Charles University in Prague

Faculty of Social Sciences
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MASTER THESIS

Implementation of Basel III: Impact on the Behaviour of the Banking Sector

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

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Prague, August 30, 2012

Signature

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Abstract

This thesis focuses on consequences of the full implementation of Basel III regulations and what impact it will have on the banking sector. The purpose of Basel III is to replace Basel II as a global regulatory standard, because of its predecessor's flaws, such as the amplifying of banks' procyclicality, overreliance on credit rating agencies or the incentive to securitize its assets. The examination of Basel III regulations has shown that the most difficult task for banks would be to raise the capital for increased requirements and implementation of liquidity ratios. This will undoubtedly change the behaviour of banks. Using the panel data model, we will analyze the relationship between the changes in regulatory capital and our dependent variables, which consist of change in interest rates, change in the amount of loans granted and the change of stability of a bank, in countries from the Visegrad Four, the Czech Republic, Slovakia, Poland and Hungary. Using estimated coefficients from our regression, we examine whether there will be unintended negative effects of Basel III implementation and whether there will be an increase in a stability of banks.

JEL Classification	G21, G28
Keywords	Basel II, Basel III, capital adequacy, liquidity ratios

Work extension: 101,200 characters

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Abstrakt

Tato práce se zabývá tím, jaké důsledky bude mít zavedení nových regulací bankovního sektoru, nazývaných Basel III, na bankovní sektor samotný. Vzhledem k chybám v regulacích Basel II, jako jsou třeba zesilování procykličnosti, přehnané spoléhání na hodnocení ratingových agentur nebo nechtěná motivace k sekuritizaci aktiv. Podrobné prozkoumání regulací Basel III a související literatury naznačilo, že jedním z nejtěžších úkolů, který čeká banky po zavedení nových regulací, je nastřádání dostatečného množství kapitálu na pokrytí zvýšené kapitálové přiměřenosti a zavedení nových ukazatelů likvidity. Toto bezpochyby zapříčiní změnu v chování bankovního sektoru. Pomocí analýzy panelových dat se proto zkoumáme souvztažnost mezi změnami v kapitálové přiměřenosti a námi vybranými závislými veličinami, změnami úrokových měr, změnami v množství poskytovaných úvěrů a změnami v stabilitě banky v zemích Visegrádské čtyřky, tedy České republiky, Slovenska, Polska a Maďarska. Pomocí odhadnutých koeficientů pak můžeme určit, zda bude mít zavedení regulací Basel III případné nechtěné negativní důsledky a zda dojde ke splnění vytyčeného cíle, zvýšení stability bank.

Klasifikace	G21, G28
Klíčová slova	Basel II, Basel III, kapitálová přiměřenost, ukazatele likvidity

Rozsah: 101 200 slov

Master Thesis Proposal

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Proposed Topic:

Implementation of Basel III. Impact on the Behaviour of the Banking Sector

Topic Characteristics:

My master thesis will focus on the impact of implementation of planned Basel III regulations on the behaviour of the banking sector. When trying to describe expected changes these new regulations will cause, I have to describe some problems that had arisen from the poor setting of Basel II regulations and its impact on the recent financial crisis. There are two shortcomings of Basel II on which most authors agree, the procyclicality and the insufficient regulation. After that, my thesis will focus on the development of the Basel III regulations and primarily on proposed changes that, according to Basel Committee on Banking Supervision, will improve the stability of the banking sector. Among these proposals I will describe are countercyclical buffer, which is aimed to increase the liquidity of banking sector, and the changes of definitions of Tier 1 and Tier 2 capital alongside with the abolition of Tier 3 capital, which should increase the quality, the transparency and the liquidity of the banking sector. Moreover, there are some other regulations, whose description cannot be omitted, mainly the alteration of credit risk measurement methods, changes in capital adequacy and introduction of the stressed VAR, which should make banks to increase their held capital and thus increase the stability of banking sector.
These new proposed regulations are supposed to cause immense changes in the behaviour of the banking sector. In my thesis, I describe these changes. To be able to describe these changes, I will create a model based on the one proposed by Repullo and Suarez and redefined by Kiema and Jokivuolle. Later on, I will try to simulate on this model how the banking sector will perform under normal circumstances and how it will respond to crisis scenario.

Hypotheses:

1. Hypothesis #1: Interest rates will increase.
2. Hypothesis #2: The stability of the banking sector will increase.
3. Hypothesis #3: The amount of granted loans will be lower.

Methodology:

- Create a model of a bank based on the model that has been proposed by Repullo and Suarez
- Implement an index as a measurement of a market risk
- Simulate the aforementioned index and observations of its impact on other variables

Outline:

1.1 History of Basel Regulations
1.2 Detailed Description of Basel II
1.3 The Role Basel II Had in Financial Crisis
2.1 Description of Proposed Basel III Regulations
2.2 Hypothetical Impact of Basel III Regulations
2.3 The criticism of Basel III
3.1 Model Characteristics
3.2 Simulation
3.3 Results

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Acronyms

BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CAR	Capital-Asset Ratio
CDO	Collateralized Debt Obligation
CEPS	Centre for European Policy Studies
CET1	Common Equity Tier 1
COC	Cost of Capital
CR	Capital Requirements
CRA	Credit Rating Agency
DTA	Deferred Tax Assets
EAD	Exposure at Default
EXP	Exposure to Systematic Risk
FCIC	Financial Crisis Inquiry Commission
FVA	Fair Value Accounting
G-10	Group of Ten
GDP	Gross Domestic Product
IMF	International Monetary Fund
IRB	Internal Ratings-Based
LASTCF	Liquid Assets to Short Term and Customer Funding
LCR	Liquidity Coverage Ratio
LGD	Loss Given Default
MBS	Mortgage Backed Security
NIM	Net Interest Margin
NSFR	Net Stable Funding Ratio
NSFR	Net Stable Funding Ratio
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
OTC	Over the Counter
PD	Probability of Default
QIS	Quantitative Impact Study
ROA	Return on Assets
ROE	Return on Equity
RWA	Risk Weighted Assets
S-VaR	Stressed -Value at Risk
VaR	Value at Risk

1. Introduction

Since the last crisis, there has been a hunt for the main culprit. Lots of these accusations were aimed at the banking sector, whose flaws had become clearly visible. The result of this was that the issue of banking regulation had become a hot issue. There are lots of reasons for this. Firstly, as mentioned earlier, banks were seen as one of culprits who had caused the immense severance of the recent crisis. Secondly, it had become imminent that banks aren't the only ones to blame, because they operate under certain environment that is set by the regulation, to be more specific, the Basel Accords. The main topic of the discussion is how the banking regulation should be changed in order to minimize the possibility of future crisis. The main role in the setting of the new environment has the Basel Committee on Banking Supervision, the author of previous versions of internationally used regulations of banking sector, Basel I and Basel II. The main task of BCBS is to improve those parts of Basel II, which were pointed out as failures, such as the procyclicality of capital requirements, which amplifies the inherited procyclicality of banks' behaviour, the overreliance on credit ranking agencies or the incentive to securitize assets. The result of BCBS' efforts is the Basel III regulations proposal, which should fix the issues of its predecessor, and increase the resilience of the banking sector, so events like the recent crisis wouldn't have such immense effect. The opinions on how this new regulation will perform differ. Of course, almost no one defies the need for the new regulation, apart from orthodox opponents of Basel Accords as such. However, almost immediately after the publication of the Basel III proposal, many studies have been published discussing its possible impact on the banking sector and its flaws.

Our objective of this thesis is to discuss and evaluate its possible impact on the biggest banks from countries from the Visegrad Group, Czech Republic, Slovakia, Poland and Hungary, by examining the relationship between features changed or set by the Basel III regulation and the behaviour of banking sector. We will work with three hypotheses. The first one deals with the relationship between the changes introduced by the Basel III and the interest rates, we want to find out, whether the implementation of Basel III will cause the increase of interest rates. Our second hypothesis deals with the issue, whether the Basel III implementation will affect the amount of loans granted by banks. And the final of our hypothesis deals with the main raison d'être of Basel III, whether the implementation of the Basel III will increase the stability of the banking sector.

The structure of this thesis will be as follows. This first section provides a brief introduction to the topic. The purpose of the second chapter will be to provide information about circumstances of the beginning of Basel Accords with the emphasis on the Basel II in order to examine its features and the role it had played in the recent crisis. The third capture provides the detailed description of the main features of Basel III, such as the changes in the structure of regulatory capital, or the introduction of innovative elements like the countercyclical buffer or liquidity ratios. The introduction of the Basel III brings out the task of its evaluation, which will be done in the fourth chapter. That particular chapter will present the literature overview, which will give us a hint of what will be consequences of Basel III implementation. The fifth chapter will present our empirical analysis, which will analyse the possible impact of the Basel III implementation. We will examine what is the relationship between changes in both capital ratios and liquidity rations, respectively, and changes in banks' behaviour. In the econometric analysis, will use both fixed and random effects panel data model, depending on the value of Breuch Pagan test statistic. Results will provide us with some insight of what will happen in the case that capital and liquidity ratios, respectively, will be increased by the regulation.

2. History of Basel Accord

2.1. Brief Introduction

To get a full picture about the Basel III proposal, we must take a look into the history to see how it was evolved. These proposals came from the Basel Committee on Banking Supervision, so we shall start our quest for the full comprehension of Basel III regulations here. As Jablecki (2009) puts it, the reason behind the establishment of the BCBS was the collapse of two large international banks. The first one was the Long Island's Franklin National Bank, bank from USA, and the latter was Bankhaust Herstat, from the West Germany. Because of this collapse, it became imminent that the home country regulations cannot affect banks' international activities as it does with their domestic activities. As a solution to this situation, the Group of Ten countries (G-10: USA, United Kingdom, Canada, France, Belgium, Germany, Italy, Japan, Sweden, Netherlands) in 1974 established the Basel Committee for Banking Supervision under the Bank for International Settlements. Although its task was to analyse the banking system and come up with a proposition for international supervision, it does not possess any authority, its purpose is only to advice. The first proposal from the BCBS came out in 1975, the Basel Concordat was aimed to establish rules determining the responsibilities of home and host countries regulators vis-à-vis cross border banks. And few years after the Latin American Debt Crisis of 1982, in the year of 1988, the BCBS came out with its framework called the Basel Accord, which was aimed at the capital regulation of international active banks

2.2. Basel I

As it has been stated in the previous text, the first of the Basel Accords, Basel I, has been introduced in the year 1988. The main concern of this accord was to force international banks to keep certain level of minimal requirements to cover the credit risk. Assets of the bank were risk weighted on the scale from 0 to 100 percent depending on the soundness of each particular asset. (Lall(2009)) The assets with assigned zero per cent weight were cash, gold and bonds issued by the governments of countries participating in the OECD. The 20% weight was assigned to claims on local public sector entities and claims on agencies of governments of countries participating in the OECD. Above that were assets with assigned weight of 50%, these were mortgages. And lastly, the 100% weight was assigned to claims on private sector, governments of countries not participating in the OECD. The capital, which should be held against the risk weighted assets, was divided into two categories by its quality, the Tier 1 and Tier 2 capital. The Basel I capital ratio then looked as follows:

$$Basel\ Capital\ Ratio = \frac{Tier\ 1 + Tier\ 2\ capital}{Risk\ Weighted\ Assets}$$

According to Basel I, banks were obliged to hold at least 8% of total regulatory capital and 4% of Tier 1 capital. As stated earlier, the original purpose was to regulate activities of internationally active banks, and leave the regulation of the domestic banks to their respective governments, but most countries had adopted Basel I both for international as well as national credit institution (Jablecki (2009)). In 1995, the Basel I regulations were enhanced by the market risk measurement.

2.3. Impact of Basel I on Banks

The original purpose of the Basel I regulations was to force banks to maintain some minimal level of regulatory capital against their risky assets and thus to put a check on their activities as originators of credit by encouraging them to enlarge their capital positions Jablecki (2009). But as almost every fifth grader knows, there are two ways to alter the fraction. The first way would be the way that the BCBS envisioned when they proposed the Basel I regulations; it is done via increasing the numerator. But the possibilities of financial markets enabled banks to alter the fraction via decreasing the denominator. This created, as the CEPS Task Force (2008) puts it in their report, 'perverse incentives' to move exposures off balance sheet. Also, because the Basel I had a limited differentiation among degrees of risk, the environment for 'gaming' of banks was created, meaning that banks engaged in regulatory arbitrage through asset securitization and other innovative financial vehicles.

2.4. Basel II

Because all assets were weighted by the same proportion without giving a regard to the quality of them, this situation lead to two things. First aspect was that banks have moved to riskier assets and the latter was that banks started to securitize to move assets from its balance sheet. This had created a need for a new regulation. The Basel II regulation itself was published in the 2004 and it brought several modifications. The Basel II was divided into three pillars.

The aim of the first pillar was to deal with the amount of reserve capital that a bank must hold against its risky assets. Unlike in the case of Basel I, the spectrum of risks was widened to provide a better reflection of a real world situation. The solution was that along with the credit risk, calculation of which has been also modified, the market risk and the operational risk were taken into account. To be specific, we have to look into the BCBS document called

International Convergence of Capital Measurement and Capital Standards, A Revised Framework. The credit risk part is similar to the one of the Basel I, but in the Basel II, bank has to add capital requirements for market risk and operational risk multiplied by 12.5 to the sum of risk weighted assets, then the result will be the sum of total weighted assets, which shall be used for calculation of minimal reserve capital. Other change that is worth noting is the change of specific weights, where the 150% weight has been added for the most risky capital.

