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Basel III Impact on Czech Banks and Effectivity of Capital Ratios to Predict Bank Distress

Dissertation thesis

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Declaration

I hereby declare that my dissertation thesis is my own work and the literature and other resources used in the thesis are listed in the attached bibliography.

Prague, July 14, 2015 Milan Matejašák

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Title of the Dissertation Thesis: Basel III Impact on Czech Banks and Effectivity of Capital Ratios to Predict Bank Distress

Abstract: The aim of this thesis is to evaluate the impact of Basel III on Czech banks and to compare the effectiveness of capital ratios in predicting bank distress. After a short introduction, in the second chapter we estimate the impact of tightened Basel III capital regulation on lending spreads in the Czech banking sector. In this chapter we conclude that the tightened capital regulation will not lead to more expensive borrowing in the Czech Republic mainly because the banking sector has been well-capitalized. In the third chapter we identify the strategies that Czech banks adopted in order to significantly increase their capital ratios between 2009 and 2013. Our analysis shows that retained earnings have played a major role in increasing the average capital adequacy of Czech banks. In addition, the Czech banks have decreased their average asset risk to further strengthen the overall capital adequacy ratio. In the last chapter, using a dataset on bank distress in European banks during 2008-2012, we compare the performance of risk-weighted capital ratios and simple leverage capital ratios to predict bank distress. Our results suggest that simple leverage ratios can perform better than complex risk-weighted capital ratios when predicting bank distress. While such a finding is not conclusive, it suggests that more complex risk modeling does not always mean better risk modeling.

Keywords: Basel III, capital adequacy, bank capital, financial distress.

Název disertační práce: Dopad Basel III na české banky a efektivita kapitálových poměrů predikovat finanční tíseň banky

Abstrakt: Cílem této práce je vyhodnotit dopad Basel III na české banky a také porovnat účinnost různých kapitálových ukazatelů při predikci finanční tísně banky. Po krátkém úvodu v druhé kapitole odhadujeme dopad zpřísněných kapitálových požadavků Basel III na úvěrové spready v českém bankovním sektoru. V této kapitole jsme dospěli k závěru, že dopad zpřísněné regulace kapitálu nepovede v České republice k dražším úvěrům zejména proto, že bankovní systém je dobře kapitalizovaný. Ve třetí kapitole identifikujeme strategie, které české banky použily, aby výrazně zvýšily svoji kapitálovou přiměřenost mezi léty 2009 a 2013. Analýza ukazuje, že hlavní úlohu při zvyšování kapitálové přiměřenosti českých bank hrály jejich zadržené zisky. Navíc, české banky také snížily průměrné riziko svých aktiv, aby ještě více posilnily nárůst kapitálové přiměřenosti. V poslední kapitole pomoci databáze evropských bank zkoumáme banky, které se dostaly do finanční tísně mezi léty 2008 až 2012. Porovnáváme výkonnost rizikově vážených kapitálových ukazovatelů s výkonností jednoduchých pákových poměrů při predikci finanční tísně banky. Naše výsledky ukazují, že jednoduché pákové ukazovatele mohou při predikci finanční tísně banky fungovat líp než komplexní, rizikově vážené ukazovatele. I když takovéto zjištění není nezvratné, naznačuje, že složitější modelování rizika ne vždy znamená také lepší modelování rizika.

Klíčová slova: Basel III, kapitálová přiměřenost, kapitál bank, finanční tíseň

Contents

1. Introduction

Nobel laureate Paul Krugman (2008) believes the 2007-2008 financial crisis arose because *'regulation didn't keep up with the system,'* and '*because of the ideological environment of the times, there was no attempt to expand regulation. I think now it will be expanded.'* Financial innovation in the period leading up to the crisis brought new derivatives and Krugman (2008) likened buying these derivatives to '*buying insurance for the Titanic from someone on the Titanic'*. Referring to the set of banking regulations, '*Dr. Doom'*, Nouriel Roubini (2009) noted: '*All the pillars of Basel II have already failed even before being implemented.'*

Regulators across the globe reacted promptly to the strong criticism that financial regulation was weak and in December 2010 the Basel Committee on Banking Supervision (BCBS) agreed to new rules outlining global regulatory standards. According to the BCBS (BCBS 2009, BCBS 2014), the new Basel III rules have four main objectives. Firstly, to strengthen global capital and liquidity regulations with the goal of promoting a more resilient banking sector. Secondly, to improve the banks' ability to absorb shocks arising from financial stress. Thirdly, to improve risk management in banks. Finally, to strengthen banks' transparency and disclosures. The new rules also address many of the shortcomings of its predecessor, Basel II.

The Basel III rules require banks around the globe to hold more and higher quality capital, provide additional stability through capital buffer requirements, introduce a global liquidity framework, and introduce a new non risk-weighted leverage ratio to prevent banks building up excessive on- and off-balance sheet leverage. Banks are required to fully implement the new rules by 2019.

While Basel III seeks to enhance financial stability, one of the major worries is that it will not be able to do so without generating significant costs, many of which will be passed on to consumers, particularly small businesses in the form of higher lending spreads. Capital is indeed critical, but capital is also costly. The aim of the second chapter *(Basel III: Will Borrowing Money from Czech Banks Become More Expensive?)* is therefore to answer the basic question of whether the implementation of Basel III in the Czech Republic will bring more expensive loans. We concentrate on two questions: When

the capital regulation is tightened, will loans in Czech banks become more expensive? By how much can lending spreads increase?

In the third chapter *(Basel III: How have Czech banks reached higher capital ratios?)* we focussed on an analysis of the impact of Basel III from a different viewpoint. Czech banks started to react to higher capital requirements quickly. As a result the average capital adequacy of Czech banks increased significantly during 2010 to 2013. In the third chapter, we analyse in detail the channel of adjustment to stricter capital requirements. We analyse the strategy that Czech banks adopted in order to increase their risk-weighted capital ratios. Banks can choose from a variety of adjustment strategies such as decreasing the portfolio risk, issuing new equity via new shares, boosting retained earnings etc. Each strategy has a different macroeconomic impact and varying implications for bank clients. Therefore in this chapter we address the following questions: When adapting to Basel III, have the Czech banks increased their capital ratios by decreasing risk, increasing capital or both? What has played the major role? How has the average portfolio risk changed?

The aim of the fourth chapter *(Can simple measures of capital adequacy outperform risk-weighted measures as predictors of bank distress?)* is to challenge the increasing complexity of Basel regulations. While Basel I, adopted in 1988, had only 30 pages, Basel III, runs to 616 pages. The natural questions then arise: does increasing regulation complexity enhance the safety of the financial system? To what extent have capital ratios been related to the distress of banks? Do more complex indicators predict bank failures better? In order to answer these questions, we use a unique dataset of bank distress during the global financial crisis (2008-2009) and subsequent European sovereign debt crisis (2010-2012). We aim to compare the relative performance of eight capital measures in predicting bank distress. Our research compares the performance of four simple (accounting based) leverage ratios and four complex (risk-weighted) capital ratios. Our primary goal is to investigate whether simple measures can outperform complex capital measures as one year-ahead predictors of bank failure although the Basel regulation is focused on the complex ratios.

Each of the previous chapters at the same time outlines possible areas for future research. The final, fifth chapter sums up the main conclusions and findings of our thesis.

The second chapter of the thesis *(Basel III: Will borrowing money from Czech banks become more expensive?)* was published in *European Financial and Accounting Journal* (2014, Vol. 9, No. 2, pp. 4 – 27) which is a peer-reviewed journal. It was also discussed at the *Global Interdisciplinary Business-Economics Advancement Conference* in Tampa (Florida, USA) in 2014.

The third chapter *(Basel III: How have Czech banks reached higher capital ratios?)* will be published in August 2015 in *Ekonomický časopis - Journal of Economics* (2015, Vol. 63, No. 5, pp. 486 – 503) which is a quality peer-reviewed journal with impact factor.

The fourth chapter has been sent for publication to *Prague Economic Papers* which is also a quality peer-reviewed journal with impact factor.

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2. Basel III: Will borrowing money from Czech banks become more expensive?

Abstract

We estimate the required increase in banks' lending spreads assuming that banks under regulatory pressure would raise lending spreads to prevent ROE from falling when the capital regulation is tightened. We focus our analysis on six Czech banks that are under regulatory pressure, and are therefore the ones most affected by the increased capital requirement. We follow the mapping methodology presented by King (2010). We find that the required increase in lending spreads to keep ROE from falling totals 6.3 basis points. We conclude that the impact of tightened capital regulation on lending spreads in the Czech banking sector is minor. If shareholders decide to absorb some of the fall in ROE, or they take other measures to prevent a fall in ROE, the potential impact on lending spreads will be even smaller.

Keywords: Basel III, capital adequacy, capital requirement, lending spreads.

JEL classification: G28

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2.1 Introduction

In Europe, Basel III is already in force. The very recent European legislative package, comprising Capital Requirements Directive IV (so-called CRD IV) and Capital Requirements Regulation (so-called CRR), has been in force since 1 January 2014. It represents a significant change for bankers because it puts the new global Basel III regulation into practice.

A number of effects is expected to follow from the implementation of this package and many of these effects are difficult to estimate. Dvořák (2010) predicts Basel III is likely to bring a number of positives, such as strengthening the quality and quantity of bank capital, strengthening the stability of the banking system and reducing the risk of systematic banking crisis. However, other effects may be less beneficial. Basel III puts significant pressure on profitability and return on equity and it leads banks to increase their risk appetite. Basel III critics argue that it may even destabilize well-capitalized banks in certain countries. For example, common worry is that foreign parent companies may 'suck' capital and liquidity from well-capitalized Czech banks as a result of the worsening financial situation of the parent companies. Last but not least, there is a worry that loans for individual and corporate clients may get more expensive.

In chapter 3 we aim to analyse the last-mentioned worry: bank loans may become more expensive. Looking at Czech banks we pose two key questions: When the capital regulation is tightened, will loans in the Czech banks become more expensive? By how much can lending spreads increase? In order to answer these questions we will follow the methodology presented by King (2010). We estimate the required increase in banks' lending interest rates assuming that banks raise the interest rates (among other measures they can take) to prevent ROE from falling when the capital is increased.

The main benefit of this study is that, to our knowledge, it is the first study that tries to analyse the impact of Basel III on interest rates in the Czech Republic. The results of this section are interesting not only for researchers, but also for clients of Czech banks.

The structure of our analysis is as follows: chapter 2.2 briefly summarizes new capital requirements and it presents the results of literature related to measuring the impact of tighter capital regulation in Europe and globally. In chapter 2.3 we present mapping methodology of higher capital requirements on lending spreads. We introduce data on Czech banks as well. Chapter 2.4 presents the final results of our analysis; it gives us an answer to the question stated in the chapter's title. Chapter 2.5 summarizes the analysis and it repeats the main findings.

2.2 Higher capital requirements in Basel III

Basel III brings a number of new measures, instruments and requirements. The key new requirement is strengthening the quality and quantity of capital. In chapter 2.2 we present it in more detail. Later in the chapter we summarize the findings of literature measuring the impacts of tighter regulation.

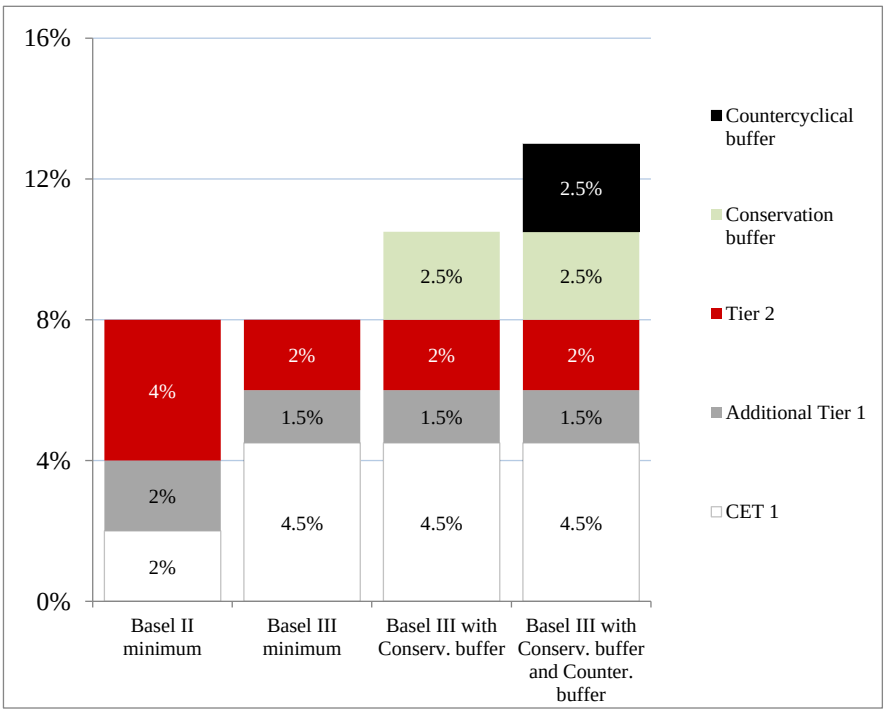
2.2.1 Basel III brings higher capital requirement

The financial crisis showed that not all banks had satisfactory capital levels. Some banks had capital of low quality, and so could not absorb the losses. Basel III reacts to this weakness. It requires banks to hold more capital of higher quality compared to Basel II. According to the new definition, capital comprises the following two components: going-concern Tier 1 capital and gone-concern Tier 2 capital. Tier 1 capital consists of Common Equity Tier 1 (CET 1) capital and Additional Tier 1 Capital.

CET 1 capital is the highest quality capital. Common shares and retained earnings must form the predominant part of CET 1. The quantity of minimum levels is required as follows (Figure 1):

- CET 1 capital ratio of 4.5 % of risk-weighted assets (RWA),
- Tier 1 capital ratio of 6 % of risk-weighted assets,
- Total capital ratio of 8 % of risk-weighted assets.

Figure 1: Basel III capital requirements



Source: BCBS (2011), ČNB (2013a), author.

Comparing Basel II and Basel III, the minimum total capital ratio remains at 8 % of RWA. However, CET 1 capital ratio increases from 2 % to 4.5 % and additional Tier 1 capital ratio decreases from 2.0 % to 1.5 %, leading Tier 1 capital ratio to increase from 4 % to 6 %. The importance of Tier 2 capital decreases by reducing the ratio from 4 % to 2 % of RWA.

On top of these changes in Tier 1 and Tier 2 capital, Basel III introduces two new buffers: a capital conservation buffer of 2.5 % and a countercyclical buffer of 0 - 2.5 %. Both buffers need to be covered by CET 1 capital. As noted by Mandel and Tomšík (2011), additional capital conservation buffer implementation is logical because forcing banks to keep fixed 8 % capital level leads to credit rationing during financial crisis. Additional capital surcharges of up to 3.0 % for systemically important financial institutions (SIFIs) are effective as well. The surcharge needs to be covered by CET 1 capital as well.

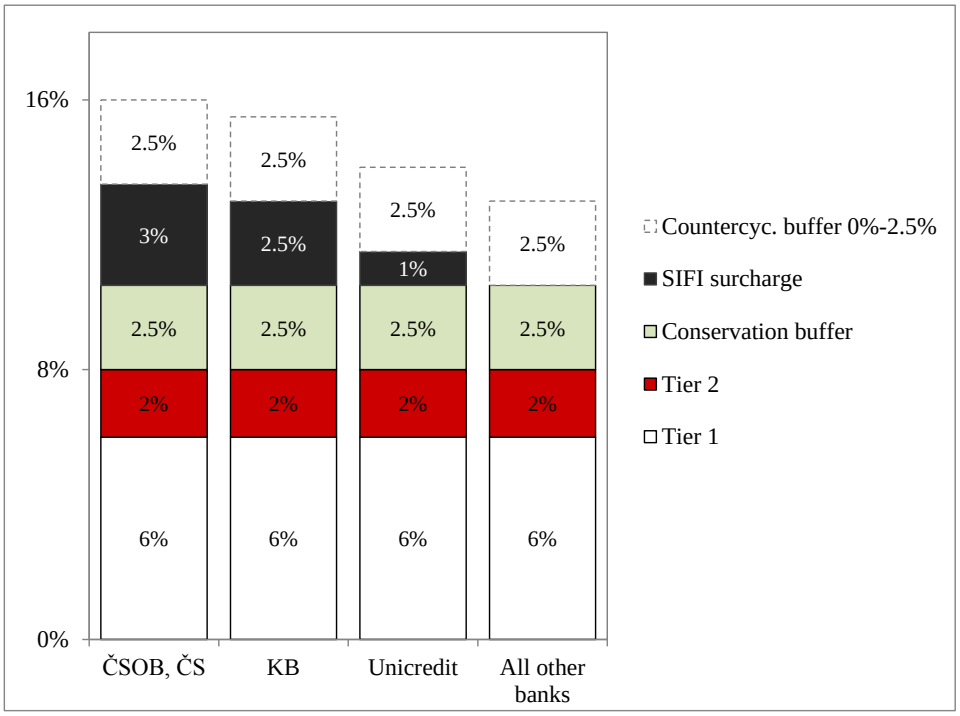
In October 2013, the Czech National Bank (ČNB 2013a, ČNB 2013b) decided it would not implement the countercyclical buffer gradually until 2019, as the original Basel III standard suggests. The ČNB requires Czech banks to implement the buffer to the full

value of 2.5 % already in 2014. Related to the countercyclical buffer, the ČNB (2013a) decided to set its value to 0 % for the years 2014 and 2015.

Moreover, the ČNB (2014) decided that the four largest banks in the Czech Republic were systemically important and the regulator imposed a SIFI surcharge for all of them: 1 % for UniCredit bank, 2.5 % for Komerční banka (KB) and 3 % for ČSOB and Česká spořitelna (ČS). For a study that discusses issues concerning the calculation of a bank's systemic importance to the banking sector we refer to Skorepa and Seidler (2014).

Hence, after taking into consideration the new capital buffers, the total capital requirement for individual Czech banks is as shown in figure 2:

Figure 2: Capital requirement for Czech banks



Source: BCBS (2011), ČNB (2014), author.

To conclude, the Czech banks that are not systemically important (all banks apart from the four largest ones) should hold their capital levels above 10.5 % in 2014 and 2015, if they do not want to face restrictions on dividend payment. Dividend restrictions apply if bank capital falls below the 10.5 % level. The 10.5 % requirement consists of the 8 % minimum and 2.5 % capital conservation buffer. However, the banks should also be prepared for an additional increase of 2.5 % in countercyclical buffer.

The four biggest banks face a SIFI surcharge on top of the 10.5 % requirement, and they should be prepared for an increase in the countercyclical buffer too. Hence, they should hold minimum capital levels from 14.0 % to 16.0 % of risk-weighted assets. This includes 8 % capital minimum, 2.5 % conservation buffer, 2.5 % countercyclical buffer and 1 % to 3 % SIFI surcharge.

