Panel Data Study

VII.1. Abstract

Recent studies have concluded that direct bank regulation around the world is not the dominant factor when banks set their capital ratios; the ratios mainly and persistently depend on their past levels and on other influencing variables. My paper deals with the same topic of direct bank regulation with regard to the banks' liquidity structure (measured as the net stable funding ratio, NSFR). By means of a partial adjustment model, calculated using the generalised method of moments regression technique, I examine explanatory regulatory variables, other country-specific variables and bank-specific variables for banks in 43 developed countries for the years 2000 to 2011. Similar to the results for capital ratios, I find evidence that the past NSFR is an important (but less persistent) explanatory factor for the present NSFR and that the ratio increases as the importance and risk of a country's banking sector increases. In addition, in common with the results for capital ratios, it seems that a greater degree of private bank monitoring also leads to lower NSFRs. This suggests that relying on private monitoring results in weaker balance sheet figures in general. Additionally, I find that banks appear to disregard the liquidity structure in the case of higher capital regulation severity, indicating that they prioritise compliance with the capital ratio rules. Further, I find evidence that economic growth leads to higher NSFRs. The latter observations seem to be highly applicable to US banks, that is, they seem to be less relevant for banks in other countries. Still, the overall results suggest that the regulation of the NSFR could be a promising instrument in future bank regulation.

Keywords: Banks, Liquidity structure, Bank regulation

JEL Classification: G21, G32, G28

VII.2. Introduction and Background

Initially, bank regulation was primarily aimed at banks' capital ratios by stipulating that a bank's eligible capital measure in relation to an asset measure had to exceed a defined threshold. The Basel Committee on Banking Supervision (1988) introduced this principle in its "Basel I" framework and this has remained in place up to today in the new "Basel III" rules (Basel Committee on Banking Supervision, 2011).

In addition to the capital structure, another aspect discussed early on by both the public and the regulators was banks' liquidity and their liquidity structure (e.g. Basel Committee on Banking Supervision, 2000). Although several researchers claim that the roots of the financial crisis in 2007 were not bank liquidity problems (e.g. Admati and Hellwig, 2013), the focus on the regulation of liquidity structure increased after the crisis (e.g. Kay, 2009 and Basel Committee on Banking Supervision, 2008). This encouraged the Basel Committee on Banking Supervision (2011) to include two numerical liquidity constraints in the Basel III framework. According to these constraints, banks have to fulfil both a long-term and a short-term oriented liquidity ratio, the net stable funding ratio (NSFR) and the liquidity coverage ratio (LCR) respectively. However, researchers have not yet tried to find evidence for the linkage between bank regulation and banks' liquidity structure (although several studies have tried to expose the influence of the regulation on banks' capital ratios).

Prompted by the increased importance of bank liquidity structure regulation and the lack of empirical work on this matter, my paper tries empirically to find explanatory factors for banks' liquidity structure, in particular for the NSFR.[85] I aim to answer the question as to whether bank regulation determines banks' NSFRs or whether banks set their liquidity structure ratios based on other factors or even individually for every bank.

Most of the studies related to banks' capital ratios find some evidence for the influence of the regulation by using various data and methods,[86]

85 Refer to section VII.3.2 for a detailed description of the NSFR.

86 E.g. Gropp and Heider (2010), Flannery and Rangan (2008), Brewer, Kaufman and Wall (2008), Schaeck and Cihák (2009) and, recently, Lucadamo (2016).

but other explanatory factors seem to be of more importance. Lucadamo (2016, p. 5) concludes that "[…] regulation is not the dominant factor when banks set their capital ratios." Based on the study of Lucadamo (2016), I intend to ascertain whether this is also valid in regard to the banks' liquidity structure.

I assume that a more severe regulation should lead to a "stronger" liquidity structure and therefore to a higher NSFR. I use the same six regulatory index variables to measure regulation severity and the same further possible bank-specific and country-specific explanatory factors as Lucadamo (2016). My dataset includes cross-country bank figures for 43 developed countries and the 12 years from 2000 to 2011 (i.e. covering the period before and after the financial crisis) in a partial adjustment model calculated with advanced dynamic panel data regression methods. I consider the idea that the explanatory variables and particularly the regulatory severity might change during the observation period.

My findings reveal that there are both similarities and differences between the results concentrating on the liquidity structure in my study and the ones focusing on the capital structure in Lucadamo (2016), even though the studies have a fairly symmetric set-up. As noted above, Lucadamo (2016) finds only limited evidence that bank regulation influences the capital ratios of banks: only one factor – higher activity restrictions – seems to lead to higher capital ratios; a higher degree of private bank monitoring even seems to lead to lower ratios. The latter also applies to the present study, suggesting that relying on the private sector leads to weaker balance sheet figures in general. Additionally, I find that banks seem to disregard the liquidity structure in the case of greater severity in capital regulation, implying that they first try to comply with the capital ratio rules. Further, I find evidence that economic growth leads to higher NSFRs. These results seem to be caused particularly by US banks, that is, they seem to be less relevant for banks in other countries. The finding that higher importance – and therefore risk – of the banking sector in a country seems to lead to higher liquidity structure ratios applies to all countries. This result is also applicable for the capital ratios in Lucadamo (2016). Also similar to the evidence for capital ratios, the current liquidity structure ratio seems to be highly dependent on its past level. However, there is less persistence in the change process compared to the capital ratios, implying that banks quickly adapt their NSFR in the case of changing circumstances.

To summarise, banks' liquidity structure-setting process would seem to be more unpredictable than the capital ratio process. Nevertheless, the NSFRs appear to matter and there are some influencing factors, especially for US banks. Considering the increasing attention paid by regulators, policy makers, academics and other stakeholders to banks' liquidity structure, the NSFR could be a promising instrument in future bank regulation.

The rest of the paper proceeds as follows: section VII.3 explains the data and methodology used, section VII.4 illustrates the descriptive statistics of the dataset before the results of the regression are revealed in section VII.5, and section VII.6 concludes the paper.

VII.3. Data and Methodology

VII.3.1. Dataset

My study uses the same dataset as the one used by Lucadamo (2016). That is, the focus is on developed countries, since I expect that the banking sector has some importance and the regulation has some influence in such countries. Lucadamo (2016) defines developed countries as the ones belonging to the Organization for Economic Co-operation and Development (OECD)[87], countries with important (i.e. "global") financial centres according to „The Global Financial Centres Index 10"[88] and the other European Union (EU) countries not included above.[89] This results in an original total population of 45 countries.

The year population consists of the 12 years from 2000 to 2011 (however, as a result of the regression methodology described below, the first year drops out and is just used for lagging and differencing). Since my study uses yearly data, the financial year-end date is rounded to the next year-end if a bank does not have 31 December as the financial year-end date.[90]

My study uses data for all banks for the described years and countries from the Bankscope[91] database. To be comparable with the paper on capital ratios by Lucadamo (2016), I only consider consolidated figures, that is, banks with Bankscope consolidation codes C1, C2 and C*.[92] In

87 These are Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Republic of Korea (KOR), Lithuania (LTU), Luxembourg (LUX), Mexico (MEX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR), and the United States of America (USA).

88 See Yeandle and von Gunten (2013). The additional countries to consider are China (CHN), Hong Kong (HKG), Russian Federation (RUS), Singapore (SGP), and the United Arab Emirates (ARE).

89 These are Bulgaria (BGR), Latvia (LVA), Malta (MLT), Republic of Cyprus (CYP), and Romania (ROU).

90 E.g. observations of banks with financial year-end 31 March 2008 are included in the population of 31 December 2008.

91 "Bankscope – World banking information source" from Bureau van Dijk Electronic Publishing BV, Amsterdam, The Netherlands.

92 Refer to section V.8.3 for a detailed explanation of the consolidation codes.

the case of double bank entries, I prefer entries for which more relevant variable data is available to the entries with less available data. If there is equality, I favour entries with C1 consolidation code over C2 and the latter over C*.

My model uses unbalanced panel data according to Wooldridge (2010), by excluding banks with missing data for the variables of interest in a particular year,[93] but including them in the years in which all necessary data is available.

All values (except for ratios) are translated in million USD (United States dollars) using the corresponding year-end foreign exchange rate according to Bankscope.

I use the same regulatory data as Lucadamo (2016), which is based on the bank regulatory survey in Barth, Caprio Jr. and Levine (2001) conducted for the years 2000, 2003, 2008 and 2011. The other years in the observation horizon adopt the value of the nearest of these four observation points (e.g. year 2001 adopts the survey data of 2000 and year 2002 adopts that of 2003). Thus, the paper assumes that changes in the severity of bank regulation occur immediately and not slowly. This appears obvious, since the possible answers to the survey questions are mostly binary ("yes" or "no").[94]

VII.3.2. Model

My model is based on the same partial adjustment model considerations as the one from Lucadamo (2016), but it changes the variable of interest from the capital ratio (in particular the Tier 1 ratio) to the NSFR.[95] The

93 The banks not included in the population for the regression of a particular year are nevertheless included in the calculation of the country-specific variables of interest for these years (such as e.g. the ratio of banks per one million capita per country).

94 However, a robustness check, which considers that regulatory severity changes smoothly by interpolating the values, does not materially change the regression results, except that the private monitoring variable (PRM) loses its significance, which is in line with other robustness checks (refer to the discussion in section VII.5 and to the overview of the robustness check results in Table VII.6). Thus, it looks as if it does not substantially matter whether the model assumes immediate or smooth changes in the severity of the regulation.

95 One could expect that the capital ratio might also directly influence the liquidity structure. However, including the Tier 1 ratio in the regression system of my paper does not substantially change the results and does not lead to a significant influence of the Tier 1-

basis of the idea is that every bank i (ranging from 1 to N) has a target NSFR ($NSFR^*_{i,t}$) in year t (ranging from 1 to T). The target ratio depends on a set of explanatory variables $D_{k,i,t}$. The explanatory variables can be bank specific (i.e. they vary for every bank i) or country specific (i.e. they are the same for all banks i in a country j at time t or they are the same for all banks i in a country j for all time periods T). Each explanatory variable has its corresponding coefficient β_k (k ranging from 0 to K) [96] to be estimated (see formula (VII.1)):[97]

$$NSFR^*_{i,t} = \sum_{k=0}^{K} \beta_k D_{k,i,t} + v_{i,t} \qquad \text{(VII.1)}$$

Publicly disclosed information does not usually reveal the target NSFRs of banks. Considering that a bank's NSFR probably does not equal its target value, one could expect a bank to try to adjust the actual value toward its target.[98] The result is that the difference between the current year's NSFR and the previous year's NSFR should equal the difference between the target NSFR and the previous year's NSFR, multiplied by all banks' invariant[99] speed of adjustment λ as shown in formula (VII.2):

$$NSFR_{i,t} - NSFR_{i,t-1} = \lambda \left(NSFR^*_{i,t} - NSFR_{i,t-1} \right) \qquad \text{(VII.2)}$$

Substituting formula (VII.1) into formula (VII.2) and rearranging results in the dynamic regression model to be estimated according to formula (VII.3):[100]

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ratio in regard to the NSFR (the same is valid for the opposite when including the NSFR in the regressions for the Tier 1 ratio in Lucadamo, 2016). This outcome suggests that I can treat the liquidity ratio setting process as an autonomous subject matter for investigation compared to the capital ratio setting process.

96 $D_{0,i,t}$ equals 1, which means that k = 0 represents the constant.

97 The formula includes a disturbance term $v_{i,t}$.

98 Refer for example to Lintner (1956), who developed a similar dividend setting mode or to Flannery and Rangan (2006), who tried to apply such a model to describe a firm's market debt ratio

99 In line with Lucadamo (2016), my model assumes that the speed of adjustment λ is the same for all banks. In my regression, the coefficient on λ does not substantially change either when performing separate regression in regard to various bank categories (e.g. small banks vs large banks, European banks vs non-European banks etc.).

100 As in Baltagi (2008), I consider the regression disturbance term as a one-way error component model $\lambda v_{i,t} = u_{i,t} = \mu_i + \varepsilon_{i,t}$, where μ_i denotes the unobservable individual specific effect and $\varepsilon_{i,t}$ denotes the remainder disturbance.

$$\mathrm{NSFR}_{i,t} = \lambda \sum_{k=0}^{K} \beta_k D_{k,i,t} + (1-\lambda)\,\mathrm{NSFR}_{i,t-1} + u_{i,t} \qquad \text{(VII.3)}$$

Note that a speed of adjustment λ converging to 0 means that the adjustment process is persistent, that is, only a small gap between the NSFR and the target NSFR closes every year and the other explanatory variables are only of minor importance. On the other hand, a speed of adjustment λ converging to 1 means that the adjustment process is immediate, that is, the past NSFR is only of minor importance and the other explanatory variables have more influence.

The Basel III framework defines the NSFR as the ratio of the available amount of stable funding to the required amount of stable funding. According to the Basel Committee on Banking Supervision (2011, p. 25), "[…] the NSFR standard is structured to ensure that long term assets are funded with at least a minimum amount of stable liabilities in relation to their liquidity risk profiles". Formula (VII.4) shows the calculation of the ratio:

$$\mathrm{NSFR} = \frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} = \frac{\sum_{a=1}^{A} wf_a L_a}{\sum_{b=1}^{B} wf_b A_b} > 100\% \qquad \text{(VII.4)}$$

The available amount of stable funding consists of various liability categories L_a (ranging from 1 to A) multiplied by their weighting factor wf_a; the higher the weighting factor, the higher the assumed stability of the respective liability category. The weighting factors range from 0 to 1, but do not add up to 1. Similarly, the denominator consists of various asset categories A_b (ranging from 1 to B) multiplied by their weighting factor wf_b; the higher the weighting factors of the asset category, the lower the assumed liquidity of the respective category. Again, the weighing factors range from 0 to 1, but do not add up to 1. A higher NSFR is related to more stable funding and therefore to a "better" mid-term liquidity situation; the Basel framework demands that the NSFR be higher than 100%.

Since the NSFR will not move to a minimum standard before 1 January 2018, banks have not been obligated to disclose their NSFR as yet and Bankscope does therefore not have this data for the observation horizon of my study.

However, based on the data that are available in Bankscope, Vazquez and Federico (2012) developed an approximation to calculate the NSFR, enabling reasonable results. My study applies this method to obtain the required NSFR data (refer to their Table 1 and to the additional comments in their paper for further explanations of the calculation).[101]

Lucadamo (2016) constructs and uses the following explanatory variables $D_{k,i,t}$, which I accordingly apply in formula (VII.3). These include regulatory variables[102], bank-specific control variables and further country-specific control variables.[103]

The following regulatory variables measure various direct or indirect regulatory components:

- Restriction (REST): This is an index measuring regulatory restrictions on the activities of banks, following the survey explained in Barth et al. (2001), that is, the variable is composed of various questions that deal with the topic of whether banks are allowed to engage in various activities. The variable's value ranges from 1 to 14, whereas a higher value is related to greater restrictions and therefore to more severe regulation. Accordingly, I expect that a higher value of the variable leads to a higher NSFR.