The capital, which the bank should use to cover the total risk weighted assets, was divided into Tiers 1, 2 and 3. The Tier 1 capital, or the basic equity capital, should consist, as its name suggests, of equity capital and disclosed reserves, because their levels are published in banks accounts and hence, it is easy to check their values. The Tier 2 capital consisted of undisclosed reserves, revaluation reserves, general provisions, hybrid debt capital instruments and subordinated term debt. And the last, Tier 3 capital, was a short-term subordinated debt covering the market risk, but its inclusion was optional and aimed only to cover the proportion of capital requirements for market risks.

As mentioned earlier, the total risk weighted assets were enhanced by the inclusion of the market risk and the operational risk and moreover, the credit risk computation itself has been changed. The Basel II offered banks two alternatives; they could either use the standardized approach, or rely on their own Internal Based Risk Approach. The standardized approach was based on the reliance on the ratings of external agencies. For example, in the case on claims on corporate, the risk weight table looked like this:

Table 1: Risk Weights under Basel II

Credit assessment	AAA to AA	A+ to A-	BBB+ to BB-	Bellow BB-	Unrated
Risk weight	20%	50%	100%	150%	100%

Source BCBS(2006)

When we look at the situation from the Czech bank perspective, we may see that this type of standardized approach doesn't change much the situation of the Basel I. Since most of the local loan seeking companies have no external rating, so they fall into the unrated bracket and the minimum capital requirements remain at the same level. To solve this, bank could use the internal based risk approach, where the bank should apply measures of probability of

default, loss given default, exposure at default and effective maturity. The aim of these approaches is to make low risk clients more attractive for banks.

In the measurement of the operational risk, Basel II offered three alternatives, The Basic Indicator Approach, The Standardized Approach and Advanced Measurement Approaches. The Basic Indicator Approach was, as it name itself suggests, basic and available to every bank. To choose The Standardized Approach the bank must fulfil given criteria, guaranteeing that the bank administration is able to compute such indicator. And if the bank chooses Advanced Measurement Approaches, or in other words, has its own internal measurement of operational risk, it must fulfil given quality and quantity standards.

And for the measurement of the last of the risks, the market risk, the Basel II again offered banks to use predefined standardized approach, or to use its own internal models, which should meet the qualitative and quantitative criteria.

The second pillar of Basel II deals with the supervisory issues. The second pillar itself was divided into four principles. These principles in a nutshell summarize duties of the banks and their supervisors. According to these principles, banks should have their internal measures to assess their own capital adequacy, supervisors should review these assessments and take actions in the case they are not satisfied. And the last two principles advise supervisors to expect banks to operate above the minimal regulatory capital ratios and to intervene as soon as possible to prevent regulatory capital to decrease below the minimum level.

The last of these pillars deals with the market discipline. According to BCBS(2006), banks should be transparent via quantitative and qualitative disclosure of each particular bank's capital and risks.

As stated earlier, the Basel II regulation has been introduced in 2004, the implementation process take place in following years. According to BCBS document from October 2011, BCBS(2011a), the Basel II has been implemented in almost every participating country, the only exceptions being Argentina, Indonesia and Russia, but the last one only because of the lagged implementation of the second pillar.

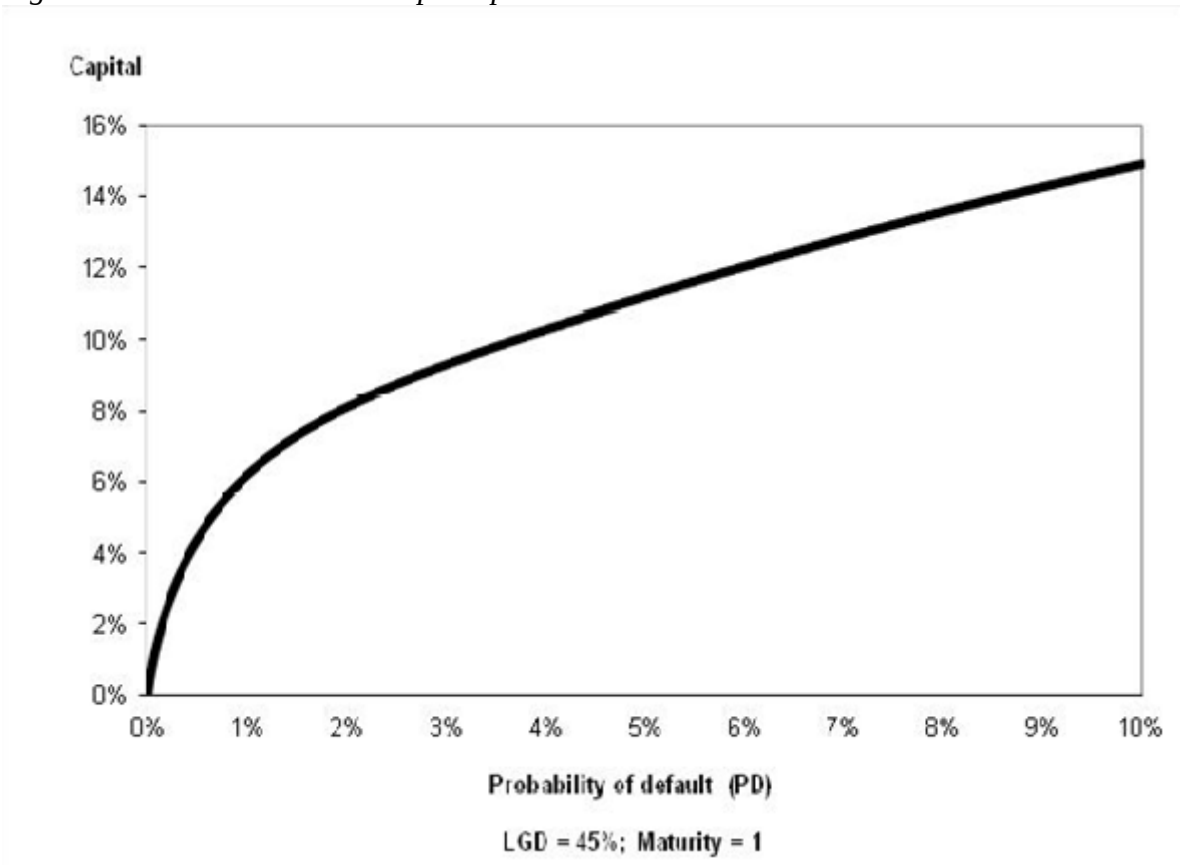
2.5. The Role of Basel II in the Recent Crisis

To evaluate the impact of the Basel II on the recent crisis is not an easy task. The easy way to look at this problem is to say that the Basel II was flawed from the very beginning and so the economy was doomed. Indeed, there were many flaws in the Basel II proposal. One of these flaws was procyclicality.

Where does this procyclicality come from? In the Basel I regulations, the capital requirement was set as the 8 percent of risk weighted assets, with no respect to any other exogenous variables, until 1995, when it had been enhanced by the coverage of market risk. Yet it was still deemed as insensitive to other variables, specifically the operational risk. This situation had lead to the introduction of a new legislative called Basel II. In Basel II, capital requirements are risk sensitive, because of the market and operational risk parts. For example Blundel-Wignal, Atkinson(2010) explain this procyclitality with the explanation, that PD, EAD and LGD, which should be used in the IRB, are a function of the cycle. This implies that the higher the risk, the higher the capital requirements. This has been noted at the time of implementation and it was partially addressed, but the procyclicality of the capital requirements remained, as we may read in Munstermann(2005). This procyclicality had created an immense flaw in regulation, which was fully exposed by the recent crisis. In the good times, when economy grows fast and risks are low, the capital requirements on the bank are at their lowest point, so the bank can utilize more money for lending to customers or institutions. What result can we make of this? The growth of the economy influences many people to try their luck, start their own entrepreneurship business. And since the economy is growing, people have some excess money they want to spend it is likely that they will succeed. But as the economy reaches the peak, the growth starts to slow down and the risks grow higher. The higher probabilities of default (in other words higher risks) come along higher capital requirements for banks. And with those higher capital requirements, the bank needs the immediate rise of their own capital. And one of the simplest ways is to call back its outstanding loans. But as some of these loans will be unpaid, because of the current insolvency of its clients, the bank is still short of capital, in other words illiquid. And let's suppose that information of this illiquidness leaks out to the public, bank customers want to withdraw their money as quickly as they can, in other words they make a run on the bank. To sum this article up, the procyclical capital regulations enables to lend out the money in good times, instead of using them as a reserve for the times of crisis. This procyclicality of Basel II has been documented by various researchers, as one of them I may cite the work of Repullo,

Saurina and Trucharte (2009) who had calculated the capital requirement for corporate exposures in a way that may be seen in the next graph.

Figure 1:CR and DP relationship in Spain

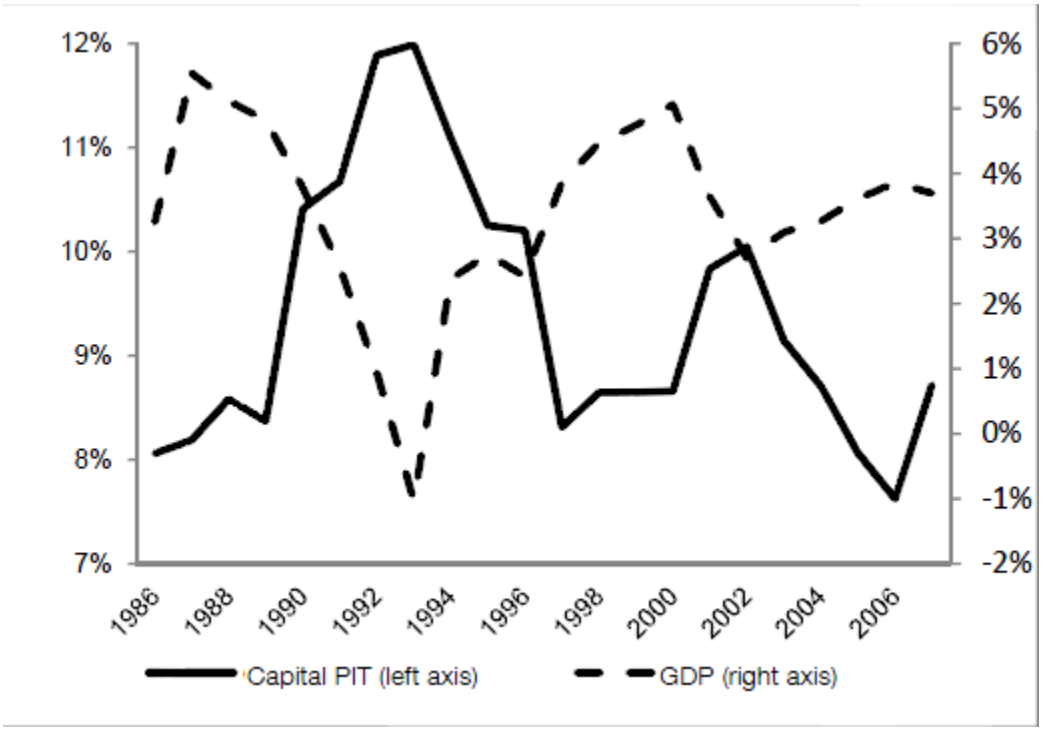


Source: Repullo, Saurina and Trucharte (2009)

This graph is representing the capital requirement corporate exposure given that loss given default is 45 percent and maturity is 1. As we may see, with the increase of probability of default from 1% to 3%, the capital requirement is increased by more than half.

And if we take a look at another graph from the Repullo, Saurina and Trucharte (2010), we may see the prove of the procyclicality of Basel II regulations shown on the datasets from Spanish banks.

Figure 2: CP and GDP growth in time in Spain



Source: Repullo, Suarez and Trucharte (2009)

This graph is plotting the aggregate point-in-time Basel II capital requirements per unit of loans for the portfolio of commercial and industrial loans of Spanish banks against the Spanish GDP growth rate. Just a simple look on this graph is enough to capture the procyclicality of Basel II capital requirements.

Another of the reasons seen as the Basel II implied triggers of the financial crisis is the overreliance on the credit agencies. As we may recall from the previous text, the risk-weight given to certain asset is determined on the base of external rating of this particular asset. But as the case of fall of Lehman Brothers showed, these ratings weren't able to describe the real situation. Having the case of Lehman brothers as an example, even in the abstract of the report, which was published on 12th September 2009, Standard and Poor´s had affirmed the AAA and AAAt to Lehman Brothers Financial Products Inc. and Lehman Brothers Derivatives Products Inc., respectively (Xie(2008)). Three days later, on the 15th September 2009, Lehman Brothers had filed for bankruptcy protection.

The most important issue, which arises from the misjudgement of the CRA, is the subsequent diminishing of the required capital requirements. As stated earlier, the higher the rating, the lower the risk-weight. And in the case of structured credit products, if their

issuance should have been successful, the AAA rating was desired. As a result of this, the banking sector had developed a broad variety of means how to make CRAs to give their products the highest possible rating Atik(2010). These ways are called the credit enhancement techniques. There are many types of these techniques, as an example of those that were most used in the recent years, we may take credit tranching or overcollateralization. In a nutshell, the credit tranching involves sequential application of the losses, so the loss will affect only those so called junior tranches, while senior tranches will remain unaffected. On the other hand, the overcollateralization implies that the value of the loan pool exceeds the total principal amount of issued securities. For illustration, *as of April 2008, about 75 percent of U.S. subprime mortgage loan originations were securitized, of which about 80 percent were funded by AAA rated MBS senior tranches*. Sy(2009).