2.2.2 Literature review

From a broad perspective, for example, Stiglitz (2009), Freixas and Rochet (2008) or Musílek (2011) summarizes the basic arguments (such as moral hazard, information asymmetry, imperfect competition, negative externalities) of mainstream financial theory why financial regulation is necessary. On the other hand, Mandel and Tomšík (2011) analyse the banking regulation from the economic theory's point of view. They explain that different schools of economic thought (Friedrich von Hayek and the Austrian school, Milton Friedman and monetarists or Hyman P. Minsky and post-Keynesian economists) have different opinion on banking regulation; however, all these schools of economic thought recommend at least some form of banking regulation.

In more detail, a number of authors have tried to estimate the impact of higher capital requirements on lending spreads; for example, King (2010), Kashyap *et al* (2010), Slovik and Cournede (2011), Roger and Vlček (2011) or more recently Šútorová and Teplý (2013). Most of the analysis has been focused on banks in large regions, such as the Euro area, US banks or globally. Their samples usually include thousands of banks.

The findings are interesting. No matter what region, all authors conclude that an increase in capital requirement leads to an increase in loan interest rates. However, their estimates of magnitude differ, sometimes a lot. For example, when looking at US banks Kashyap *et al* (2010) state that one percentage point increase in capital leads to an increase in loan interest rates by 2.5 basis points (bps), while Roger and Vlček (2011) estimate a much higher impact, around 60 bps. Alternatively, for the EU banks Šútorová and Teplý (2013) estimate an increase of 18.8 bps in lending spreads while Roger and Vlček (2011) estimate totals 65 bps. For the comparison of results see table 1.

Table 1: Impact of 1 percentage point increase in the capital ratio on loan interest rate

Authors	Region	Increase in loan interest rate in basis points
Šútorová and Teplý (2013)	EU	18.8 bps
Sun, Hoon and Wonhong (2012)	Globally	0.1 - 29.7 bps
Roger and Vlček (2011)	USA, Euro area	USA: 60 bps Euro area: 65 bps
Slovik and Cournede (2011)	USA, Euro area	USA: 23.4 bps Euro area: 14.3 bps
Kashyap, Stein and Hanson (2010)	USA	2.5 bps
Eliott (2010)	USA	19 bps
King (2010)	Globally	15 bps

Source: Šútorová and Teplý (2013), author.

In contrast to the literature listed in table 1 we have decided not to include all banks from a chosen region; in our case not all banks from the Czech Republic are included in our sample. We have chosen to include only those banks that are under regulatory pressure. We assume that banks with high capital ratios have little motivation to increase their capital in order to meet regulatory standards, as their capital levels are already above the regulatory requirements. Hence, our approach is that we do not include all banks from the Czech Republic but only a subset of banks, those banks that are under regulatory pressure. We explain our approach in more detail in the following chapter related to methodology.

2.3 Methodology and Data

In this chapter we present the mapping methodology used to estimate the impact of one percentage point increase in capital on lending spreads. The analysis presented here, while intended to be broadly realistic, is necessarily simplified. The remainder of this chapter provides data description and financial statements of a representative bank.

2.3.1 Methodology

This section explains the mapping methodology of higher capital requirement to interest rate spread. The mapping methodology was firstly introduced by King (2010) and later was used by others, for example, Sun, Hoon and Wonhong (2012). As noted by King (2010), the methodology does not consider the impact on lending spreads during the transition stage, only during the steady state.

The mapping exercise begins with the stylized balance sheet for a representative bank (see equations 1 and 2). Bank assets *(A)* consist of cash *(C)*, interbank claims *(IBC)*, trading assets *(TrA)*, loans *(Lo)*, investments in securities *(Inv)* and other assets *(OA)*. The major part of assets is loans, which consist of mortgage loans, corporate loans and consumer loans. However, this differentiation of loan types is not important in this mapping exercise, so we will treat them equally as one type of loan. Bank liabilities *(L)* consist of deposits *(Dep)*, interbank funding *(IBF)*, trading liabilities *(TrL)*, debt *(D)* and other liabilities *(OL)*. Debt consists of short-term borrowings, senior debt and subordinated borrowing.

$$A = C + IBC + TrA + Lo + Inv + OA \tag{1}$$

$$L = Dep + IBF + TrL + D + OL \tag{2}$$

Further, when looking at a representative bank´s profit and loss statement, its net income *(NI)* consists of four major categories: net interest income, net non-interest income *(NII)*, operating expenditure *(OE)* and tax. When looking at net interest income in more detail, it may be divided into three broad categories: loans interest income *(LII)*, other interest income *(OII)* and interest expense *(IE)* (see equation 3).

$$NI = \left[\left(LII + OII - IE\right) + NII - OE\right] \cdot (1 - tax) \tag{3}$$

Loans interest income *(LII)* is generated by loans *(Lo)*, interbank claims *(IBC)* and investments *(Inv)*. Interest expense *(IE)* is generated by deposits *(Dep)*, interbank funding *(IBF)* and debt *(D)* which from the maturity criterion may be divided into short term debt (maturing within one year) and long term debt (maturity over one year). This

maturity split with a one year threshold is important in order to have estimates of lending spread increase more precise, as we will explain later.

$$D_t = D_t \cdot \beta_t + D_t \cdot (1 - \beta_t) \tag{4}$$

where β_t = portion of debt maturing within one year,

Non-interest income *(NII)* consists of fees, commissions and trading income, which is generated by trading assets *(TrA)* and trading liabilities *(TrL).* Operating expenditure *(OE)* is mainly personnel expense, administrative costs and other.

In equation 4, the division of debt into long term funding and short term funding with a one year threshold may seem arbitrary, but this threshold is important not only in Basel III (for example, in the calculation of Net Stable Funding Ratio) but also for the purpose of more precise calculation of interest expense and funding costs. In published annual reports interest expense *(IE)* is reported as one number even though it is generated by a number of different liability components. The interest expense is calculated as follows:

$$IE = r_D \cdot Dep + r_{ST} \cdot (IBF + TrL + D_t \cdot \beta_t) + r_{LT} \cdot D_t \cdot (1 - \beta_t) \tag{5}$$

where r_D = cost of deposits,
r_{ST} = cost of short term debt maturing within one year,
r_{LT} = cost of long term debt.

In this study it will be important to distinguish the costs that generate interest expense: cost of deposits, cost of debt maturing within one year and cost of debt maturing above one year.

The cost of deposit is set to value *x %*. For example, if cost of deposits is 2 % p.a. then x = 0.02, while the cost of short term debt is cost of deposits plus 100 bps and cost of long term debt is cost of deposits plus 200 bps (see equations 6 to 8). The figures (spreads) are arbitrary, they are model parameters and they can be changed. For the purpose of this analysis we set the spreads as follows:

$$r_D = x \tag{6}$$

$$r_{ST} = x + 0.01 \tag{7}$$

$$r_{LT} = x + 0.02 \tag{8}$$

We have chosen the specific model values based on the ČNB (2013d) quarterly interest rate statistics from the April 2012 - September 2013 period. The average spread between the ČNB repo rate (an approximation of r_D) and interest rate for household deposits with maturity up to one year (an approximation of r_{ST}) totalled 0.9 %. In addition, average spread between the interest rate for household deposits with maturity up to one year (the approximation of r_{ST}) and interest rate for household deposits with maturity over one year (an approximation of r_{LT}) totalled 1.1 %. Hence the chosen model values are realistic. The chosen interest rate spreads generate an upward sloping yield curve.

The specific value of *'x'* can be calibrated for every bank by solving the equations 5 to 8. As noted by King (2010), the lowest cost of deposits is consistent with the existence of deposit insurance schemes, which lowers the risk of deposits in comparison with other sources of bank funding.

The final source of bank funding is shareholders' equity. The cost of equity is defined as return on equity *(ROE),* which is the ratio of net income *(NI)* to equity *(Eq).* ROE measures the amount of profit in dollars that is generated in a given year per one dollar of shareholders' equity.

$$r_{Equity} = ROE = \frac{NI}{Eq} \tag{9}$$

where r_{Equity} = cost of equity

ROE = return on equity

While ROE may be quite volatile in the short term, in the long term it provides a good estimate of the return expected by bank shareholders. When making comparison of funding costs, in line with equations 6 to 8 and in consistency with the classical work of Miller and Modigliani (1958), the deposits are the cheapest form of funding, followed by short-term debt and long-term debt. The most expensive source of bank funding is equity as it has the smallest residual claim on bank assets.

$$r_D < r_{ST} < r_{LT} < r_{Equity} \tag{10}$$

Accounting capital (and ratios) should be distinguished from regulatory capital (and ratios). The Bankscope database contains total capital ratios for all individual banks.

$$TotalCapitalRatio = \frac{E}{RWA} \tag{11}$$

where E = regulatory capital,

RWA = risk weighed assets.

Given the relationships in equations 1 to 11 we can calculate the impact of higher capital requirements on interest rates. We assume that in order to meet a target capital ratio (increase by 1 percentage point) the quantity of shareholders' equity is increased relative to RWA.

We hold volume, composition and riskiness of assets constant. From this follows that RWA is held constant as well. However, in order to meet higher capital ratio the relative share of total liabilities to shareholders equity changes. As noted by King (2010), an increase of the capital ratio by 1 percentage point will lead to a smaller rise in shareholders' equity. This is caused by RWA which are typically smaller than total assets (equation 12).

$$E_{t+1} = E_t + \Delta TotalCapitalRatio \cdot RWA_{t+1} \tag{12}$$

The increase in the quantity of equity is offset by a decrease in the quantity of liabilities. We assume that the most expensive form of liabilities is offset, hence long-term debt (equation 13).

$$\Delta D = -\Delta Eq \tag{13}$$

The increase in the quantity of capital at the expense of long-term debt has a number of effects. First, banks´ average cost of capital rises as a more expensive one substitutes a cheaper form of funding. On the other hand, net income increases as interest expense falls. Interest expense falls because the relative size of long-term debt is smaller.

However, ROE falls (equation 9) as the increase in net income (numerator of the ROE ratio) is smaller than the increase in shareholders' equity (denominator of the ROE ratio).

Banks want to respond to a fall in ROE. They can take a number of measures. They can redirect their activities to more profitable products, increase non-interest income via commissions and fees or reduce personnel costs and administrative costs. The bank management may decide to take a mixture of these measures or it may even absorb a partial fall in ROE. However, in this study we assume that shareholders do not want to absorb a fall in ROE, they want to get it back to pre-regulatory levels. The bank management decides to take only one measure to achieve that goal: it increases net income by increasing the lending spread *(α)* charged on loans. Later in the chapter we will relax this strict assumption because usually the bank management has a great variety of choices. However, first we will keep the assumption in order to estimate the maximum impact on lending spreads.

The magnitude of α is determined such that the increase in loan interest income exactly offsets the initial increase in cost of capital so that ROE returns to pre-regulatory levels.

$$\alpha = \frac{LII_{t+1} - LII_t}{Lo_{t+1}} \tag{14}$$

When combining equations 3, 9 and 14, we get a final measure of the rise in lending spreads needed to offset the fall in ROE associated with 1 percentage point increase in capital ratio.

$$\alpha = \frac{\left[\frac{ROE_{t+1} \cdot E_{t+1}}{1 - tax} - (OII_{t+1} + NII_{t+1} - IE_{t+1} - OE_{t+1})\right] - LII_t}{Lo_{t+1}} \tag{15}$$

Sun, Hoon and Wonhong (2012) note (and we will see later in the results in table 4 as well) that, as long as long-term debt is replaced by equity and the costs of debt and equity remain constant, the increase in lending spreads rises linearly with the increase in capital ratio. If a bank decides to replace cheaper forms of liabilities than long-term debt (for example, short-term debt) with more expensive equity, the rise in lending spreads is higher because the fall in interest expense is relatively lower.

2.3.2 Data

For our analysis we are using the Bankscope database, which is a comprehensive, global database with banks´ financial statements. Bankscope contains information on over 30,000 banks. Balance sheets, income statements, interim reports and other information (regulatory capital, financial ratios and ratings) of more than 8,000 European banks and 15,000 US banks are included in the database with information up to the last 16 years. As our primary focus is Czech banks, we have checked that all of them are included as well. The latest data for Czech banks that are available from the database are the financial reports as of December 2012.

As suggested previously, our analysis is focused on those Czech banks that are under regulatory pressure. These banks need to increase their capital due to Basel III. Our methodology is in contrast to other literature like King (2010) or Sun, Hoon and Wonhong (2012) who included all banks from a chosen region (for example USA) in their sample. Even banks that had very high capital ratios were included. For example King (2010) excluded only banks with very high capital ratios over 100 % (8 % is regulatory minimum).

We assume that banks with very high capital ratios have little motivation to increase their capital levels even further as they already meet tighter capital requirements. Therefore our analysis applies only to those banks that are under regulatory pressure as these are the ones that are motivated to increase their capital. These are the banks that may be motivated to increase their lending spreads and net income in order to get capital to the required level.

The banks under regulatory pressure can be identified in several ways. We will adopt a simple approach wherein the bank is under regulatory pressure if the bank´s capital is below the 13 % level. The 13 % capital ratio is arbitrary. It consists of 8 % regulatory minimum, 2.5 % conservation capital and 2.5 % countercyclical buffer. We set the ratio to 13 %, as this is the level of capital when a bank does not feel any regulatory pressure to increase its capital and simultaneously, the bank is fully prepared for a potential increase in countercyclical buffer, which is currently set to 0 %. As noted introduction, the regulator may raise the countercyclical buffer to as high as 2.5 % in 2016.

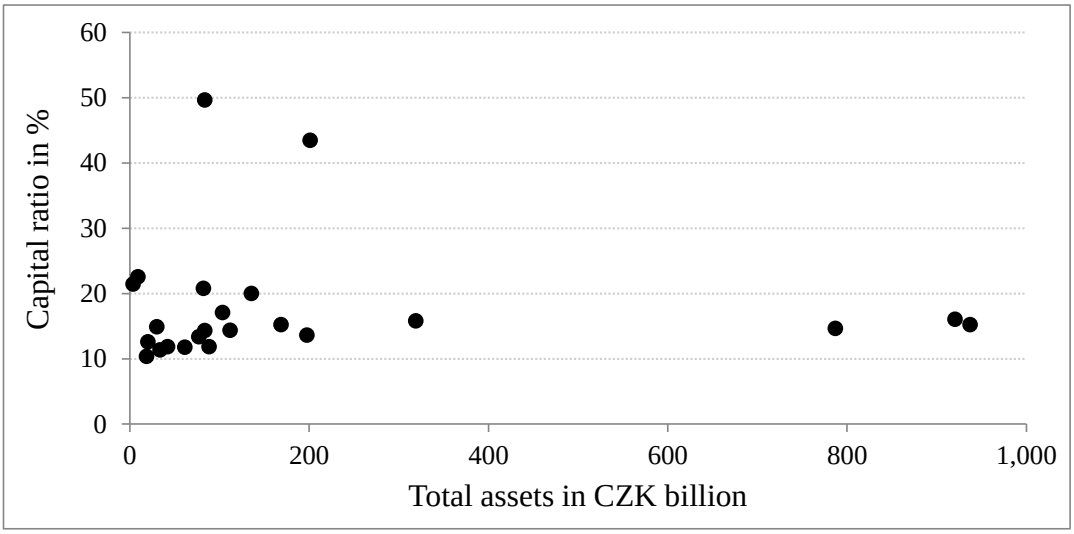
As the top four Czech banks (ČSOB, Česká spořitelna, Komerční banka and UniCredit Bank) also face a SIFI surcharge of 1 to 3 % (see chapter 2.2.1), the 13 % threshold needs to be increased to 14 – 16 % for these four banks.

According to the Czech National Bank (2013c) statistics, as of December 2012 there were 23 commercial banks (including five building societies) and 20 foreign bank branches operating in the Czech Republic, hence 43 banks in total. The total assets of the Czech banking sector stood at CZK 4,633 billion at the end of 2012.

The structure of Czech banking sector is fairly stable, however, from a long-term perspective. Four large banks (by ČNB methodology banks over CZK 250 billion in assets) managed approximately 52.4 % of gross loans and 58.3 % of deposits. As noted in the Czech Banking Association (2013) report, all competition indicators reflect an environment of healthy competition among Czech banks.

The list of 23 commercial banks is a starting point for our analysis. We omit foreign bank branches, as they do not hold equity. The average capital adequacy of the 23 banks was 18.0 % as of 2012 year-end. Figure 3 shows the capital adequacy of all individual banks in relation to their size.

Figure 3: Total assets and capital adequacy of Czech banks as of December 2012



Source: Bankscope, author's calculations.

Figure 3 shows that the banks with the lowest capital ratios are the smallest banks with total assets below CZK 100 billion.

Only six banks had a capital ratio below the 13 % threshold as of September 2013, see table 2. These are the banks 'under regulatory pressure'. Average capital ratio of the six banks totalled 11.6 %. Further analysis will be focused only on these six banks, as these are the banks with capital ratios below the 13 % threshold.

Table 2: Capital ratios and size of banks under regulatory pressure

Name	Total Capital Ratio as of September 30, 2013 in %	Total assets as of September 30, 2013 in CZK billion
J&T BANKA	12.97	95.5
PPF banka	12.51	108.6
Sberbank CZ	11.40	65.0
Wüstenrot hypoteční banka	11.29	27.0
Fio banka	10.89	24.5
Air bank	10.80	48.1

Source: Quarterly financial statements of the banks as of September 30, 2013.

When looking at the top four banks, all four banks passed their 14 - 16 % threshold, which includes the SIFI surcharge. Their average capital adequacy totalled 16.5 % as of September 2013. We omit these four banks from further analysis as well as they are under no regulatory pressure, they are fully prepared for an increase in the countercyclical buffer as well.

After identification of the banks under regulatory pressure, a representative balance sheet and income statement is constructed for the six banks in the sample. For that purpose we use the Bankscope database to extract a balance sheet, income statement and regulatory ratios for each of the six banks. Then we construct a representative balance sheet and income statement by taking the weighted average values of individual components. The weights are based on total assets. Table 3 shows the stylized balance sheet and income statement for the representative bank. All items are shown as % of total assets.