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101 As a robustness check, I apply an alternative calculation used by the International Monetary Fund (2011); refer to their Table 2.1 and the corresponding further explanations for more details regarding this method. Overall, this calculation leads to higher NSFRs on average (1.25 compared to 1.05 in the basis method) and only the coefficients on lagged NSFR and the annual gross domestic product growth GGDP remain significant in the regression. The changes to the basis regression are therefore similar to the changes from the basis regression to the regression without US banks. In the basis calculation method, the NSFR average of US banks is significantly different from the overall average (by 0.14, significant at the 1%-level). In the regression with alternative NSFR calculations, this significant mean difference disappears. Considering that US banks seem to influence much of the coefficients' significance (as discussed in detail in section VII.5), the non-existing mean difference between US banks and the overall average might lead to the coefficients losing their significance in the alternative NSFR calculation method.

102 As a further robustness check, I drop the regulatory component, i.e. the six regulatory variables, from the regression. This leads to the insignificance of the coefficients on the variables banks per million capita (BMC) and annual gross domestic product growth (GGDP). This result does not change substantially when dropping only separate regulatory variables.

103 Refer to section VII.8.1 for more detailed definitions explanations of the sources of the variables used.

- Regulatory body power (RBP): This is an index measuring the direct power of the regulatory body, following the survey explained in Barth et al. (2001). The maximum value of the variable is 13; I link a higher value to more severe regulation and therefore expect it to lead to a higher NSFR.
- Capital regulation (CAPR): This index measures the regulatory oversight of bank capital, following the survey explained in Barth et al. (2001). Again, a higher value relates to greater capital regulation (the maximum value is 5) and therefore to a more severe regulation, which should lead to a higher NSFR.
- Entry requirements (ERQ): This is an index measuring the difficulty of operating as a bank in a specific country, following the survey explained in Barth et al. (2001). The variable can take a maximum value of 8. The higher the value, the greater the difficulty for banks to enter the country's market and therefore the more severe the regulation. Therefore, I expect higher values to lead to higher NSFRs.
- Private monitoring (PRM): This is an index measuring the degree to which the private sector is empowered, facilitated and encouraged to monitor banks, following the survey explained in Barth et al. (2001). The maximum value of the variable is 12. As noted in Lucadamo (2016), the expected influence of this variable is ambiguous. On the one hand a higher private monitoring index could be related to a more severe regulation and therefore leads to higher NSFRs, while on the other hand one could assume that a higher index is associated with more outside or self-regulation and therefore less severe bank regulation, which will consequently lead to lower NSFRs.
- Ownership (OWN): This index measures the degree to which regulations control for ownership of banks, following the survey explained in Barth et al. (2001). The higher the index, the stricter the ownership regulation. The maximum value of the variable is 3 and therefore I expect a higher value to lead to a higher NSFR.

The model's bank-specific variables are the following:

- Log of total assets (LTA): This variable measures the size of a bank by using the natural logarithm of the sum of all assets of the bank according to Bankscope.[104] In line with the results for capital ratios in Lucadamo (2016), I expect that larger banks have lower NSFRs, because for example they might be more diversified and therefore less risky or because they need lower liquidity cushions, since they have a lower cost of raising new liquidity.

- Ratio of loan loss reserves to gross loans (LLRGL): This variable is the ratio of the part of the loans for which the bank expects losses (but does not charge off) to the total loan portfolio according to Bankscope. It is a measure of the bank's credit risk, having higher values for higher credit risks. I assume that higher credit risks lead banks to have higher NSFRs, since affected banks need higher liquidity cushions to absorb such credit risks.

- Return on average assets (ROAA): The ROAA is the ratio of the net income to the total assets (calculated as an average of the previous and the subsequent year-end) of a bank taken from Bankscope. This variable measures the profitability of a bank. With respect to the capital ratios, studies have found profitability to have a positive influence (e.g. Flannery & Rangan, 2008 for banks or Öztekin & Flannery, 2012 for non-banks). However, higher profitability could be related to less riskiness and therefore to lower capital ratios. I assume the same ambiguousness for the NSFR.

- Dividend dummy (DIV): This is a dummy variable that takes the value of 1 if a bank has paid out a dividend in the specific year and 0 otherwise. The data are based on Bankscope. Again, the relationship of this variable is ambiguous: On the one hand, the possibility of paying out a dividend might indicate that a bank is already in good financial condition and therefore a higher NSFR

[104] Since the NSFR and the sum of assets are both balance sheet based figures, I also performed my regression with non-balance sheet based figures, but used income statement based variables to measure bank size (the net interest revenue, other operating income and overhead expenses) in order to test for a possible correlation bias. My results do not change if I use these variables. Therefore, I continue with the total assets figure only, since this is the more commonly known variable for measuring firm size.

could be expected. On the other hand, according to formula (VII.4), the (cash) pay out of a dividend directly decreases the NSFR.

- Banks' total assets to the sum of all banks' total assets for a country (BASA): BASA is the ratio of banks' total assets to the sum of all banks' total assets for the country for a specific year according to data from Bankscope. This variable is a measure of the relative importance (and therefore the system relevance) of a bank in its country. An important ("too big to fail") bank could experience different treatment from an unimportant bank, thus affecting its NSFR:[105] The system relevance could cause the regulator to be stricter with the banks and therefore ask for a higher NSFR. On the other hand, higher system relevance might increase a bank's power over the regulator; together with the assumption that such a bank knows that it would obtain support in case of failure, this could lead to a lower NSFR. Following Lucadamo (2016), I include two measures of system relevance in the basis regression:[106] BASA is the relative measure, whereas SYS is a more stringent dummy variable. The value for SYS is 1 if the BASA value of a bank is higher than 10% in its country in a specific year.[107] The argument for the sign prediction of SYS is the same as for BASA.

The further country-specific variables are the following:

- Bank concentration (CON): This dummy variable takes the value of 1 if the banking industry in a country is highly concentrated and 0 otherwise. Following Lucadamo (2016), I define an industry as highly concentrated if the sum of total assets of the three largest banks is more than 50% of all a country's banks' total assets for a

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105 Stern and Feldman (2004) trace the term "too big to fail" back to a statement from Stewart B. McKinney made during congressional hearings related to the bailout of the insolvent bank Continental Illinois in 1984. The term is used in connection with banks that have such a high systemic risk that their failure would result in extensive negative macroeconomic impacts. To avoid these impacts, their failure has to be prevented by support from the government or another superior body.

106 Note that the regression results do not change by using only either of the two variables or both together.

107 There is no exact numeric definition for regulators to rate a bank as system relevant; therefore, the 10% threshold is a discretionary value. The regression results do not materially change when using another threshold.

specific year.[108] The basis for the data is Bankscope. This variable is similar to the variable SYS above, that is, instead of the importance of just one bank, it measures the importance of several banks together. Accordingly, the explanation for the sign prediction is also the same as for SYS, resulting in an ambiguous prediction.

- Banks per million capita (BMC): This variable measures the size of the banking sector in a country in relation to its population, based on data explained in The World Bank (2012). In Lucadamo (2016), a higher number of banks per population indicated a better risk distribution among the banks in a country and led to lower capital ratios. The same explanation might also be the case for the liquidity ratios. On the other hand, a higher relative number of banks points to higher bank sector importance, which causes similar sign ambiguity as for the variable CON discussed above.
- Bank deposits per gross domestic product (BGDP): This variable is the amount of demand, time and savings deposits in deposit money banks as a share of the GDP of a country. The data originate from the financial development and structure dataset (as explained in Beck, Demirguc-Kunt & Levine, 2000). BGDP is a measure of the importance of the banking system relative to the economy of the country in a specific year. Applying similar explanations as for the above variables CON and BMC, the sign prediction is ambiguous.
- Gross domestic product per capita in USD (GDPC): This variable is a measure of the health of a country's economy in a specific year. GDPC and the variable annual gross domestic product growth (GGDP) implement the influence of macroeconomic conditions on the banks' financial structure. Both variables are based on the database described in The World Bank (2012). Better economic health could be linked to banks that are more profitable; as discussed above, profitability has an ambiguous sign prediction, resulting in an ambiguous prediction for these two variables as well.
- Bank z-score (BZS): This variable measures the probability of default of a country's banking system. The data are based on the financial development and structure dataset as explained in Beck et

[108] Using other similar thresholds does not materially change the regression results.

al. (2000). The z-score divides a bank's buffers (capitalisation and returns) by the volatility of those returns (a lower z-score therefore indicates a higher probability of default). BZS is the weighted average of the z-scores of a country's banks, using the individual banks' total assets as weights. Obtaining a negative coefficient's sign, Lucadamo (2016) found that – especially in the USA – banks seem to have higher capital ratios in the case of higher default profitability (i.e. when they are in a less "comfortable" environment). However, considering that lower NSFRs should be accompanied by a higher default probability per se, one would expect a positive sign prediction. The total prediction is therefore also ambiguous.

- Inflation (INF): This variable measures the influence of the price level on the banks' liquidity structure. This variable is based on the database described in The World Bank (2012). Since inflation could both increase the assets of a bank or increase the liabilities, the prediction for the sign of this coefficient is ambiguous.
- Crisis country (CRC): CRC has the value of 1 if a country suffered a bank crisis during the financial crisis and 0 otherwise. In line with Lucadamo (2016), bank crisis countries are the "systemic cases" according to Laeven and Valencia (2010). Lucadamo (2016) found a negative relationship between the variable and the capital ratios of banks. He expected this result because of the explanation that the country underwent a crisis because the banks did not have sufficiently high capital ratios. However, the results were only valid for US banks; that is, non-US banks had even higher capital ratios in cases where they were crisis country banks (a possible explanation raises doubt about the correct disclosure of the capital ratios). I expect that there is no such contradiction in the liquidity ratios, that is, I assume a negative sign prediction in my study.

VII.3.3. Regression Methodology

As stated above, the model I apply according to formula (VII.3) is a dynamic regression model. Combined with panel data, as in my study, it becomes a DPD (dynamic panel data) model (Baum, 2006). There are various features of such a model that might restrict the use of conventional estimation models. Nickel (1981) showed by way of example for the within-group estimator with fixed effects that serious biases could occur if these features are not considered. The following two problems in particular require attention:

- The lagged dependent variable might cause autocorrelation issues: Applied to my formula (VII.3), the explanation in Baltagi (2008) shows that the current NSFR ($NSFR_{i,t}$) is a function of the unobservable and time-invariant individual specific effect μ_i. It immediately follows that the previous year's NSFR (i.e. $NSFR_{i,t-1}$) is also a function of μ_i. Therefore, the right-hand regressor $NSFR_{i,t-1}$ is correlated with the error term $u_{i,t} = \mu_i + \varepsilon_{i,t}$,[109] which could lead to serious biases. This even applies when the $\varepsilon_{i,t}$ are not serially correlated (Baum, 2006). There are methods for correcting for possible correlations between the error term and the other regressors in conventional estimation methods such as ordinary least squares (OLS). One example is the use of the within transformation, which eliminates the individual specific effect μ_i. However, as Bond (2002) reveals, the correlation with the lagged dependent variable remains. In studies like mine in particular, which use a large number of individuals and a small number of time periods ("large N, small T" studies), the magnitude of possible biases might be considerably high (Hsiao, 2007).

- There could be issues of explanatory variables that are not strictly exogenous: Greene (2008) explains that such explanatory variables violate the necessary assumptions of conventional estimation methods. However, as in Lucadamo (2016), one of the central assumptions of my paper is the exogeneity of the regressors; banks set their NSFR as a residual figure based on various decisions made and circumstances given. Economically speaking, it is not reasonable that the NSFR has an impact on the explanatory variables.[110] One would, for example, not assume that the NSFR in time t has an impact on a bank's profitability in the same or in past

[109] Note that in terms of this assumption there would also be autocorrelation in formula (VII.1), since $v_{i,t} = \frac{\mu_i}{\lambda} + \frac{\varepsilon_{i,t}}{\lambda}$.

[110] Based on both the economic logic and the various regression tests discussed below, there is no evidence of endogeneity issues in my model.

periods. Following the argument of Lucadamo (2016), it may only be possible that some variables are predetermined. That is, shocks in the NSFR in time t could have an impact on such variables in following periods. However, it is not likely that this would be the case for the country-specific variables; because they are macroeconomically related one would not assume that the NSFR of a bank influences such macroeconomic conditions. However, predetermination might be possible for the bank-specific and the regulatory variables.

In order to avoid biases in DPD models, there are two established methods. Kiviet (1995) introduced the first method, which entails the application of bias-corrected least square dummy variables (LSDVC). These corrected variables adjust the bias caused by the presence of the lagged dependent variable as a regressor. Whereas Kiviet's (1995) paper concentrates on balanced panels, Bruno (2005a) showed that the application of LSDVC is also possible in the case of unbalanced panels. It seems that the method works well in the case of a small population of individuals N (refer e.g. to Judson & Owen, 1999), but not in case of a big N (Baltagi, 2008) or in the case of not strictly exogenous regressors (Bruno, 2005b).

Considering my dataset and the assumptions discussed above, and following Lucadamo (2016), the second method for dealing with DPD models appears more adequate: the generalised method of moments (GMM) estimators. These use instrumental variables (also called "iv" or "instruments") that are correlated with the explanatory variables but not with the error term (Greene, 2008). Even if the explanatory variables are correlated with the error term, the accurate use of instruments leads to unbiased results. Anderson and Hsiao (1981) as well as Anderson and Hsiao (1982) suggest this method for DPD models by way of a first differencing approach. Applied to my formula (VII.3), the following expression (VII.5) results:

$$\mathrm{NSFR}_{i,t} - \mathrm{NSFR}_{i,t-1} = \lambda \sum_{k=0}^{K} \beta_k (D_{k,i,t} - D_{k,i,t-1}) + (1-\lambda)(\mathrm{NSFR}_{i,t-1} - \mathrm{NSFR}_{i,t-2}) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \tag{VII.5}$$

Formula (VII.5) shows that differencing causes the individual specific effect μ_i in the error term $u_{i,t} = \mu_i + \varepsilon_{i,t}$ to disappear. As explained in Baltagi (2008), this allows the $NSFR_{i,t-2}$ to be deployed as an instrument for ($NSFR_{i,t-1} - NSFR_{i,t-2}$), since the term is highly correlated with ($NSFR_{i,t-1} - NSFR_{i,t-2}$), but not correlated with ($\varepsilon_{i,t} - \varepsilon_{i,t-1}$). According to Baum (2006) even if the error term is not i.i.d. (independently, identically distributed), the instrument in the form of the lagged dependent variable leads to consistent parameter estimates. Additional information is available in older time periods or in other variables. Hence, GMM estimators increase efficiency by also using $NSFR_{i,t-3}$ and further lags as well as the other variables $D_{k,i,t}$ as instruments.