But this artificial enhancement has its consequences, which were fully revealed in the recent crisis. In the case of MBS, where, according to the FCIC (2011), Moody's have rated nearly 45000 of them as AAA between 2000 and 2007, there were 83% downgraded. In the case of CDOs, the downgrade of U.S. CDO securities in the year 2007 affected 20% of them and in 2009, 91% of them were downgraded. One of the mistakes made by CRAs was the neglecting of correlations between the CDOs. To be more specific, we may cite the FCIC*: In plainer English, Witt said, Moody's didn't have a good model on which to estimate correlations between mortgage-backed securities—so they "made them up."*

Now it seems like an easy call to condemn CRAs for eternity, but better way out of this mess is to enhance regulatory environment in which CRAs operate, because there are still some benefits that external credit rating may provide. Sy(2009)

i) They help to mitigate the fundamental informational asymmetry in capital markets between investors and firms seeking external financing

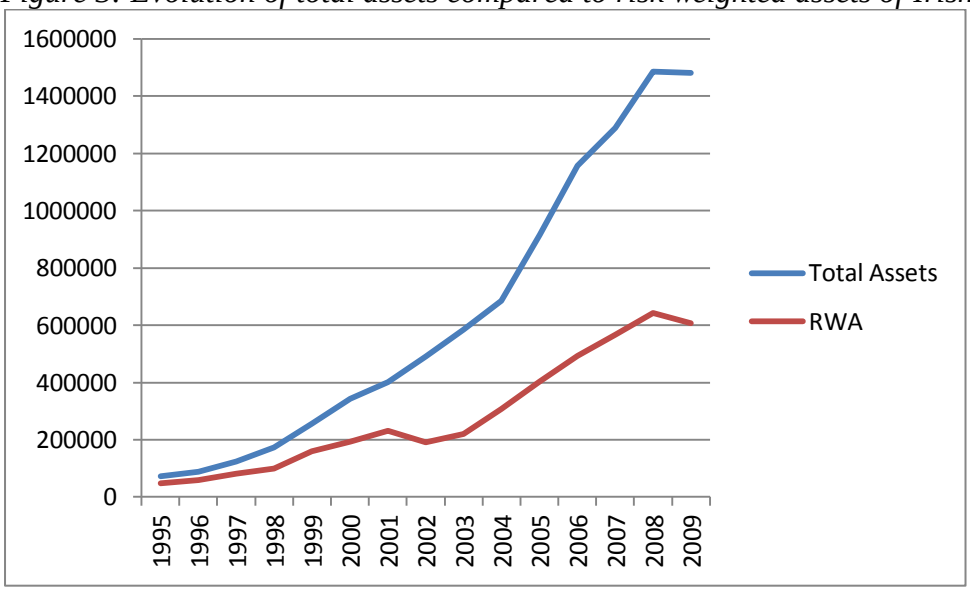
ii) They can solve some principal-agent problems

iii) They can solve collective action problems between dispersed bond investors, where the downgrade below given level can trigger investors to take an action and seek debt restructuring

The other reason, why is the Basel II seen as one of the reasons behind the immense scope of the recent crisis, is due to the inherited issues from Basel I. This can be shown on the charts

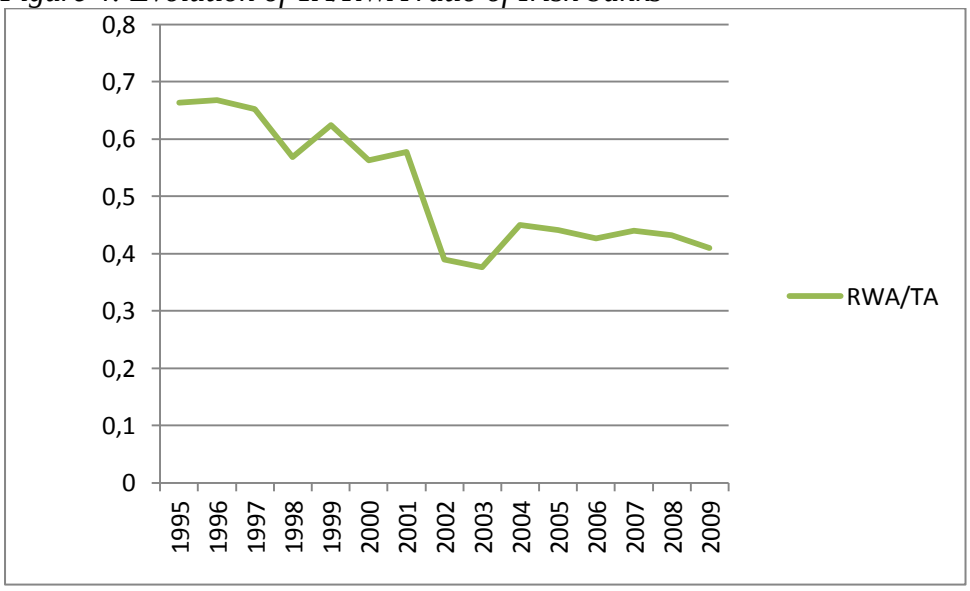
below, which depict the evolution of total assets and risk weighted assets of Irish banks and the evolution of its ratio, respectively.

Figure 3: Evolution of total assets compared to risk weighted assets of Irish banks



Source: OECD

Figure 4: Evolution of TA/RWA ratio of Irish banks



Source: OECD

From the chart above, we may clearly see that the increase in total assets of Irish banks is far steeper than the rise of risk weighted assets. This is supported by Lall(2009), who claims that the Basel II had failed to neutralize the systemic threat of undercapitalization.

3. Basel III

3.1. Basel III Introduction

Following the recent crisis, when many flaws of Basel II regulation came onto the surface, it was obvious that a new regulation is needed. As a result of this, in the 2010 the BCBS issued a report, in which it responded to the issues that had aroused from the then-recent crisis. There were two sets of reforms in this response, micro prudential and macro prudential. The main goal of micro prudential reforms is to ensure the higher liquidity of banks via strengthening and enhancing their reserve capital. As the crisis had shown, 2% level of equity capital was not enough, so the level should be raised. And concerning the liquidity, the Liquidity Coverage Ratio and the Net Stable Funding Ratio should ensure that the bank is ready for the times of financial distress. From the macro prudential reforms, the most important thing is according to BCBS to deal with procyclicality of Basel II via several capital buffers. These proposals were then released in the December of 2010 and revised version was released in June 2011.

3.2. Change of Capital Ratios

The first of these important micro prudential topics covered in the Basel III documents is the desired structure of banks' capital. As mentioned earlier, in the Basel II regulations, the regulatory capital was divided into three groups, Tier 1, Tier 2 and Tier 3 capitals. Because of the insufficient high quality capital and inconsistencies in definitions of capital across definitions, the new proposal deals with the desired structure of banks capital (BCBS(2011)). In the Basel III proposal, the structure has been reduced to two Tiers, Tier 1 and Tier 2, Tier 1 being the going concern capital and Tier 2 the gone concern capital. In other words, the Tier 1 should be used to ensure bank's ability to fulfil its obligations and Tier 2 to settle the debts after the potential default.

In the proposal, the Tier 1 itself has been divided to Common Equity Tier 1 and Additional Tier 1. The Common Equity Tier 1 capital consists of (BCBS(2011b)):

i) common shares issued by the bank that meet the criteria for classification as common shares for regulatory purposes

ii) stock surplus resulting from the issue of instruments included in Common Equity Tier 1

iii) retained earnings

iv) accumulated other comprehensive income and other disclosed reserves

v) common shares issued by bank's subsidiaries and held by third parties, these shares must meet the criteria for inclusion into the Common Equity Tier 1
vi) regulatory adjustments applied in the calculation of Common Equity Tier 1

As we can see from the previous list, these types of capital are high quality and moreover, they should be highly liquid. The most illiquid of these would be the common shares issued by the bank, so the BCBS has added into the Basel III proposal criteria to be fulfilled so the common share can be used for regulatory purposes. These criteria states, that such capital must be equity and must be accounted as equity.

The latter part of the Tier 1 capital is the Additional Tier 1 capital. According to BCBS, it consists of these elements.
i) instruments issued by the bank that meet the given criteria for inclusion in the Additional Tier 1 capital and moreover, it must not be already included into the Common Equity Tier 1.
ii) stock surplus resulting from the issue of instruments included in the Additional Tier 1 capital
iii) instruments issued by consolidated subsidiaries of the bank and held by third parties, and as in the case of Common Equity Tier 1, these instruments must meet the criteria for inclusion in the Additional Tier 1 capital and they should not be already included in the Common Equity Tier 1 capital
iv) regulatory adjustments applied in the calculation of Additional Tier 1 capital

Criteria for inclusion in Additional Tier 1 capital are such that only an instrument that behaves like equity can be included. This means that the instrument should be perpetual, subordinated and not secured in any way and the bank has full discretion to cancel dividend payments and this cancellation should not be seen as an event of default at any time.
Now let us have a look at the Tier 2 capital. According to the BCBS proposal, the Tier 2 capital should consist of these elements:
i) instruments issued by the bank that meet the criteria for inclusion in the Tier 2 capital and that are not included in the Tier 1 capital.
ii) stock surplus resulting from the issue of these instruments
iii) instruments issued by bank's consolidated subsidiaries and held by third parties that meet the criteria for inclusion in the Tier 2 capital and are not included in the Tier 1 capital in the same time
iv) certain loss provisions

v) regulatory adjustments applied in the calculations of Tier 2 capital

These criteria for inclusion into the Tier 2 capital are the loosest of all beforehand mentioned. It shares the element of subordination, but unlike the Tier 1 capital, Tier 2 capital can mature, but this maturity should be at least 5 years.

3.3. Capital Conservation Buffer

Another innovation proposed by BCBS in the Basel III is the so called Capital Conservation Buffer. This buffer is aimed to guarantee that the bank can remain solvent in periods of stress. This capital conservation buffer is established as 2.5% reserve comprised of Common Equity Tier 1 held above minimum capital requirement for common equity in the Tier 1 capital, which is set to 4.5%. One of the features of this buffer is that in the event when the amount of the buffer falls below 2.5%, the capital distribution constraints will be imposed on the bank. In other words, if the buffer is too small, the bank must use its earnings to refill it in a way that is suggested in the BCBS material. For example the bank that has its Common Equity Tier 1 capital ratio between 5.75% and 6.375% can distribute only 40% of its earnings. To achieve higher amount of redistributable earnings, it must enlarge its CET1 capital ratio.

The calibration of this capital framework in Basel III looks like this:

Table 2: Capital Ratios under Basel III

	Common Equity Tier 1	Tier 1 Capital	Total capital
Minimum	4.5	6.0	8.0
Conservation Buffer	2.5		
Minimum plus conservation buffer	7.0	8.5	10.5

Source: BCBS(2011b)

3.4. Deductions

To strengthen the regulatory capital, the BCBS(2011b) have set a list of regulatory adjustments, which should be applied in the calculation of CET1. The list of items that should be deducted from the CET 1 calculation consists of:

- *Goodwill and other intangibles*
- *Deferred tax assets that rely on future probability*
- *Cash flow hedge reserve that relates to the hedging of items that are not fair valued on the balance sheet*
- *Shortfall of the stock provisions to expected losses*
- *Gain or sale related to securitization transactions*
- *Cumulative gains and losses due to changes in own credit risk on fair valued financial liabilities*
- *Defined benefit pension fund assets and liabilities*
- *Investments in own shares*
- *Reciprocal cross holdings in the capital of banking, financial and insurance entities Investments in the capital of banking, financial and insurance entities that are outside the*
- *Scope of regulatory consolidation and where the bank does not own more than 10% of the*
- *Issued common share capital of the entity*
- *Significant investments in the capital of banking, financial and insurance entities that are outside the scope of regulatory consolidation*
- *Threshold deductions*
- *Former deductions from capital*

3.5. The Countercyclical Buffer

The countercyclical buffer is one of the most innovative instruments introduced in the Basel III proposal. Its purpose is to, as the name itself suggests, to force banks to act countercyclically, not procyclically. The depiction of procyclicality was provided earlier, so now it is time to look at the measures that BCBS have taken in the Basel III regulations.

The Basel III legislative is well aware of the procyclicality of its predecessor and it suggests a remedy for this problem. A remedy called the countercyclical buffer. According to BCBS(2011b), the countercyclical buffer is aimed to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate. The countercyclical buffer regime will consist of three parts, the national, the bank specific and the extension of the capital conservation buffer. On the national level, there would be need to identify an authority, which will be responsible for the setting of countercyclical buffer, and in the case of excess credit growth which would later lead to build up of system wide risk, it may utilize said buffer. Amount of this buffer will be between 0% and 2.5% of risk weighted assets. The adjustment period of this buffer will differ according to the nature of the change. In the case of increase of this buffer, the 12 month adjustment period is proposed. On the other hand, in the case of decrease of this buffer, there would be no adjustment period, changes can be made immediately. The look of BCBS from the bank perspective is following. Banks will be subject to this countercyclical buffer that will vary between 0% and 2.5%. Moreover, this buffer should be met using the Tier 1 assets. The fact that the buffer is met by Tier 1 assets is based on the fact of their going concern nature, so the bank would be able to meet them without declaring default. In the case of internationally active banks, those banks should calculate their required countercyclical buffer based on the geographical location of their private sectors exposures and calculate its weighted average.