Table 3: Representative financial statements as of 31 December 2012

Balance sheet	Average	Income statement	Average
Cash and balances at Central Banks	9.3	Interest income	3.88
InterBank claims	10.3	Interest expense	1.93
Trading assets	5.3	A. Net interest income	1.96
Net loans	49.7	Trading income	0.52
Investments and securities	23.7	Fees, comissions	0.54
Other assets	1.8	B. Non interest income	1.06
Total Assets	100.0	C. Total revenue (A+B)	3.02
Deposits	73.2	Personnel expense	0.62
Interbank funding	6.4	Other administrative costs	1.61
Trading liabilities	2.0	D. Total operating expense	2.22
Debt (Wholesale funding)	6.6	E. Operating profit (C-D)	0.79
Other liabilities	4.1	F. Tax	0.16
Total Liabilities	92.2	G. Net income	0.63
Total Equity	7.8		
Total Liabilities and Equity	100.0	ROE (%)	8.1%
Total capital ratio	11.9	Leverage multiple = Total assets/Equity	12.9
RWA/Total assets	50.4	Average effective tax rate (%)	21%

Source: Author's calculations.

Loans represent about half of total assets, followed by investments (23.7 %) and interbank claims (10.3 %). These are usually financed by deposits (73.2 %), equity (7.8 %), wholesale funding (6.6 %) and interbank funding (6.4 %). Risk weighted assets amount to 50.4 % of total assets. This is an important ratio, as it tells us that an increase on capital ratio by 1 percentage point requires a rise in shareholder equity of only half a percentage point.

When looking at the consolidated income statement in table 3, net interest income is the main source of net income. Net interest income totals 1.96 % and non-interest income 1.06 %. Total operating expense totals 2.22 % and net income around 0.63 % of total assets. This implies an average return on equity of 8.1 %. The average tax rate is 21 %.

2.4 Impact of higher capital requirement

Chapter 2.4 presents our findings. First, we present the results in a basic scenario where we assume that shareholders do not want to absorb any fall in ROE. Later we leave this assumption and present the results where shareholders allow a fall in ROE.

2.4.1 Impact of 1 percentage point increase in the capital ratio on lending spreads

Table 4, column A presents the results of our calculations[1]. It assumes the following assumptions are valid: that a representative bank wants to increase its capital level, that it does not want its ROE to fall, it does not want to change the structure and riskiness of its assets, it substitutes long-term debt by equity, the cost of debt remains unchanged and the bank wants to increase net income only by increasing lending spread (and not by other means such as reducing operational expense). Given these assumptions, we can conclude that an increase in capital ratio by 1 percentage point leads to an increase in lending spread by 6.3 basis points.

Table 4: Impact of 1 percentage point increase in capital on interest rate assuming changes in ROE and no change in cost of debt

	A	B	C	D
Increase in Capital ratio (in percentage points)	No change in ROE	ROE falls by 5 basis points	ROE falls by 10 basis points	ROE falls by 15 basis points
	Increase in lending spread in basis points			
1	6.3	5.2	4.2	3.1
2	12.5	10.4	8.3	6.2
3	18.8	15.6	12.5	9.4

Source: Author's calculations.

Note that the relationship between an increase in capital ratio and a rise in lending spread is linear. For example, if a bank wants to raise capital ratio by 2 percentage points, than the increase in lending spreads amounts to 12.5 basis points. If we compare our

[1] Columns B to D will be explained later in the chapter. They present scenarios when ROE is allowed to fall.

results with the literature listed in table 1, we can conclude that the impact of Basel III on banks in the Czech Republic with 6.3 basis points increase in lending spreads is low.

The major factors that affect the lending spreads are the ratio of RWA to total assets (the lower the ratio, the smaller the impact on lending spreads), the relative size of loan to total assets (the higher the relative size of loans to total assets, the lower the impact) or the long- term interest rate on debt (the higher interest rate, the lower impact) ceteris paribus.

Table 5 shows our calculation in more detail. Column A shows the initial position of the representative bank with its liabilities and equity, complete income statement and initial ROE. Assets are not shown, as there is no change during the process of accommodation. Column B shows the change in quantities of capital and long-term debt and the resulting decrease in interest expense. The equity increases by 0.5, which is the required increase in order to raise capital ratio from the initial 11.9 % to the desired 12.9 %. Column C shows the financial statements after the increase in capital. We can see that net income increases from 0.63 % to 0.65 %, however, ROE falls from 8.08 % to 7.83 %. Hence, the accommodation process continues and column D shows the required increase in interest income to get ROE back to its pre-regulatory level of 8.08 %. The required increase in interest income totals 0.03 basis points, which is achieved by a rise in lending spread by 6.3 basis points.

It is worth to mention that our methodology used for estimating the changes in spreads is likely to give higher estimates because it abstracts from competition by those banks, which are not under ‘under regulatory pressure’, 17 out of 23 banks had a capital ratio above the 13 % threshold. The banks with capital, which is higher than future capital requirements, compete directly with the banks under regulatory pressure and this will tend to mitigate eventual changes in spreads.

Table 5: Calculation of rise in lending spreads for 1 percentage point increase in capital ratio assuming no change in ROE and cost of debt

	A	B	C=A+B	D	E=C+D
	Initial position	Change 1: Increase in equity and no change in lending spreads	Position after change 1	Change 2: Increase in lending spreads	Change 2: Position after increase of lending spreads
	% of total assets				
Increase in lending spread		0.0		6.3	
RWA/Total assets	50.4	0.0	50.4	0.0	50.4
Total capital ratio (%)	11.9	1.0	12.9	0.0	12.9
Deposits	73.2	0.0	73.2	0.0	73.2
Interbank funding	6.4	0.0	6.4	0.0	6.4
Trading liabilities	2.0	0.0	2.0	0.0	2.0
Debt (Wholesale funding)	6.6	-0.5	6.1	0.0	6.1
Other liabilities	4.1	0.0	4.1	0.0	4.1
Total Liabilities	92.2	0.0	92.2	0.0	92.2
Total Equity	7.8	0.5	8.3	0.0	8.3
Total Liabilities and Equity	100.0	0.0	100.0	0.0	100.0
Income statement					
Interest income	3.88	0.00	3.88	0.03	3.92
Interest expense	1.93	-0.02	1.91	0.00	1.91
A. Net interest income	1.96	0.02	1.98	0.03	2.01
Trading income	0.52	0.00	0.52	0.00	0.52
Fees, comissions	0.54	0.00	0.54	0.00	0.54
B. Non interest income	1.06	0.00	1.06	0.00	1.06
C. Total revenue (A+B)	3.02	0.02	3.04	0.03	3.07
Personnel expense	0.62	0.00	0.62	0.00	0.62
Other administrative costs	1.61	0.00	1.61	0.00	1.61
D. Total operating expense	2.22	0.00	2.22	0.00	2.22
E. Operating profit (C-D)	0.79	0.02	0.81	0.03	0.84
F. Tax	0.16	0.00	0.16	0.01	0.17
G. Net income	0.63	0.02	0.65	0.02	0.67
ROE (%)	8.08%	-0.25%	7.83%	0.25%	8.08%

Source: Author's calculations.

2.4.2 Impact of 1 percentage point increase in capital ratio on lending spreads if ROE is allowed to fall

So far we have been conservative and we have assumed no fall in ROE. We have assumed that the bank wants to keep its ROE at its initial level even though the leverage has decreased. The theory suggests that ROE may fall as the leverage and riskiness of the representative bank falls. We can find the theoretical basis for the fall in ROE in Miller and Modigliani's (1958) theory, which suggests that the expected ROE of an unleveraged firm should be lower than the ROE of a leveraged firm. The theory deals primarily with a firm, not a bank, but we cannot a priori reject its applicability to banks. We believe it is worth exploring the impact on lending spreads if the ROE is allowed to fall. We assume three additional scenarios in which the ROE falls by 5, 10 or 15 basis points. For results see table 4, columns B to D.

The calculation results show that the impact on lending spreads is smaller if a partial fall in ROE is allowed. For example, the scenario of a 1 percentage point increase in capital ratio leads to an increase in interest rates of 6.3 basis points if ROE remains constant. On the other hand, the rates increase only by 3.1 basis points if ROE is allowed to fall by 15 basis points. Relaxing constant ROE has a major effect on final lending spreads. These findings are interesting for analysis of assumptions sensitivity, as constant ROE is one of the assumptions.

Future research on this topic can be broadened in a number of ways. This analysis is a starting point and we can relax a number of assumptions in future research. For example, the bank reacts to tightened regulation by a mix of measures, not only by an increase in interest rates. It may simultaneously increase interest rates, reduce operational expenditure and change the structure of assets. A mix of measures is closer to reality. This would lead to another decrease in the impact on lending spreads from starting 6.3 %, which is already quite a low figure. Alternatively, we could use long-term ROE rather than the most-recently reported ROE in order to decrease the volatility of our estimate.

Overall, we can conclude that the possible impact of tighter capital regulation on interest rates in the Czech Republic is small. The majority of Czech banks hold capital adequacy far above the required minimum. Out of 23 banks only six banks have capital ratio below 13 %, hence these six banks may feel regulatory pressure, as they are not fully

prepared for a potential increase in the countercyclical buffer. If these banks decide to increase their capital level by raising interest rates, to prevent ROE from falling, the impact will be slight. The interest rates in these six banks will rise by roughly 6.3 basis points.

2.5 Conclusion

We have analysed a common concern that is raised with the implementation of Basel III (and hence CRD IV/CRR) and tighter capital regulation in the Czech Republic. The concern is that borrowing money from Czech banks will become more expensive. Analysing the data of Czech banks we have provided answers to two key questions: will loans in all Czech banks become more expensive? By how much could lending spreads increase? In order to answer these two key questions we have followed the methodology presented by King (2010).

Our analysis shows that the capital adequacy of Czech banks is at a high level, far above the required regulatory minimum and hence we do not expect any impact of tighter regulation on interest rates in these banks. However, out of a total of 23 banks, there are six banks that are above the required 8 % minimum, but below the 13 % threshold. These six banks may fall under regulatory pressure if the countercyclical buffer is increased from the current 0 % to 2.5 %. They will need to increase their capital levels. Therefore, we have targeted our analysis on these six banks. Our calculations show that the impact of tightened regulation on lending interest is rather minor also in these six banks. The higher costs associated with a one percentage point increase in capital ratio can be recovered by increasing lending spreads 6.3 basis points. The change is even smaller if ROE is not constrained to fall. The two major factors that affect the change in lending spreads are the ratio of RWA to total assets and the relative size of loan to total assets ceteris paribus.

In addition, the methodology used for estimating the changes in spreads is likely to give higher estimates because it abstracts from competition by those banks, which are not under ‘under regulatory pressure’. The banks with capital, which is higher than future capital requirements, compete directly with the banks under regulatory pressure and this will tend to mitigate eventual changes in spreads.

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3. Basel III: How have Czech banks reached higher capital ratios?

Abstract:

According to the Czech National Bank, the average capital adequacy of Czech banks increased from 14.1 % in 2009 to 17.1 % in 2013. For the sample of 17 Czech banks we aim to identify the strategies that Czech banks adopted in order to increase their capital ratios. Our analysis shows that as with the large multi-national banks from advanced economies, retained earnings have played a major role in increasing the average capital ratio of Czech banks. In addition, the Czech banks have decreased their risk to strengthen the overall ratio. The results of our analysis are useful mainly from a regulatory point of view as currently the countercyclical buffer is set to its minimum of 0 % of risk-weighted assets and the Czech National Bank may increase the buffer up to 2.5 % in the medium or long term.

Keywords: Basel III, capital adequacy, bank capital.

JEL Classification: G21, G28

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3.1 Introduction

In late 2009, in response to the financial crisis, the Basel Committee on Banking Supervision (BCBS) published the first version of the Basel III regulation. Among other goals, Basel III specifically aims to improve the quantity of capital which banks have to hold by providing additional stability through new capital buffers (BCBS 2009, BCBS 2011). In addition, it aims to improve the quality of capital by redefining Tier 1 and Tier 2 capital.

Czech banks started to react to the new regulatory framework promptly. As a result, as the ČNB (2014b) data shows, the average capital adequacy of Czech banks increased significantly from 14.1 % at end-2009 to 17.1 % at end-2013.

Based on sample of 17 Czech banks we aim to identify the strategies that Czech banks adopted in order to increase their risk-weighted capital ratios from 2009 to 2013. We address the following questions: Have the Czech banks increased their capital ratios by decreasing risk, increasing capital or both? What has played the major role? How has the average portfolio risk changed? Is there a difference in adjustment strategy between different groups of banks?

We answer these questions by decomposing the change in risk-weighted capital ratio from end-2009 to end-2013. In general, there are three factors that influence the increase in capital ratio: change in capital, change in portfolio riskiness and change in total assets. We separate, measure and describe contribution of each of the three factors in increasing capital ratio.

The results of our analysis are useful from a regulatory point of view. As already suggested, a bank has a variety of options when it aims to improve its risk-weighted capital ratio. A bank's choice of strategy will determine the macroeconomic impact of increase in its capital ratio. The main contribution of this paper is in identifying the major strategy of Czech banks, measuring its importance and discussing its potential macroeconomic effect: who and how is mostly affected by the strategy. The countercyclical buffer, which was introduced by Basel III, is currently set in the Czech Republic to its minimum of 0 % of risk-weighted assets. It may be increased by the Czech National Bank (ČNB) up to 2.5 % in medium or long term.

Research based on Czech banking sector is interesting because, as Horváth *et al.* (2014) note, it does not contain very large banks. It contains banks of various sizes with mainly small banks. The research on channels of capital ratio adjustment might be of particular importance because, as the authors note, small banks face greater difficulties in increasing their capital ratios.

This analysis is organized as follows: Chapter 3.2 discusses the strategies that banks can take when aiming at higher capital ratio and summarizes related literature. Chapter 3.3 introduces a methodology for strategy analysis and presents our dataset. Chapter 3.4

presents the results of an empirical analysis: how bank capital, portfolio risk and total assets interacted in increasing capital ratios. The results are compared among different groups of banks. Chapter 3.5 concludes and provides motivation for further research.

3.2 Theoretical Background and Literature Review

Chapter 3.2 consists of two parts. In the first part we present the options a bank has at its disposal when it seeks to increase its capital adequacy. The second part presents related literature.

3.2.1 Strategies to achieve higher capital ratio

As Cohen and Scatigna (2014) note, a bank has a variety of options when it aims to improve its risk-weighted capital ratio. They explain all the strategies.

The first option is to make changes on the asset side of the balance sheet in order to decrease the riskiness of the portfolio. The strategy is to replace the assets with high risk weights by the assets with lower risk weights. For example, if a bank holds corporate bonds with high risk weights in its assets, the bank may sell it and cash received from the sale bears minimum, zero risk-weight. This leads to a decrease in the total risk-weighted assets, and finally it leads to an increase in capital adequacy. However, a decrease in portfolio risk may also be natural especially when demand for loans is weakening. If demand for loans drops then the bank's ratio of loans to total assets decreases and the portfolio riskiness falls as well if a bank holds the proceeds of loan repayments in cash or government bonds.

The second option for increasing capital ratio is to issue new equity via the issue of new shares on the open market, or rights issue to existing shareholders. This option may not be attractive for existing bank shareholders as new shares tend to reduce the market value of existing shares. Moreover, increasing equity may raise the cost of borrowing for everyone because ‘equity is expensive’.

An alternative, third way of increasing capital (and capital ratio) is to boost retained earnings. This involves two measures: raising net income and/or decreasing dividends. In

theory, a bank can increase net income in a number of ways: it can increase interest rate on loans, decrease interest rate paid on deposits, decrease operating expenses or increase received fees from customers. In reality, as the banking sector is very competitive, the choices are limited: the bank cannot increase lending spreads or reduce operating expenses easily. Usually there will be other banks which do not need to increase its equity and hence do not need to increase the lending spread or reduce operating expenditure. These banks represent the limits for increasing net income. Lending spreads could rise across the system if all banks needed to reach the same goal (i.e. if all banks needed additional capital) and if all banks chose to follow the same strategy (increase of lending spread). Moreover, alternative funding channels would have to offer less attractive rates than banks.

A more straightforward option for increasing retained earnings is to decrease dividends. However, as with equity offering on the open market, this option is also not very attractive to existing shareholders.

Finally, there is a rather more extreme strategy: to sell assets, sell part of the loan portfolio and use the sale proceeds to decrease bank debt. This strategy, like the first strategy, leads to a decrease in risk weighted assets. Moreover, it leads to the shrinking of total assets as well.

Cohen and Scatigna (2014) conclude that a bank's choice among a variety of strategies will determine the macroeconomic impact of any increase in capital ratio. For example, if a bank chooses the first strategy then the bank will reduce portfolio riskiness and it will reduce lending to riskier projects. Alternatively, a mortgage bank can choose to reduce or stop lending on mortgages with high loan-to-value ratio which will have a major impact on bank clients. These are two examples where bank strategy constrains investment and consumption. Evidence that the slowdown results from reduced bank lending supply, as opposed to decrease of consumer demand for loans, would emerge in the form of tighter bank lending standards.

On the other hand, a strategy to decrease dividends or issue new shares has no or little macroeconomic impact. It is mainly the existing shareholders who are affected by these measures.

3.2.2 Literature review

Classical works on banking regulation include Stigler (1971), Dewatripont and Tirole (1994), Mishkin (2000), González (2005), Stiglitz (2009), Mandel and Tomšík (2011), Musílek (2011) or Revenda *et al.* (2012). For an overview of contemporary theories and empirical studies on banking regulation we refer to Santos (2001) or Tchana (2009).

The literature on the channels of adjustment to the new Basel III requirements shows that capital ratios have increased since the financial crisis in 2008 for banks worldwide. For example, Cohen and Scatigna (2014) conclude that for a sample of 94 large banks from advanced and emerging economies, which cover 64 % of the assets of the top 1,000 global banks, capital ratio increased from 11.4 % at end-2009 to 13.9 % at end-2012. During the same period, for a sample of top 16 US banks the ratio increased from 14.0 % to 17.6 % and for a sample of 35 large European banks the ratio rose from 12.1 % to 14.5 % during the same period. Their analysis shows that retained earnings account for the bulk in increase in capital ratio with reductions in risk playing a lesser role. Cannata *et al.* (2013) on a sample of 13 Italian banking groups state similarly that the improvement in capital ratios during end-2010 and end-2012 was driven more by capital increase than a decrease in risk.

Cohen and Scatigna (2014) note that in recent years some observers have expressed concerns that if banks have to hold more capital, this will have a negative macroeconomic impact as the banks may pull back from lending to finance investment. As a response, a number of studies have evaluated the potential macroeconomic impact of Basel III. An analysis of the potential increase in lending spread and decrease of annual GDP growth rate was carried out by Miles *et al.* (2013), Šútorová and Teplý (2013), Roger and Vlček (2011), Slovik and Cournede (2011), IIF (2011), MAG (2010) or King (2010).

The impact estimates of one percentage point increase in capital ratio on lending spread and on annual GDP growth rate differ even within the same region. For example, when comparing the impact of Basel III on global growth, MAG (2010) predicts a decrease of only 5 basis points over 4 years while, for example, IIF (2011) forecasts a total drop of 30-60 basis points over 5 years.