Considering that GMM methods allow for the potential autocorrelation and endogeneity issues discussed above to be dealt with, my study applies these methods in line with Lucadamo (2016). One can perform GMM in the form of the difference GMM (as introduced by Arellano & Bond, 1991) or the system GMM (as explained by Arellano & Bover, 1995, as well as Blundell & Bond, 1998). The former uses lagged levels of the explanatory variables as instruments for equations in first differences as shown above. The system GMM, on the other hand, increases the possible utilisable instruments and uses lagged differences of the explanatory variables as instruments for equations in levels (Blundell & Bond, 1998). Compared to the difference GMM, the system GMM can improve precision and reduce finite sample bias (see Wooldridge, 2010). Moreover, system GMM suffers less from gaps in unbalanced panels and it does not eliminate time invariant explanatory variables (Roodman, 2009b). Accordingly, the system GMM seems to perform better in numerous studies (refer e.g. to Flannery and Hankins, 2013). While there are additional constraints to be considered when using the system GMM (refer to the discussion below), it is important to note that the results from section VII.5 do not differ substantially when I use either the system GMM or the difference GMM. Depending on the robustness regression applied, more coefficients become insignificant in the difference GMM (which is not surprising, since the difference GMM is less precise than the system GMM). As in Lucadamo (2016), this fact and the results of the specification tests indicate that there is no evidence that the use of the system GMM is not appropriate in my study.

Further, one can perform GMM estimators in the one-step or the two-step form. As Bond (2002) explains, the latter form shows some efficiency gains in the robust version. Since I do not see such gains in my regressions, I apply the one-step estimator.

Of course, GMM estimators also have limitations. One possible issue pertaining to these methods is the instrument count (i.e. the number of instrumental variables used for the regression) relative to the sample size. According to the discussion in Roodman (2009a), a high instrument count might lead to invalid results not being detected because specification tests are weakened at the same time. Further, as noted by Flannery and Hankins (2013), GMM estimators need the absence of second-order serial correlation in the residuals. To address the possible issues, I implement the same specification tests and robustness checks as Lucadamo (2016):

- One of the compulsory tests when applying GMM estimators is Hansen's (1982) tests for over-identification (Baum, Schaffer & Stillman, 2003 and Baum, 2006): Since the null hypotheses assume correct model specifications and valid over-identifying restrictions, the test must not be rejected, as this would call into question either or both of those hypotheses. However, the Hansen test is one of the tests discussed above that could be violated if too many instruments are used.[111] Roodman (2009a) emphasises that too many instruments could even lead to implausibly perfect probability values (p-values) of 1.00. Roodman (2009b) states that there are no clear rules on what constitutes "too many instruments". I therefore follow his suggestions, firstly, to report and assess the instrument count in comparison to the sample size, secondly, to use techniques for reducing the instrument count and, finally, to perform robustness checks in order to observe the changes in the results and the test statistics when the instrument count is changed.
- As explained above, GMM estimators require second-order serial correlation to be absent. The relevant test, as per Arellano and Bond (1991), analyses whether there is such a correlation in the residuals

[111] Note that the Sargan statistic (Sargan, 1958) is similar to the Hansen statistic; it is not weakened by too many instruments but requires homoscedastic errors, which I cannot assume in the context of my paper. Therefore, I do not use this specification test.

("Arellano-Bond test for AR(2) in first differences"). The null hypothesis for second-order serial correlation must not be rejected, since it states that there is no serial correlation of second order.

- Roodman (2009b) explains that the additional assumption for the use of the system GMM is that changes in the instrumenting variables have to be uncorrelated with the individual fixed effects. According to the example in Roodman (2009a), the coefficient on the dependent variable $(1 - \lambda)$ has to be smaller than 1 and the dependent variable converges to steady-state levels. I will therefore analyse the persistence of the estimated coefficient on the lagged dependent variable. Further, I will apply the difference-in-Hansen test to examine the validity of the additional moment conditions as suggested by Bond (2002):[112] The test takes the difference of two Hansen test statistics and allows the subsets of instruments to be checked. One statistic is computed from the fully efficient regression (using the whole set of over-identifying restrictions) and the other is computed from an inefficient but consistent regression (removing a set of instruments from the list). The null hypothesis must not be rejected, since it states that the specified variables are proper instruments.
- Roodman (2009b) proposes the inclusion of time dummies in the regression, which I do in my study. The dummies make it more likely that there is no correlation across individuals in the disturbances (this is assumed by the autocorrelation test and the robust estimates of the standard errors of the coefficients).
- I will assess whether the coefficient that is obtained on the lagged dependent variable lies between the estimated coefficients of OLS (ordinary least squares) and FE (fixed effects) estimators, which should be expected according to Bond (2002).
- To correct the standard errors in the case of any heteroscedasticity or serial correlation in the errors, I apply the robust estimator of the covariance matrix of the parameter estimates according to Roodman (2009b). Moreover, the robust option is a precondition for

[112] A high instrument count also weakens the difference-in-Hansen test (Roodmann, 2009a), emphasising the need to carefully assess the number of instruments used.

performing the Hansen and the difference-in-Hansen specification tests discussed above.

I use the software STATA[113], in particular the GMM syntax "XTABOND2" by Roodman (2009b), to calculate the complete regression according to formula (VII.6) to estimate the coefficients $\lambda\beta_k$ of the dependent variable $NSFR_{i,t}$:

$$\begin{aligned} NSFR_{i,t} = \; & \lambda\beta_0 + (1-\lambda)NSFR_{i,t-1} + \lambda\beta_1 REST_{j,t} + \\ & \lambda\beta_2 RBP_{j,t} + \lambda\beta_3 CAPR_{j,t} + \lambda\beta_4 ERQ_{j,t} + \lambda\beta_5 PRM_{j,t} + \\ & \lambda\beta_6 OWN_{j,t} + \lambda\beta_7 LTA_{i,t} + \lambda\beta_8 LLRGL_{i,t} + \lambda\beta_9 ROAA_{i,t} + \\ & \lambda\beta_{10} DIV_{i,t} + \lambda\beta_{11} BASA_{i,t} + \lambda\beta_{12} SYS_{i,t} + \lambda\beta_{13} CON_{j,t} + \\ & \lambda\beta_{14} BMC_{j,} + \lambda\beta_{15} BGDP_{j,t} + \lambda\beta_{16} GDPC_{j,t} + \lambda\beta_{17} GGDP_{j,t} + \\ & \lambda\beta_{18} BZS_{j,t} + \lambda\beta_{19} INF_{j,t} + \lambda\beta_{20} CRC_j + \nu_t + u_{i,t} \end{aligned} \qquad \text{(VII.6)}$$

i is the numbering for the individual banks, ranging from 1 to N, t is the numbering for the individual years, ranging from 1 to T and j is the numbering for the various countries, ranging from 1 to J. The explanatory regulatory variables for country j in year t are $REST_{j,t}$, $RBP_{j,t}$, $CAPR_{j,t}$, $ERQ_{j,t}$, $PRM_{j,t}$ and $OWN_{j,t}$, the bank-specific control variables for bank i in year t are $LTA_{i,t}$, $LLRGL_{i,t}$, $ROAA_{i,t}$, $DIV_{i,t}$, $BASA_{i,t}$ and $SYS_{i,t}$ and the country-specific control variables for country j in year t are $CON_{j,t}$, $BMC_{j,t}$, $BGDP_{j,t}$, $GDPC_{j,t}$, $GGDP_{j,t}$, $BZS_{j,t}$, $INF_{j,t}$ and CRC_j (the last variable is the same for all years T in a country j). The time dummy ν_t for every year t controls for the unobserved time-fixed effects and $u_{i,t}$ denotes the disturbance term.

Following the wording of Roodman (2009b), the lagged NSFR[114] enters the regression as an endogenous variable ("gmm style instrument with two lags"), all country-specific variables except the regulatory variables enter as strictly exogenous ("iv style instruments") and the rest of the variables enter as predetermined ("gmm style instruments with one lag").

[113] "STATA® Data Analysis and Statistical Software" by StataCorp LP, Texas, USA.

[114] $NSFR_{i,t-1}$ or L.NSFR (L. stands for "lagged")

Using the collapse option[115] of XTABOND2, and limiting the lag periods to three, reduces the risk of too many instruments. The inclusion of the robust option corrects the standard errors in the case of any heteroscedasticity or any serial correlation in the errors.

Section VII.5 reveals the detailed results of this regression, but first the next section, section VII.4, discusses the most important descriptive statistics of the dataset.

115 The collapse option creates only one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance. Together with the lag limitation, this strongly decreases the number of instruments, which would otherwise be quite high and might cause the problems discussed.
When performing the regression without lag limitation and without the collapse option, the variables capital regulation (CAPR), private monitoring (PRM), banks per million capita (BMC) and bank deposits per gross domestic product (BGDP) become insignificant, although the additional lags should provide more information. However, the test diagnostics are not satisfied at all, indicating expected instrument issues (total instruments are now 906, compared to 71 in the basis regression). The effect is similar when limiting the lags without using the collapse option or when using the collapse option and not limiting the lags.
In the case of a regression with maximally restricted lags (in which test diagnostics remain intact), only the banks per million capita (BMC) and bank deposits per gross domestic product (BGDP) lose their significance. The loss of information (there are only 45 instruments) anticipates this effect.

VII.4. Descriptive Statistics

The original dataset taken from Lucadamo (2016) contains 44 141 observations for the years 2000 to 2011. All observations pertaining to the countries Chile and Romania (233 and 110 respectively) drop out completely from this original population, since they do not have data for the bank deposits per gross domestic product (BGDP) or for the bank z-score (BZS). After eliminating the observations that have no values in regard to the important variables, 32 855 observations remain.

Within the observation horizon, 5 182 different banks have 1 to 11 useable observations per bank.[116] The minimum number of observations per year is 2 162, whereas the maximum is 4 060; that is, the relative frequency ranges from 7 to 12%, meaning that the observations are quite evenly distributed within the observation horizon (refer to Table VII.1).

More than half of the total observations is based on the USA (17 879 observations, or approximately 54%),[117] followed by France (1 651 and 5% respectively) and Japan (1 539 and 5% respectively). No other country equals or constitutes more than 5% of the observations. The country with the fewest number of observations is the United Arab Emirates (22 observations). Refer to Table VII.1 for further details.

[116] Since the regression loses the first observation year (it has no lagged NSFR), the descriptive statistics also consider only the 11 years from 2001 to 2011.

[117] As discussed in Lucadamo (2016), the USA plays an important role in the intercontinental debate on whether bank regulators outside the USA are sufficiently strict. A robustness check without US banks reveals that the results of the basis regression to the liquidity structure of banks are strongly influenced by this country (note that the test diagnostics are satisfied): apart from the lagged NSFR, only the coefficient on the banks deposit per gross domestic product (BGDP) remains significant in such a robustness regression (however, compared to the study on capital ratios in Lucadamo, 2016, there are no significant sign reversions in the regressions without US banks). Refer to the presentation of results in section VII.5 for a discussion of this outcome. Note that the regression without US banks shows similar characteristics in regard to other robustness checks as the basis regression.

Table VII.1: Observations per country and per year

Observations per country						Observations per year		
Country	**Observations**	**%**	**Country**	**Observations**	**%**	**Year**	**Observations**	**%**
ARE	22	0%	ITA	767	2%	2001	2'788	8%
AUS	431	1%	JPN	1'539	5%	2002	2'951	9%
AUT	487	1%	KOR	200	1%	2003	3'691	11%
BEL	307	1%	LTU	78	0%	2004	3'887	12%
BGR	88	0%	LUX	160	0%	2005	4'060	12%
CAN	461	1%	LVA	132	0%	2006	2'839	9%
CHE	733	2%	MEX	367	1%	2007	2'752	8%
CHN	147	0%	MLT	71	0%	2008	2'758	8%
CYP	94	0%	NLD	441	1%	2009	2'723	8%
CZE	84	0%	NOR	124	0%	2010	2'274	7%
DEU	777	2%	NZL	105	0%	2011	2'162	7%
DNK	360	1%	POL	152	0%	**Total**	**32'885**	**100%**
ESP	795	2%	PRT	260	1%	**Max:**	**4'060**	
EST	62	0%	RUS	785	2%	**Min:**	**2'162**	
FIN	148	0%	SGP	141	0%			
FRA	1'651	5%	SVK	94	0%			
GBR	1'385	4%	SVN	119	0%			
GRC	129	0%	SWE	193	1%			
HKG	352	1%	TUR	174	1%			
HUN	166	1%	USA	17'879	54%			
IRL	204	1%	**Total**	**32'885**	**100%**			
ISL	95	0%	**Max:**	**17'879**				
ISR	126	0%	**Min:**	**22**				

Statistics per country: ARE (United Arab Emirates), AUS (Australia), AUT (Austria), BEL (Belgium), BGR (Bulgaria), CAN (Canada), CHE (Switzerland), CHN (China), CYP (Republic of Cyprus), CZE (Czech Republic), DEU (Germany), DNK (Denmark), ESP (Spain), EST (Estonia), FIN (Finland), FRA (France), GBR (United Kingdom), GRC (Greece), HKG (Hong Kong), HUN (Hungary), IRL (Ireland), ISL (Iceland), ISR (Israel), ITA (Italy), JPN (Japan), KOR (Republic of Korea), LTU (Lithuania), LUX (Luxembourg), LVA (Latvia), MEX (Mexico), MLT (Malta), NLD (Netherlands), NOR (Norway), NZL (New Zealand), POL (Poland), PRT (Portugal), RUS (Russian Federation), SGP (Singapore), SVK (Slovakia), SVN (Slovenia), SWE (Sweden), TUR (Turkey), USA (United States of America)

Source: Own calculations.

Table VII.2 shows that almost every variable correlates significantly with the other variables at least at the 10% significance level, but the correlation coefficients are quite low. The coefficient is just slightly higher than 0.5 for four variable pairs: the correlation between the NSFR and its lagged value; between the regulatory body power index (RBP) and the restriction index (REST); between the bank z-score (BZS) and bank concentration (CON); and between the dummy for crisis countries (CRC) and the USD gross domestic product per capita (GDPC).