Now that we know what is the rationale behind the Countercyclical Buffer, we should take a look how it shall work in reality according to the Basel III proposal, as according to BCBS(2010)

The BCBS has selected the credit-to-GDP ratio as a measure on which the countercyclical buffer should be based. According to the BCBS, there are several advantages of this approach. One of these advantages is that this ratio is normalized to the size of the respective economy, so there shouldn't be any "one approach fits all" inconsistencies. Another advantage is that there shouldn't be any spurious activity in this ratio and moreover, it should be able to point out the build-up phase. Now it is time to summarize the procyclicality buffer as it is proposed in the guidance materials provided by BCBS. As the measure, which will indicate what percentage of capital should be kept by banks BCBS suggests the credit to GDP ratio. Let's define the gap as $z_t=x_t-\dot{x}_t$. Then the formula for the percentage is 0 if z_t is smaller than L, $2.5*z_t$-L/H-L if z_t is smaller than Z and larger than L and 2.5 if z_t is higher than Z. Suggested

values of L and H are 2 and 10, respectively. This measure shall ensure that the values of the Countercyclical buffer will move within the proposed interval between 0 and 2.5

3.6. Risk Coverage

Another important part of the Basel III regulations is the enhancement of risk coverage. This section of regulations needed revision, because according to BCBS(2011b), the *failure to capture on and off balance sheet risks, as well as derivative related exposures was a key factor that amplified the crisis*. There are several changes to the Basel II regulations, almost all of them are done via insertion of respective paragraphs. To describe the full extent of these changes would mean to write down loads of Basel II paragraphs, so in our thesis, we will stick to the highlighting those changes, which are the most important.

Probably the most important theme from this section is the stress testing. The Basel III regulations state that banks have to perform a comprehensive stress testing for a counterparty credit risk, which must include several specified element. Via this stress testing, the bank should be able to identify concentrations of directional sensitivities and reduce them. In these stress tests, the bank should set the severity of factors to capture extreme market environments, but also they should be plausible. The Basel III also enhances the requirements for model backtesting, which should be done regularly and the board of directors and senior management should be actively involved in this task. Another part of this enhancement is the keeping of the Stressed Value at Risk (S-VaR) as an addition to the regular Valuer at Risk (VaR). This measure is partially identical to the regular VaR, but the most important difference is the fact that it should be calibrated to historical data from a continuous 12 month period of significant financial stress, which should be relevant to the bank' portfolio. BCBS(2011b). This should deal with the shortcomings of the regular VaR, such as understating of risks, since its purpose was to capture regular bad outcomes, which were expected to happen, not outcomes of crisis panic, as Varotto(2011) claims.

3.7. Liquidity Ratios

Due to the fact that the illiquidity of banks portfolios is seen as one of the reasons behind the recent crisis, the BCBS(2011c) has come out with two standards, whose following by banks should ensure, that they wouldn't fall into the illiquidity again. The first of these ratios is the Liquidity Coverage Ratio and the latter is called The Net Stable Funding Ratio. Their time horizon is one month and one year, respectively.

3.7.1. **The Liquidity Coverage Ratio**

The Liquidity Coverage Ratio is aimed to ensure that bank can fulfil its obligations during 30 days of significantly severe liquidity stress scenario specified by supervisors. The horizon of 30 days has been set because its authors assume that after this period, corrective actions would be taken and the functionality of the bank can be resolved.
The ratio is defined as follows:

$$\frac{\text{Stocks of high} - \text{quality liquid assets}}{\text{Total net cash outflows over the next 30 calendar days}} \geq 100\%$$

This ratio should be calculated daily, for 30 calendar days into the future and the bank is supposed to meet this ratio continuously. To fully grasp this formula, the numerator and the denominator should be defined. The numerator, stocks of high quality liquid assets, is defined in this way. They should have low credit and market risk, be easily valuated, have low correlation with risky assets and listed on developed and recognized exchange market. All these fundamental characteristics guarantee that when in need, bank should be able to sell these assets on reliable market for certain value to regular risk averse buyer. The market characteristics of these assets comprise of such properties as active and sizeable market, presence of committed market makers, low market concentration and so called flight to quality, whose should guarantee that market, on which these assets are traded, would be large with active traders willing to buy these assets even in the time of crisis.

These assets are divided into level 1 assets and level 2 assets, level 1 assets having more quality and liquidity and no imposed restrictions, level 2 assets on the other hand being worse in those qualities and having a restriction, which impose that they should be included only up to 40% percent of the overall amount of stocks of high-quality assets. To be more specific, level 1 assets consist of cash, central bank reserves and marketable securities guaranteed by large and important institution, such as central bank or International Monetary Fund, with 0% risk weight under the Basel II Standardized approach. In the case of level 2 assets, these consist of marketable securities with 20% risk weight under Basel II Standardized Approach and corporate bonds and covered bonds, whose external credit assessment (or internally estimated probability of default) is at least AA-. Because of lesser quality and liquidity of these assets, there is a minimal haircut of 15%, which is to be applied to the current market value of level 2 assets.

Now when the high-quality assets are described, it is important to look at the definition of total net cash outflows. As the term net suggests, its value is equal to total expected cash outflows minus total expected cash inflows during the specified scenario for the subsequent 30 days. The expected cash inflows should not exceed 75% of expected cash outflows. The formula that depicts this looks like this:

Total net cash outflows over the next 30 days = outflows – min{inflows; 75% of outflows}

The important thing to note is that banks cannot double count any item, once it is in one part of the fraction, it cannot be added to the other. The term "cash outflows" is in the BCBS is divided into several subcategories. This division mainly depends on the owner of the deposit, whether it is a natural person or a legal entity and whether it is secured or unsecured, plus there is a detailed specification of those that didn't fit into any of previous subdivisions. Cash inflows are defined as inflows coming in next 30 days and moreover, the source of this cash inflow should be stable, reliable and with none prospect of default whatsoever within the 30 day horizon. And as mentioned earlier, the level of cash inflows is capped at 75% level of total expected cash outflows to prevent banks to rely only on the predicted cash inflows. The simple mathematics then tells us that bank has to hold at least one quarter of its predicted cash outflows in liquid assets.

3.7.2. **Net Stable Funding Ratio**

Whereas the Liquidity Coverage Ratio is aimed at ensuring liquidity of a bank in a short period, the latter ratio, Net Stable Funding Ratio, should promote more medium and long term funding of assets and activities of banking organizations. To do so, it should force banks to fund their long term assets with at least a minimum amount of stable liabilities. To quote the BCBS, the NSFR aims to limit over-reliance on short-term wholesale funding during times of buoyant market liquidity and encourage better assessment of liquidity risk across on-balance and off-balance sheet items. This ratio is defined as follows:

$$\frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} > 100\%$$

And as in the case of previous ratio, for full understanding it is important to define both parts of the fraction. The numerator, available amount of stable funding, is in the BCBS materials defined as total amount of banks capital, proffered stock with maturity longer than one year, liabilities with maturities of one year or greater, the portion of non-maturity deposits and/or term deposits with maturities of less than one year that would be expected to stay with the institution for an extended period in an idiosyncratic stress event and finally, the portion of wholesale funding with maturities less than one year that it expected to stay with the institution for an extended period in an idiosyncratic stress event. To sum this up, these sources of stable funding should be available to the bank during the time or crisis. This would ensure that the bank is solvent enough to fulfil possible obligations. When calculating this ratio, these sources of stable funding are sorted into brackets and each of these brackets is assigned with its own weight.

When it comes to description of the latter part of this fraction, the required amount of stable funding, the BCBS material offers its readers much less information. The determination of what amount should be required is given to supervisors, who should use their supervisory assumptions to do so. The supervisor should utilize characteristic of the liquidity risk profiles of particular institutions assets, off-balance sheet exposures and other selected activities. The amount of assets the institution possesses should be added up, each of these assets should be multiplied by the factor given to its bracket, that is similar to the approach to the available amount of stable funding, and then the result should be added up to the institution's amount of off-balance sheet activity.

Here we can see BCBS' endeavour to mitigate the lack of attention given to the off-balance sheet items, which were one of the reasons of the severity of recent crisis. So if the supervisor examines the situation correctly, the bank should be able to fulfil its medium/long-term obligations even in the time of an extended period of an idiosyncratic stress event.

3.7.3. **Monitoring Tools**

To ensure the ongoing liquidity of the bank, the BCSB suggest a set of monitoring tools, which should help supervisors to detect possible threats. These metrics are: the contractual maturity mismatch, the concentration of funding, the available unencumbered assets, the LCR by significant currency and the market related monitoring tool. The focus of these metrics is

self-evident from their names. The contractual maturity mismatch is aimed to identify gaps between contractual inflows and outflows of liquidity for defined time brands. Leverage Ratio

Another of the new arrangements proposed by the Basel III regulations is the leverage ratio. The rationale behind this ratio is to prevent banks from building up an excessive leverage ratios, both on-balance and off-balance sheet, respectively. According to BCBS(2011b), this ratio should be non-risk based and calibrated to, as stated earlier, constrain the build-up of leverage in the banking sector and to reinforce the risk based requirements with non risk based measure. The proposal states, how the capital and the exposure should be measured.

The capital measure should be based on the Tier 1 ratio as it is defined in the Basel III regulations and there should be no double counting, so the items, which are completely deducted from the capital, should be also deducted from the measure of exposure. And the exposure measure should consist of on-balance and off-balance items, which means Security Financing Transactions, such as repurchase agreements and securities finance, on the on-balance sheet side and instruments, such as commitments, direct credit substitutes, trade letters of credit, failed transactions or unsettled securities. These off-balance sheets should have uniform 100% credit conversion factor, because the BCBS recognizes them as a source of potentially significant leverage. The only exception will be unconditionally cancellable commitments, which should have a 10% credit conversion factor.

The actual form of this ratio is yet to be specified by BCBS, but according to the material, the minimum Tier 1 leverage ratio of 3% will be tested between January 2013 and January 2017, plus it should be decided, whether there should be a wider definition of exposures.

3.8. Timeline of the Implementation

The timeline of the implementation of Basel III is proposed as can be seen in the following table.

Table 3: Timeline of Basel III Implementation

	2011	2012	2013	2014	2015	2016	2017	2018	As of 1.1. 2019
Leverage Ratio	Supervisory monitoring		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015					Migration to Pillar 1	
Minium Common Equity Ratio			3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital Conservation Buffer						0.625 %	1.25%	1.875%	2.50%
Minimum Common Equity Plus Capital Conservation Buffer			3.5%	4.0%	4.5%	5.125 %	5.75%	6.375%	7.0%
Phase-in of Deductions from CET1				20%	40%	60%	80%	100%	100%
Minimum Tier 1 Capital			4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum Total Capital			8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum Total Capital Plus Conservation Buffer			8.0%	8.0%	8.0%	8.625 %	9.25%	9.875%	10.5%
Capital Instruments that No Longer Qualify as non-core Tier 1 Capital or Tier 2 Capital			Phase out over 10 year horizon beginning 2013						
Liquidity Coverage Ratio	Observation period begins				Introduce minimum standard				
Net Stable Funding Ratio	Observation period begins							Introduce minimum standard	

Source: BCBS(2011b)

4. Literature overview

4.1. Quantitative Impact Study

Before we start our own analysis of the impact of Basel III regulations on banks, we should look at the results of other authors' works. But since the Basel III is a relatively new regulation, the spectrum of authors, which had tried to examine the impact of the Basel III regulation on the economy, is relatively low. But nonetheless, there are some important results, which may enlighten us in our research. The first and one of the most important works on this field is the Comprehensive Quantitative Study (from now on referenced as BCBS(2010b)). This study was conducted in order to examine how the new definitions of capital affect will affect the accounting values of capital of banks. But why is this study so important to our research? The answer is simple; the importance of this study arises from the quality of data it has been working with. The first thing to note is that the scope of the work is impressive, a total of 263 banks from 23 countries have participated in this research, all of them were asked to provide consolidated data as of 31st December 2009. And the second important fact is that banks had sent non-public data. For further notice, banks in this study were divided into two groups, first consisting of internationally active banks with Tier 1 Capital higher then €3,000,000,000, the latter consisting of the rest. The results in this study represent an aggregate bank; it is obvious that results of individual banks can differ.

4.1.1. Change of Capital Ratios

The first fact we may take from the BCBS(2010b) is the change in banks' capital ratios due to the Basel III redefinitions of CET1, Tier 1 Capital, Tier 2 Capital and of the calculation of risk weighted assets.