3.3 Methodology and Data

Chapter 3.3 consists of two parts. The first part introduces the model used for empirical analysis. The second part presents the dataset of 17 Czech banks in sample.

3.3.1 Methodology

In order to understand how banks have responded to tighter capital requirements, we analyze the changes in the risk-weighted capital ratio and distinguish the basic components. We follow the methodology presented by Cohen and Scatigna (2014).

There are three factors that influence the change in capital ratio: change in capital, change in riskiness of portfolio (risk-weighted assets to total assets) and change in total assets. Equation 16 isolates the changes from time 0 and time 1 as follows:

$$\frac{CAR_1}{CAR_0} = \frac{K_1 / K_0}{\left(\frac{RWA_1 / TA_1}{RWA_0 / TA_0} \right) \frac{TA_1}{TA_0}} \tag{16}$$

where CAR_i = capital adequacy ratio at time i,
K_i = regulatory capital at time i,
RWA_i = risk-weighted assets at time i,
TA_i = total assets at time i.

In contrast to Cohen and Scatigna (2014), we do not focus our analysis on changes in common equity but our approach is more direct. We focus on changes in regulatory capital. Regulatory capital can increase from end of period 0 to end of period 1 by net income generated at time 0 (after it is audited and approved by the shareholders' meeting during period 1). However, the increase is reduced by dividends deducted from the net income (they are paid at time 1). The last term, other changes, is calculated as residual, based on reported data on regulatory capital, net income and dividends (see equation 17).

$$K_1 = K_0 + INC_0 - DIV_1 + OTH_1 \tag{17}$$

where INC_0 = net income at time 0,
DIV_1 = dividends paid at time 1,
OTH_1 = other changes to regulatory capital at time 1,

To give an example, regulatory capital can increase from end-2009 to end-2010 by net income reported as at end-2009; it can decrease by the dividends paid in 2010; and it can change as other changes to regulatory capital occur during 2010.

Regulatory capital is likely to be less than the capital reported on balance sheet**s** because of the deduction for goodwill, other intangible assets, deferred tax assets and other items. Hence the residual term in equation 17, other changes in regulatory capital, includes also changes in the deductibles.

In order to better understand the impact of different factors on percentage point change in the capital adequacy, it is helpful to transform the equation 16 so that different quantities can be expressed as additive components. To do this, we substitute equation 17 into equation 16 and take logarithms of both sides.

$$Log\left(\frac{K_1/RWA_1}{K_0/RWA_0}\right) = Log\left(\frac{\frac{K_0 + INC_0 - DIV_1 + OTH_1}{K_0}}{\left(\frac{RWA_1/TA_1}{RWA_0/TA_0}\right)\frac{TA_1}{TA_0}}\right) \tag{18}$$

Then we multiply both sides of the equation 18 by a common factor, so the resulting equation is as follows:

$$\frac{K_1}{RWA_1} - \frac{K_0}{RWA_0} = F \cdot Log\left(1 + \frac{INC_0}{K_0} - \frac{DIV_1}{K_0} + \frac{OTH_1}{K_0}\right) - F \cdot \left(Log\left(\frac{RWA_1}{TA_1}\right) - Log\left(\frac{RWA_0}{TA_0}\right)\right) - F \cdot Log\left(\frac{TA_1}{TA_0}\right) \tag{19}$$

where F, the normalization factor, equals:

$$F = \frac{\frac{K_1}{RWA_1} - \frac{K_0}{RWA_0}}{Log\left(\frac{K_1}{RWA_1}\right) - Log\left(\frac{K_0}{RWA_0}\right)} \tag{20}$$

After breaking down a change in capital ratio into its basic components (change in capital, risk and total assets) we focus on the first component (change in capital). We break it down further in order to determine what role individual components of capital

(net income, dividends, and other changes) played in increasing capital adequacy. Have the retained earnings played the major role? Or have the banks increased their capital in a different way? As in equation 18, it is useful to express capital components in terms of percentage-point increases in the risk-weighted capital ratio. Again, we want an additive relationship. To do so, we decompose and transform the first term on the right hand side of the equation 19 as follows:

$$F \cdot Log\left(\frac{K_1}{K_0}\right) = G \cdot \left(\frac{INC_0}{K_0}\right) - G \cdot \left(\frac{DIV_1}{K_0}\right) + G \cdot \left(\frac{OTH_1}{K_0}\right) \tag{21}$$

where G, the normalization factor, equals:

$$G = \frac{F \cdot Log\left(\frac{K_1}{K_0}\right)}{\left(\frac{K_1}{K_0}\right) - 1} \tag{22}$$

We use the equations 19 and 21 to decompose the increase in capital ratio in equation 19 so we show sources of changes in bank capital normalized to percentage points of risk-weighted assets.

3.3.2 Data

According to the Czech National Bank (ČNB, 2014b) statistics, as of December 2013 there were 23 commercial banks (including five building societies with a specialized banking license) and 21 foreign bank branches operating in the Czech Republic, hence 44 banks in total. The total assets of the Czech banking sector stood at CZK 5,142 billion at the end-2013. The vast majority of Czech banks are foreign-owned. Czech banks maintain a traditional, conservative business model concentrated on the domestic market, i.e. providing loans to households and to non-financial corporations. Bank business activities are mainly financed from high volume of domestic deposits, which is well illustrated with relatively stable and low loan-to-deposit ratio constantly under 80 %, which is exceptional in Europe.

The Czech banking sector structure is fairly stable, however, from a long-term perspective. Four large banks (by current methodology over CZK 250 billion in assets), ČSOB (KBC Group), Česká spořitelna (Erste Group), Komerční banka (Societe Generale Group), and UniCredit Bank – manage approximately 59 % of all assets. As noted in the Czech Banking Association (2013) report, all competition indicators reflect an environment of healthy competition among Czech banks.

European Banking Federation (2012) report summarizes that Czech banks have been only marginally hit by the financial, mortgage and sovereign-debt crisis of 2008-2012. There was neither public assistance nor taxpayers' money needed to be pumped into the banking sector for a number of reasons. The banks have held very few exotic 'toxic assets', their exposure to Greece's government bonds is low. They report very favorable loan-to-deposit ratio and favorable liquidity position leading to a very low dependence on the inter-bank market. Moreover most banking activities are undertaken in domestic currency (both on the assets' and liabilities' side of the balance sheets) implying low exposure to foreign exchange. Finally, as already noted, they maintain traditional conservative business model, they enjoy excellent capital adequacy and most of the capital is made up of high-quality Tier 1 capital (as of December 2013 the capital ratio for the sector stood at 17.1 % and Tier 1 capital ratio came to 16.8 %). Good capitalization has enabled the Czech banks to sustain even extremely stressful scenarios simulated by conservative supervision of the Czech central bank. The Czech banking sector has remained consistently very profitable throughout the crisis with return on equity (ROE) between 15 and 20 %. ČNB (2014a) concludes this figure significantly outperforms not only the Eurozone's average but Western-European regional peers as well.

To get data on individual Czech banks we use the Bankscope database (for more information see section 2.3.2). Risk-weighted assets (RWA, see equation 16) are not directly available in Bankscope. Therefore we computed it using capital adequacy ratio (CAR) and total regulatory capital (K) which are figures directly available in the database. We estimated RWA using the following formula:

$$RWA_i = \frac{K_i}{CAR_i} \tag{23}$$

In order to analyze the adjustment strategy between December 2009 and December 2013 we exported the dataset of all Czech banks that existed at the beginning and end of that period.

End-2009 is a starting point of our observation period because in 2009 the BCBS published first set of documents (e.g. BCBS, 2009) which revised Basel II standards, hence, in 2009 it published the first version of Basel III which suggested higher capital requirements.

New banks which started to operate in 2010 or later (such as Air Bank) and state owned banks which have specialized banking (such as Česká Exportní Banka) were not included in the sample. In addition, foreign bank branches (not to be confused with subsidiaries of foreign banks) are not included in the sample because they do not hold any equity in the Czech Republic.

The list of 17 commercial banks with total assets of CZK 4,692 billion at end-2013 is the starting point for our analysis. Our sample of 17 banks accounts for 94 % of total assets of 23 Czech banks which have to hold capital. For the list of banks in the sample, their total assets at end-2013 and their capital adequacy ratios see the table 6.

Table 6: List of banks in sample

#	Name	Total Assets bil.CZK (2013)	Capital Adequacy (2013)	Capital Adequacy (2009)	Capital Adequacy change (2013-2009)	Size**	Under press.	Build. savings bank
			a	b	c = a-b			
1	ČSOB	1,034.8	15.6%	15.0%	0.6%	L		
2	Česká spořitelna	968.7	18.6%	12.2%	6.4%	L	●	
3	Komerční banka	864.0	15.8%	14.1%	1.7%	L		
4	UniCredit Bank	464.6	15.4%	12.6%	2.8%	L	●	
5	Hypoteční banka	213.9	33.8%	40.2%	-6.4%	M		
6	Raiffeisenbank	197.0	13.7%	11.1%	2.6%	M	●	
7	Českomor. stav. spoř.	165.6	16.1%	15.7%	0.3%	M		●
8	GE Money Bank	134.6	23.7%	19.1%	4.6%	M		
9	J&T BANKA	110.2	15.9%	11.8%	4.1%	M	●	
10	PPF banka	105.0	11.6%	10.5%	1.1%	M	●	
11	Stav. spoř. České spoř.	99.2	13.4%	23.5%	-10.1%	M		●
12	Modrá pyramida	82.2	21.1%	11.1%	10.0%	M	●	●
13	Raiffeisen stav. spoř.	81.9	13.9%	10.1%	3.7%	M	●	●
14	Sberbank CZ	70.5	15.8%	15.5%	0.3%	M		
15	Wüstenrot stav. spoř.	43.0	14.4%	10.5%	3.9%	S	●	●
16	LBBW Bank CZ	31.5	15.8%	12.9%	2.8%	S	●	
17	Wüstenrot hypo. banka	25.0	11.1%	12.1%	-1.0%	S	●	
	Total*	4,691.8	16.4%	14.3%	2.1%			

* Total for columns a,b,c = weighted average using end-2013 assets as weights

** L=large, M=medium, S=small

Source: Bankscope, author's calculations.

The average capital adequacy of the banks in the sample increased from 14.3 % at end-2009 to 16.4 % at end-2013. These capital figures comfortably exceed the 2014 benchmark of the 10.5 % minimum limit (Tier 1 plus Tier 2 plus the conservation buffer). Even the four largest banks considered to be systemically important reported capital ratios higher than the required 11.5 % - 13.5 % (Tier 1 plus Tier 2 plus the conservation buffer plus the SIFI surcharge). Their capital ratios exceeded 15 % at end-2013.

The ČNB average figures are slightly different. According to the ČNB (2014b), the average capital ratio increased from 14.1 % in December 2009 to 17.1 % in December 2013. Our figures differ for two reasons. Firstly, our sample does not include all Czech banks, only those that existed at both: end-2009 and end-2013. Secondly, we show a weighted average using end-2013 total assets as weights.

In addition to analyzing the whole sample of 17 banks we created six additional subsamples where we focused on 'banks under regulatory pressure'. The remaining five subsamples included banks not under regulatory pressure, large banks, medium banks, small banks and building saving banks. We traced and compared the adjustment strategy between different groups of banks as we expected that there would be differences among the groups of banks.

The banks under regulatory pressure can be identified in several ways. Likewise to chapter 2.3, we adopted a simple approach wherein the bank was under regulatory pressure if the bank´s capital was below the 13 % level as of *December 2009*. The 13 % capital ratio is arbitrary. It consists of the 8 % regulatory minimum, the 2.5 % conservation capital and the 2.5 % countercyclical buffer. We set the ratio to 13 % as this was the minimum level at which a bank:

i) fulfilled the minimum Basel III capital requirement 8 % of risk-weighted assets and
ii) was prepared for the implementation of the conservation buffer in full amount of 2.5 % of risk-weighted assets and
iii) was prepared for the implementation of the countercyclical buffer in full amount of 2.5 % of risk-weighted assets and
iv) expected that it would not have to hold any SIFI surcharge.

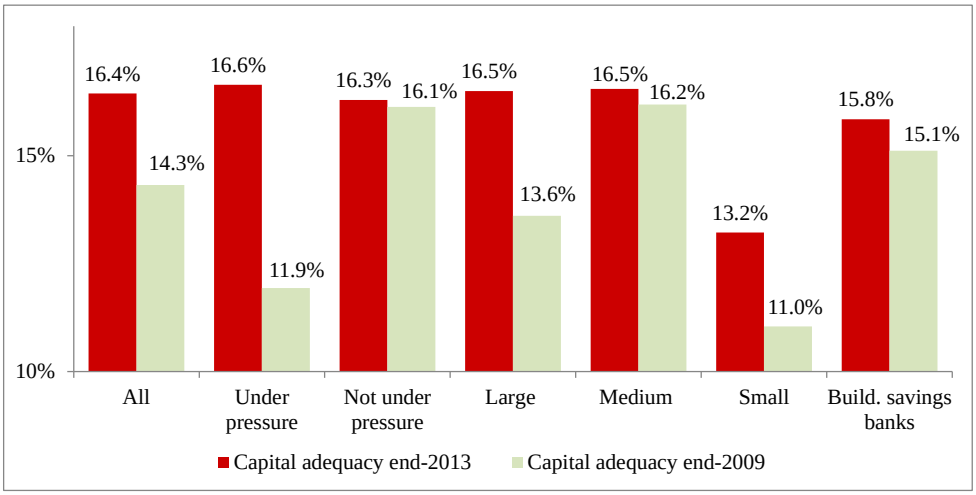
Table 6 shows that our sample included the 10 banks with a capital ratio below the 13 % threshold at end-2009. Hence, these banks were considered to be 'under regulatory pressure' and we focused on them. We expected that these banks would boost their capital more than their peers as they were close to the minimum limits. We wanted to analyze whether these banks behaved differently compared to other banks. The complementary group is the group of banks with capital ratio above 13 % at end-2009. These were the banks 'not under regulatory pressure'.

Following the ČNB definitions, large banks were banks with total assets (at December 2013) above 250 billion CZK, medium banks with total assets between 50 and 250 billion CZK and small banks with total assets below 50 billion CZK. Our sample included 4 large banks (it should be noted that all of them have to hold SIFI surcharge), 10 medium sized banks and 3 small banks (see table 6). The last group of banks that we

recognized was building savings banks which are specialized banks. There were 5 building savings banks in the Czech Republic.

After we defined the whole sample and all relevant subsamples we looked into how risk-weighted capital ratios changed among the different subsamples. Figure 4 shows the changes in risk-weighted capital ratios from end-2009 to end-2013 for 'all banks' and the additional six subgroups: banks under pressure (10 banks), banks not under pressure (7 banks), large banks (4 banks), medium sized banks (10 banks), small banks (3 banks) and building savings banks (5 banks). The figures are shown in terms of weighted averages using end-2013 total assets as weights[2].

Figure 4: Change in bank capital ratios, end-2009 to end-2013



Source: Bankscope, author's calculations.

As already mentioned, the banks in our sample increased their risk-weighted capital ratio by 2.1 percentage points, from 14.3 % at end-2009 to 16.4 % to end 2013. However, we noticed big differences among different groups of banks.

Figure 4 shows that the increase was driven mainly by the banks which were under regulatory pressure in 2009. The banks under regulatory pressure increased their capital ratio by 4.7 percentage points from 11.9 % at end-2009 to 16.6 % at end-2013. The banks which were not under regulatory pressure saw almost no change in their capital ratio, their capital ratio increased only by 0.2 percentage points during the 4-year period. The reason

[2] Unless stated otherwise, the capital ratio figures in text, graph and tables are weighted averages using end-2013 total assets as weights. This applies not only for the full sample of 17 banks but for each of the six subsamples as well.

is that the capital ratio of the banks not under pressure was already rather high in 2009. These banks did not have any strong motivation to increase their capital levels. From the perspective of size, figure 4 shows that it was mainly the small banks that had low capital adequacy at end-2009, therefore this group of banks needed the most to boost their capital.

In the next chapter we attempt to answer the question in the title of our study. Our goal is to recognize the strategies that different groups of banks used in order to increase their capital ratios and how banks adjusted the riskiness of their portfolios. We answer the questions stated in the introduction: Did the Czech banks increase their capital ratios by decreasing risk, increasing capital or both? What played the major role? How did the average portfolio risk change? Was there a difference in adjustment strategy between different groups of banks? What was the main source of capital increase?

3.4 Empirical Analysis

This chapter consists of two parts. In the first part using the methodology described in section 3.3 we distinguish the various sources of changes in bank capital ratios between 2009 and 2013. We show the sources of capital ratio change as three additive components of the percentage point change in the risk-weighted capital ratio. In the second part we focus on one of the three components, the capital. We analyze the sources of capital change.

3.4.1 Sources of changes in bank capital ratios

Regulatory capital of the banks in the sample increased during the 2009-2013 period by more than 30 %, from CZK 281 billion to CZK 378 billion (table 7). The rise was considerable for the banks under pressure. They accounted for CZK 71 billion of the CZK 97 billion increase. Capital rose for all groups of banks, as shown in table 7. Total assets *(TA)* and risk-weighted assets *(RWA)* rose for all of the groups as well.

Table 7: Bank capital and assets, 2009-2013

in CZK billion (bn)

	Count	End 2013			End 2009		
		Total Assets	RWA	Regulatory capital	Total Assets	RWA	Regulatory capital
All	17	4,692	2,209	378	3,810	1,967	281
Under pressure	10	2,109	1,153	188	1,634	979	117
Not under pressure	7	2,583	1,055	190	2,176	988	164
Large	4	3,332	1,476	244	2,674	1,375	185
Medium	10	1,260	682	127	1,061	544	90
Small	3	99	51	7	75	48	6
Build. savings banks	5	472	138	22	457	128	18

Source: Bankscope, author's calculations.

Measured in relative terms, the next table 8 shows three important findings. Firstly, regulatory capital grew substantially in most of the subsamples. The most notable capital increase was in the group of banks under pressure where the capital rose by 70 %, from CZK 117 billion in 2009 to CZK 188 billion in 2013. By contrast, the banks not under pressure increased their capital less, only by 12 % from CZK 164 billion in 2009 to CZK 190 billion in 2013. Secondly, all the banks enjoyed high growth of total assets, apart from the building savings companies where the business remains under pressure, lending continues to fall and is losing to mortgages, and the volume of the savings has been stagnating since 2010 as the state support falls. Finally, a rather surprising finding: on average Czech banks grew in size and lowered their average risk. Risk we define as the ratio of risk-weighted assets to total assets *(RWA/TA).* Despite the economic recession, average risk was about 9 % lower in 2013 than four years earlier. The average risk, decreased from 0.50 in 2009 to 0.45 in 2013.