Table VII.2: Correlations between variables

	NSFR	L.NSFR	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
NSFR	1.00 ***																					
L.NSFR	0.53 ***	1.00 ***																				
REST	-0.03 ***	-0.03 ***	1.00 ***																			
RBP	-0.02 ***	-0.02 ***	0.57 ***	1.00 ***																		
CAPR	0.00	-0.01	0.04 ***	-0.03 ***	1.00 ***																	
ERQ	0.01	0.00	0.17 ***	0.23 ***	0.04 ***	1.00 ***																
PRM	0.00	0.00	0.11 ***	0.03 ***	0.08 ***	-0.02 ***	1.00 ***															
OWN	0.01	0.00	0.12 ***	-0.02 ***	0.16 ***	0.13 ***	0.26 ***	1.00 ***														
LTA	-0.01	0.00	-0.19 ***	-0.32 ***	0.08 ***	-0.20 ***	0.08 ***	0.11 ***	1.00 ***													
LLRGL	-0.01	-0.01	-0.01	-0.08 ***	0.03 ***	-0.05 ***	0.05 ***	0.07 ***	0.03 ***	1.00 ***												
ROAA	0.00	0.00	-0.03 ***	0.00	-0.03 ***	0.01	0.00	-0.02 ***	-0.05 ***	-0.06 ***	1.00 ***											
DIV	-0.02 ***	-0.01	0.22 ***	0.26 ***	-0.04 ***	0.06 ***	0.00	-0.14 ***	-0.04 ***	-0.06 ***	0.09 ***	1.00 ***										
BASA	0.00	0.00	-0.11 ***	-0.13 ***	-0.01 **	-0.10 ***	0.00	0.10 ***	0.40 ***	0.04 ***	-0.01	-0.01 **	1.00 ***									
SYS	0.00	0.00	-0.09 ***	-0.10 ***	-0.02 ***	-0.07 ***	0.01	0.09 ***	0.32 ***	0.03 ***	0.00	0.01 **	0.84 ***	1.00 ***								
CON	0.01	0.01	-0.31 ***	-0.29 ***	0.03 ***	-0.15 ***	0.04 ***	0.19 ***	0.17 ***	0.08 ***	0.03 ***	-0.19 ***	0.33 ***	0.27 ***	1.00 ***							
BMC	0.00	0.00	0.17 ***	0.44 ***	-0.24 ***	0.22 ***	-0.18 ***	-0.07 ***	-0.28 ***	-0.10 ***	0.04 ***	0.16 ***	-0.02 ***	-0.02 ***	-0.07 ***	1.00 ***						
BGDP	0.02 ***	0.03 ***	-0.21 ***	-0.13 ***	-0.08 ***	-0.22 ***	0.12 ***	0.09 ***	0.27 ***	0.00	-0.05 ***	0.00	0.02 ***	0.02 ***	0.12 ***	0.07 ***	1.00 ***					
GDPC	0.00	0.01	0.23 ***	0.31 ***	0.05 ***	0.21 ***	-0.05 ***	0.11 ***	-0.06 ***	-0.16 ***	-0.04 ***	0.13 ***	-0.21 ***	-0.16 ***	-0.23 ***	0.46 ***	0.26 ***	1.00 ***				
GGDP	0.01	0.01	-0.03 ***	0.06 ***	-0.16 ***	0.00	0.12 ***	0.12 ***	-0.08 ***	-0.02 ***	0.13 ***	0.04 ***	0.07 ***	0.06 ***	0.09 ***	0.11 ***	-0.18 ***	-0.23 ***	1.00 ***			
BZS	-0.02 ***	-0.02 ***	0.44 ***	0.45 ***	0.01	0.28 ***	-0.08 ***	-0.02 ***	-0.31 ***	-0.11 ***	0.01	0.17 ***	-0.21 ***	-0.16 ***	-0.50 ***	0.31 ***	-0.28 ***	0.31 ***	0.04 ***	1.00 ***		
INF	0.00	0.00	-0.07 ***	-0.07 ***	0.11 ***	0.03 ***	-0.02 ***	0.05 ***	-0.10 ***	0.09 ***	0.04 ***	-0.07 ***	0.07 ***	0.06 ***	0.11 ***	-0.07 ***	-0.34 ***	-0.36 ***	0.25 ***	-0.13 ***	1.00 ***	
CRC	0.00	0.01	0.24 ***	0.46 ***	-0.04 ***	0.32 ***	-0.19 ***	-0.22 ***	-0.33 ***	-0.16 ***	-0.03 ***	0.18 ***	-0.23 ***	-0.18 ***	-0.47 ***	0.43 ***	-0.21 ***	0.50 ***	-0.07 ***	0.48 ***	-0.10 ***	1.00 ***

*Correlation coefficients between variables for all possible combinations. *** shows a correlation, which is significant at the 1%-level, ** is significant at the 5%-level and * is significant at the 10%-level.*

The variables are: NSFR (net stable funding ratio), L.NSFR (lagged NSFR), REST (restriction), RBP (regulatory body Power), CAPR (Capital regulation), ERQ (Entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (Return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance), CON (Bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (Annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country).

Source: Own calculations.

The correlation is higher than 0.8 only between the bank's total assets to the sum of all banks' total assets for a country (BASA) and the dummy variable for system relevance (SYS). Based on this analysis, I do not expect serious regression biases caused by correlations between the variables.[118]

An analysis of the means and the standard deviations (sd) of the various variables (refer to Table VII.3 for details classified per country) reveals that the average NSFR of 1.1 is slightly above the minimum standard of 1 (equals 100%) that will be requested by Basel III. The maximum average NSFR of 2.2 belongs to Hong Kong, while the minimum of 0.7 belongs to Ireland. The standard deviations of the various average NSFRs per country are quite high for Canada, the United Kingdom, Hong Kong and Hungary, which is caused by some outliers in these countries.[119]

Table VII.4 shows that slightly more than 60% or 554 of the possible NSFR differences between various countries are significant at least at the 10% level.

118 The results of eight separate regressions, each excluding one of the above-mentioned eight variables (apart from the NSFR), confirm this expectation; i.e. there are no substantial changes in the regression results, except that the variable banks per million capita (BMC) partially loses its significance (as in other robustness checks discussed later).

119 A robustness check without outliers (i.e. without observations with a NSFR above a discretionary value of 400%) results in several changes. Whereas the coefficient on the variables private monitoring (PRM) and banks per million capita (BMC) lose their significance (in line with some other robustness checks), three more coefficients become significant: the one for the regulatory body power (RBP), the one for the ownership index (OWN) and the one for the banks z-score (BZS); all three with a negative sign (refer to the overview in Table VII.6). However, this result should not be overstated in view of the strongly violated test diagnostics. The results are similar when using other thresholds for eliminating outliers, when winsorising the NSFR at various percentile levels or when just dropping the above-mentioned countries from the regression.

Table VII.3: Mean and standard deviation (sd) of variables per country

		NSFR	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
ARE	Mean	1.0	10.0	10.0	5.0	8.0	10.0	1.0	8.9	5.2	0.5	0.7	4.5	0.2	1.0	2.8	57.8	45 653	4.9	22.5	0.9	0.0
	SD	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.4	3.0	4.1	0.5	5.9	0.4	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
AUS	Mean	1.0	5.7	10.3	2.8	7.6	9.7	1.2	8.7	1.5	1.2	0.5	2.5	0.1	0.9	2.1	78.4	37 247	3.0	11.0	3.0	0.0
	SD	0.5	0.6	1.4	0.7	0.5	1.2	0.4	2.2	5.5	2.5	0.5	5.3	0.3	0.3	0.3	12.9	12 287	0.9	2.8	0.8	0.0
AUT	Mean	1.0	3.1	10.1	3.2	7.8	6.4	0.2	9.0	1.6	0.6	0.3	2.2	0.1	0.1	5.7	89.0	39 695	1.7	26.4	2.0	1.0
	SD	0.5	0.8	1.2	1.8	0.4	0.8	0.4	1.8	2.0	2.4	0.4	4.1	0.3	0.4	0.4	6.0	8 296	2.1	6.8	0.8	0.0
BEL	Mean	1.2	4.0	11.0	3.5	7.8	7.2	0.2	9.5	0.5	1.3	0.4	3.6	0.2	0.9	2.8	95.5	36 744	1.5	5.9	2.2	1.0
	SD	0.7	0.8	0.0	1.1	0.4	0.9	0.4	2.4	1.2	3.4	0.5	6.2	0.4	0.3	0.3	7.1	8 192	1.5	1.3	1.1	0.0
BGR	Mean	1.1	5.3	10.1	3.5	8.0	8.3	0.3	7.2	3.6	1.7	0.3	12.1	0.3	1.0	1.2	46.5	5 030	3.3	16.8	5.6	0.0
	SD	0.5	1.5	0.2	0.9	0.0	0.4	0.4	1.6	3.1	1.6	0.5	17.5	0.5	0.0	0.3	12.8	1 850	4.0	1.7	3.0	0.0
CAN	Mean	1.8	4.0	8.4	2.0	8.0	7.5	1.0	8.0	1.3	1.2	0.5	1.7	0.1	0.2	2.0	137.1	34 693	2.3	21.4	2.2	0.0
	SD	15.4	1.0	1.5	0.0	0.0	1.4	0.0	2.7	3.6	4.6	0.5	4.1	0.3	0.4	0.2	13.7	7 911	0.8	1.6	0.3	0.0
CHE	Mean	1.3	3.3	12.2	3.0	8.0	8.2	0.5	8.2	1.8	1.3	0.6	1.5	0.0	1.0	9.4	129.0	54 581	1.7	7.4	0.8	1.0
	SD	0.5	1.5	1.9	1.1	0.0	0.4	0.5	2.3	6.2	3.8	0.5	5.4	0.2	0.0	0.7	8.7	12 616	1.6	1.4	0.7	0.0
CHN	Mean	1.1	11.4	10.0	3.0	7.4	8.8	1.1	10.8	2.2	1.3	0.5	3.9	0.2	0.3	0.0	46.8	4 013	10.0	19.0	3.3	0.0
	SD	0.5	0.6	0.0	1.0	0.6	1.2	0.5	2.3	1.9	1.0	0.5	6.6	0.4	0.5	0.0	4.1	1 136	1.5	2.4	2.5	0.0
CYP	Mean	1.0	6.6	10.2	2.5	5.4	8.0	0.6	7.9	6.6	0.1	0.2	11.7	0.4	1.0	8.5	195.4	24 107	2.6	4.2	2.7	0.0
	SD	0.2	1.1	1.7	1.5	2.1	0.8	0.5	1.9	5.2	4.5	0.4	14.0	0.5	0.0	0.8	33.5	6 213	2.0	1.7	1.1	0.0
CZE	Mean	1.0	7.8	8.3	2.6	8.0	8.3	0.1	8.3	7.9	0.7	0.5	10.4	0.3	1.0	1.0	60.7	13 899	3.4	8.6	2.6	0.0
	SD	0.3	0.8	1.3	0.5	0.0	0.8	0.3	1.8	14.4	4.4	0.5	11.1	0.5	0.0	0.1	1.8	4 869	3.7	1.0	1.8	0.0
DEU	Mean	0.9	2.8	9.0	2.0	6.6	7.6	0.0	9.7	1.2	0.1	0.3	1.3	0.0	0.2	1.0	103.7	36 157	1.1	11.2	1.6	1.0
	SD	0.4	0.8	1.0	1.1	1.0	0.6	0.0	2.6	2.4	3.9	0.5	2.8	0.1	0.4	0.1	8.4	6 610	2.6	1.8	0.7	0.0
DNK	Mean	1.0	5.6	9.1	2.2	8.0	7.8	0.2	8.4	2.9	0.7	0.3	3.0	0.1	1.0	6.6	56.4	50 306	0.5	14.6	2.1	1.0
	SD	0.4	0.6	1.1	1.0	0.0	0.8	0.4	2.0	5.5	2.4	0.5	7.5	0.3	0.0	1.0	6.9	10 106	2.5	2.5	0.6	0.0
ESP	Mean	0.8	2.8	9.1	4.8	7.6	8.6	0.2	9.3	2.5	0.6	0.4	1.3	0.0	0.4	1.8	111.8	26 506	2.0	23.7	2.8	1.0
	SD	0.2	0.8	1.0	0.4	0.5	0.5	0.7	1.8	4.3	1.7	0.5	3.7	0.2	0.5	0.2	30.9	6 306	2.3	1.7	1.2	0.0
EST	Mean	1.0	3.1	12.0	2.6	8.0	7.7	0.1	6.4	3.6	2.1	0.2	17.7	0.4	1.0	4.4	39.8	11 237	4.5	7.4	4.2	0.0
	SD	0.4	1.8	0.9	1.1	0.0	0.7	0.4	2.5	4.2	4.3	0.4	26.7	0.5	0.0	0.7	10.1	4 446	6.6	2.2	2.6	0.0
FIN	Mean	1.2	4.0	7.9	1.1	6.5	7.5	0.2	8.5	0.5	1.3	0.5	7.3	0.2	1.0	2.7	52.9	40 081	1.7	18.3	1.7	0.0
	SD	0.7	0.9	1.0	1.1	1.5	1.9	0.4	2.5	0.9	3.9	0.5	13.9	0.4	0.0	0.3	6.7	8 553	3.9	7.2	1.3	0.0
FRA	Mean	0.8	4.3	9.1	3.4	6.7	7.9	0.2	9.1	3.0	1.1	0.4	0.6	0.0	0.0	2.5	70.2	34 664	1.1	16.2	1.7	1.0
	SD	0.4	1.9	1.0	1.4	0.7	0.9	0.4	2.1	4.5	2.8	0.5	2.0	0.1	0.0	0.1	6.7	7 181	1.6	2.9	0.6	0.0
GBR	Mean	2.1	0.1	8.1	3.0	8.0	8.5	0.0	8.4	1.1	1.0	0.4	0.6	0.0	0.0	2.7	127.0	35 961	1.6	11.1	2.0	1.0
	SD	17.5	0.3	1.0	0.0	0.0	0.5	0.0	2.6	3.3	9.5	0.5	1.9	0.1	0.0	0.1	22.5	6 602	2.5	5.0	0.7	0.0