Table 4: Comparison of Basel II and Basel III CR calculated as of 2009

	Number of banks	CET 1		Tier 1		Total	
		Gross	Net	Current	New	Current	New
Group 1	74	11.1	5.7	10.5	6.3	14.0	8.4
Group 2	133	10.7	7.8	9.8	8.1	12.8	10.3

Source BCBS(2010b)

Before we start to make conclusions from the table above, we must first define, what is meant by numbers within. In the column named CET1, the column 'Gross' shows us the ratio of gross CET1 to risk weighted assets under the current definition and the column 'Net' shows the net ratio of net CET1 to the risk weighted assets under the new definition. Next columns

are self-explanatory; both show us how the new definition of Tier 1 and Tier 2 capital, respectively, will change values of capital reserve rations of banks. If we are to interpret the meaning of these numbers, there is no doubt what the main message is. In both groups all ratios decline. In the case of Group 1 banks this decline is huge; the Tier 1 ratio would decline by 40%, from 10.5% to 6.3%. To see a clearer picture, we may take into an account the edge level of Tier 1 capital that was used to split banks into two groups. Given, that our hypothetical bank has €3 billion of Tier 1 capital, we may find that under the new Basel III regulation, this value will fall to €1.8 billion, in other words €1.2 billion would need to be replaced by capital with higher quality in order to maintain on its' original ratio. The fall in total capital ratios of Group 1 is expected the same, again by 40%, this time from 14.0% to 8.4%. The decline in Tier 1 ratio and total capital ratio, respectively, of Group 2 banks is expected to be smaller, in both cases it is a little bellow the 20%. This is certainly one of the reasons behind the Basel III regulations; the quality of reserve capital should increase. But there is other side to this change; the banks would still need to maintain their capital ratios. The BCBS(2010b) gives us few numbers, which shows us, how much will banks from their sample need to meet the minimum capital requirements of Basel III. In the Group 1, banks would need additional capital of €165 billion just to meet the 4% CET1 minimum requirement. In case of 7% CET1 requirement, the amount of additional capital will increase to €577 billion. And given that BCBS(2010b) states that the sum of profits after taxes across the Group 1 was €209 billion, we may see that the task of raising capital would not be easy. In the case of Group 2 banks, the estimates are less threatening, the additional amount needed to achieve the 4% CET1 ratio is €8 billion, in the case of 7% CET1 ratio it is €25 billion and the sum of their profits after taxation is €20 billion. The main reason behind these declines is the deduction of goodwill, deferred tax assets and holdings in other financial institutions. The most important parts of these deductions from the CET1 for Groups 1 and 2 are depicted in the following table

Table 5: Deductions from the CET1 under Basel III

	Goodwill	DTA	Intangibles	Financials	Total
Group 1	-19.0%	-7.0	-4.6	-4.3	-41.3
Group 2	-9.4%	-2.8	-2.3	-5.5	-24.7

Source BCBS(2010b)

Again, we may see that the impact of Basel III regulations will be more severe in the case of Group 1 banks.

To conclude the section concerning capital ratios, we may say that if Basel III regulation were implemented instantly, the decline in capital ratios will be immense and that it would be difficult for banks to replace this capital due to the fact that they would need to raise more capital, then they earn. But as mentioned earlier, the Basel III implementation is a long process, so banks have time to increase their capital level incrementally.

4.1.2. **Changes in Risk Weighted Assets.**

So far, we have had dealt with the issue how would the full implementation of Basel III regulations in the end of 2009 affect the accounting values of capital in the surveyed banks. But as we have mentioned in chapters concerning the Basel III regulations, there are more things that will change apart from the capital ratios. In the case of risk weighted assets, the situation is reversed. The table below will show the impact of full Basel III implementation.

Table 6: Changes in RWA under Basel III

	Def. Of Capital	Counterparty Credit Risk	Securitization in the Banking Book	sVAR	Incremental Risk Charge and Securitizations in the trading book	Equity SMM	Overall
Group 1	6.0	7.6	1.7	2.3	5.1	0.2	23.0
Group 2	3.2	0.3	0.1	0.3	0.1	0.2	4.0

Source BCBS(2010b)

Numbers in the table above shows us that again, the purpose of the Basel III regulations is fulfilled. As we can clearly see, the increase in risk weighted assets is driven by the changed measurement of the counterparty credit risk and securitizations, thus answering one the most troubling issue of the recent crisis. Moreover, we may again spot the difference of impact of Basel III implementation on banks from Group 1 and Group 2, respectively. Again, the impact on the larger banks is going to be more severe.

4.1.3. **Implementation of Liquidity Ratios**

The last part of the BCBS(2010b) study is the one, which deals with the effects of liquidity ratios, the aforementioned Liquidity Coverage Ratio and the Net Stable Funding Ratio. As we may recall from the earlier text, the aim of the LCR is to promote short term

resilience of banks to potential liquidity disruptions, so they would be able to withstand a period of 30 day crisis. And again, if we recall the previous text, the denominator of LCR is the net outflow of cash outflow as expected during severe crisis, the numerator is the amount of high quality assets and the fraction as a whole should be higher than 100%. According to BCBS(2010b), the LCR of Group 1 banks was 83%, while Group 2 banks have 98%. As stated in the beginning of this section, these results are just aggregate values, which should show us results of hypothetical bank. In the case of individual banks, the result is that 46% of banks in the sample have already met the minimal LCR requirement. Moreover, with the assumption of unchanged risk profile, the amount of additional capital needed for banks to pass the minimal requirement is estimated at €1.73 trillion. Here it is important to note the most important elements that made up the LCR; the numbers are in the table below.

Table 7: Sources of Cash Outflows

Cash Outflows	Unsecured retail and small bus. cust.	Unsecured Non Financial Corporates	Unsecured Financial Institutions	Collateral, securitizations and own debt
Group 1	9.7	15.9	27.6	24.9
Group 2	18.1	21.4	26.3	10.9

Source BCBS(2010b)

Among other things, the table above clearly depicts the difference between the large and the small bank. The business model of the large international bank is aimed on large customers; whereas the small banks are more aimed at small customers with little interest in securitization. If we take a look at values of cash outflows, we may notice similar notions. According to QIS data, the level of Group 1 banks cash inflows make up only 22.2% of their cash outflows, whereas in the case of Group 2 banks, the amount of cash inflows stacks up to cover the 40.5% of their cash outflows.

In the case of NSFR, whose aim is to address liquidity mismatches and push banks towards the use of sound sources of funding for their activities, the results seem to be so far the best of all mentioned ratios. The average ratio in Group 1 banks is 93% and in Group 2 banks 103%. However, the percentage of banks, which already meet the ratio, is 43%, so the seemingly positive result is probably caused by the curse of the average. The addition capital needed for banks, which didn't met the NSFR minimal requirement of 100%, is €2.89 trillion, but it should be noted that additional capitals for meeting the LCR and NSFR requirements,

respectively, aren't additive, because increase in one ratio can cause the increase in the latter one.

This concludes the results of the Quantitative Impact Study as provided by BCBS. These results shed light at the task of determining the outcome of the Basel III implementation. We may take few main points, which are important for our work. Firstly, it is obvious that the impact on the Group 1 banks is going to be more severe than the impact on the Group 2 banks. The implication of this relationship is the fact that the larger and more internationally active the bank is, the more issues it will have. Secondly, the main changes that will affect the banks behaviour will be the change in capital requirements and the inclusion of liquidity ratios. The capital requirements will not only be higher because of the redefinition done by Basel III, but also the increase of weights of certain assets and the decrease or regulatory capital due to the more strict definitions will make it more difficult for banks to meet these requirements. Moreover, the implementation of liquidity ratios will bring need for even more capital to be held by bank. These two notions will be later on the cornerstones of our model. But more on that later.

4.2. McKinsey Research

Another important research, which may help us understand the consequences of the Basel III implementation is the one conducted by Härle, Lüders, Pepanides, Pfetsch, Poppensieker, Stegeman(2010). The main difference and the source of the importance of this study is the fact that it deals with the Basel III implementation from the view of the banks and tries to anticipate their possible reaction. They have provided their own estimates of the impact of the implementation of new capital ratios. Under requirements 4.5% for core Tier 1 capital, 6% for all Tier 1 capital, 2.5% for the Capital Conservation Buffer and the anticipated additional cushion on top of the regulatory minimum, the total capital shortfall in Europe in 2019 is estimated as €1.1 trillion. There is one interesting note, surprisingly the leverage ratio hasn't added much to this shortfall, but as in the case of the QIS, it may differ across the banking sector. In the case of the LCR, the shortfall is estimated at €1.3 trillion and in the case of NSFR the shortfall is estimated at €2.3 trillion. Moreover, under the assumption of full implementation of all measures of Basel III, the ROE before taxation would decrease by 3.7% or 4.3% the latter is in the case of full NSFR implementation.

The interesting part from their work is the breakdown of impact of Basel III implementation on different business segments. In the case of the retail banking, they

conclude that the main factor, which will affect banks, will be the higher capital and liquidity ratios, because they have been working at lower capital ratios than wholesale banks. This study expects increase in costs of short term retail loans because of the higher risk weights and the higher need for banks liquidity. In the corporate banking sector, the study expects similar effects as in the retail sector; the funding cost of long term corporate loans and long term based financial businesses. The costs will be either transmitted to customers, or will lead to reduction in profitability and consequentially to the decrease of capital allocated to this type of business. There is also expected the severe impact on the unsecured loans due to the higher risk weights. The investment banking sector is also expected to be affected by higher capital ratios, but also by the new securitization and market risk framework. Due to these changes, the profitability of OTC derivatives, cash trading and securitization will decrease.

This study offers us with three options, how the banking sector could react on the Basel III implementation: no regret moves, balance sheet restructuring and business model adjustment. The no regret move option comprises of thorough adaptation to the Basel III regulations, in other words to improve capital efficiency and optimize market risk models in response to higher capital ratios. The balance sheet restructuring would mean to combine optimizing of assets and liabilities together, because under Basel III it would not be affordable. And lastly, banks can adjust their business model, for example they could increase the proportion of short term lending, revise the structure of their customers and subsequently try to optimize this structure to generate higher income with lower risks or they could try to transfer their risk via ways like credit syndication et cetera.

4.3. Other Works about the Basel III

So far, we have described how the new Basel III regulations will look like and how it would change the balance sheet of banks if it was implemented at the end of 2009. Now it is time and place to dip into the views of other authors, unlinked with BCBS. If we look at the big picture, we may find that there are several groups of opinions regarding the Basel III regulations. As in the previous case, we will move through Basel III regulation section by section. In the recent literature, we may find several opinions on the Basel III. Some authors, like Hannoun (2010) address the Basel III as a decisive breakthrough. Others, such as Blundel-Wignal and Atkinson (2010) approve with the purpose of Basel III, but point out some faults, for example the one size fits all approach, which doesn't take into an account

idiosyncratic risk that is associated with individual borrowers in different businesses and regions. Another criticism as mentioned by Blundel-Wignal and Atkinson is the assumption of portfolio invariance, which does not penalise concentrations in portfolios.

4.3.1. Change of Capital Ratios

The one of the most visible changes brought by the Basel III regulations is the change in regulatory capital ratios. Hannoun(2010) argues that the innovation of Basel III is a breakthrough, but this view may be a little biased, because the author is a Deputy General Manager of Bank for International Settlements, under whose auspices the BCBS operates. But nonetheless, these views should be mentioned. The aforementioned breakthrough is, in author's opinion, the focus on the tangible common equity as the component with the highest quality of capital and the greatest loss absorbing capacity. Moreover, author state that the changes to the risk coverage measurement, in other words the change in denominator, are also a breakthrough, because they solve the issues of Basel II. Allen, Chan, Milne and Thomas(2010) add a few remarks about the positive impact of the increase of capital requirements. The first of these arguments is in the line with the initial Basel I argument, which states that higher capital requirements can increase efficiency of banks through encouraging them to make cost reductions and discouraging them from seizing excessive market share at the same time. The second argument states that with higher capital requirements there is higher exposure to the shareholders and so the incentives for risk taking should be reduced. And the last argument they mention is that with higher capital ratios, it is unlikely that banks will ever again engage in excessive extension of credit. Miu , Ozdemir and Geisinger(2010) appreciate the deduction of hybrid instruments from the regulatory capital, because the recent crisis had proven that they are not able to absorb losses. They also imply that the Total Common Equity to RWA is significantly better in predicting the distress than either Tier 1 to RWA ratio or the sum of Tier 1 and Tier 2 ratio, respectively. As mentioned earlier in the text, the increase of the capital requirements raises the question of where will hte banking sector find funds to do so. Slovik and Cournede (2011) found out, for the reaching of capital requirements as demanded in 2015, banks would have to increase their lending spreads by 15 basis points. Moreover, to reach capital requirements as 2019, the increase in lending spreads would be 50 basis points. This increase in lending spreads would have negative effect on the GDP growth, authors' estimate is -0.05 to -0.15 percentage points per annum.

4.3.2. **Capital Conservation Buffer**

In the case of the Capital Conservation Buffer, there are again several opinions. Hannoun (2010) again points out the introduction of the Capital Conservation Buffer as a breakthrough, because it will restrict banks' ability to make inappropriate distributions of capital in the case their capital strength declines, as we may have seen it during the time of recent crisis. Miu, Ozdemir and Geisinger(2010) on the other hand point out not only those aforementioned benefits of the Capital Conservation Buffer, but also mention some negative points. Among the positive notions regarding this buffer, they mention that it should reduce the discretion of senior management in the moments, when capital levels are depleted. This is supported by their citation from the 2009 Financial Stability Report of Bank of England, which concludes that with 20% decrease in discretionary distributions, there would have been generated £75 billion, a number higher than an amount provided by the public sector during the crisis. However, they also mention a few negative impacts of implementation of Capital Conservation Buffer. Their counterpoint points out that in the case of conservative financial institutions, which have a tradition of consistent dividend levels and thus investing in them can be similar to pension savings, this particular buffer will either force them to either significantly increase their target minimal capital level above the buffer, or to have investors potentially bear the risk of higher volatility of dividend payments. Either way it would likely reduce their valuation in long term.