Table 8: Change in bank risk, capital and total assets, 2009-2013

in percent

	Count	RWA/TA 2013	RWA/TA 2009	Change in Risk	Change in Regulatory Capital	Change in Total Assets
		a	b	c = a/b -1	d	e
All	17	0.45	0.50	-9.2%	36.7%	28.4%
Under pressure	10	0.55	0.62	-11.2%	69.9%	41.6%
Not under pressure	7	0.38	0.42	-7.6%	11.5%	18.4%
Large	4	0.44	0.53	-15.8%	30.9%	27.1%
Medium	10	0.47	0.45	6.5%	49.6%	29.8%
Small	3	0.48	0.58	-16.2%	41.4%	50.0%
Build. savings banks	5	0.29	0.28	9.4%	25.5%	3.4%

Note: Weighted averages using end-2013 total assets as weights are shown.

Source: Bankscope, author's calculations.

The most significant decrease in risk we observed in the group of small banks where the ratio dropped from 0.58 at end-2009 to 0.48 at end-2013, hence a 16 % decrease in average risk. By contrast, the building savings banks were the only group of banks which increased its portfolio riskiness, from 0.28 in 2009 to 0.29 in 2013. However, table 8 confirms that the average risk of building savings banks was substantially lower than in other commercial banks. Average risk of the building savings banks totaled 0.29 at end - 2013 while for the full sample the figure amounted to 0.45. It is worth noting that the average risk of the banks under pressure was noticeably higher than the average risk of the banks that were not under pressure, 0.55 and 0.38 respectively at end-2013.

Decrease of risk was an important source of the increase in capital ratio. Comparing the change in average risk between the banks not under pressure and the banks under pressure, we can conclude that the development was similar. Both groups decreased their risk by 8 % and 11 % respectively.

This result suggests that Czech banks shifted their assets to classes with lower risk weights. As noted in chapter 3.2, decrease in portfolio risk may also be natural when demand for loans is weakening. If demand for loans drops and a bank holds the proceeds of loan repayments in cash (or securities with zero risk weight) then the bank's ratio of risk-weighted assets to total assets decreases and the average portfolio riskiness falls as

well. A natural decrease in portfolio risk does not constrain investment and consumption. On the other hand, decrease in risk may also indicate, as BIS (2014) warns on a global level, that something more than a genuine reduction in assets' riskiness has been at play. There is a risk that since the financial crisis banks might have redesigned their risk models in order to lower capital requirements by underestimating risk and providing optimistic asset valuations. This concern is intensified if we observe that risk weights for similar assets varies substantially across banks.

In order to better understand the impact of different factors on risk-weighted capital ratios, we use equation 19 to express different components of capital adequacy change as additive factors. Calculating elements of equation 19 gives us the results presented in table 9.

Table 9: Sources of changes in bank capital ratios, 2009-2013

in percent, normalised to percentage points of risk-weighted assets.

	Count	Capital adequacy 2013	Capital adequacy 2009	Change in capital adequacy	Change in Regulatory Capital	Change in Risk	Change in Total Assets
		a	b	c = a-b = d+e+f	d	e	f
All	17	16.4%	14.3%	2.1%	4.2%	1.4%	-3.4%
Under pressure	10	16.6%	11.9%	4.7%	6.9%	1.8%	-4.0%
Not under pressure	7	16.3%	16.1%	0.2%	2.0%	1.0%	-2.9%
Large	4	16.5%	13.6%	2.9%	3.7%	2.6%	-3.4%
Medium	10	16.5%	16.2%	0.4%	5.3%	-1.5%	-3.4%
Small	3	13.2%	11.0%	2.2%	3.7%	2.3%	-3.8%
Build. savings banks	5	15.8%	15.1%	0.7%	2.4%	-1.2%	-0.5%

Note: Weighted averages using end-2013 total assets as weights are shown.

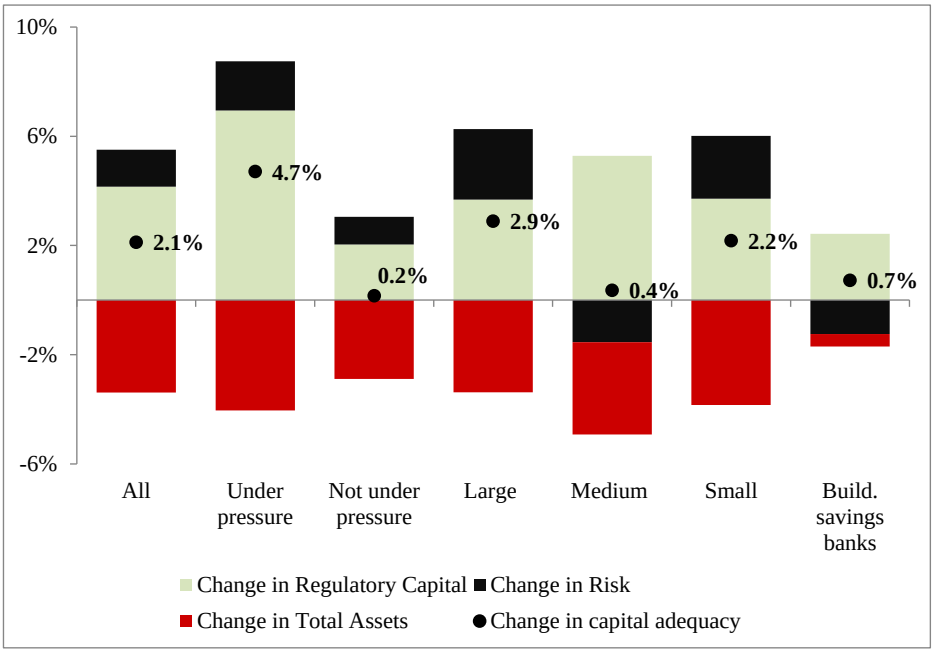
Source: Bankscope, author's calculations.

Table 9 confirms our previous conclusions. The increase in reported risk-weighted capital ratios largely resulted from higher capital. The increase in capital drove the overall ratio higher in all six subsamples. The shift to assets with lower risk weights played a secondary, additional role. Increase in overall ratio was slowed down because the Czech banks enjoyed high asset growth.

Table 9 shows how the change in capital adequacy from 14.3 % at end-2009 to 16.4 % at end-2013 (see 'All' banks row), which represents an increase of 2.1 percentage points,

can be broken down as follows: roughly 4.2 percentage points of the overall increase reflected higher capital; an additional increase of 1.4 percentage points resulted from a decline in risk-weighted assets. These two positive effects, totaling 5.6 points (of which 75 % reflected higher capital and 25 % resulted from a decline in risk-weighted assets), were counteracted by the rise in total assets, less the equivalent of 3.4 percentage points from the ratio which gives us (after rounding) the final 2.1 percentage points of capital adequacy change. Figure 5 is a graphic illustration of the results presented in table 9.

Figure 5: Sources of changes in bank capital ratios, 2009-2013



Source: Bankscope, author's calculations.

Figure 5 shows that boosting capital was a major source of increasing the capital ratios, and decrease in risk was a minor source. These were the two main adjustment strategies for all subgroups of banks, apart from the building savings banks. As already noted, the building saving banks increased their risk slightly which subtracted 1.2 percentage points from the overall ratio.

Perhaps the most interesting findings come from a comparison of banks from the regulatory pressure view. The banks under regulatory pressure increased their risk-weighted capital ratio by 4.7 percentage points. This reflected a distinct increase in capital, which added 6.9 percentage points; a decrease in risk added 1.8 percentage points and an increase in total assets subtracted 4.0 percentage points.

The banks not under pressure increased their capital much less than the banks under pressure. Their overall ratio increased only by 0.2 percentage points. Higher capital contributed 2.0 percentage points, lower average level of risk-weights added 1.0 percentage points and an increase in total assets reduced the ratio by 2.9 percentage points, which resulted in a final increase of 0.2 percentage points (after rounding).

Figure 5 illustrates a number of additional findings. For example, it shows that there was no group of banks for which the bulk of the increase in capital ratio resulted from lower risk rather than higher capital. To put it more simply, there was no group of banks for which decreasing portfolio riskiness was the major strategy: it was usually the supporting strategy.

We can conclude that additional capital was the key driver of capital adequacy change. In the next section we analyze what was the major source of capital increase. Was it retained earnings or something else, such as an issue of new shares?

3.4.2 Sources of changes in bank capital

For the full sample and for all subsamples, retained earnings (net income minus dividends) accounted for most of the increase in capital from 2009 to 2013. Table 10 breaks down the increase in regulatory capital into its components, as defined in equation 17. The last term is residual and it comprises share issue or change in goodwill which was subtracted from regulatory capital.

For the full sample of banks, as noted in a previous section, regulatory capital increased from CZK 281.4 billion at end-2009 to CZK 378.3 billion at end-2013. Retained earnings accounted for the bulk of the increase; it totaled CZK 83.1 billion of the CZK 96.9 billion increase. Other changes to capital amounted only to CZK 13.8 billion (see table 10).

Table 10: Sources of changes in regulatory capital, 2009-2013

in CZK billion (bn)

	Count	Regulatory Capital 2013	Regulatory Capital 2009	Increase in Regulatory Capital	Net income 2009-2012	Dividends 2010-2013	Retained earnings	Other sources of capital
		a	b	c = a-b = f+g	d	e	f = d+e	g
All	17	378.3	281.4	96.9	227.6	-144.5	83.1	13.8
Under pressure	10	188.3	117.1	71.2	84.5	-36.8	47.8	23.5
Not under pressure	7	189.9	164.3	25.6	143.1	-107.7	35.3	-9.7
Large	4	243.9	185.3	58.6	170.4	-116.6	53.8	4.8
Medium	10	127.2	90.4	36.7	56.6	-27.9	28.7	8.0
Small	3	7.2	5.7	1.5	0.6	0.0	0.6	0.9
Build. savings banks	5	22.1	17.8	4.3	20.2	-12.9	7.2	-2.9

Source: Bankscope, author's calculations.

Reduced dividends helped to increase retained earnings. While the banks not under pressure paid in dividends 74 % of the 2009-2012 net income (CZK 106.2 billion dividends from CZK 143.1 billion net income), the dividend payout ratio totaled only 43 % for the banks under pressure (CZK 36.7 billion dividends from CZK 84.5 billion net income).

As we saw in a previous section, it is useful to look at sources of capital change in terms of percentage point increases in capital ratio. To make an additive relationship, we use equation 21. The calculation results are presented in table 11.

Table 11: Sources of changes in regulatory capital, 2009-2013, normalized to percentage points of risk-weighted assets

in percent

	Count	Change in Regulatory Capital	Net income 2009-2012	Dividends 2010-2013	Retained earnings	Other sources of capital
		a = d+e	b	c	d = b-c	e
All	17	4.2%	11.5%	-8.1%	3.5%	0.7%
Under pressure	10	6.9%	8.5%	-3.6%	5.0%	2.0%
Not under pressure	7	2.0%	13.8%	-11.5%	2.4%	-0.3%
Large	4	3.7%	12.5%	-8.9%	3.6%	0.1%
Medium	10	5.3%	10.0%	-6.7%	3.3%	2.0%
Small	3	3.7%	2.0%	0.0%	2.0%	1.7%
Build. savings banks	5	2.4%	16.6%	-12.0%	4.6%	-2.2%

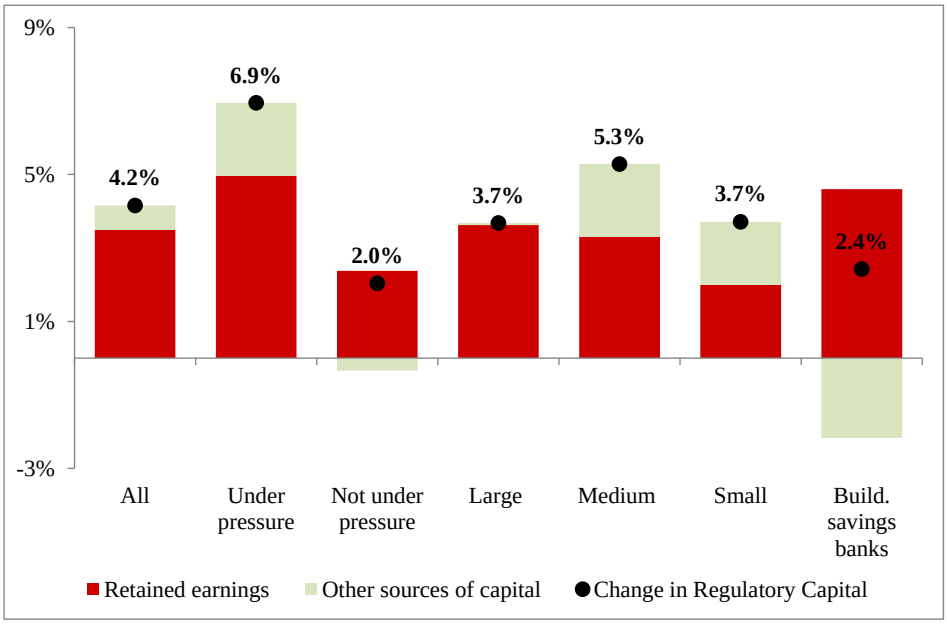
Note: Weighted averages using end-2013 total assets as weights are shown.

Source: Bankscope, author's calculations.

When expressed in terms of percentage points of the risk-weighted capital ratio, retained earnings accounted for 3.5 out of 4.2 percentage points increase in capital, while capital from other sources accounted for the remaining 0.7 percentage points. In the case of large banks, other sources played almost no role, retained earnings accounted for 3.6 out of 3.7 percentage points increase in capital. In contrast, in the group of under pressure banks other sources of capital were an important factor. Other sources of capital accounted for 2.0 percentage points of the 6.9 percentage increase.

Figure 6 shows that there was no group of banks where other sources of capital were more important than retained earnings.

Figure 6: Sources of changes in regulatory capital, 2009-2013



Source: Bankscope, author's calculations.

Previous section concludes that capital increase was the major source of improved capital adequacy ratios among Czech banks. The results in this section show that accumulation of retained earnings played a key role in supplying fresh capital.

These conclusions are in line with the Cohen and Scatigna (2014) study of large-international banks. Advanced-economy banks, globally systemically important banks (G-SIBs), advanced-economy non-G-SIBs, US banks, European banks, and banks from other advanced economies, on the whole achieved most of their adjustment in recent years through the accumulation of retained earnings.

This strategy has little or no macroeconomic impact compared to other strategies such as decreasing portfolio riskiness in the environment of growing demand for loans. It is mainly existing shareholders who are affected by this strategy; the shareholders do not receive dividends or receive only reduced dividends, and only a share of net income is paid out. Our findings are useful mainly from a regulatory point of view as currently the countercyclical buffer is set to its minimum of 0 % of risk-weighted assets and the Czech National Bank may increase the buffer in the medium or long term.

3.5 Conclusion

The Czech banking sector has made progress in adjusting to the new regulatory environment. According to the Czech National Bank, the Czech banks increased their average regulatory capital ratio from 14.1 % of risk-weighted assets in 2009 to 17.1 % in 2013. Our sample of 17 Czech banks in this paper shows that increasing capital was the major strategy to increase the reported risk-weighted capital ratios. Accumulation of retained earnings played a key role in supplying fresh capital. A supporting driver of the improvement in banks' capital ratios was the reduction in the average risk weight in bank portfolios. Comparing different groups of Czech banks, it was mainly the banks under regulatory pressure which increased their risk-weighted capital ratios. Banks not under pressure reported only a minor increase in the ratio as their motivation to increase the ratio was limited. Their capital ratios had already comfortably exceeded the 2014 benchmark by 2009.

A comparison of our results with other studies suggests that the behavior of small Czech banks is similar to the behavior of large multi-national banks from advanced economies.

The results of our analysis are useful mainly from a regulatory point of view as currently the countercyclical buffer is set to its minimum and it may be increased in the medium or long term. The strategy to increase capital through accumulation of retained earnings has little or no impact on the broader macroeconomy. It is mainly foreign shareholders of Czech banks who are affected; they receive reduced returns.

Further research is needed to evaluate whether the decline in average risk weight in bank portfolios assets was only a natural outcome of the weakening demand for loans, or a result of bank management business decisions as a response to the financial crisis or, finally, whether it was an outcome of redesigned risk models with the aim of lowering capital requirements.

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4. Can simple measures of capital adequacy outperform risk-weighted measures as predictors of bank distress?

Abstract:
We examine and compare the performance of risk-weighted capital ratios and simple leverage ratios to predict bank distress in major European banks. Using yearly bank data and a unique dataset of bank distress in European banks during 2008-2012, firstly we evaluate the performance of capital ratios as stand-alone indicators of bank distress. Secondly, by applying the CAMEL model we evaluate the performance of the ratios when additional information on bank condition is taken into account, e.g. quality of assets. Our results suggest that risk-weighted ratios beat leverage ratios as single predictors of bank distress with tangible common equity to risk-weighted assets being the best single predictor. On the other hand, when more information on bank condition is taken into account, simple leverage ratios perform better than risk-weighted capital ratios. While such a finding is not conclusive, it suggests that more complex risk modeling does not always mean better risk modeling. Therefore regulators should not focus only on risk-weighted ratios or simple leverage ratios but regulation of banks based on both types of ratios is necessary.

Keywords: Basel III, capital adequacy, bank capital.
JEL Classification: G21, G28
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4.1 Introduction

Banking regulation is becoming too complex. The Basel I Accord, adopted in 1988, had only 30 pages. Basel II, adopted in 2004, increased to 347 pages. Finally, Basel III, adopted in 2014, runs to 616 pages. While Basel I includes no calculus equations, Basel III includes 78 such equations. As Haldane and Madouros (2012) suggests, the primary

source of increasing complexity is granular, model-based risk weighting. The questions then arises: does increasing regulation complexity enhance the safety of the financial system? To what extent have capital ratios been related to the distress of banks? Which type of capital ratios, simple leverage ratios or complex risk-weighted ones, are most likely to reduce the probability of bank distress? Do more complex indicators predict bank failures better?

In order to answer the above questions, using a sample of 118 major European banks we aim to compare the relative performance of eight capital measures in predicting bank distress during the global financial crisis (2008-2009) and subsequent European sovereign debt crisis (2010-2012). We compare the performance of four simple (accounting based) leverage ratios and four complex (risk-weighted) capital ratios. Our primary goal is to investigate whether simple measures can outperform complex capital measures as one year-ahead predictors of bank failure although the Basel regulation is focused on the complex ratios.

Our analysis makes a contribution to the field of missing research. We have created a unique dataset and to the best of our knowledge, we are among the first to analyze the performance of bank ratios in predicting bank distress in major European banks during the global financial crisis and European sovereign debt crisis. The results of our analysis are useful not only from a regulatory point of view (whether to focus regulation on simple or risk–weighted ratios, and whether to adjust early warning systems), but also for the general public, who might be interested to know which indicator performed best in predicting bank distress in recent years.