		NSFR	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
GRC	Mean	0.8	5.0	9.1	2.5	7.0	8.3	0.2	9.5	4.0	-0.5	0.3	6.9	0.3	1.0	1.3	86.2	24 687	1.1	2.1	3.3	1.0
	SD	0.2	0.0	1.8	0.5	0.0	0.8	0.4	1.5	4.3	4.4	0.5	8.0	0.4	0.0	0.1	10.7	3 959	4.1	1.7	0.9	0.0
HKG	Mean	2.2	1.5	9.3	2.1	6.2	8.6	0.2	8.5	1.2	1.5	0.6	2.5	0.1	1.0	6.0	267.9	28 768	4.8	11.7	1.6	0.0
	SD	15.9	0.5	0.5	1.0	0.4	0.9	0.4	2.3	2.2	5.7	0.5	5.9	0.3	0.0	0.3	27.5	3 317	3.3	1.9	2.2	0.0
HUN	Mean	1.7	6.3	11.8	4.4	7.9	8.1	0.3	7.7	2.7	1.7	0.4	6.6	0.2	1.0	1.6	42.6	10 828	1.9	15.6	5.5	1.0
	SD	10.0	1.5	0.4	0.5	0.3	0.8	0.4	2.1	3.9	4.4	0.5	7.9	0.4	0.0	0.1	4.3	3 046	3.3	1.6	1.7	0.0
IRL	Mean	0.7	3.6	10.7	2.6	4.5	8.6	0.2	9.9	2.1	0.0	0.3	4.8	0.2	0.8	5.3	91.4	48 412	2.3	3.4	2.4	1.0
	SD	0.4	0.5	2.0	0.5	4.0	0.5	0.4	1.7	5.7	3.7	0.5	7.2	0.4	0.4	0.9	14.0	8 223	4.1	1.9	2.7	0.0
ISL	Mean	1.2	4.9	8.2	2.9	7.9	7.5	0.5	7.4	3.3	1.7	0.4	10.0	0.3	1.0	37.7	68.9	47 237	3.7	-0.4	5.5	1.0
	SD	0.6	1.2	1.5	1.0	0.3	0.5	0.5	1.7	5.5	6.0	0.5	14.2	0.4	0.0	11.4	19.9	11 611	3.7	1.8	2.9	0.0
ISR	Mean	1.0	9.3	8.0	3.6	4.1	9.1	0.2	9.1	3.1	0.7	0.3	8.7	0.3	1.0	1.7	86.6	22 358	3.2	24.5	2.2	0.0
	SD	0.3	0.7	1.0	0.9	1.9	0.3	0.4	1.6	2.2	1.2	0.5	9.7	0.5	0.0	0.3	2.7	4 561	2.3	2.3	1.8	0.0
ITA	Mean	0.9	6.4	7.8	2.2	8.0	8.4	0.2	9.2	2.8	0.7	0.1	1.4	0.0	0.5	1.3	63.0	31 222	0.4	13.6	2.2	0.0
	SD	0.4	1.3	2.1	0.4	0.0	0.8	0.4	1.8	3.4	1.9	0.4	3.7	0.2	0.5	0.1	13.7	5 619	2.2	4.8	0.7	0.0
JPN	Mean	0.9	7.8	10.3	2.1	6.9	8.8	0.0	9.9	4.1	0.0	0.8	0.5	0.0	0.1	1.4	194.4	35 045	0.4	9.9	-0.2	0.0
	SD	0.2	0.9	0.7	0.3	0.3	0.6	0.0	1.5	18.7	2.8	0.4	1.5	0.1	0.3	0.0	7.5	2 425	2.3	2.3	0.7	0.0
KOR	Mean	0.8	8.1	9.2	2.4	7.7	10.0	0.7	10.9	2.1	0.8	0.6	5.2	0.1	0.2	0.4	65.0	17 537	4.1	6.0	3.3	0.0
	SD	0.2	2.0	1.5	0.9	0.5	0.8	0.5	1.1	1.0	0.8	0.5	4.0	0.3	0.4	0.1	3.9	3 710	1.8	1.7	0.7	0.0
LTU	Mean	0.9	6.1	11.3	2.0	8.0	7.8	0.4	7.0	3.5	0.3	0.2	13.7	0.5	1.0	2.2	30.3	9 157	4.4	5.6	3.4	0.0
	SD	0.2	1.7	1.5	1.1	0.0	1.0	0.8	1.5	3.5	1.7	0.4	14.3	0.5	0.0	0.2	7.6	3 450	7.0	1.6	3.2	0.0
LUX	Mean	1.2	4.7	11.2	2.4	8.0	8.2	1.2	9.4	0.8	1.0	0.4	6.6	0.2	0.7	33.3	338.5	89 347	2.3	32.2	2.3	1.0
	SD	0.4	2.1	1.0	0.8	0.0	0.4	0.4	1.7	1.2	2.8	0.5	6.8	0.4	0.5	5.3	36.7	24 149	3.3	2.7	0.9	0.0
LVA	Mean	1.1	3.7	10.5	3.1	8.0	8.0	0.3	6.7	4.7	0.1	0.3	7.8	0.3	1.0	6.4	34.1	9 982	3.2	3.4	6.0	1.0
	SD	0.4	0.4	0.6	1.2	0.0	0.7	0.4	1.5	6.5	3.0	0.4	8.6	0.5	0.0	1.4	6.4	3 427	9.2	0.7	4.7	0.0
MEX	Mean	1.0	4.5	9.8	3.0	8.0	9.3	0.8	8.4	5.6	1.5	0.2	2.9	0.1	0.0	0.3	22.5	8 361	2.0	26.4	4.5	0.0
	SD	0.4	2.1	1.2	0.9	0.0	1.0	0.8	1.8	7.6	3.6	0.4	3.8	0.3	0.0	0.0	2.0	1 314	3.4	4.7	0.8	0.0
MLT	Mean	1.3	6.6	12.6	2.6	8.0	8.1	0.6	7.3	3.3	2.2	0.9	15.2	0.5	1.0	17.9	139.1	17 102	1.7	16.3	2.4	0.0
	SD	0.6	0.5	0.6	0.5	0.0	0.2	0.5	1.3	4.5	5.3	0.4	15.1	0.5	0.0	3.7	4.6	3 555	2.4	4.2	0.9	0.0
NLD	Mean	1.0	1.6	8.8	3.1	7.6	8.0	0.2	9.3	0.9	0.7	0.3	2.4	0.1	1.0	2.7	111.9	40 601	1.4	8.9	2.0	1.0
	SD	0.5	0.5	1.0	0.5	0.5	0.9	0.4	2.3	2.6	4.3	0.4	6.2	0.3	0.0	0.3	14.7	8 756	1.9	6.6	0.9	0.0
NOR	Mean	0.9	3.8	9.0	5.0	8.0	7.7	1.0	8.0	1.1	1.8	0.5	3.1	0.1	1.0	7.9	49.9	62 373	2.5	24.3	1.7	0.0
	SD	0.3	2.8	0.0	0.0	0.0	0.5	0.0	1.7	0.8	4.5	0.5	7.5	0.3	0.0	1.0	1.1	9 035	1.0	1.9	0.8	0.0
NZL	Mean	1.1	0.5	7.2	0.2	6.5	10.8	0.1	8.0	0.6	2.0	0.4	9.3	0.4	1.0	2.9	80.5	25 911	2.3	18.7	2.6	0.0
	SD	0.5	1.7	0.4	0.6	0.5	0.6	0.3	2.5	0.8	3.6	0.5	10.6	0.5	0.0	0.5	6.6	5 423	2.0	7.1	0.7	0.0

		NSFR	REST	RBP	CAPR	ERQ	PRM	OWN	LTA	LLRGL	ROAA	DIV	BASA	SYS	CON	BMC	BGDP	GDPC	GGDP	BZS	INF	CRC
POL	Mean	0.9	5.3	8.8	2.5	7.4	8.0	0.2	9.1	5.7	1.3	0.4	6.9	0.2	0.2	0.4	41.0	10 095	4.1	11.3	3.0	0.0
	SD	0.2	3.4	0.8	0.9	0.5	0.0	0.4	1.0	4.4	1.5	0.5	5.8	0.4	0.4	0.1	4.6	3 049	1.7	1.5	1.3	0.0
PRT	Mean	0.8	6.8	11.9	3.3	7.0	6.5	0.2	8.7	3.1	0.9	0.5	4.2	0.1	1.0	2.3	95.7	18 499	0.5	16.5	2.6	1.0
	SD	0.3	1.8	0.3	0.9	0.0	0.5	0.4	1.8	3.7	1.6	0.5	6.3	0.3	0.0	0.3	15.6	3 845	1.5	4.5	1.3	0.0
RUS	Mean	1.0	3.7	7.4	3.3	7.7	8.5	0.3	7.5	6.4	1.8	0.4	1.4	0.0	0.8	0.6	26.6	7 650	4.7	8.0	11.6	1.0
	SD	0.4	0.5	1.1	1.0	0.5	0.6	0.4	1.7	5.1	4.7	0.5	4.9	0.2	0.4	0.1	7.6	3 533	4.6	1.4	3.5	0.0
SGP	Mean	1.4	6.2	10.5	2.9	8.0	10.3	0.1	7.9	5.1	2.3	0.7	6.2	0.3	1.0	3.7	104.3	28 878	4.6	20.7	1.5	0.0
	SD	0.7	1.0	1.3	0.3	0.0	0.7	0.3	2.5	14.0	3.9	0.4	9.8	0.5	0.0	0.5	8.3	5 707	4.0	5.8	1.9	0.0
SVK	Mean	1.1	7.5	11.1	2.6	8.0	6.4	0.2	7.9	5.3	1.2	0.4	11.3	0.4	1.0	1.7	52.4	12 770	4.5	8.0	4.3	0.0
	SD	0.3	1.2	0.8	0.5	0.0	0.8	0.4	1.3	4.6	2.3	0.5	10.7	0.5	0.0	0.2	2.9	4 178	3.8	1.0	2.4	0.0
SVN	Mean	0.8	6.2	12.3	4.7	7.7	7.9	0.6	7.6	5.5	0.5	0.4	9.2	0.2	1.0	5.8	52.2	19 973	2.3	13.7	3.7	1.0
	SD	0.3	1.2	0.5	0.5	0.5	0.3	0.5	1.2	4.0	1.2	0.5	12.2	0.4	0.0	0.8	3.3	5 176	4.0	1.7	2.3	0.0
SWE	Mean	1.0	4.6	6.9	2.1	6.9	7.0	0.0	8.9	1.1	0.9	0.4	3.6	0.1	1.0	3.1	46.9	43 561	1.9	19.6	1.3	1.0
	SD	0.5	1.5	1.0	1.0	1.0	0.0	0.0	2.3	3.5	2.1	0.5	7.3	0.4	0.0	0.3	5.5	5 653	3.0	2.0	1.2	0.0
TUR	Mean	1.1	4.3	12.3	4.7	7.2	8.6	0.3	7.7	5.6	1.3	0.3	3.3	0.1	0.0	0.5	34.3	5 949	5.9	9.4	23.0	0.0
	SD	0.4	2.0	1.1	0.7	0.4	1.0	0.5	2.1	6.9	5.0	0.4	4.7	0.4	0.0	0.1	5.7	2 449	4.7	8.9	17.4	0.0
USA	Mean	1.0	7.4	11.7	2.9	7.9	8.1	0.1	6.9	1.5	0.8	0.7	0.1	0.0	0.0	6.6	71.0	42 108	1.9	23.4	2.5	1.0
	SD	2.5	0.7	0.4	0.9	0.3	0.3	0.3	1.7	1.2	2.3	0.4	0.4	0.0	0.0	2.2	5.9	4 039	1.8	1.4	1.0	0.0
Total	**Mean**	**1.1**	**6.0**	**10.7**	**2.9**	**7.7**	**8.2**	**0.2**	**7.8**	**2.1**	**0.9**	**0.6**	**1.3**	**0.0**	**0.2**	**5.1**	**85.4**	**37 525**	**1.9**	**19.0**	**2.6**	**0.8**
	SD	**4.8**	**2.4**	**1.7**	**1.1**	**0.8**	**0.8**	**0.4**	**2.2**	**5.2**	**3.4**	**0.5**	**4.6**	**0.2**	**0.4**	**4.1**	**44.0**	**12 052**	**2.5**	**7.0**	**2.8**	**0.4**

Mean and Standard deviation per country:
ARE (United Arab Emirates), AUS (Australia), AUT (Austria), BEL (Belgium), BGR (Bulgaria), CAN (Canada), CHE (Switzerland), CHN (China), CYP (Republic of Cyprus), CZE (Czech Republic), DEU (Germany), DNK (Denmark), ESP (Spain), EST (Estonia), FIN (Finland), FRA (France), GBR (United Kingdom), GRC (Greece), HKG (Hong Kong), HUN (Hungary), IRL (Ireland), ISL (Iceland), ISR (Israel), ITA (Italy), JPN (Japan), KOR (Republic of Korea), LTU (Lithuania), LUX (Luxembourg), LVA (Latvia), MEX (Mexico), MLT (Malta), NLD (Netherlands), NOR (Norway), NZL (New Zealand), POL (Poland), PRT (Portugal), RUS (Russian Federation), SGP (Singapore), SVK (Slovakia), SVN (Slovenia), SWE (Sweden), TUR (Turkey), USA (United States of America)

and per variable:
NSFR (net stable funding ratio), REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance), CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank z-score), INF (inflation), CRC (crisis country).

Source: Own calculations.

Table VII.4: Significance of mean NSFR differences between countries

	ARE	AUS	AUT	BEL	BGR	CAN	CHE	CHN	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HKG	HUN	IRL	ISL	ISR	ITA	JPN	KOR	LTU	LUX	LVA	MEX	MLT	NLD	NOR	NZL	POL	PRT	RUS	SGP	SVK	SVN	SWE	TUR	USA
ARE							**						***			**		***			***				***	***	**	*			**				**	***		**	*	***			
AUS				***	***		***	***					***		***	***		***			***	***	*		***	***		***	***		***	**		***		***	***	***	***	**		***	
AUT				***	***		***	***					***		***	***		***	*		***	***			***	***	**	***	***		***	*		**	*	***	*	***	***	***		**	
BEL								*	***	**	***	***	***	**		***		***			***		***	***	***	***	***			***		***	***	*	***	***	***	**		***	***	***	*
BGR							**		**	*	***	***	***			***		***			***		**	***	***	***	***			***		*	***		***	***	***	***		***	**		
CAN													*			***									**																		***
CHE								***	***	***	***	***	***	***		***		***			***		***	***	***	***	***	**	***	***		***	***	***	***	***	***	**	***	***	***	***	***
CHN									*		***	***	***		*	***		***			***			***	***	***	***			***	**	*	***		***	***	**	***		***	**		
CYP													***		***	***		***			***	***		*	***	***	***	***	**		***		**		***	***		***	***	***			
CZE											*		***		**	***		***			***	**		**	***	***	***	***		*	***		***		***	***		***	**	***			
DEU													***		***	***	*	***	**	**	***	***	**		***	***		***	***		***	***		***		***	***	***	***	**		***	
DNK													***		***	***		***			***	***		**	***	***	***	***	***		***		*	**	**	***		***	***	***		**	
ESP														***	***	***	**		**	**	***	***	***	***	**			***	***	***	***	***	***	***	***		***	***	***		***	***	
EST															**	***		***			***	**			***	***	**	**			***		*		**	***		***	*	***			
FIN																***		***			***		***	***	***	***	***			***		***	***	*	***	***	***	*		***	***	***	
FRA																	***		***	***	**	***	***	***	***			***	***	***	***	***	***	***	***		***	***	***		***	***	***
GBR																								*	***												*						***
GRC																					**	***	***	***	*			***	***	***	***	***	***	***	***		***	***	***		***	***	
HKG																								**	***												**						***
HUN																								**	***												*						***
IRL																						***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	
ISL																							**	***	***	***	***			***		***	***		***	***	***	**		***	***	**	

	ARE	AUS	AUT	BEL	BGR	CAN	CHE	CHN	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HKG	HUN	IRL	ISL	ISR	ITA	JPN	KOR	LTU	LUX	LVA	MEX	MLT	NLD	NOR	NZL	POL	PRT	RUS	SGP	SVK	SVN	SWE	TUR	USA
ISR																								***	***	***	***	***	*	*	***		***		***	***		***	**	***			
ITA																									***	***	*	***	***		***	***		***		***	***	***	***	***	**	***	
JPN																										**		***	***	***	***	***	**	***	**	**	***	***	***		***	***	*
KOR																												***	***	***	***	***	***	***	***		***	***	***		***	***	
LTU																												***	***	***	***	***		***	*		***	***	***		**	***	
LUX																														***		***	***		***	***	***	***		***	***	**	
LVA																														***	**	*	***		***	***	***	***		***	**		
MEX																															***	**		***		***	***	***	***	***		***	
MLT																																***	***	**	***	***	***		**	***	***	***	
NLD																																	**		***	***		***	*	***			
NOR																																		***		***	***	***	***	**	*	***	
NZL																																			***	***	*	***		***			
POL																																				***	***	***	***	**	**	***	
PRT																																					***	***	***		***	***	
RUS																																						***	***	***		*	
SGP																																							***	***	***	***	*
SVK																																								***	**		
SVN																																									***	***	
SWE																																											
TUR																																											
USA																																											

Significances of differences in the mean NSFR between various countries using t-tests for all possible combinations.