4.3.3. **Countercyclical Buffer**

The proposed Countercyclical Buffer bears the same designation as the previous proposals mentioned in this chapter, Hannoun(2010) describes is as an another breakthrough, due to its aim to eliminate the procyclicality that is inherent in banking and moreover, it was amplified by the risk sensitive capital requirements.

But as Repullo and Saurina (2011) found out, the credit to GDP gap, which is use as the common reference point for taking buffer decision, is moving countercyclically with regard to GDP growth. This had been discovered by computing a correlation between the GDP growth and the Credit to GDP gap and found out, that the relation is generally negative. This means that the low credit to GDP ratio would imply that the buffer should be lowered, but at the same time the GDP growth would be high, so the procyclicality issue wouldn't be solved at all, if anything, this will have an amplifying effect. According to authors' suggestion, the problem with the credit to GDP gap is the fact, that it usually lags the business

cycle. Moreover, it takes some time for the ratio to adjust, as it is shown on the example of the Great Depression. In the middle of said depression, the credit to GDP gap in the UK was 29.9, far above the threshold levels, so the countercyclical buffer would be still set in its maximum, not helping to reduce the procyclicality. But we must keep in mind that the credit to GDP ratio is but a suggestion for consideration, so the final common reference point might be something else. Suggestion of Repullo and Saurina is to use the deviations of credit growth to a long run average. It would share the credit to GDP rationale, but unlike its predecessor, it will be more precise. This is confirmed by their calculations, where they show positive correlation with the growth of GDP. On the other hand, Blundel-Wignall and Atkinson(2010) argue that macro prudential recommendation on the credit growth is likely to perform poorly in practice.

4.3.4. **Liquidity Ratios**

Unlike all of the previous cases, Hannoun(2010) doesn't mention any of liquidity ratios suggested by in the Basel III regulations, Liquidity Coverage Ratio and Net Stable Funding Ratio, as a breakthrough, so we should be a little suspicious about them.

Al-Darwishm, Hafeman, Impavido, Kemp and O'Malley(2011) point out the fact that because banks' senior unsecured bonds doesn't qualify as a source of liquidity neither for LCR, nor for NSFR, it is likely that demand for unsecured debt will decrease and the demand for covered bonds will increase as well as the demand for sovereign debt. Blundel-Wignal and Atkinson (2010) argue that it is unwise to treat banks as naive in running their own businesses and try to meddle in the management of their liquidity. Another form their arguments against these liquidity ratios is the aforementioned increase demand for sovereign bonds, resulting in decrease of lending to the private sector, particularly the SMEs. Their objections against the NSFR are based on the assumption that the need to hold liquid, less risky capital, could serve as an incentive to the more risky behaviour in other areas. The document from The Clearing House (2011) claims that the calculated shortfalls of capital needed to reach to 100% ratio in both LCR and NSFR is understated, because to avoid regulatory criticism, banks will aim for ratios higher than 100% and thus increasing the amount of required additional capital.

4.3.5. **Criticism of Basel Accords as a Whole**

Lastly, we may mention those, who deem Basel Accords as such as failed experiment, which is doomed. One of them is Lall, whose work from 2009 is befittingly named *Why Basel*

II Failed and why any Basel III Is Doomed. One of the interesting points he had stated, is the fact that although the BCBS provides banks with proposals for regulation, they are responsible only to central bank governors G-10. Moreover, as a reason behind the failure of Basel II and author's anticipated failure of Basel III author points at the regulatory capture, in which some of the international banks were able to transform rules of international capital regulation in such way that it would maximize their profits.

5. Empirical Analysis

5.1. Methodology

Since the implementation process of Basel III is still at the beginning, the task of finding out how will the full implementation of said regulation affect the behaviour of banks will not be a simple task. But there are several ways, which should enlighten us about what will happen after the completion of this implementation. The method we will use is the extrapolation of the information from the past, which will provide us with the information how the change of regulatory capital and the introduction of liquidity ratios will affect the behaviour of the bank. To be more precise, will have to look how changes in these ratios affect with variables that may be used to describe the behaviour of the bank and its stability, respectively. Our models may seem simple, but sometimes it is wiser to use simpler models instead of overfitted models with loads of variables, which may have seem to give better results, but which are affected by autocorrelation in its independent variables and are difficult to be applied on some other data due to the complexity of its independent variables. The main idea behind our models as a whole is such that if we want to examine the impact of Basel III implementation, we should focus on the elements, which have changed most. In the case of Basel III, it would be the increase of capital requirements and the introduction of liquidity ratios.

5.2. Hypotheses

Our hypotheses, which will be tested, are:

Hypothesis #1: *Interest rates will increase*

This hypothesis reflects one of the possible outcomes of Basel III regulations. It is based on the assumption that with higher amount of regulatory capital held by bank, the bank would hold tight to its capital, so the cost of capital will be higher, resulting in banks charging higher interest rates.

Hypothesis #2: *The amount of granted loans will be lower*

This hypothesis reflects another of the possible outcome of Basel III regulations. This hypothesis is close linked to the previous one. Since the bank has to hold higher amount of

capital as a capital reserve, chose more carefully who to lend to. And combined with our first hypothesis, the higher interest rates may repent some investors.

Hypothesis #3: *The stability of banking sector will increase*

This hypothesis captures the main goal of the Basel III regulations. As the title of the document where the Basel III regulations were introduced, *Basel III: A global regulatory framework for more resilient banks and banking systems*, suggests, the foremost reason for Basel III is enhancing the stability of the banking sector.

5.3. Brief Literature Overview

If we look into the brief history of discussions about Basel III, we may find that there are not many works, which focuses on the impact the Basel III regulations would have on banks. One of the few that have done so is the work by Cosimano and Hakura (2011). Their paper investigates the impact of the new capital requirements introduced under the Basel III framework on bank lending rates and loan growth. To do so, they use bank-by-bank data for advanced economies for period of 2001 to 2009, while their estimation method is the generalized method of moment. Their goal was to examine the impact of Basel III implementation on banks' choice of capital, the loan rate, banks loans and empirical strategy, whilst they work under the assumption of monopoly power of a bank. If we take a look at their results, we may find out that they provide us with some information that could be useful in evaluation of our own empirical analysis. Concerning the loan rate, they have found out that with the increase in equity to assets ratio, as requested by Basel III, loan rates will increase. On the other hand, the decrease in loans is estimated to be relatively small, this is explained by the small elasticity of demand for loans in the case of large banks. Another of conclusions of Cosimano and Hakura (2011) we may later on find useful is the remark of possible variability of banks' responses caused by cross-country variations in the tightness of capital constraints, banks' net cost of raising equity, and elasticities of loan demand with respect to changes in loan rates.

5.4. Dataset

Because the main task of this thesis is to determine the impact on banks, we will use the dataset from the banking sector. As in the case of our many predecessors, there is no possible way to use banks internal data. Our solution is to use the best possible available option, in our

case this would be the Bankscope database, which collects the data from the world banks and was available to our research thanks to Charles University. The dataset we will use will cover annual financial statements of banks from the Visegrad Group (CZE,SK,HUN,POL) over the period between 2003 and 2010. The full list of included banks and their respective countries is listed in the appendix. In order to find out, how the implementation of Basel III will affect the behaviour of banking sector in individual countries, we will split our dataset into four parts, each consisting of banks from one country. The primary idea was to have ten banks in each section, but because of the fact that lots of Slovakian and Hungarian banks had its financial data missing, the final count will be ten Czech banks, twelve Polish banks nine Hungarian and eight Slovakian banks, giving us the total of 39 banks. Next part of the dataset is the indicator of the state of the economy in each respective country. As this measure, we will use the return on the total share prices in each respective country, as it was reported by the OECD. Later on, it will be referred to as a return from the market portfolio. The important notion concerning this measure is that it has been transformed in such a way that its value in the year 2005 is equal to 100. This transformation allows us to compare the growths and falls in relative countries.

5.5. *Hypothesis 1*

To examine our first hypothesis, we will base our work on the models from Repullo and Suarez(2004) and Kiema and Joukivuolle(2010), who examined the loan pricing under the Basel capital requirements. According to the Repullo and Suarez(2004) model, the interest rate for an individual firm depends on the capital requirements, probability of default, the loss given default, the cost of capital and the exposure to systematic risk. The original function of the interest rate, as proposed by Repullo and Suarez (2004) looked like this:

Equation 1)

$$r = f(CR, PD, LGD, EXP, COC)$$

Where CR is credit requirements, PD is probability of default, LGD is loss given default, EXP is exposure to the systematic risk and COC is the cost of capital. For the purposes of our first model, we will suppose that firms are homogenous, so their loss given default, probability of default and the exposure to systematic risk are the same. Now we have to take into an account that we are dealing with the aggregated data collected over the financial year, but the relationship between these variables should be similar.

Equation 2)

$$r = F(CR, PD, LGD, EXP, COC)$$

Now we have to solve the other issue. Our task is to examine, how the change of capital requirements will influence the interest rate. Our solution will be that we will transform the equation by differentiating our data in time. After this transformation, the equation will look like this:

Equation 3)

$$\Delta r = F(\Delta CR, \Delta PD, \Delta LGD, \Delta EXP, \Delta COC)$$

Where the delta sign stands for the change in time. Next step is to eliminate some of the variables, which will be useless in the future regression. From now on, we will work under the assumption that the exposure to the systematic risk and the value of the loss given default wouldn't change in time, because they are dependent on the legal environment and so they do not change in time. As a result of this, we will assume that values of ΔEXP and ΔLGD would be equal to zero. After their elimination, the equation will look like this.

Equation 4)

$$\Delta r = F(\Delta CR, \Delta PD, \Delta COC)$$

In this form, the model will capture the impact of changes of capital requirements, but it will also assess, if these changes weren't caused by change of probability of default, in other words by change of economic situation in the respective country. As stated earlier, we may use the return of the market portfolio as a measure of the state of the economy.

Now we have to a transformation that is forced by the nature of our data source. The Bankscope database provides neither interest rate on loans, nor on the deposits, but only the net interest margin, which is defined as a difference between the generated interest income and the interest expenses. But we may still use this ratio to evaluate the change of interest rates, because as we may find in English(2002), he expects that the higher net interest margin, the higher the yield curve will be. And the higher yield curve, the higher interest rates will be. Moreover, the higher the net interest margin, the higher bank's income, which would be

needed to raise capital for new capital requirements. Given these relationships, we may assume that we can use it as a proxy for interest rates. The next important part in setting of our model is the choice of our independent variables. As we may recall from the previous text, the first of these variables should be the change of total regulatory capital ratio. But the Basel III will bring more changes than that, most importantly, it will impose liquidity ratios on banks, which will force banks to retain more liquid capital in order to remain solvent for the duration of a possible crisis. The Bankscope database provides us with the ratio of Liquid Assets to Short Term and Customer Funding (LASTCF), which is similar to the Liquidity Coverage Ratio as proposed by the Basel III, both tell us, how is the bank able to withstand short-term crisis. We will add a change of this ratio in time as a measure of the impact of the banks liquidity on its behaviour. Given this, our final equation will look like this:

Equation 5)

$$\Delta NIM = F(\Delta CR, \Delta LASTCF, rSP)$$

We assume that relation between our variables is linear, so the final equation will have this form

Equation 6)

$$\Delta NIM = \beta_0 + \beta_1 \cdot \Delta CR + \beta_2 \Delta LASTCF + \beta_3 rSP$$

5.6. Hypothesis 2

To examine the second hypothesis, we will base our model on the model of Hussain, Hassan and Haque (2011), but we will change the set of independent variables. Since the aim of this model should be to determine, how the Basel III regulations will affect the amount of loans granted, the dependent variable is the change of amount of loans in time. Here we have to take into an account that our banks differ in size of their total assets and so will their amount of loans granted – the more assets it has the higher value of loans granted it will provide. To solve this problem and to get rid of possible inconsistencies in our results, we will divide the net amount of loans by the magnitude of bank's assets. Because of the division by the total assets, the size effect will be erased, so there should be no distortion in examining banks of different sizes. Our independent variables should contain of variables, which will influence the amount of loans granted. The return of the market portfolio will capture changes in the loan demand and changes of capital requirements and liquidity ratios, respectively, will

capture the effect of changed regulations, in other words the changes of loan supply. Our final relationship will look like this.