This study is organized as follows: Chapter 4.2 summarizes related literature. Chapter 4.3 introduces methodology and presents our dataset. Chapter 4.4 presents the results of an empirical analysis of which capital ratio performs best when predicting bank distress. The final section concludes and provides motivation for further research.

4.2 Theoretical Background and Literature Review

From a broad perspective, for example Stigler (1971) or more recently Stiglitz (2009), Mandel and Tomšík (2011), Musílek (2011), Revenda *et al.* (2012) or Šútorová and Teplý (2014) discuss financial market regulation.

From a narrow perspective, this study is linked with two sub-branches of the literature. Firstly, it is related to the investigation of leverage and risk-based capital ratios and their role in bank distress. Secondly, it is linked to predicting bank distress as a whole, developing various early-warning systems which are useful mainly for supervisory authorities in order to identify future problem banks.

With the increasing complexity of Basel rules a number of papers have been devoted to the comparison of simple and complex capital ratios. The critics (e.g. Hoenig, 2013) argue that all of the Basel capital accords, including Basel III, look backwards and then assign a risk weight into the future. And it does not work then. Despite all of the advancements made over the last decades in risk modelling, it is impossible to reliably anticipate how and to what degree risks will change. The author calls Basel III *'a well-intended illusion'* and compares the relationship of the tangible leverage and Basel Tier 1 capital ratios to various market measures (price-to-book ratio, credit default swaps or market value of equity) for the largest global banks. In Hoening´s (2013) view, the simple leverage ratio is a superior alternative to the risk-weighting schemes that have proven to be an illusion of precision. The correlation of the tangible leverage ratio to the market variables is higher than for the risk weighted Basel 1 capital ratio. The results suggest that investors, when deciding where to place their money, rely upon leverage ratio more than Basel capital ratio. The author finally recommends that others would do well to follow the investors´ example.

Haldane and Madouros (2012) view of complex risk-weighted capital ratios is similar. They argue that when the financial environment is uncertain, complex risk-weighting may be suboptimal and simpler weighting measures may be more robust. In their empirical analysis of 100 of the world's largest, most complex banks during the course of the financial crisis, they suggest that the explanatory power of the simple leverage measures is about 10 times greater than the complex risk-weighted ones. In predicting bank failure, measures of risk-weighted capital are statistically insignificant while the leverage ratio is

significant at the 1 % level. Their results are robust to the inclusion of a broader set of macro factors such as GDP growth. They warn that however well complex measures perform in theory or in-sample, they do not appear to have performed well in practice or out-of-sample.

Other studies that contrast risk-based and non-risk based measures of capital adequacy and conclude similarly, that the non-risk-weighted capital measures explain bank distress better (or at least not worse) than risk-weighted measures are Demirguc-Kunt *et al.* (2010) or Mayes and Stremmel (2014).

In contrast to the above authors, Buehler *et al.* (2009) support the predictive superiority of risk-based ratios over simple leverage ratios. They use different methodology and data of 115 large, global banks between 2007 and 2009. Their study concludes that capital ratios based on risk-weighted assets and higher-quality forms of capital (e.g. tangible common equity, Tier 1) are more important predictors of bank distress than ratios based on total assets and broader measures of regulatory capital such as Tier 1 plus Tier 2. They argue that imposing a leverage requirement on institutions already subject to a risk-based capital requirement appears to provide no further benefit. While in isolation simple leverage measures have some predictive power of bank failure, they do not appear to have any incremental predictive power in addition to risk-weighted ratio.

The second branch of the literature relates to developing early warning systems for bank failures. Over recent decades, a wide range of central banks and/or supervisory authorities have developed such models in order to identify problem banks. Also, a considerable number of authors have done research in this area. Most of the models stem from the uniform Financial Rating System introduced in 1979 by the US regulators. The system is known as the CAMEL rating system where the *C* stands for Capital adequacy, *A* for Asset quality, *M* for Management quality, *E* for Earnings and *L* for Liquidity. Since 1996 the system includes also *S* which stands for Sensitivity to market Risk (so CAMELS rating system). Hence the CAMEL rating system takes into account all the bank-specific information that is believed to have a major influence on bank condition and its probability of failure.

A brief review of recent work published on the CAMEL models is summarized in table 12. For the detailed meta-analysis of previous work we refer to Mayes and Stremmel (2014).

Table 12: Overview of recent Banking-Failure Literature

	Method				CAMELS variables used					
Authors	Model	Data period	Banks	Region	C	A	M	E	L	S
Mayes and Stremmel (2014)	LOGIT, HAZARD	1992-2012	16,188	USA	•	•	•	•	•	•
Betz *et al.* (2013)	LOGIT	2000-2013	546	Europe	•	•	•	•	•	•
Buchholst and Rangvid (2013)	LOGIT	2008-2012	95	Denmark	•	•	•	•	•	•
Cole and White (2012)	LOGIT	2004-2008	7,146	USA	•	•	•	•	•	
Jin e*t al.* (2011)	LOGIT	2007-2010	6,437	USA	•	•				
Poghosyan and Čihák (2009)	LOGIT	1996-2008	5,708	Europe	•	•	•	•	•	
Männasoo and Mayes (2009)	HAZARD	1995-2004	600	East. Europe	•	•		•	•	•
Andersen (2008)	LOGIT	2000-2005	136	Norway	•	•	•	•	•	
Halling and Hayden (2006)	LOGIT	1995-2002	150	USA	•	•	•	•		
Curry *et al.* (2003)	LOGIT	1988-1995	200	USA	•	•	•	•	•	
DeYoung (2003)	LOGIT, HAZARD	1980-1985	2,371	USA	•	•	•	•	•	

Source: Mayes and Stremmel (2014), author.

All studies listed in table 12 report a high success of CAMEL models in predicting bank failure. Not all study papers included all six CAMELS variables, e.g. Jin *et al.* (2011) used only capitalization *(C)* and asset quality *(A).* On the other hand some of the CAMEL models were supported by additional variables, e.g. stock prices and house prices (Betz *et al*., 2013), real estate investment (Cole and White, 2012) or audit variables (Jin *et al*., 2011).

As can be noticed in table 12, most of the studies are focused on US banks. There are rather few studies dealing with European banks as a whole. The primary reason is data limitation which arises from the low number of direct bank failures in Europe. Therefore Männasoo and Mayes (2009) focus only on Eastern European countries, so there is no focus on the core European countries. Poghosyan and Čihák (2009) create distress (failure) variable using keyword searches on *'rescue,' 'bailout,' 'financial support,' 'liquidity support,'* etc. in news articles, so these data may be inherently noisy. Further remarks on the data sample will be found in the next section.

4.3 Data and Methodology

Subchapter 4.3 consists of two parts. In the first part we present our data and define bank distress. In the second part we introduce the methodology that we use to compare risk-weighted and simple-weighted capital measures.

4.3.1 Data and definition of bank distress

Banks from all countries that belong to at least one of the following regions were included: Eurozone, EU 28 or Iceland. We focused on large European banks whose entry into distress mattered most to the European economy, hence only banks with total assets above EUR 50 billion at end-2007 were included in the sample. Moreover, large banks are likely to hold a variety of asset classes. As Haldane and Madouros (2012) note, risks to the large, complex banks should be better captured by risk-sensitive capital measures. So the difference between risk-based and non-risk based indicators in large banks is more significant and the performance comparison of the ratios is more relevant.

We used Bankscope database as a data source for individual banks (for more information see section 2.3.2). The final sample of 118 largest European banks with total assets of EUR 39.2 trillion at end-2007 was the starting point of our analysis. For the banks in the sample we exported end-year data from 2007 to 2012.

Our definition of default is similar to the definition of distress used by Poghosyan and Čihák (2009) or Betz *et al.* (2013). We define a distressed bank as any bank that has received state aid, required government intervention or was merged under distress. State aid includes government bailout, government takeover, government capital injection, individual bank guarantee, etc.

In order to compile a dataset on distress in European banks we combine two sources of information. The first source of information is the EU Directorate-General for Competition database on EU Commission-approved aid to the financial sector (European Commission, 2013). This database contains all decisions adopted by the EU Commission linked to the European financial sector crisis, hence all decisions in which the Commission approved government bail-outs, capital injections, guarantees, recapitalization schemes, restructuring aid, etc. We combine this with the second source,

the Failed Bank Tracker database, which is an un-official post-2007 bank distress dataset prepared by Open Economics Working Group (2014). This database includes information on more than 130 European bank failures, both large and small banks.

Combining the two sources of information we have created a unique dataset on bank distress in major European banks. As already mentioned, there are a number of studies that have evaluated the performance of capital measures when predicting bank distress. However, the majority of the studies focus on US banks as there exists a database on US bank failures. The database is maintained by the Federal Deposit Insurance Corporation (FDIC). This is not the case for European banks. National supervisors or central banks in individual European countries have similar databases. However, they are not available to the public and they are limited to individual countries. So to the best of our knowledge there exists no central, official database of European bank failures similar to the FDIC database. As a result, the majority of the studies are focused on US banks, or in the case of European banks the studies are usually limited to bank failures in one country, such as Norwegian banks (Andersen, 2008), Danish banks (Buchholst and Rangvid, 2013), German savings banks and cooperative banks (Porath, 2006) or Croatian banks (Kraft and Galac, 2007). As already mentioned, the exceptions are Poghosyan and Čihák (2009) and Betz *et al.* (2013) who analyze European banks as a whole. However, the Poghosyan and Čihák (2009) data sample does not include bank failures after 2008 which is our primary focus as this period contains many examples of bank distress. The Betz *et al.* (2013) study includes bank distress data which covers most of the EU countries until 2013. However, their goal is different to ours. For example, they do not evaluate performance of capital ratios on stand-alone basis.

Based on our definition of bank distress we have created a bank distress dummy variable, equal to 1 if there is a reference to distress in the particular bank in that particular year, and 0 otherwise. In line with Porath (2006) banks that are still in existence after distress are eliminated from the sample. Using this strategy, we identified 41 distress banks during the 2008–2012 period.

There are some limitations to our analysis. First of all, we use end-year data so the length of time between bank distress date and end-year varies among banks. If there are two banks, bank A and bank B, and bank A failed in January 2009 and bank B failed in December 2009, for both of them we determine 2009 as a distress year. Thereafter, for

both of them we use end-year data 2008 as one year-lagged predictors. However, for bank A these are actually only one-month lagged predictors while for bank B these are truly one-year lagged predictors. Using quarterly financial data (if available) would produce more precise and comparable findings.

Another limitation is that we use *'publicly known distress year'* while using *'real distress year'* would give us more accurate results. For example, a bank might have received a government guarantee in January 2009 but its *'real'* financial distress might have started already in December 2008. In this case *'real'* and *'publicly known'* distress year vary. However, it is difficult if not impossible to determine when *'real distress'* started. On the other hand, as we use yearly data which is rather a long period, then for many banks the *'real'* and *'publicly known distress'* year may be identical.

4.3.2 Methodology

In our search for the answer to the question in the chapter title we have evaluated the performance of eight measures of bank capital strength. We have employed four different, commonly used definitions of bank capital: equity *(E),* tangible common equity *(TCE),* Tier 1 *(T1)* regulatory capital, and Tier 1+Tier 2 *(T1+T2)* regulatory capital. TCE we define as equity less goodwill and intangible assets. Then we employ two approaches to modelling bank risk: risk-weighted assets *(RWA)* and total assets *(TA).* Hence, in total we have evaluated the performance of the following eight measures:

- *E / RWA*
- *E / TA*
- *TCE / RWA*
- *TCE / TA*
- *T1 / RWA*
- *T1 / TA*
- *(T1+T2) / RWA*
- *(T1+T2) / TA*

We have divided these eight measures into two groups: a group of four risk-weighted ratios *(E/RWA, TCE/RWA, T1/RWA, (T1+T2)/RWA)* and a group of four leverage (simple, non-risk weighted) ratios *(E/TA, TCE/TA, T1/TA, (T1+T2)/TA).*

In the first part of our empirical analysis we compare the effectiveness of capital adequacy measures in predicting bank distress when taking into account only the individual capital ratios, hence all other additional information on bank performance and condition, such as quality of assets or liquidity, is neglected. To achieve our goal we have combined a number of statistical techniques, two tailed t-test for testing mean differences, Gini coefficients, the receiver operating characteristic *(ROC)* curve and the area under the receiver operating characteristic curve *(AUC).*

Firstly, for each of the eight measures we test the hypothesis that the average capital measure of distressed banks is the same as the average capital measure of non-distressed banks. We want to find out whether there is a difference in capital adequacy or leverage between *'good banks and bad banks'*. So for each of the eight capital ratios we have tested the following null and alternative hypotheses at 1 % significance level:

$$H_0 : \mu_{distress} = \mu_{non-distress}$$

$$H_A : \mu_{distress} \neq \mu_{non-distress}$$

Where $\mu_{distress}$ is the mean of the ratios for the distressed banks and $\mu_{non-distress}$ is the mean of the ratios for the non-distress banks. The null hypothesis states that the mean of the ratios for the distressed banks is equal to the mean ratios of the non-distress banks. An alternative hypothesis states that there is a difference between distressed and non-distressed banks; in particular, they have different means. The ratios included in the analysis are one year ahead of evaluating whether a bank is distressed or not. So for a group of distressed banks, the mean includes capital ratios of all distressed banks one year prior to bank distress. In a group of non-distressed banks, the mean includes all capital ratios for all non-distress banks from 2007 to 2011.

We use independent samples, a two-tailed t-test for testing mean differences and Levene's test to verify whether the assumption of equal variances has been met for the samples.

Secondly, in order to rank the performance of individual measures we use Gini coefficients which measure how accurate each of the eight capital ratios are. In order to calculate Gini coefficients, first we construct the receiver operating characteristic *(ROC)* curve and calculate the area under the ROC curve *(AUC).* Then we calculate Gini coefficients.

As Porath (2006) explains, AUC can be calculated by first ordering the data according to the variable of interest, in our case individual risk-weighted and leverage ratios, and then calculating the percentages of distressed and non-distressed banks above a certain threshold value of the variable. Using these percentages we can construct the ROC curve which plots the percentages of the distressed banks against the percentages of the non-distressed banks for all possible threshold values.

The performance of a test variable is measured by the AUC. As the ROC coordinates are normalized to unity, the values of AUC range between 0 and 1. An area of 1 represents a perfect test (the test variable has maximal positive discriminative power), an area of 0.5 represents a worthless test (the test variable has no discriminative power) and an area of 0 represents that the test variable has maximal negative discriminative power. For more details on the AUC and the ROC curve, see Hosmer and Lemeshow (2000). Afterwards, the popular Gini coefficient can be easily obtained using the AUC:

$$Gini = 2 * AUC - 1 \tag{24}$$

Equation 24 explains that if AUC totals 1, then Gini is equal to 1 too and it is a perfect test, the test variable has maximal positive discriminative power. If AUC totals 0.5, then Gini totals 0 and it represents a worthless test. The closer Gini is to 1, the better the selected variable is as an indicator of bank distress. We rank the performance of eight measures using Gini coefficients.

In the second part of our empirical analysis we compare risk-weighted and non-risk weighted capital measures when more information on bank condition is taken into account, e.g. information on quality of bank assets or liquidity. We compare the effectiveness of capital adequacy measures in predicting bank distress using the CAMEL logit model.

As shown in table 12, logit and hazard models are mostly used when modeling bank distress. Buchholst and Rangvid (2013) compare the models. Logit and hazard models have both strengths and weaknesses. The hazard rate model may be preferred to a logit model primarily because there is no conflict with the assumption of independent observations in the hazard model. However, in hazard models the time to failure is estimated. The weakness of hazard models, as they suggest, is that it is assumed that all banks will fail eventually (survival theory). This assumption is not included in logit models. By contrast, the logistic model assumes the independence of errors across individual banks and time. This assumption is likely to be violated if the structure of our data is panel data and the data contains multiple observations from the same bank at different consecutive years. Poghosyan and Čihák (2009) note that neglecting the violation of the independence of errors assumption leads to downward biased estimates of standard errors of the coefficients. Nevertheless, most authors prefer the logit motel to the hazard model. In this study we follow Betz *et al.* (2013), Buchholst and Rangvid (2013), Cole and White (2012) and we also use a multiple logistic regression model. We estimate the model with the explanatory variables being lagged one year.

The logit model can be represented in the form of the log odd's ratio:

$$\log \frac{P_{it}}{1-P_{it}} = \beta_0 + \sum_{k=0}^{K} \beta_k X_{k,it-1} \tag{25}$$

where the $\log \frac{P_{it}}{1-P_{it}}$ is the log odd's ratio, measuring the probability of bank distress relative to the probability of no distress and P_{jt} is the probability that bank i will experience distress in year t, given a vector of K explanatory variables X_{it-1}. Finally, β_k is a slope coefficient which measures the linear impact of the k-th explanatory variable on the log odd's ratio.

The CAMELS rating system, as already mentioned, is a method of assessing the overall soundness of banks and stands for capital adequacy, asset quality, management, earnings, liquidity and sensitivity to market risk. The hypothesis is that these factors are key elements in assessing the health of a bank.

The primary focus of this study is capital adequacy, covariate *C* in the CAMELS rating system. We use all four leverage ratios and all four risk-weighted capital ratios to

represent capital adequacy. Hence we calculate eight CAMEL models and evaluate whether the capital ratios are significant predictors of bank distress. A higher level of capital acts as a buffer against financial losses protecting a bank's solvency, it makes the bank more resilient to shocks such as a decrease in the value of the bank's assets and therefore it is expected to reduce the probability of a bank failure.

As regards the second CAMEL covariate, asset quality *(A)*, it is represented by the share of non-performing loans to total assets. A higher share of non-performing loans to total assets is expected to increase the probability of bank distress. In contrast to other authors (Poghosyan and Čihák, 2009), we do not proxy asset quality by the ratio of loan loss provisions to total loans because the effect of reserves for loan losses as a share of non-performing assets is potentially ambiguous. As Betz *et al.* (2013) suggest, while higher reserves should correspond to a higher cover for expected losses, they could also proxy for higher expected losses.

It is not possible to directly assess the third CAMEL covariate, management *(M)*, through a financial statement. Therefore we proxy the managerial effectiveness by the cost-to-income ratio. A lower cost-to-income ratio suggests better managerial quality and it is expected to reduce the probability of bank distress.

To measure the fourth covariate, bank earnings *(E)*, we use the standard measure of (after-tax) return on average equity *(ROE)* and it is expected to be negatively associated with bank distress.

Liquidity, the fifth covariate *(L)*, is represented by the ratio of liquid assets to deposits and short-term funding. A higher ratio is expected to be negatively associated with bank distress.