**** shows a difference in the mean NSFR significant at the 1%-level, ** is significant at the 5%-level and * is significant at the 10%-level.*

The countries are: ARE (United Arab Emirates), AUS (Australia), AUT (Austria), BEL (Belgium), BGR (Bulgaria), CAN (Canada), CHE (Switzerland), CHN (China), CYP (Republic of Cyprus), CZE (Czech Republic), DEU (Germany), DNK (Denmark), ESP (Spain), EST (Estonia), FIN (Finland), FRA (France), GBR (United Kingdom), GRC (Greece), HKG (Hong Kong), HUN (Hungary), IRL (Ireland), ISL (Iceland), ISR (Israel), ITA (Italy), JPN (Japan), KOR (Republic of Korea), LTU (Lithuania), LUX (Luxembourg), LVA (Latvia), MEX (Mexico), MLT (Malta), NLD (Netherlands), NOR (Norway), NZL (New Zealand), POL (Poland), PRT (Portugal), RUS (Russian Federation), SGP (Singapore), SVK (Slovakia), SVN (Slovenia), SWE (Sweden), TUR (Turkey), USA (United States of America)

Source: Own calculations.

An analysis of the change that occurs in important variables during the observation horizon shows that the highest NSFR average across all banks was 1.4 in 2007; i.e. just before/during the financial crisis (tables not displayed). This is significantly (at least at the 10% level) higher than the average for the years 2001 to 2004 and for 2008 (indicating that the NSFRs dropped during the financial crisis). Furthermore, the average for 2011 is significantly higher than the one for 2001 and 2003. The mean of the six various regulatory variables (tables not displayed) is significantly[120] higher in 2011 than in 2001, 2003 and 2008; the only exception is the mean for the Regulatory Body Power index, which is higher in 2003 than in 2011. This supports the obvious assumption that the regulation became more severe after the financial crisis. The significant mean differences for the various years confirm that it makes sense to include time dummies in the regressions.[121]

Considering these observations, the next section, section VII.5, aims to give explanations for the significant differences in the NSFRs.

[120] At least at the 10% level.

[121] A regression with just the time dummies on the NSFR results in a significant F-test value and additionally supports this statement.

VII.5. Regression Results

Table VII.5 reveals the result of the basis regression. The diagnostics obtained, which are discussed in section VII.3.3, do not contradict the model. There is not enough evidence to reject the null hypothesis regarding the second-order serial correlation Arellano-Bond test, indicating that there is no second-order serial correlation. Further, there is insufficient evidence to reject the Hansen test for over-identification, implying that the instruments used are valid. Analogously, there is not enough evidence for rejecting the null hypotheses related to the difference-in-Hansen test.[122] The coefficient obtained on the lagged dependent variable (0.44) is higher than the coefficient resulting from a fixed effect estimation (0.30) and lower than the one from an OLS estimation (0.59). These results assume that there are no endogeneity issues and suggest that the system GMM method is preferable to the difference GMM method,[123] since the steady state assumption seems to be satisfied. There is a low number of instruments (71) relative to the number of various individual banks (8 182) and observations (32 855), which supplements the evidence that the regression is not weakened by too many instruments. In view of these supporting test diagnostics, the following passage discusses the results of the regression.

[122] The figures listed in my regression tables show the test statistics of the two default difference-in-Hansen tests of XTABOND2 in STATA. The default separately calculates a statistic for every instrument subset: one for the exogeneity of the lagged differences of endogenous/predetermined variables in the level equation and one for the exogeneity of the non-endogenous or non-predetermined instrumental variables. Yet, XTABOND2 offers the possibility to perform further distinctions of the difference-in-Hansen test. As Roodman (2009a, p. 148) states "[…] researchers should consider applying a difference-in-Hansen test to all the system GMM instruments for the levels equation […]" As in Lucadamo (2016), performing a separate difference-in-Hansen test for all instruments separately does not reveal problems in the regression.

[123] Nevertheless, the content of the results does not change when using the difference GMM instead of the system GMM.

Table VII.5: Basis Regression

Dependent variable: NSFR				
Explanatory variable	Predicted sign	Coefficient		t-value
L.NSFR	+	0.4368	***	(2.75)
REST	+	0.0589		(1.21)
RBP	+	-0.0362		(-1.11)
CAPR	+	-0.1256	**	(-2.16)
ERQ	+	-0.3971		(-1.45)
PRM	+/-	-0.5847	*	(-1.69)
OWN	+	-0.5865		(-1.46)
LTA	-	-0.1958		(-1.02)
LLRGL	+	-0.0036		(-0.70)
ROAA	+/-	0.0048		(1.06)
DIV	+/-	-0.1469		(-0.59)
BASA	+/-	0.0014		(0.03)
SYS	+/-	-0.1497		(-0.52)
CON	+/-	-0.0034		(-0.04)
BMC	+/-	-0.0233	*	(-1.86)
BGDP	+/-	0.0030	**	(2.26)
GDPC	+/-	0.0000		(0.88)
GGDP	+/-	0.0556	**	(2.15)
BZS	+/-	-0.0105		(-1.02)
INF	+/-	0.0041		(0.26)
CRC	+/-	-0.1780		(-0.64)
Observations:		32 885		
Groups:		5 182		
Instruments		71		
Arellano–Bond test for AR(2) in first differences		0.31		
Hansen test of joint validity of instruments (df = 36)		32.58		
Difference-in-Hansen test of exogeneity of GMM style instrument subset (df = 13)		13.22		
Difference-in-Hansen test of exogeneity of IV style instrument subset (df = 19)		11.55		

One-step system GMM regression with robust standard errors. Dummy control variables and constant not displayed.

NSFR (net stable funding ratio) is the dependent variable.
L.NSFR (lagged NSFR) is an endogenous explanatory variable with instrument lags 2 to 4.
REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (Return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance) are predetermined explanatory variables with instrument lags 1 to 3.
CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank Z-score), INF (inflation), CRC (crisis country) are strictly exogenous explanatory variables.

**** shows a significance at the 1% level for the various variables and test diagnostics, ** at the 5% level and * at the 10% level. df are the degrees of freedom for the test diagnostics.*

Source: Own calculations.

As noted above, the coefficient on the lagged NSFR $(1 - \lambda)$ has a positive sign and is below unity; the significance is at the 1% level. This result is the only one that is robust for all the mentioned key robustness checks (refer to the overview of the results of the checks in Table VII.6). It therefore seems that a substantial part of the current NSFR is influenced by the past ratio and that the lagged NSFR is one of the fundamental variables to explain the current NSFR. However, the relatively low coefficient implies a high speed of adjustment λ of 0.56, compared to the low speed of 0.06 obtained for the capital ratio by Lucadamo (2016). This indicates that banks rapidly close the gap between the past NSFR and the target NSFR every year (in contrast to the past *capital ratio* and its target value) and they adapt flexibly to changing circumstances.

With respect to the regulatory variables, the basis regression shows significant coefficients on two variables: the index for private monitoring (PRM) and the one for capital regulation (CAPR). The significance level is 10% and 5% respectively and the sign is negative for both coefficients. The negative sign related to the private monitoring variable implies that a greater dependence on private monitoring and, in turn, a lower dependence on direct regulation seem to lead to lower bank NSFRs; this result also occurred for the capital ratio in Lucadamo (2016). However, stricter capital regulation also seems to decrease the NSFRs. A possible explanation could be that banks – when setting their priorities – negatively disregard their liquidity structure and try to fulfil the regulations regarding the capital ratios (even though Lucadamo, 2016 has not found the severity of the capital regulation on the capital ratios to have a significant impact). This somehow disagrees with theories that state that "higher equity requirements benefit rather than interfere with liquidity provision" (Admati, DeMarzo, Hellwig & Pfleiderer, 2013, p. 37). Note that both coefficients are not completely robust;[124] when considering the regression results without the USA in particular, it seems that the two variables are of interest primarily for US banks and not for banks outside the USA.

[124] They lose their significance in the regression without lag limits and collapse option, in the regression without US banks, in the regression with interpolated data (only PRM) and in the regression with an alternative NSFR calculation.

Table VII.6: Overview of various robustness check results

Explanatory variable	Predicted sign	Basis GMM regression. Dep. variable: NSFR.	GMM regression without lag limits and collapse option. Dep. variable: NSFR.	GMM regression with further restricted lags. Dep. variable: NSFR.	GMM regression without USA. Dep. variable: NSFR.	GMM regression without outliers. Dep. variable: NSFR.	Basis GMM regression with intrapolated data. Dep. variable: NSFR.	Basis GMM regression without regulatory variables. Dep. variable: NSFR.	Basis GMM regression with alternative NSFR calculation. Dep. variable: NSFR.
L.NSFR	+	+	+	+	+	+	+	+	+
L.LTD	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
REST	+							n/a	
RBP	+					(-)		n/a	
CAPR	+	-	( )	-	( )	-	-	n/a	( )
ERQ	+							n/a	
PRM	+/-	-	( )	-	( )	( )	( )	n/a	( )
OWN	+					(-)		n/a	
LTA	-								
LLRGL	+								
ROAA	+/-								
DIV	+/-								
BASA	+/-								
SYS	+/-								
CON	+/-								
BMC	+/-	-	( )	( )	( )	( )	-	( )	( )
BGDP	+/-	+	( )	( )	+	+	+	+	( )
GDPC	+/-								
GGDP	+/-	+	+	+	( )	+	+	( )	+
BZS	+/-					(-)			
INF	+/-								
CRC	-								
Test diagnostics:		ok	not ok	ok	ok	not ok	ok	ok	ok

Results of the various regressions. "+" means that the coefficient on the corresponding variable is positive and significant at least at the 10% level. "-" means the same for negative coefficients. Figures in parentheses "( )" mean that there are changes in the significance compared to the basis regression. Figures in exclamation points "! !" mean that there are changes in the signs of significant coefficients compared to the basis regression.

If just one of the test diagnostics discussed is not within the expected result, this is indicated as "not ok" in the lowermost line.

The variables are: NSFR (net stable funding ratio), L.NSFR (lag of NSFR), TCR (total capital ratio), L.TCR (lag of TCR), REST (restriction), RBP (regulatory body power), CAPR (capital regulation), ERQ (entry requirements), PRM (private monitoring), OWN (ownership), LTA (log of total assets), LLRGL (ratio of loan loss reserves to gross loans), ROAA (return on average assets), DIV (dividend dummy), BASA (bank's total assets to sum of all banks' total assets of a country), SYS (dummy for system relevance), CON (bank concentration), BMC (banks per million capita), BGDP (bank deposits per gross domestic product), GDPC (gross domestic product per capita in USD), GGDP (annual gross domestic product growth), BZS (bank Z-score), INF (inflation), CRC (crisis country)

Source: Own calculations.

The other regulatory variables (including the restriction variable, which was relevant with respect to the capital ratios in Lucadamo, 2016) seem not to have any significant influence in regard to the banks' NSFRs. In other words, although the liquidity structure of banks has received increasing attention by the regulators in recent years, the impact of the regulatory severity on the NSFR during my observation period is limited. It will be interesting to see whether this result will change with the introduction of binding NSFR thresholds in Basel III.

Based on the results of the other country-specific and bank-specific variables in Lucadamo (2016), the banks' riskiness seems to somehow be implemented in the banks' capital ratios. I find a similar, although less strong, indication regarding the liquidity structure NSFR: the riskiness does not appear to be important with respect to a single bank (since the related – and also all other – bank-specific variables are not significant) but does seem to be important with regard to the whole banking sector in a country. This interpretation follows from the significant coefficients on the variables bank deposits per gross domestic product (BGDP) and banks per million capita (BMC). The coefficient for the bank deposits per gross domestic product is positive and significant at the 5% level. This implies that the more important the banking sector of a country is relative to its economy in a specific year, the higher will be the NSFRs of the banks of this country. As mentioned, this could be explained by the assumption that a more important banking sector is also a riskier banking sector and therefore leads to stronger liquidity structures, that is, higher NSFRs. Although the result for the bank deposits per gross domestic product is not robust in all checks,[125] it also applies to banks outside the USA, implying that non-US banks also hold higher NSFRs in the case of more important banking sectors.

The coefficient on banks per million capita (BMC) is negative and significant at the 10% level. This means that the more banks a country has in a specific year relative to its population, the lower the NSFRs of these banks appear to be. Given the result of the variable discussed previously, a possible interpretation of this negative significance could be that a greater number of banks in a country results in a better risk

[125] The coefficient loses its significance in the regression without lag limits and the collapse option, in the regression with further restricted lags and in the regression with an alternative NSFR calculation.

distribution between these banks and therefore the NSFRs tend to be lower. However, in contrast to the variable discussed above, the coefficient on banks per million capita loses its significance in almost all robustness checks and also in the regression without US banks.[126] Although the isolated variable should therefore not be over-interpreted, it nevertheless emphasises the result of the variable bank deposits per gross domestic product (BGDP).