Equation 7)

$$\frac{\Delta L}{A} = f(rSP, \Delta CR, \Delta LASTCF)$$

Again, we will work under the assumption that relations between our variables are linear, so the model equation will look like this

Equation 8)

$$\frac{\Delta L}{A} = \beta_0 + \beta_1 \cdot \Delta CR + \beta_2 \cdot \Delta LASTCF + \beta_3 rSP$$

*5.7. **Hypothesis 3***

To test our final hypothesis, we would need an indicator of a financial health of a financial institution. Since the use of the classic Altman´s Z score is strongly discouraged in the case of financial institutions, we must take a look for another measure. The solution is to use the Z-score as it was defined by Roy (1952), which should be able to describe the healthiness and solvency of the banking sector. This ratio was used before, for example in the work of Laeven and Levine (2008). In our model, it is important to determine which factors affect the z-score of the banking industry. Strobel(2012) describes this Z-score in this way: let us consider that the bank insolvency is a state where (CAR + ROA) ≤ 0, where the CAR stands for capital-asset ratio and the ROA for return on asset. And if ROA is a random variable with finite mean and variance, respectively, then the Bienayme-Chebshev inequality allows us to define $p(ROA \leq -CAR) \leq Z^{-2}$ where the Z score is defined as $Z = \frac{ROA+CAR}{\sigma_{ROA}}$ as an upper bound of the probability of insolvency. The CAR is defined as the equity to total assets ratio. Since the values of Z-score tend to be heavily skewed, it is advised to use the natural logarithm of this variable, so we will do so. The procedure should be to compute the natural logarithm of a Z-score (which will be for the sake of simplicity later on described as the Z-score) and use it as a dependent variable. And since we are interested in finding what factors affects changes of the Z-score, we would use the change of Z-score in time as a dependent variable as in our previous hypotheses. As for our independent variables, the

choice is similar to previous cases, because of the relative similarity of these tasks. The return of the market portfolio will be the measure of the state of the economy and the changes of capital ratio and liquidity ratio, respectively, will capture what will happen in the case of their change based on the implementation of a new regulation.

Equation 9)

$$\Delta z = f(rSP, \Delta CR, \Delta LASTCF)$$

And again, we assume the linearity in our equation, so the final equation will look like this.¨

Equation 10)

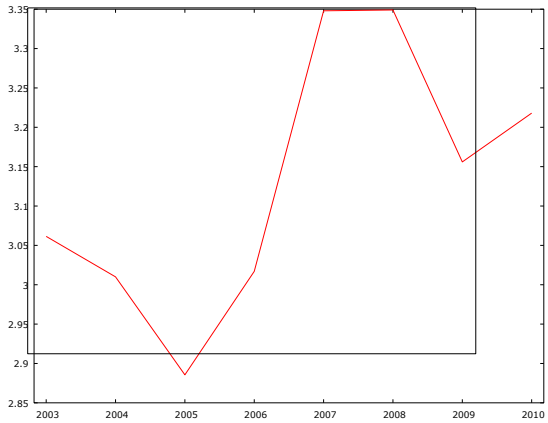
$$\Delta z = \beta_0 + \beta_1 \cdot \Delta CR + \beta_2 \cdot \Delta LASTCF + \beta_3 rSP$$

*5.8. **Structure of the Dataset***

Before we start our analysis, let us have look at the data we are going to work with. In our models, it will be the Net Interest Margin, the Total Capital Ratio, the Liquid Assets to Short Term, the Customer Funding ratio, the Net Loans to Total Assets ratio, the Z score and the Return on the Market Portfolio.

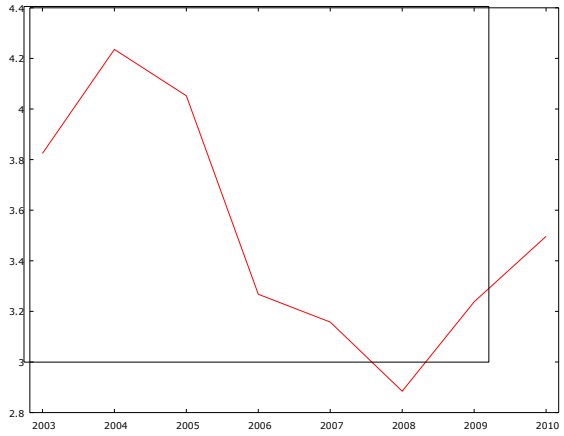
Table 8: NIM Group Means

Czech Banks



Polish Banks

Hungarian Banks



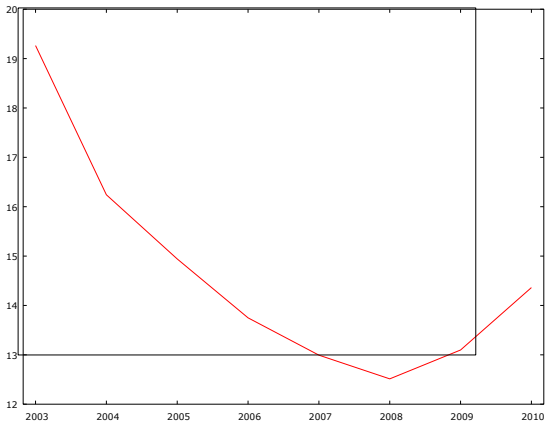
Slovakian Banks

Source: Authors' Calculations, Bankscope

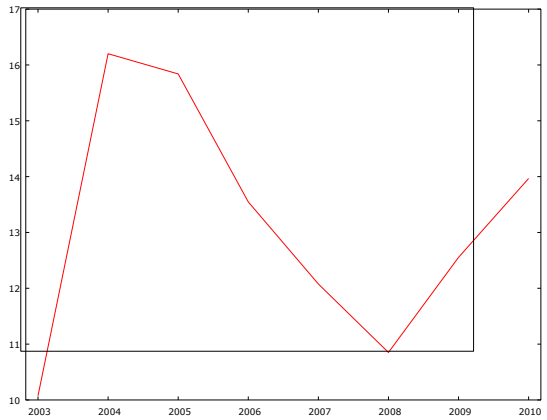
In those four charts above, we may find similar patterns. As we main notice, there has been a drop in the net interest margin around the time of the recent financial crisis. We may also see that Hungarian banks have the highest values of the net interest margin and Polish banks on the other hand have the lowest values of the net interest margin.

Table 9: TCR Group Means

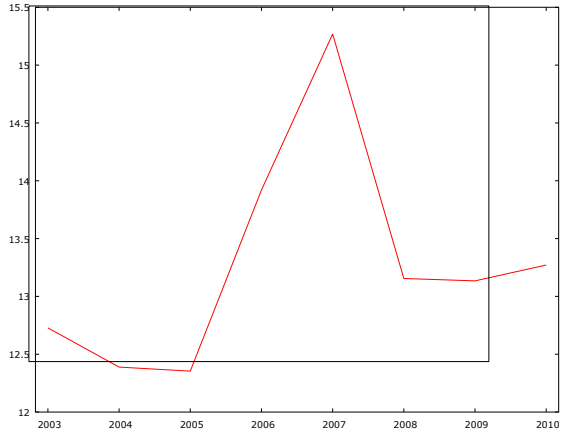
Czech Banks



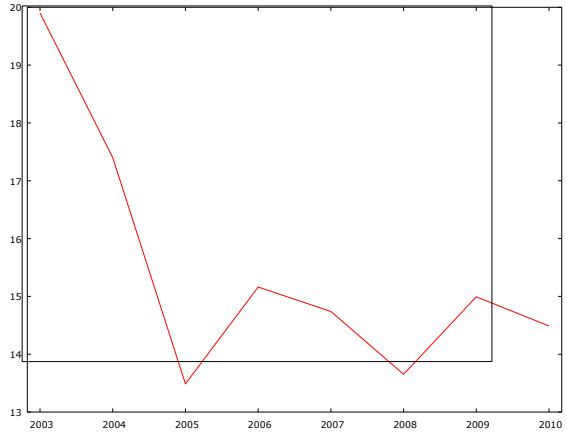
Polish Banks



Hungarian Banks



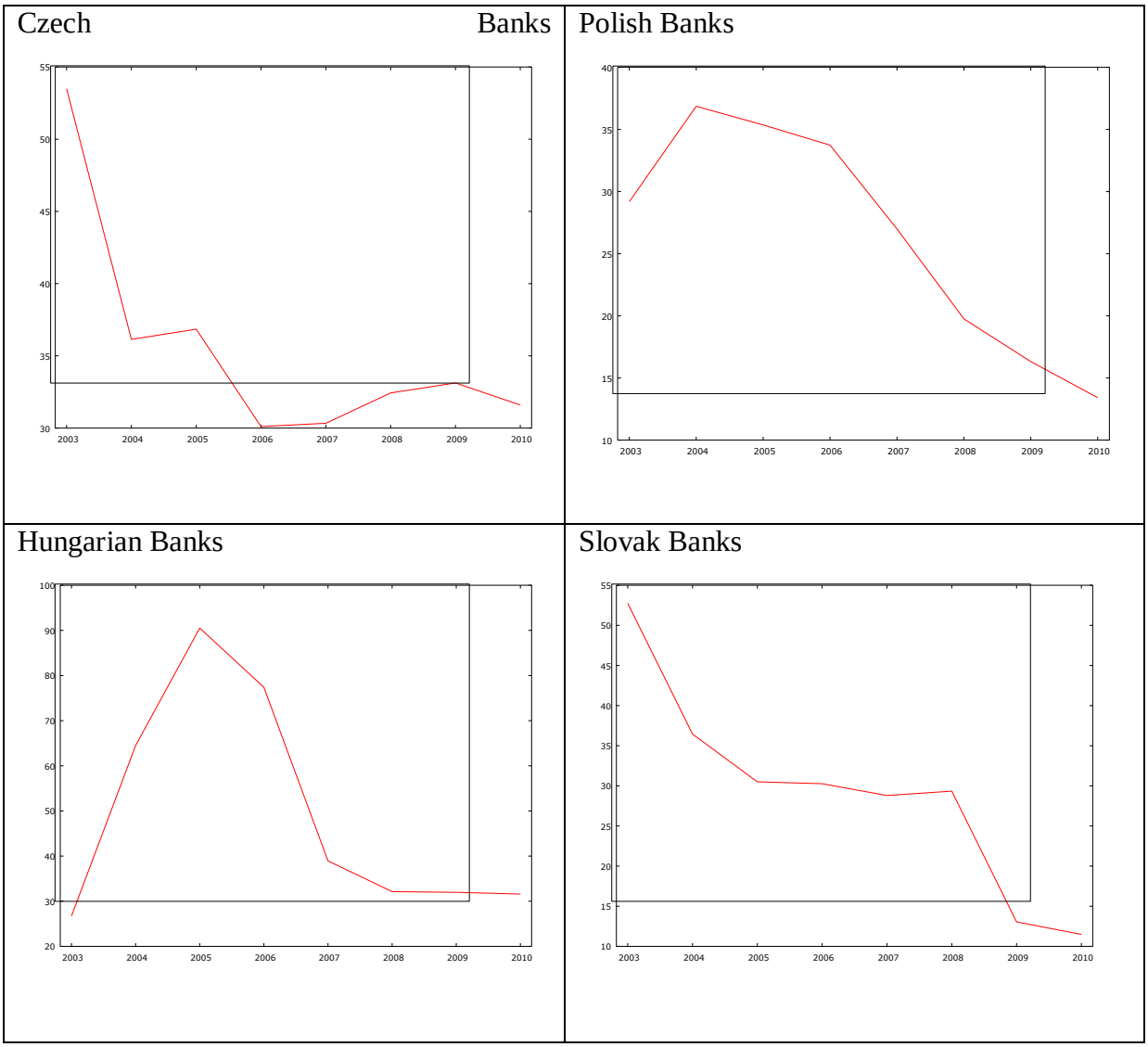
Slovak Banks



Source: Authors' Calculations, Bankscope

As in the previous case, we may notice a drop of the total capital ratio around the time of the financial crisis. Moreover, it is evident that Czech and Slovak banks hold more regulatory capital then Hungarian and Polish banks. Given this piece of information, we may assume that the change of the minimal regulatory capital shouldn't affect the behaviour of Czech and Slovak banks as much as in the rest of our countries.