In line with most of the studies listed in table 12 we do not consider the *S* covariate, the sensitivity to market risk. The share of trading income is often used as a proxy for the covariate. As Betz *et al.* (2013) note, the relation of this covariate with respect to bank distress is ambiguous. On the one hand, a higher trading income could be associated with a riskier business model as trading income is a volatile source of earnings. Hence the *S* covariate is expected to be positively associated with bank distress. On the other hand, investment securities are more liquid than e.g. loans, and thus allow a bank to minimize sale losses in the event of a changing macro-financial environment. Following the

interpretation, the *S* covariate is expected to be negatively associated with bank distress. We have also not considered market-based indicators because we are aiming at using a broad sample of banks, rather than only listed banks.

Table 13: Correlation Matrix

	(T1+T2) / RWA	T1 / RWA	TCE / RWA	E / RWA	(T1+T2) / TA	T1 / TA	TCE / TA	E / TA	A	M	E	L
(T1+T2)/RWA	1.00	0.91	0.36	0.34	0.08	0.08	0.14	0.09	-0.04	-0.08	-0.05	0.26
T1/RWA		1.00	0.42	0.40	0.06	0.20	0.26	0.18	-0.02	-0.13	-0.04	0.13
TCE/RWA			1.00	0.99	-0.05	0.02	0.48	0.39	-0.06	-0.12	-0.01	0.05
E/RWA				1.00	-0.04	0.02	0.46	0.42	0.03	-0.09	0.00	0.04
(T1+T2)/TA					1.00	0.92	0.81	0.82	0.38	-0.19	0.06	-0.07
T1/TA						1.00	0.86	0.84	0.38	-0.22	0.04	-0.09
TCE/TA							1.00	0.94	0.27	-0.22	0.09	-0.07
E/TA								1.00	0.37	-0.19	0.10	-0.09
A									1.00	-0.04	-0.24	-0.22
M										1.00	-0.39	-0.06
E											1.00	-0.04
L												1.00

Source: Author's calculations using data from the Bankscope.

The CAMELS indicators are little correlated (table 13), so that this should limit any problems of multi-collinearity in estimation. Some capital adequacy ratios are correlated, however, they are substitutes and they are not used simultaneously. Therefore, the data do not seem to contain any serious correlation issues and we can use our estimation techniques.

We identify outliers using the criteria of studentized residuals greater than +/- 2.0. For each of the eight capital ratios we run a revised CAMEL logistic regression excluding outliers.

4.4 Empirical results and Discussion

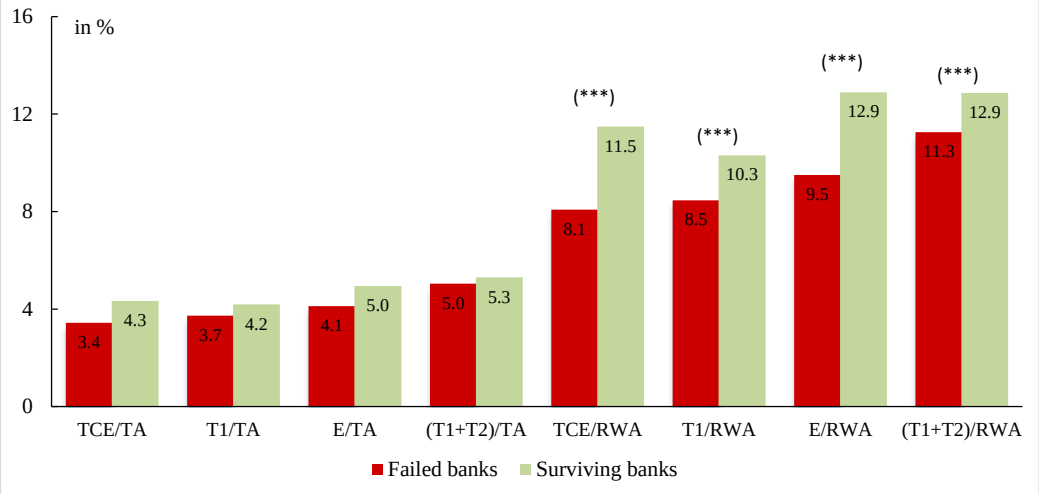
Chapter 4.4 consists of two parts. In the first part we evaluate the performance of capital measures as single (isolated) predictors of bank distress. In the second part we evaluate the performance of the ratios using the standard CAMEL model when additional information on bank performance is taken into account, such as bank asset quality and liquidity.

4.4.1 Horse race – round one: in search for the best stand-alone predictor of bank distress

Figure 7 compares the mean ratios between the two groups of banks – distressed (failed) and non-distressed (non-failed, surviving) banks with respect to four risk-weighted and four leverage ratios. In line with our expectations, the figure shows that the mean ratios for surviving banks always show higher capital holdings than failed banks. For example, total risk based capital to risk weighted assets *((T1 + T2)/RWA)* of surviving banks (12.9 %) is higher than failed banks (11.3 %) by on average 1.6 percentage points.

Measured in absolute terms, in percentage points the difference between failed and non-failed banks is biggest when comparing *TCE/RWA* and *E/RWA* ratios. The difference in both cases is 3.4 percentage points with surviving banks showing a higher ratio. The smallest difference between failed and non-failed banks arises when we compare means for total risk based capital to total assets *(T1+T2)/TA*, hence means for the total regulatory capital leverage ratio. The mean for failed banks totals 5.0 % while for surviving banks it totals 5.3 %.

Figure 7: Average solvency ratios of major European banks, 2007-2011



Source: Author's calculations using data from the Bankscope.

Note: (***) Denotes null hypothesis of mean equality rejected at the 1 % significance level.

An examination of the t-test of all eight measures reveals two findings: first, when considering the four leverage ratios there are not statistically significant differences in capital holding ratios between the two groups of banks - failed and surviving. On the other hand, all risk-weighted capital ratios of surviving banks, whether it is tangible common equity capital to risk-weighted assets *(TCE/RWA)*, or Tier 1 capital to risk-weighted assets *(T1/RWA)*, or equity to risk-weighted assets *(E/RWA)*, or total risk based capital to risk weighted assets *((T1+T2)/RWA)*, were significantly higher than those of failed banks.

The (statistically) significant difference in capital holding ratios in all four risk-weighted ratios supported by t-test rejects the null hypothesis that there is no difference between the two groups of banks, at the 1 % significance level. The rejection of the null hypothesis provides strong evidence that there are differences in capitalization between the failed and non-failed banks when risk-weighted assets are taken into account.

Table 14 compares the predictive power of the eight measures. It gives us an answer to one of the key questions: which single measure best predicts bank distress? The table shows the Gini coefficient for each of the four leverage and four risk-weighted ratios.

Table 14: Gini coefficient for capital and leverage ratio as indicator of bank distress rate of major European banks

	Capital ratio (based on RWA)	Leverage ratio (based on total assets)
TCE	0.45	0.23
E	0.40	0.18
T1+T2	0.23	0.04
T1	0.35	0.13

Source: Author's calculations using data from the Bankscope.

Table 14 illustrates three findings. Firstly, it shows there is no perfect or near perfect stand-alone predictor of bank distress. We do not see any Gini coefficient equal or close to 1. The Gini coefficients range from 0.04 to 0.45.

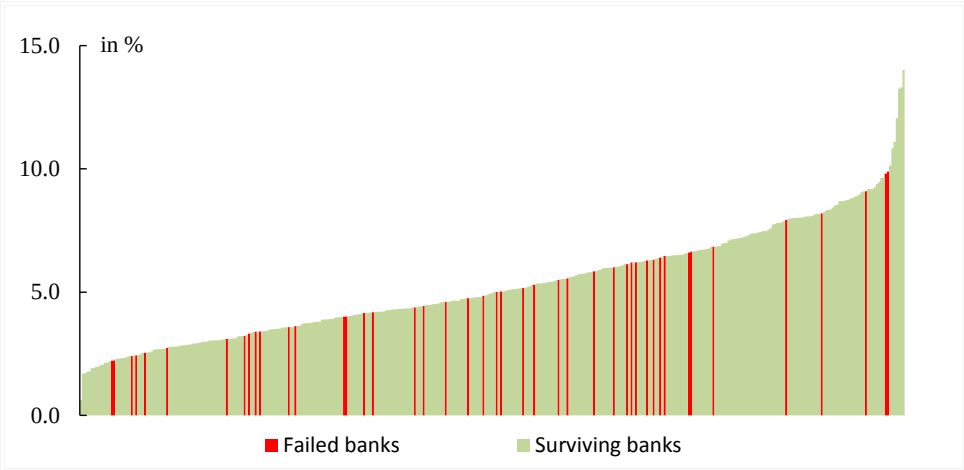
Secondly, risk-based capital ratios are markedly better indicators of future bank distress than leverage ratios. This is the most important finding in this section. Capital ratios based on RWA always show a higher Gini coefficient than the corresponding leverage ratio alternative, no matter which of the four definitions of bank capital we use. For example, the Gini coefficient totals 0.45 for tangible common equity capital to risk-weighted assets *(TCE/RWA)* while it amounts only to 0.23 for tangible common equity capital to total assets *(TCE/TA).*

Thirdly, table 14 shows that the tangible common equity to risk-weighted assets *(TCE/RWA)* ratio has the highest predictive power. It is the best stand-alone indicator of future bank distress. Its Gini coefficient totals 0.45 and is the highest one. It is followed by equity to risk-weighted assets *(E/RWA)* and Tier 1 to risk-weighted assets *(T1/RWA)* ratios with Gini coefficients amounting to 0.40 and 0.35 respectively. Rather surprisingly, capital and leverage ratios based on Tier 1 plus Tier 2, the broadest measures of capital, have the lowest predictive power. The poorest stand-alone predictor of future bank distress is the ratio of Tier 1 plus Tier 2 to total assets *((T1+T2)/TA)* with Gini coefficient close to zero.

Figures 8 and 9 show the above mentioned conclusion visually. Figure 8 plots the performance of the worst measure Tier 1 plus Tier 2 to total assets ratio *((T1+T2)/TA)* while figure 9 plots the performance of the best measure, tangible common equity capital

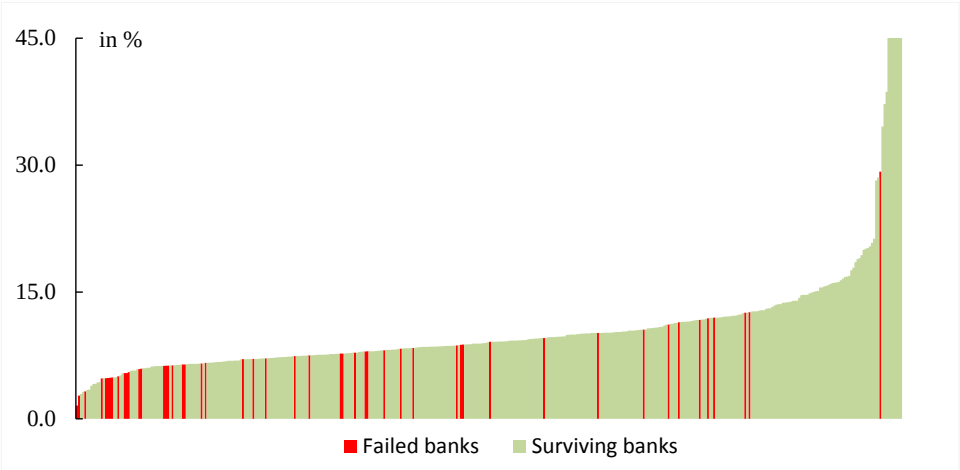
to risk-weighted assets *(TCE/RWA)*. Both charts distinguish *'surviving'* and *'distressed/failed'* banks during the 2008 and 2012 period. The measures are one-year lagged. So, for example, if a bank 'failed' in 2009, the banks' *TCE/RWA* ratio for end - 2007 (as 'a surviving bank') and end-2008 is (as 'a failed bank') is included in the figure 9. If a bank 'survived' the whole 2008 - 2012 period, then all end-year *TCE/RWA* ratios from 2007 to 2011 are shown in figure 9.

Figure 8: (Tier 1 + Tier 2)/Total assets ratios of major European banks, 2007-2011



Source: Author's calculations using data from the Bankscope.

Figure 9: TCE/RWA ratios of major European banks, 2007-2011



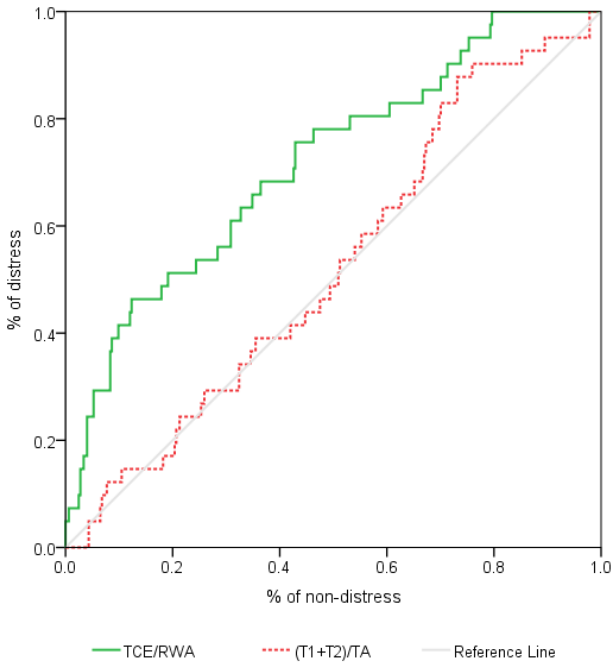
Source: Author's calculations using data from the Bankscope.

Note: Due to better visualization banks with TCE/RWA ratio above 45 % are shown as banks with the ratio equal to 45 %.

In figure 8 there is little visual correlation between levels of Tier 1 + Tier 2 to total assets ratio and subsequent bank failure. Banks with small ratios failed as often as banks with high capital ratios. On the other hand, the pattern in figure 9 seems visually more systematic. Banks with lower *TCE/RWA* ratios are associated with failing banks more often than banks with higher *TCE/RWA* ratio. The number of distressed banks is high especially at the left-hand corner of the figure. *TCE/RWA* ratio of 8 % would have affected most banks that became distressed, 26 out of 41 distressed banks.

We can visualize how well each of the indicators performs also using the ROC curves, (figure 10) which plots the ROC curve for the best and worst indicator, *TCE/RWA* and *(T1+T2)/RWA* respectively.

Figure 10: ROC curve for TCE/RWA and (T1 + T2)/TA, major European banks



Source: Author's calculations using data from the Bankscope.

The distance of the ROC curve from the reference line (diagonal) is a graphical measure of the discriminative power of the variable (capital ratio). Figure 10 shows that the distance of the ROC curve for *TCE/RWA* from the diagonal is always higher than the distance of the ROC curve for total risk based capital to total assets *(T1+T2)/TA* demonstrating the better discriminative power of the *TCE/RWA* variable. The ROC curve for *(T1+T2)/TA* is very close to the reference line, which means that the variable does not

report any discriminative power. Figures 11 - 14 in section 4.7 show the ROC curves for all eight measures. Each of the figures plots the ROC curve for capital ratio based on RWA and its corresponding leverage ratio alternative based on total assets. The figures graphically confirm the dominance of risk–weighted measures over leverage ratios as the ROC curves of risk–weighted measures are more distant from the diagonal than the ROC curves of the corresponding leverage ratio alternative.

These findings are not surprising. Risk-weighted capital ratios include more information on bank characteristics than leverage ratios; they also include the risk-appetite of a bank, so it is in line with our expectations that the risk-weighted ratios should beat simple ratios.

Our findings in this section are in line with the Buehler *et al.* (2009) study which analyzed 115 large, global banks between 2007 and 2009. Their analysis also suggests that the tangible common equity to risk-weighted assets ratio is the strongest predictor of future bank distress. Moreover, it appears to be a significantly better predictor than traditional measures, like Tier 1 to risk-weighted assets or Tier 1 plus Tier 2 to risk-weighted assets. Their analysis concludes that risk-weighted measures are better indicators of bank distress than leverage ratios.

4.4.2 Horse race – round two: CAMEL models

Tables 15 and 16 contrast the results of a logit regression of European bank distress using the CAMEL indicators as predictors. Table 15 shows the results for four risk-weighted measures of C variable and table 16 shows the results for four leverage ratios used as the C dimension in the CAMEL model.

Table 15: CAMEL model for risk-weighted capital ratios

Variable	Model 1	Model 2	Model 3	Model 4
Capital (T1+T2)/RWA	-.425 ***			
	(0.142)			
Capital T1/RWA		-.419 ***		
		(0.130)		
Capital TCE/RWA			-.463 ***	
			(0.114)	
Capital E/RWA				-.449 ***
				(0.110)
Assets	-.247	-.284	-.285	-.100
	(0.184)	(0.182)	(0.191)	(0.164)
Management	.028 ***	.020 ***	.025 ***	.026 ***
	(0.008)	(0.008)	(0.009)	(0.008)
Earnings	-.124 ***	-.093 ***	-.122 ***	-.133 ***
	(0.035)	(0.033)	(0.036)	(0.037)
Liquidity	-.027 **	-.016 *	-.027 **	-.027 **
	(0.011)	(0.009)	(0.012)	(0.012)
Constant	0.693	0.167	-0.105	-0.125
	(1.582)	(1.257)	(0.120)	(1.126)
Number of observations	338	339	333	332
Nagelkerke R Square	0.25	0.23	0.32	0.33

Note: Standard errors are shown in brackets.

* p<0.1, ** p<0.05, *** p<0.01

Source: Author's calculations using data from the Bankscope.

Table 16: CAMEL model for leverage ratios

Variable	Model 5	Model 6	Model 7	Model 8
Capital (T1+T2)/TA	-.684 ***			
	(0.211)			
Capital T1/TA		-1.307 ***		
		(0.290)		
Capital TCE/TA			-1.061 ***	
			(0.233)	
Capital E/TA				-.815 ***
				(0.198)
Assets	.040	.337 *	.224	.276
	(0.262)	(0.193)	(0.181)	(0.18)
Management	.020 **	.011	.011	.016 *
	(0.008)	(0.008)	(0.01)	(0.008)
Earnings	-.249 ***	-.158 ***	-.164 ***	-.213 ***
	(0.054)	(0.043)	(0.041)	(0.046)
Liquidity	-.076 ***	-.065 ***	-.056 ***	-.059 ***
	(0.021)	(0.016)	(0.015)	(0.016)
Constant	-0.994	1.544	0.227	-1.070
	(1.359)	(1.21)	(1.119)	(1.124)
Number of observations	309	320	333	332
Nagelkerke R Square	0.38	0.36	0.38	0.40

Note: Standard errors are shown in brackets.

* p<0.1, ** p<0.05, *** p<0.01

Source: Author's calculations using data from the Bankscope.