The last significant coefficient in the basis regression is the one on the annual gross domestic product growth (GGDP). The sign is positive and is significant at the 5% level. Again, the result is not robust for regressions without US banks (although it is quite robust with respect to the other robustness checks[127]). Therefore, the interpretation is that positive growth in the annual gross domestic product leads to higher NSFRs for US banks (note that the absolute value of the gross domestic product per capita itself seems not to matter). This might be because strong growth phases resulted in US banks being more profitable and using the profits to build up strong liquidity structures (and not e.g. to use the profits to pay out higher dividends, as the non-significant coefficient on the dividend dummy variable [DIV] confirms).

To summarise, the basis regression shows some expected results, but the robustness checks imply that the NSFR setting process is much more unpredictable in nature than the capital ratio setting process. The various explanatory variables seem to matter mainly for US banks, whereas there is limited evidence for factors influencing the liquidity structure of non-US banks. Nevertheless, note that the various results do not give evidence that casts doubt on the accuracy of the correct disclosure of the dependent variable NSFR (as Lucadamo, 2016 finds regarding the capital ratios).

The next section, section VII.6, summarises these results and concludes the paper.

[126] It is only robust in the regression with interpolated data.

[127] Apart from the regression without US banks, it loses its significance only in the regression without regulatory variables.

VII.6. Conclusion and Outlook

Many studies have tried to find explanatory factors for the capital ratios of banks and the influence of regulation on the capital ratios (i.e. a ratio of a bank's equity figure to its asset figure). In contrast, researchers have so far neglected studies on the liquidity structure of banks (i.e. a ratio of a bank's available funding to its required funding).

Prompted by this lack of empirical evidence, I examine explanatory factors for the liquidity structure ratios – using the net stable funding ratio (NSFR) – of banks following a study by Lucadamo (2016), which inspected the same with regard to the capital ratios. I focus on banks from 43 developed countries in the time period between 2000 and 2011 and apply various regulatory, bank-specific and country-specific explanatory variables. The inclusion of the lagged dependent variable as an additional explanatory factor forms a partial adjustment model, which I calculate using the GMM method.

An analysis of the data reveals that there are significant differences in the average NSFRs between most countries. One could therefore expect to find significant regulatory and other country-specific explanatory variables. During the observation horizon, the average NSFRs increased until the financial crisis and then dropped significantly during the crisis, before they once again started to build up after the crisis. Likewise, it seems that bank regulation all over the world became stricter after the crisis, illustrated by higher average mean regulatory variables at the end of the observation horizon. One could therefore expect that the (more severe) regulation influences the liquidity structure ratios.

Indeed, my results find evidence for opposite effects that seem to be particularly relevant for US banks: greater private monitoring such as external audits and credit ratings results in banks having lower liquidity structure ratios. This is consistent with the effect on capital ratios in Lucadamo (2016), revealing that – in general – greater indirect regulation (in the sense of increased private monitoring) and therefore lower direct regulation seem to lead to weaker bank balance figures. Furthermore, I find evidence that greater capital regulation also leads to lower liquidity structure ratios. A possible explanation for this observation might be that banks prioritise compliance with the capital ratio standards and not the liquidity structure ratios, because binding standards have not yet been implemented for the latter.

I do not find any significant bank-specific explanatory factors and the highly significant and robust coefficient on the lagged dependent variable is relatively low (compared with the coefficient on the lagged capital ratio in Lucadamo, 2016). This gives evidence that banks alter their NSFRs relatively quickly to their desired ratio, but this desired ratio is idiosyncratic for every single bank.

Nevertheless, interpreting the other country-specific variables, I find evidence that the importance – and therefore the risk – of a country's banking sector as a whole influences the liquidity structures of the banks of these countries: higher importance seems to lead to higher NSFRs. This result is consistent with the result for capital ratios in Lucadamo (2016). Additionally, I find that higher growth in the annual domestic product leads to higher NSFRs, indicating that banks do not pay out all of their profits in times of economic growth. As for the regulatory variables discussed above, this result also seem to be highly influenced by US banks, that is, the growth rate in the annual domestic product does not seem to be relevant for banks outside the USA.

What are the implications for the future of bank regulation? Obviously, past regulation has had a limited impact on banks' liquidity structure in the various countries – as would also seem to be the case with regard to the capital structure in Lucadamo (2016). The latter may be somewhat surprising, taking into account that bank regulation often focused on the capital structure. As far as the former is concerned, however, it might be understandable, since bank regulators are just starting to implement binding rules for the liquidity structure. The fact that no substantial connection between bank regulation and liquidity structure was found in the past does not mean that regulation of the liquidity structure could not be an effective regulatory instrument in future. Especially in light of the frequent accusation that the capital ratio (alone) might be too imprecise an instrument (as e.g. supposed by Lucadamo, 2016), binding rules on the more easily calculable, and therefore the more easily controllable NSFR, could become a meaningful supplementary instrument.

VII.7. References

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VII.8. Appendices

VII.8.1. Detailed Explanations of Variables

Name of variable	**Explanation**	**Source**
Net stable funding ratio (NSFR)	Measure of (regulatory) liquidity structure, calculating the available amount of stable funding as a percentage of the required amount of stable funding.	Own calculation based on Bankscope[128] and on classification made by Vazquez and Federico (2012).
Restriction (REST)	Measure for regulatory restrictions on the activities of banks following the survey explained in Barth et al. (2001). The variable can take a maximum value of 14 and is composed as following: It adds 0 each, if the answer to the following questions[129] • 4.1 "What are the conditions under which banks can engage in securities activities?"	Variable taken from Lucadamo (2016) based on Barth et al. (2001).

[128] Analogous to Lucadamo (2016), observations in Bankscope that only had the value N (i.e. no value) for "common positions" were eliminated if they could not be manually calculated from other available positions. Common positions are those that are expected for every bank (such as total assets). Non-common variables (such as e.g. loan loss reserves, i.e. positions that could have no value because the bank does not have any) were considered with value 0.

[129] Lucadamo's (2016) explanations regarding the calculation of the regulatory variables are based on the question verbalisation and question numbering from the latest update of the survey in 2011, as introduced by Cihak, Demirguc-Kunt, Peria and Mohseni-Cheraghlou (2012). The variables include questions only, which – with regard to contents – also agree to the other three surveys. Questions not answered in one of the surveys were considered to be "no" if not otherwise derivable.

Name of variable	Explanation	Source
	• 4.2 "What are the conditions under which banks can engage in insurance activities?" • 4.3 "What are the conditions under which banks can engage in real estate activities?" • 4.4 "What are the conditions under which banks can engage in nonfinancial businesses except those businesses that are auxiliary to banking business (e.g. IT company, debt collection company etc.)?" is "A full range of these activities can be conducted directly in banks." It adds 1 point each if the answer to the above questions is "A full range of these activities are offered but all or some of these activities must be conducted in subsidiaries, or in another part of a common holding company or parent." It adds 2 points each if the answer to the above questions is "Less than the full range of activities can be conducted in banks, or subsidiaries, or in another part of a common holding company or parent." It adds 3 points each if the answer to the above questions is "None of these activities can be done in either banks or subsidiaries, or in another part of a common holding company or parent." Moreover, it adds 1 if the answer to	

Name of variable	**Explanation**	**Source**
	• question 7.2 "Are there any regulatory rules or supervisory guidelines regarding asset diversification?" is yes, • question 7.2.2 "Are banks prohibited from making loans abroad?" is yes.	
Regulatory body power (RBP)	Measure for the direct power of the regulatory body following the survey explained in Barth et al. (2001). The variable can take a maximum value of 13 and is composed as follows: It adds 1 if the answer to • question 5.9 "Are auditors required to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse?" is yes, • question 5.10 "Does the banking supervisor have the right to meet with the external auditors and discuss their report without the approval of the bank?" is not no, • question 5.12b "In cases where the supervisor identifies that the bank has received an inadequate audit, does the supervisor have the powers to take actions against the auditor?" is yes, • question 5.7.a "Do supervisors receive a copy of the following: The	Variable taken from Lucadamo (2016) based on Barth et al. (2001).

Name of variable	Explanation	Source
	auditor's report on the financial statements" is yes, • question 10.5.b "Do banks disclose to the supervisors off-balance sheet items?" is yes, • question 12.3.2 "Can the supervisory authority force a bank to change its internal organizational structure?" is yes, • question 11.1.f "Please indicate whether the following enforcement powers are available to the supervisory agency: Require banks to constitute provisions to cover actual or potential losses?" is yes, • question 11.1.j "Please indicate whether the following enforcement powers are available to the supervisory agency: Require banks to reduce or suspend dividends to shareholders?" is yes, • question 11.1.k "Please indicate whether the following enforcement powers are available to the supervisory agency: Require banks to reduce or suspend bonuses and other remuneration to bank directors and managers?" is yes, • question 11.5.a "Which authority has the powers to perform the following problem bank resolution	

Name of variable	Explanation	Source
	activities: Declare insolvency?" is "Bank Supervisor", • question 11.5.b "Which authority has the powers to perform the following problem bank resolution activities: Supersede shareholders' rights" is "Bank Supervisor", • question 11.5.b "Which authority has the powers to perform the following problem bank resolution activities: Remove and replace bank senior management and directors" is "Bank Supervisor", • question 12.20 "How frequently are onsite inspections conducted in large and medium size banks?" is more than yearly.	
Capital regulation (CAPR)	Measure for the regulatory oversight of bank capital following the survey explained in Barth et al. (2001). The variable can take a maximum value of 5 and is composed as follows: It adds 1, if the answer to • question 1.4.2 "Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities?" is yes, • question 1.4.3 "Can the initial disbursement or subsequent injections of capital be done with	Variable taken from Lucadamo (2016) based on Barth et al. (2001).

Name of variable	Explanation	Source
	assets other than cash or government securities?" is no, • question 1.5 "Can initial capital contributions by prospective shareholders be in the form of borrowed funds?" is no, • question 3.2.a "Which risks are covered by the current regulatory minimum capital requirements in your jurisdiction: Credit risk?" is yes, • question 3.2.a "Which risks are covered by the current regulatory minimum capital requirements in your jurisdiction: Market risk?" is yes.	
Entry requirements (ERQ)	Measure for the difficulty of operating as a bank in a specific country following the survey explained in Barth et al. (2001). The variable can take a maximal value of 8 and is composed as following: It adds 1, if the answer to • question 1.6.a "Which of the following are legally required to be submitted before issuance of the banking license: Draft bylaws?" is yes, • question 1.6.b "Which of the following are legally required to be submitted before issuance of the banking license: Intended organizational chart?" is yes,	Variable taken from Lucadamo (2016) based on Barth et al. (2001).

Name of variable	Explanation	Source
	• question 1.6.d "Which of the following are legally required to be submitted before issuance of the banking license: Market / business strategy?" is yes, • question 1.6.e "Which of the following are legally required to be submitted before issuance of the banking license: Financial projections for first three years?" is yes, • question 1.6.f "Which of the following are legally required to be submitted before issuance of the banking license: Financial information on main potential shareholders?" is yes, • question 1.6.g "Which of the following are legally required to be submitted before issuance of the banking license: Background/experience of future Board directors?" is yes, • question 1.6.h "Which of the following are legally required to be submitted before issuance of the banking license: Background/experience of future senior managers?" is yes, • question 1.6.i "Which of the following are legally required to be submitted before issuance of the	

Name of variable	Explanation	Source
	banking license: Source of funds to be used as capital?" is yes.	
Private monitoring (PRM)	Measure for the degree to which the private sector is empowered, facilitated and encouraged to monitor banks following the survey explained in Barth et al. (2001). The variable can take a maximal value of 12 and is composed as following: It adds 1, if the answer to • question 5.1 "Is an audit by a professional external auditor required for all commercial banks in your jurisdiction?" is yes, • question 5.1.1.a "Does the external auditor have to obtain a professional certification or pass a specific exam to qualify as such?" is yes, • question 5.1.2 "Are specific requirements for the extent or nature of the audit spelled out?" is yes, • question 8.1 "Is there an explicit deposit insurance protection system for commercial banks?" is no, • question 9.3 "Does accrued, though unpaid, interest/principal enter the bank's income statement while the loan is classified as non-performing?" is no, • question 9.5 "If a customer has multiple loans and advances and one of them is classified as non-performing, are all the other	Variable taken from Lucadamo (2016) based on Barth et al. (2001).

Name of variable	Explanation	Source
	exposures automatically classified as non-performing as well?" is yes, • question 10.1 "Are banks required to prepare consolidated accounts for accounting purposes?" is yes, • question 10.5.1.b "Do banks disclose to the public: Off-balance sheet items" is yes, • question 10.5.1.c "Do banks disclose to the public: Governance and risk management framework" is yes, • question 10.5.2 "Are bank directors legally liable if information disclosed is erroneous or misleading?" is yes, • question 10.7 "Are commercial banks required by supervisors to have external credit ratings?" is yes, • question 10.8 "How many of the top ten banks (in terms of total domestic assets) are rated by international credit rating agencies (e.g., Moody's, Standard and Poor)?" is 10.	
Ownership (OWN)	Measure for the degree to which regulations control for ownership in banks following the survey explained in Barth et al. (2001). The variable can take a maximum value of 3 and is composed as following: It adds 1, if the answer to	Variable taken from Lucadamo (2016) based on Barth et al. (2001).

Name of variable	Explanation	Source
	• question 2.3 "Is there a maximum percentage of a bank's equity that can be owned by a single owner?" is yes, • question 2.5.1 "Can related parties own capital in a bank?" is yes, • question 2.6.d "2.6 Can nonfinancial firms own voting shares in commercial banks: Nonfinancial firms cannot own any equity investment in a commercial bank?" is yes.	
Log of total assets (LTA)	Natural logarithm of the sum of all assets of a bank.	Based on data from Bankscope.
Ratio of loan loss reserves to gross loans (LLRGL)	This is the ratio of the part of the loans for which the bank expects losses (but does not charge off) to the total loan portfolio.	Bankscope.
Return on average assets (ROAA)	This is the ratio of the net income to the total assets (calculated as an average of the previous and the subsequent year-end) of a bank.	Bankscope.
Dividend dummy (DIV)	Dummy variable, which is 1 in the case that the bank has paid out a dividend in the specific year and 0 otherwise.	Own calculation following Lucadamo (2016) based on data from Bankscope.
Bank's total assets to sum of all banks'	Ratio of a bank's total assets to the sum of all banks' total assets of the country for a specific year.	Own calculation following Lucadamo (2016)

Name of variable	Explanation	Source
total assets of a country (BASA)		based on data from Bankscope.
Dummy for system relevance (SYS)	Dummy variable, which is 1 in the case that the bank's total assets to the sum of all banks' total assets of the country for a specific year is higher than 10% and 0 otherwise.	Own calculation following Lucadamo (2016) based on data from Bankscope.
Bank concentration (CON)	Dummy variable, which is 1 in the case that the total assets of the three biggest banks is more than 50% of all a country's banks' total assets for a specific year, 0 otherwise.	Own calculation following Lucadamo (2016) based on data from Bankscope.
Banks per million capita (BMC)	Number of banks per country for a specific year divided by the total population of this country in millions.	Own calculation following Lucadamo (2016) based on data from world development indicators (The World Bank, 2012).
Bank deposits per GDP (BGDP)	Demand, time and savings deposits in deposit money banks as a share of GDP.	Financial development and structure dataset (as explained in Beck et al., 2000)
Gross domestic product per capita in USD (GDPC)	Explained by the variable's name.	World development indicators (The

Name of variable	Explanation	Source
		World Bank, 2012).
Annual gross domestic product growth (GGDP)	Explained by the variable's name.	World development indicators (The World Bank, 2012).
Bank Z-score (BZS)	Measures the probability of default of a country's banking system. BZS is the weighted average of the z-scores of a country's individual banks (the weights are based on the individual banks' total assets). The individual Z-score divides a bank's buffers (capitalisation and returns) by the volatility of those returns (refer to formula (VII.7)). A lower z-score indicates a higher probability of default. $$\frac{\text{ROA} + \frac{\text{Equity}}{\text{Total Assets}}}{\text{Standard deviation of ROA}} \quad \text{(VII.7)}$$	Financial development and structure dataset (as explained in Beck et al., 2000)
Inflation (INF)	Explained by the variable's name.	World development indicators (The World Bank, 2012).
Crisis country (CRC)	Dummy variable, which is 1 if the country suffered a bank crisis during the financial crisis, 0 otherwise. Bank crisis countries are the ones named as systemic cases according to Laeven and Valencia (2010).	Own calculation following Lucadamo (2016) based on classification made by Laeven

Name of variable	Explanation	Source
		and Valencia (2010).

VII.8.2. Table of Abbreviations

AR(2)	Autoregressive process of order 2
ARE	United Arab Emirates
AUS	Australia
AUT	Austria
BEL	Belgium
BGR	Bulgaria
CAN	Canada
CHE	Switzerland
CHL	Chile
CHN	China, People's Rep. of
CYP	Cyprus
CZE	Czech Republic
DEU	Germany
Dep.	Dependent
df	Degrees of freedom
DNK	Denmark
DPD	Dynamic panel data
e.g.	Exempli gratia (for example)
ESP	Spain
EST	Estonia
et al.	Et alii (and others)
EU	European Union
FE	Fixed effects
FIN	Finland
FRA	France
GBR	United Kingdom
GMM	Generalised method of moments
GRC	Greece
HKG	Hong Kong
HUN	Hungary
i.e.	Id est (that is)
i.i.d	Independently, identically distributed
IRL	Ireland
ISL	Iceland
ISR	Israel
ITA	Italy
iv	Instrumental variable
JEL	Journal of Economic Literature
JPN	Japan
KOR	Republic of Korea
LCR	Liquidity Coverage Ratio

LSDVC	Least square dummy variable correction
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MEX	Mexico
MLT	Malta
n/a	Not applicable
NLD	Netherlands
No.	Number
NOR	Norway
NSFR	Net stable funding ratio
NZL	New Zealand
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary least squares
POL	Poland
pp.	Pages
PRT	Portugal
ROU	Romania
RUS	Russian Federation
sd	Standard deviation
SGP	Singapore
SVK	Slovakia
SVN	Slovenia
SWE	Sweden
TUR	Turkey
USA	United States
USD	United States dollar
Vol.	Volume
vs	Versus

VII.8.3. Table of Symbols

&	and
A	Total number of categories for liabilities
A_b	Asset category (ranging from 1 to B)
B	Total number of categories for assets
β	Coefficient to be estimated
C1	Consolidation code according to Bankscope: statement of a mother bank integrating the statements of its controlled subsidiaries or branches with no unconsolidated companion
C2	Consolidation code according to Bankscope: statement of a mother bank integrating the statements of its controlled subsidiaries or branches with an unconsolidated companion
C*	Consolidation code according to Bankscope: additional consolidated statement
D	Explanatory variable
$\varepsilon_{i,t}$	Remainder disturbance for individual bank i at time t; $\varepsilon_{i,t} = u_{i,t} - \mu_i$
i	Numbering for individual bank (ranging from 1 to N)
j	Numbering for country (ranging from 1 to J)
J	Total number of countries
k	Numbering for explanatory variables (ranging from 0 to K)
K	Total number of explanatory variables
L.	Lagged
L_a	Liability category (ranging from 1 to A)
λ	Speed of adjustment
μ_i	Unobservable specific effect for individual i; $\mu_i = u_{i,t} - \varepsilon_{i,t}$.
ν_t	Unobservable time effect
N	Total population of individual banks

®	Registered trademark
t	Numbering for time (ranging from 1 to T)
t-test	Student's test
T	Total time periods
$u_{i,t}$	Regression disturbance term for individual i at time t; $\lambda v_{i,t} = u_{i,t} = \mu_i + \varepsilon_{i,t}$
$v_{i,t}$	Disturbance term in estimation of target NSFR for individual bank i at time t
wf_a	Weighting factor for liability category a
wf_b	Weighting factor for asset category b
%	Percentage
*	Target

VIII. Conclusion of the Thesis

VIII.1. Conclusion of Paper 1

In my first paper, I apply a partial adjustment model using the generalised method of moments regression technique in order to find explanatory variables for the capital ratios of banks around the world. These variables include various regulatory factors, which cover different aspects of regulation severity. However, only for activity restrictions, I find strong evidence that there is an impact on the capital ratios of banks; greater restrictions seem to educate banks on the need to have higher capital ratios. On the other hand, I find no evidence that countries' power over the regulatory body, ownership restrictions, entry requirements or capital requirements influence banks' capital ratios. On the contrary, there are indicators related to the USA that stronger private monitoring such as external audits or credit ratings may even lead banks to have lower capital ratios.

While the impact of the regulation on capital ratios therefore seems to be limited, I find strong evidence that the previous year's capital ratio has a persistent impact on the present capital ratio. The yearly adjustment of the target capital ratio is only approximately 6%; that is, the adjustment seems to be considerably slower than some former studies have estimated.

Apart from the variables above, I also find support for a couple of significant explanatory bank-specific and other country-specific factors. There is evidence that banks paying dividends have higher capital ratios. A possible reason for this could be that a bank being able to pay out a dividend is a bank in good financial condition, which leads to a higher capital ratio. Further, larger banks seem to have smaller capital ratios. One could therefore at first glance agree to the regulatory argument that splitting larger banks into several smaller banks leads to higher capital ratios, since it reduces the "too big to fail" issue. However, my results imply that larger banks have lower capital ratios precisely because they are less risky than smaller ones. A bank having a higher (systemic) risk does indeed seem to have a higher capital ratio. This could be an indicator that such banks face greater (e.g. political) pressure to have larger capital cushions. Applied to the country-specific factors, this observation also holds for the banking sector as a whole: the more important the banking sector of a country relative to the rest of the economy, the higher the capital ratios of its banks appear to be. Additionally, the capital ratios seem to fall when the bank risk in an economy is shared among more banks. Overall, the results suggest that the riskiness of banks appears to have already been somehow implemented in the bank capital ratios.

What do these results mean in relation to the future of bank regulation? Evidently, the past regulations across the various countries were not sufficiently accurate to have a direct impact on the capital adequacy of banks; bank-specific and other country-specific factors seem to be more important. It could be interesting for further research to examine whether the availability of more post-crisis data in future years will alter these results. However, merely increasing the regulatory severity as requested by the US camp might also remain ineffective in future. Prospective changes in bank regulation should concentrate on the effective variables such as the activity restrictions or the “risk” topic. Additionally, changes should cause the ineffective variables to become more powerful.

VIII.2. Conclusion of Paper 2

The bank regulation framework Basel II, which was published in 2004, aimed to strengthen the banking system around the world. However, already at the time of publication, critical votes erupted and it became apparent that not all important countries planned to introduce the new rules at the speed and the magnitude stipulated by the Basel Committee on Banking Supervision. One of the most intensively discussed questions was, among others, whether the new rules would change the capital ratios of banks (the originators of the framework had intended an increase in the ratios).

In the second paper, I attempt to ascertain whether there is a measurable change in the capital ratios that was caused by the new framework. I perform a DiD approach by comparing early-comprehensive introducers (the treatment group) of Basel II with late-partial adopters (the control group), using 2004 as the treatment date. I also include a couple of control variables in the calculations. To ensure similarity between treatment banks and control banks, I use propensity score matching strategies and construct comparable groups, before applying the DiD computations.

The results regarding the control variables are similar to other work performed on the subject of banks' capital ratios: I find very strong evidence that bigger banks have lower capital ratios than smaller banks. There is also strong support for the finding that the ratio increases with a bank's profitability and the economic health of its environment. Further, I find some evidence that banks' ratios decrease as the banks' riskiness increases. For a few regressions only, I find that dividend payers seem to have lower capital ratios, that capital ratios appears to be lower in the case of higher growth rates of the gross domestic product and that ratios seem to be higher in the case of higher inflation rates and the greater importance of the banking sector in a country.

The results regarding the treatment effect are of far more interest for my study. I find evidence of such an effect in the amount of roughly 100 basis points. This result is highly robust in terms of variations in both the matching strategy and the DiD strategy. That is, it seems that the announced comprehensive introduction of Basel II in 2004 led the affected banks to hold higher capital ratios in this amount compared to banks from countries with no introduction. However, it turns out that the regulation change is not necessarily the only factor that led to the treatment effect. There is evidence that simultaneous changes in bank reporting standards – mainly from cost-based local regulatory standards to fair-value-based IFRS – led to higher capital ratios as well. In other words, book values changed and therefore the capital ratios went up because of a change in the measurement method. The “real” effect might have been much smaller than it appears at first, although the evidence regarding the reporting standards change is not entirely robust. Considering the results of other studies relating to the influence of the regulation, it is nevertheless apparent that the introduction of Basel II had at best only a partial positive effect on the capital ratios of banks.

This result is of interest with regard to future changes in bank regulation, especially the introduction of Basel III. The increase in capital ratios alone does not necessarily mean that banks or the banking system have become more stable with the introduction of Basel II. The financial crisis that occurred after my observation horizon revealed that several banks ran into existential problems despite the application of the Basel II rules. Accordingly, a topic for further research could be whether the introduction of Basel III or other future framework developments have a positive effect on the capital ratios of banks; future crises will show whether this effect has the power to prevent such problems from occurring in the banking sector in the future.

VIII.3. Conclusion of Paper 3

Many studies, including the first two papers of my thesis, have tried to find explanatory factors for the capital ratios of banks and the influence of regulation on the capital ratios. In contrast, researchers have so far neglected studies on the liquidity structure of banks (i.e. a ratio of a bank's available funding to its required funding).

Prompted by this lack of empirical evidence, I examine explanatory factors for the liquidity structure ratios – using the net stable funding ratio (NSFR) – of banks. I apply various regulatory, bank-specific and country-specific explanatory variables and the inclusion of the lagged dependent variable as an additional explanatory factor forms a partial adjustment model, which I calculate using the generalised method of moments technique.

I find evidence that greater capital regulation leads to lower liquidity structure ratios. A possible explanation for this observation might be that banks prioritise compliance with the capital ratio standards and not the liquidity structure ratios, because binding standards have not yet been implemented for the latter. Furthermore, I find that greater private monitoring such as external audits and credit ratings results in banks having lower net stable funding ratios.

I do not find any significant bank-specific explanatory factors and the highly significant and robust coefficient on the lagged dependent variable is relatively low. This gives evidence that banks alter their NSFRs relatively quickly to their desired ratio, but this desired ratio is idiosyncratic for every single bank.

Nevertheless, interpreting the other country-specific variables, I find evidence that the importance – and therefore the risk – of a country's banking sector as a whole influences the liquidity structures of the banks of these countries: higher importance seems to lead to higher NSFRs. Additionally, I find that higher growth in the annual domestic product leads to higher NSFRs, indicating that banks do not pay out all of their profits in times of economic growth. As for the regulatory variables discussed above, this result also seem to be highly influenced by US banks.

What are the implications for the future of bank regulation? Obviously, past regulation has had a limited impact on banks' liquidity structure in the various countries. However, this result might be understandable, since bank regulators are just starting to implement binding rules for the liquidity structure. The fact that no substantial connection between bank regulation and liquidity structure was found in the past does not mean that regulation of the liquidity structure by the new Basel II framework could not be an effective regulatory instrument in future.

VIII.4. Overall Conclusion of the Thesis

Overall, the thesis shows that the influence of regulation on the capital and financing structure of banks appeared to be limited in the past. I do not find a measurable effect on the financing structure and only minor evidence of an effect on the capital structure. To conclude, bank regulations aiming for stronger capital and liquidity structures have not achieved the desired results with the old regulatory frameworks. The current discussion regarding the new Basel III framework shows that the topic is still controversial and it will be interesting to see if this new framework alters the results of my thesis.

IX. Curriculum Vitae

Dino Lucadamo, born on 6 March 1980 in Bern (Switzerland)

Professional Experience

2016 – today	Läderach Treuhand, Heimberg: Deputy managing director
2015 – today	EXPERTsuisse, Zürich: Member of the “Standeskommission”
2015 – today	EXPERTsuisse, Zürich: Lecturer for courses in audit
2013 – today	Universität Basel, Basel: Lecturer for courses in group accounting
2011 – today	Universität Bern, Bern: Lecturer for courses in accounting
2004 – 2016	PricewaterhouseCoopers AG, Bern: Auditor
2008 – 2011	European Business School AG, Thun: Lecturer for courses in finance
2001 – 2004	Coiffeursalon Jeunesse Hairdress, Bern: Accounting employee
2003 – 2003	BDO Visura AG, Solothurn: Consulting trainee
2002 – 2003	Energieforum Schweiz, Bern: Back office employee
2001 – 2002	EKB GmbH, Schönbühl: Telephone advertising employee
2000 – 2002	Freelancer for courses in accounting, mathematics and chemistry

Academic Career

2011 – 2016	Universität Bern, Bern (until 2012) / Universität Basel, Basel (since 2012): “Dr. rer. pol.” (i.e. Ph.D.)
2005 – 2008	Akademie für Wirtschaftsprüfung, Zürich: „Eidg. dipl. Wirtschafsprüfer“ (i.e. Swiss certified CPA)
2000 – 2004	Universität Bern, Bern: “Lic. rer. pol.” (i.e. Master of Science in Business Administration)
1993 – 2000	Untergymnasium / Gymnasium Lerbermatt, Köniz: “Kantonale Wirtschaftsmaturität” (i.e. grammar school matriculation in economics)
1991 – 1993	Sekundarschule (secondary school), Liebefeld
1987 – 1991	Primarschule (elementary school), Liebefeld