Contrasting tables 15 and 16 brings out a number of findings. First of all, we find that both leverage and risk-weighted measures are important factors when modeling bank distress. For all eight models capital is the major driver in explaining bank distress. A negative sign of *C* covariate means that banks that are better capitalized are less likely to experience distress in the upcoming year. This is in line with our expectations and economic theory. But the question is which type of ratio is more useful?

Comparing R-squared indicates that using leverage ratios may be more useful. Models based on leverage ratio always show higher R-squared than the corresponding models based in risk-based ratio. For example, the R-squared totals 0.36 for Tier 1 to total assets *(T1/TA)* while it amounts only 0.23 for Tier 1 to risk-weighted assets *(T1/RWA).*

In addition, while R-squared ranges from 0.36 to 0.40 for models based on leverage ratios, it ranges from only 0.23 to 0.33 for models based on risk-based ratios.

In order to compare the performance of different ratios we also calculate Gini coefficients. Table 17 confirms the previous conclusion.

Table 17: Gini coefficient for CAMEL models using different definitions of capital

	Capital ratio (based on RWA)	Leverage ratio (based on total assets)
TCE	0.82	0.90
E	0.80	0.89
T1+T2	0.76	0.88
T1	0.75	0.89

Source: Author's calculations using data from the Bankscope.

CAMEL models with leverage ratios show a higher Gini coefficient than the corresponding models with risk-based alternatives. However, the difference in using any of the eight ratios is not as big as it is in 'horse race one'. In the previous 'horse race one' Gini coefficients range from 0.05 to 0.44, while Gini coefficients for CAMEL models range from 0.75 to 0.90. It is not a surprise that Gini coefficients for CAMEL models are significantly higher than the coefficients for single capital measures. There are two reasons for this. CAMEL models include five parameters, not just one parameter and the outliers have been omitted in CAMEL models.

The superiority of a simple capital measure is a rather surprising finding which is in contrast to the conclusion in the 'horse race one' section. Contrary to the risk-sensitivity doctrine, in CAMEL models simple risk-modeling appears to offer more than complex modeling. Tables 15, 16 and 17 taken together suggest that when we predict bank distress using more information on bank condition and risk profile, leverage ratios can beat risk-weighted measures.

The superiority of leverage ratios may have a number of explanations. Firstly, it is their simplicity. If we evaluate a bank from several perspectives, the inclusion of simple leverage ratios may be more efficient because the leverage ratio is transparent and more difficult to manipulate. By using leverage ratios we avoid some of the threats of complex risk modeling such as variations in the measurement of risk-weighted assets across banks, failure of risk models to capture the increasing complexity and ability to game the system.

Secondly, leverage ratios may perform better because other CAMEL covariates incorporate bank risks, hence the key comparative advantage of risk-weighted ratios (they obtain information on bank risk profile) diminishes and as a result leverage ratios can better capture bank capital strength.

Finally, during a financial crisis, hence during an unstable and complex environment, a simple leverage ratio may be a better indicator of future problems because complex rules may perform poorly in an unstable environment. As Gigerenzer (2010) suggests, the more complex the environment, the greater the perils of complex models. The optimal response to a complex environment is often not a fully state-contingent rule. Rather, it is to simplify. Simple rules may be more robust. DeMiguel *et al* (2007) give an example for investors. Investors with simple passive strategies outperform investors with complex, active strategies.

Our conclusion is in line with other studies like Mayes and Stremmel (2014). They analyze 16,188 US banks between 1992 and 2012. They employ the CAMEL model as well in order to compare the performance leverage ratio and risk based capital ratio. They conclude that the leverage ratio explains bank distress best and with considerable accuracy. Moreover, our results support Kling's (2013) view that capital measures used by regulators will, over time, come to be outperformed by a measure that the regulators are not using. A good indicator of bank distress ceases to be a good measure when it becomes a target for regulators.

Reverting back to the remaining CAMEL covariates, we observe that liquidity *(L)* and earnings *(E)* do come out as significant factors in all eight models. This is not very surprising as good earnings indicate a better likelihood of preventing bank distress in the upcoming year and liquidity was an issue during the financial crisis. Lack of liquidity raises the vulnerability of banks immediately. Indeed, it is a lack of liquid assets, not capital, that leads to immediate bank distress, or even closure of a bank.

However, there are some drawbacks in the models. Most of the models fail to find any significant influence from the assets quality *(A)* variable on the distress of banks. Moreover the parameter does not have the expected positive sign in the models (1) to (4) based on risk-based ratios, table 15.

There is a possible explanation for this. Firstly, it is not the poor quality of loans that was a key reason for bank distress among top European banks during the crisis. Rather, it was a result of the crisis. We noticed that the majority of the distressed banks had a low share of non-performing loans to total assets one year prior to distress. After the distress year the indicator rose sharply. However, the after distress observations are omitted from the sample as we predict bank distress one year ahead: e.g. Allied Irish Bank reported 1.6 % of non-performing loans to total assets in 2008. In February 2009 the Irish government injected EUR 3.5 billion into the bank. The ratio of non-performing loans rose sharply thereafter, to 8.3 % in 2010 and 24 % in 2012.

Managerial quality *(M)* has an expected positive sign in all eight models. It suggests that good earnings or low costs indicate a better likelihood of preventing bank distress in the upcoming year. However, the management variable has no significant influence on the distress of banks in models (6) and (7), table 16.

When discussing our overall findings, while the superiority of leverage ratios in CAMEL models is not conclusive, they do suggest that 'more complex risk modeling' does not necessarily mean 'better risk modeling'. We agree with Pakravan (2014) who suggests that complex Basel rules have brought an illusion that a model-driven quantitative approach to capital adequacy leads to a more robust and shock-proof system. Therefore we support the view that regulation based on both risk-based and simple leverage ratios is necessary. The inclusion of a simple leverage ratio constraint into Basel III is a good step. In our view it is likely to enhance the safety of the financial system especially during unstable periods. Haldane and Madouros (2012) argue there is a distinct rationale for simple rules. Complex rules may cause banks to manage to the rules, for fear of falling foul of them. Complex rules may induce banks to focus on the small print at the expense of the bigger picture.

Further research is needed on evaluating the performance of using both leverage ratios and risk-weighted ratios simultaneously, which is the target of regulators. The question is, by how much does using both ratios simultaneously produce better results than using just risk-weighted ratios or leverage ratios? The answer to this question is useful in setting the minimum leverage ratio in European regulatory legislation. By the end of 2016 the European Commission is required to submit a legislative proposal to introduce a binding leverage ratio which will be applicable from 1 January 2018 onwards. The binding

leverage level (or binding levels for different business models) will be calculated during the 2015 and 2016 monitoring period. The current minimum of 3 % for Tier 1 capital divided by an institution's on- and off-balance sheet items is only indicative.

4.5 Conclusion

In this chapter we have evaluated the performance of four risk-weighted capital ratios and four leverage ratios to predict bank distress among top European banks during the global and Eurozone financial crisis in 2008-2012. Using a unique dataset of bank distress we have evaluated the ratios´ performance in two ways. Firstly, we have compared the performance individual ratios as single indicators of bank distress and we have searched for the best single indicator. Secondly, we have applied the well-established CAMELS method in order to compare the performance of the risk-weighted and leverage ratios when additional information on bank condition is considered.

Taken together, our analysis brings a synthesis among those who argue which measures are better in predicting bank distress, whether it is risk-weighted ratios or leverage ratios. The answer to this question is more complex: 'It depends'. It depends on what precisely we are looking for. Are we looking for the best single indicator or the best additional capital indicator to other parameters of bank condition?

We have found that risk-weighted measures do outperform simple leverage ratios as single indicators of bank distress. The reason is that risk-weighted ratios include more information on bank condition (its risk profile) than simple leverage ratios. The ratio of tangible common equity to risk-weighted assets is the best single indicator. Capital ratios based on higher-quality of capital (e.g. Tier 1) are better indicators of distress rate than ratios based on a broader definition of capital (e.g. Tier 1 plus Tier 2).

However, when we take into consideration more information on bank condition and its risk profile, such as assets quality or liquidity, then including simple leverage ratios can bring better results than including risk-weighted measures. The reason is that leverage ratios are transparent, they are more difficult to manipulate and their primary weakness (they contain less information on bank condition than risk-weighted ratios) is diminished in this case because bank risk is already captured by other model variables. In addition,

complex risk-weighting rules may perform poorly in an unstable environment. While such findings are not conclusive, they suggest that ‘more complex risk modeling’ does not always mean ‘better risk modeling’ and therefore we support the view that regulators should not focus only on risk-weighted ratios: regulation based on simple leverage ratios is necessary as well. The inclusion of a leverage ratio constraint into Basel III is a good step.

Further study is necessary in order to evaluate how much additional benefit leverage ratio brings when risk-weighted ratio is already considered. The results will provide a useful insight regarding the appropriate level of minimum leverage ratio which will be set by regulators by 2016.

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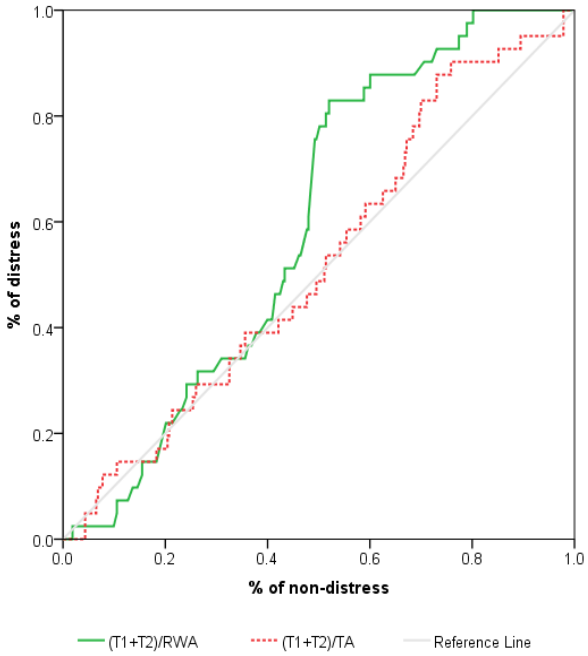
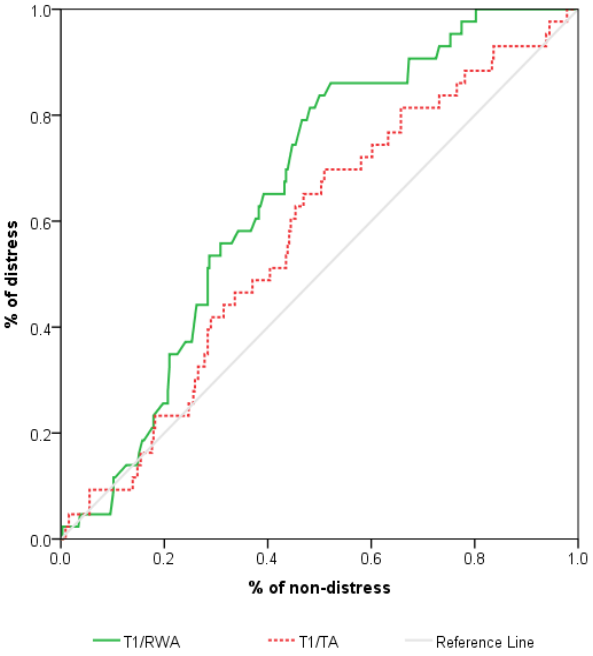
4.7 Appendix

Figure 11: ROC curves for Tier 1 + Tier 2



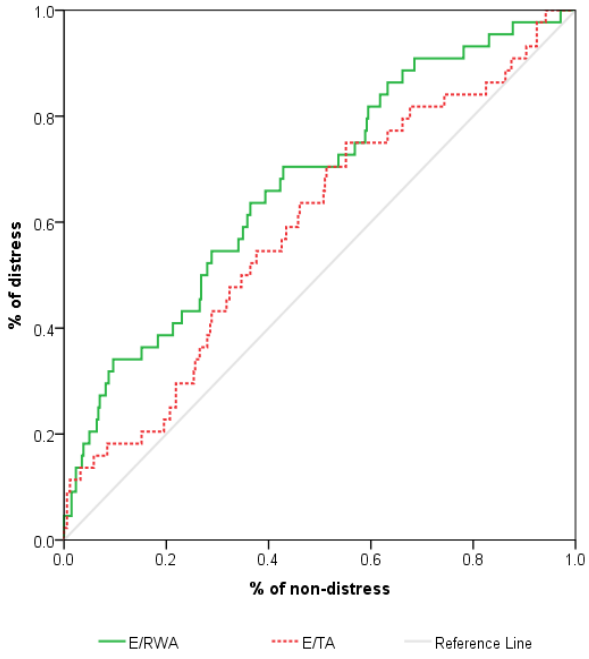
Source: Author's calculations using data from the Bankscope.

Figure 12: ROC curves for Tier 1



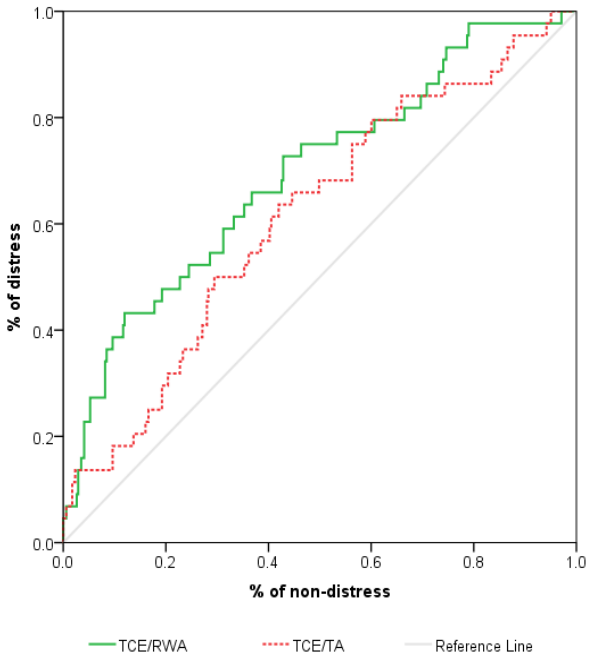
Source: Author's calculations using data from the Bankscope.

Figure 13: ROC curves for Equity



Source: Author's calculations using data from the Bankscope.

Figure 14: ROC curves for Tangible Common Equity



Source: Author's calculations using data from the Bankscope.

5. Final Conclusion

Basel III represents a key milestone in strengthening banking supervision and the development of bank regulation. It aims to promote a safer and sounder financial system and attempts to correct the flaws of Basel I and II. The new framework puts emphasis on the quality and quantity of core capital. Furthermore, the framework has introduced a regime that incorporates new liquidity rules as well as a macro-prudential approach to financial regulation directed at the reduction of systemic risk. The overall impact of Basel III on banks is manifold, ranging from capital, liquidity and leverage requirements to technology and strategy implications.

To implement the reforms is costly, especially because capital is costly. The aim of the second chapter was therefore to analyse whether increased capital requirements in 2014 will be pushed on to consumers in the form of higher lending spreads and borrowing money from Czech banks will become more expensive. We estimate the required increase in banks' lending spreads assuming that banks under regulatory pressure would raise lending spreads to prevent ROE from falling when the capital regulation is tightened. As the capital adequacy of Czech banks was at a high level, far above the required regulatory minimum, we focus our analysis on six Czech banks that are under regulatory pressure, and are therefore the only ones most affected by the increased capital requirement.

Our calculations show that the impact of tightened regulation on lending interest is rather minor. The higher costs associated with a one percentage point increase in capital ratio can be recovered by increasing lending spreads 6.3 basis points. If shareholders decide to absorb some of the fall in ROE, or they take other measures to prevent a fall in ROE, the potential impact on lending spreads will be even smaller than 6.3 basis points. In addition, our methodology used for estimating the changes in spreads is likely to give higher estimates because it abstracts from competition by those banks, which are not under 'under regulatory pressure'. The banks with capital, which is higher than future capital requirements, compete directly with the banks under regulatory pressure and this will tend to mitigate eventual changes in spreads.

Third chapter was dedicated to analysing the strategies that Czech banks adopted in order to increase their capital ratios from 2009 to 2013. Our analysis shows that increasing

capital was the major strategy to increase the reported risk-weighted capital ratios. The second driver of the improvement in banks' capital ratios was the reduction in the average risk weight in bank portfolios. When achieving higher regulatory capital, retained earnings played a key role in supplying fresh capital.

Comparing different groups of banks, it was mainly the banks under regulatory pressure which increased their risk-weighted capital ratios. Banks not under pressure reported only a minor increase in the ratio as their motivation to increase the ratio was limited.

A comparison of our results with other studies suggests that the behaviour and strategy of Czech banks is similar to large multi-national banks from advanced economies.

The results of the third chapter are useful mainly from a regulatory point of view as currently the countercyclical buffer is set to its minimum of 0 % of risk-weighted assets and the Czech National Bank may increase the buffer up to 2.5 % in the medium or long term.

Fourth chapter focussed on the rather controversial question of whether increasing regulation complexity enhances the safety of the financial system, whether more complex indicators predict bank failures better than simple indicators. We compare the performance of risk-weighted capital ratios and simple leverage ratios to predict bank distress in major European banks. Using yearly bank data and a unique dataset of bank distress in European banks during 2008-2012, firstly we evaluate the performance of capital ratios as stand-alone indicators of bank distress. Secondly, by applying the CAMEL model we evaluate the performance of the ratios when additional information on bank condition is taken into account, e.g. quality of assets.

We find that risk-weighted measures do outperform simple leverage ratios as single indicators of bank distress. The reason is that risk-weighted ratios include more information on bank condition (its risk profile) than simple leverage ratios. The ratio of tangible common equity to risk-weighted assets is the best single indicator. In addition, capital ratios based on higher-quality of capital (e.g. Tier 1) are better indicators of distress rate than ratios based on a broader definition of capital (e.g. Tier 1 plus Tier 2).

However, when we take into consideration more information on bank condition and its risk profile (e.g. CAMEL models) then including simple leverage ratios can bring

better results than including risk-weighted measures. This finding is rather surprising. In our view the reason is that leverage ratios are transparent, they are more difficult to manipulate and their primary weakness (they contain less information on bank condition than risk-weighted ratios) is diminished in CAMEL models because bank key risks are captured by other model variables. In addition, complex risk-weighting rules may perform poorly in an unstable environment.

While such findings are not conclusive, they suggest that 'more complex risk modeling' does not necessarily mean 'better risk modeling' and therefore we support the view that regulators should not focus only on risk-weighted ratios: regulation based on simple leverage ratios is necessary as well.

Apart from future research suggested in the individual chapters – for example into the reasons lying behind the decline in average risk weight in Czech bank portfolios or research into how much additional benefit leverage ratio brings when risk-weighted ratio is already considered – we believe that regulators especially should evaluate and weigh Basel III's costs and benefits at each stage of the new framework's implementation.

6. List of figures

7. List of tables