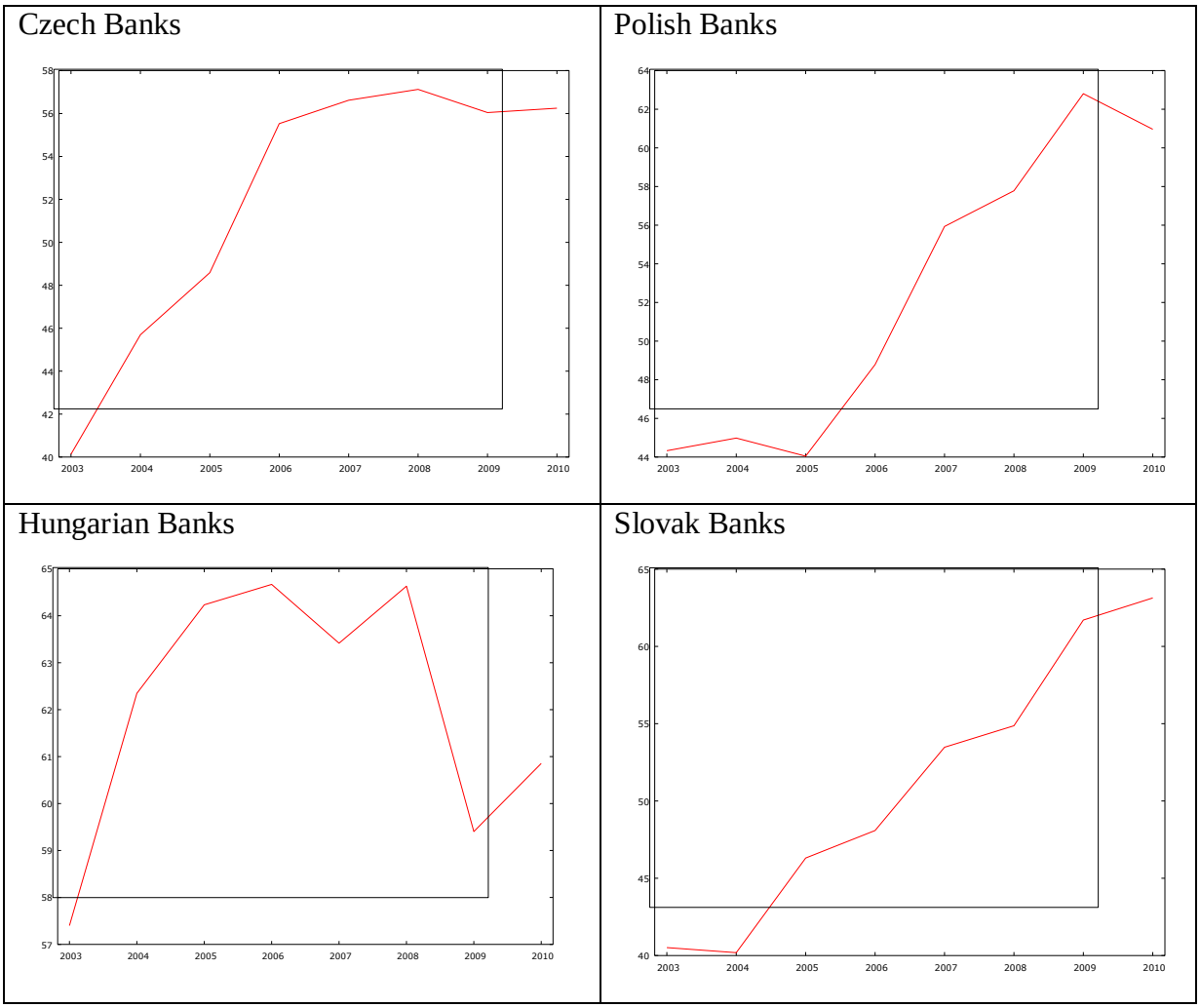
Table 10: LASTCF Group Means



Source: Authors' Calculations, Bankscope

These four charts above expose the core of the recent financial crisis, banks illiquidity. As we can clearly see, there are huge drops in this liquidity ratio in the period when the recent financial crisis started. If we look for the most liquid banks, the answer is the Czech and Hungarian banks. The liquidity of Polish and Slovak banks was decreasing over time to the level of 10%.

Table 11: Loans to Total Assets Ratio: Group Means

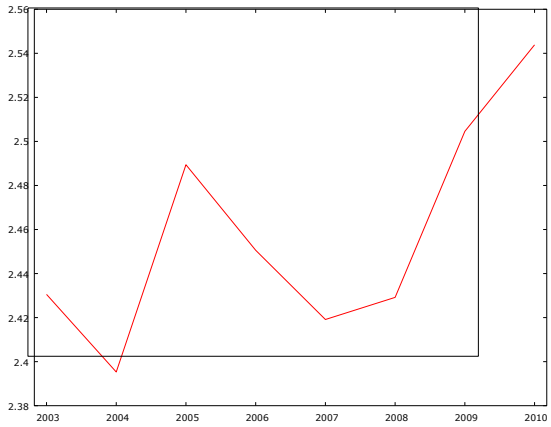


Source: Authors' Calculations, Bankscope

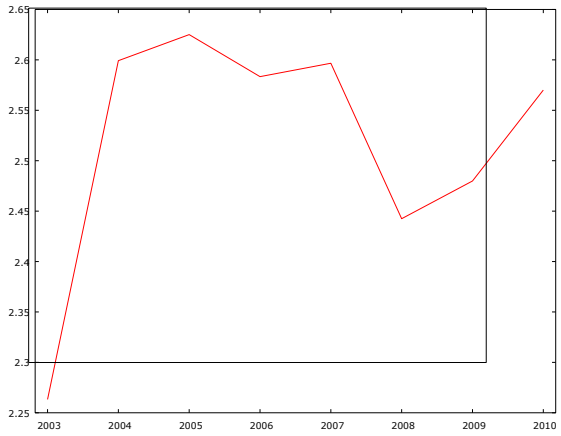
This group of charts shows us a couple of things to note. First of all, we may see the immense increase in the ratio in years preceding the recent financial crisis. And afterwards, in all but the Slovak banks, we may see that this ratio has decreased in the years following the eruption of the financial crisis due to the write-off of the part of their loan portfolio. Hungarian banks were those who had the highest value of this ratio, but due to the crisis its value sharply decreased.

Table 12: Z – score – Group Mean

Czech Banks

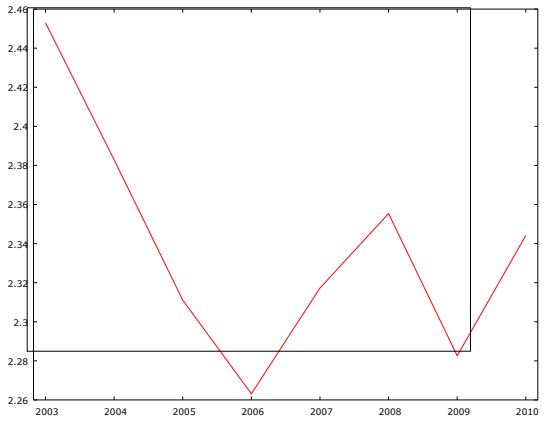


Polish Banks



Hungarian Banks

Slovak Banks



Source: Authors' Calculations, Bankscope

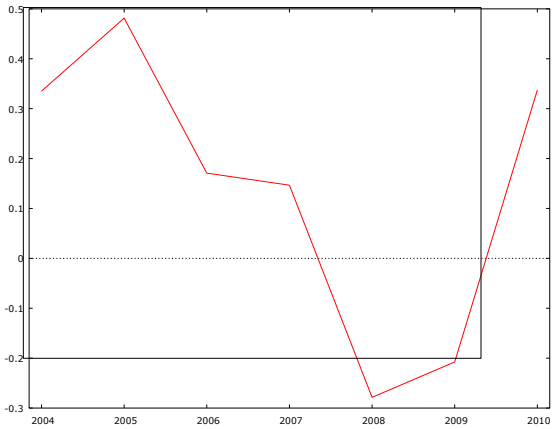
If we look at patterns in these four charts, we may notice what happened to the stability of banks during the last few years. We may see an increase in the Z-score during the stable period, the decrease in the times of economic slowdown and lastly, apart from Hungarian banks, recovery of their financial health. Banks from the Czech Republic and Poland were healthiest; banks from Hungary on the other hand were the unhealthiest of our selection.

Table 13: Return of the Market Portfolio

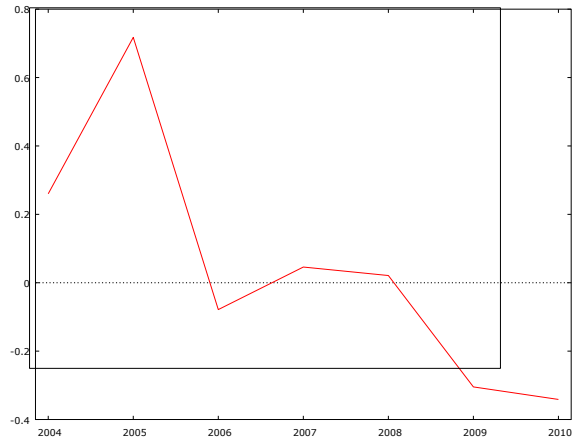
Czech Banks

Polish Banks

Hungarian Banks



Slovak Banks



Source: Authors' Calculations, OECD

The values of the return of the market portfolio were similar in all of our countries. The initial increase is followed by series of decreases, the highest of them caused by the recent financial crisis.

4.9. Results

4.9.1. Results of 1st Hypothesis

After we have analysed our dataset, it is time to start with our regression, the first task is to determine the impact of implementation of Basel III regulations on the net interest margins. But first of all, we have to determine precisely the regression method we are going to use. The core method is obvious; these are panel data, so we will use the panel regression. An important question arise at this moment, we have to decide whether we are going to use the fixed or random effects model. The solution is offered to us in a form of the Breuch Pagan test that will on the basis of residuals obtained from the OLS regression determine which method better suits each individual region in our dataset. The test statistic of the Breuch Pagan test is as follows, values close to 0 favours the random effects model, opposite cases favour fixed effects model.

$$LM = \frac{N \cdot T}{2(T-1)}\left[\frac{\sum_{i=1}^{N}[\sum_{t=1}^{T} e_{it}]^2}{\sum_{i=1}^{N}\sum_{t=1}^{T} {e_{it}}^2} - 1\right]$$

After we have plugged in values from our dataset, test statistics were as in the following table.

Table 14: Breuch Pagan Test Statistics for the 1st Hypothesis

CZ	LM = 0.734522 with p-value = prob(chi-square(1) > 0.734522) = 0.391421
PL	LM = 2.08375 with p-value = prob(chi-square(1) > 2.08375) = 0.148874
HU	LM = 2.1194 with p-value = prob(chi-square(1) > 2.1194) = 0.145443
SK	LM = 0.0490681 with p-value = prob(chi-square(1) > 0.0490681) = 0.824693

Source Authors calculations

From these test statistics, we may infer that we shell use random effect model for the Czech Republic, Poland and Hungary, whereas for Slovakia, the fixed effects model will be more suitable.

Table 15: CZ Results of the 1st Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
constant	*Constant*	***0.0857***	*0.0505*	*1.698*	*0.0956 **
d_TCR	Change of CR	0.0328	0.0249	1.314	0.1946
d_LACSTF	Change of liquidity ratio	0.0032	0.0044	0.7376	0.4641
ld_SP	*Return from the market portfolio*	***0.3728***	*0.1950*	*1.911*	*0.0616 **

Source: Authors Calculations

Table 16: PL Results of the 1st Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	-0.0617	0.0547	-1.127	0.2635
d_TCR	Change of CR	0.0141	0.0182	0.7776	0.4395
d_LACSTF	*Change of liquidity ratio*	***-0.0101***	*0.0057*	*-1.760*	*0.0828 **
ld_SP	*Return from the market portfolio*	***0.2811***	*0.1652*	*1.702*	*0.0933 **

Source: Authors Calculations

Table 17: HU Results of the 1st Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	-0.0429	0.1261	-0.3409	0.7346
d_TCR	Change of CR	-0.0203	0.0335	-0.6048	0.5482
d_LACSTF	*Change of liquidity ratio*	***0.0057***	*0.0017*	*3.211*	*0.0024 ****
ld_SP	Return from the market portfolio	-0.146	0.4254	-0.3433	0.7329

Source: Authors Calculations

Table 18: SK Results of the 1st Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
constant	Constant	-0.0631	0.0721	-0.8756	0.3874
d_TCR	Change of CR	-0.0051	0.0295	-0.1734	0. 8634
d_LACSTF	Change of liquidity ratio	0.0025	0.0048	0.5151	0. 6098
ld_SP	*Return from the market portfolio*	***0.47***	*0.2407*	*-1.953*	*0. 0591 **

Source: Authors Calculations

The results of our regressions aren't very conclusive, but they may still provide us with some information, we just have to look for it in the places, where it seems that there are no results at all. First of all, there seem to be no connection whatsoever between changes in the net interest margin and changes in the banks´ total capital requirement ratio, because its coefficients are immensely insignificant in all of these cases. Our conclusion is that the increase of the capital requirements, which is the core part of Basel III regulations, shouldn't affect net interest margins nor yield curves in a significant way. Impacts of changes in the liquidity ratio have are a little bit more significant then changes in capital ratios, but its value are close to zero, so the conclusion is similar to the previous case, their change won't impact

the net interest margins. The distortions in estimated coefficients of return of the market portfolio are caused by different policymaking in each respective region.

4.9.2. **Results of the 2nd Hypothesis**

Now let us move to the next case and evaluate the impact of the implementation of Basel III regulations on the amount of granted loans. As in the previous case, the first task in our regression would be to determine, whether to use fixed effects model or random effects model. The procedure would be the same as before, we will calculate the test statistic of Breuch Pagan test and according to its value, we will chose the appropriate model.

Table 19: Breuch Pagan Test Statistics for the 2nd Hypothesis

CZ	LM = 9.78452 with p-value = prob(chi-square(1) > 9.78452) = 0.00175987
PL	LM = 2.77916 with p-value = prob(chi-square(1) > 2.77916) = 0.0954981
HU	LM = 0.0071339 with p-value = prob(chi-square(1) > 0.0071339) = 0.932689
SK	LM = 2.45067 with p-value = prob(chi-square(1) > 2.45067) = 0.117475

Source Authors Calculations

The results inferred by our test statistics are similar to the previous one, three regions should be examined by the random effects model and the data from Hungarian banks should be examined by the fixed effects model.

Table 20: CZ Results of the 2nd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	0.8005	1.1544	0.6934	0.4912
d_TCR	Change of CR	-0.125	0.3131	-0.3993	0.6913
d_LACSTF	*Change of liquidity ratio*	***-0.3721***	*0.0527*	*-7.052*	*4.50e-09 ****
ld_SP	Return from the market portfolio	1.8233	2.3431	0.7782	0.4401

Source: Authors Calculations

Table 21: PL Results of the 2nd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	*Constant*	***1.3177***	*0.6929*	*1.901*	*0.0614 **
d_TCR	*Change of CR*	***-0.8083***	*0.2356*	*-3.431*	*0.0010 ****
d_LACSTF	*Change of liquidity ratio*	***-0.2945***	*0.0704*	*-4.180*	*8.29e-05 ****
ld_SP	Return from the market portfolio	0.0365	2.1386	0.017	0.9864

Source: Authors Calculations

Table 22: HU Results of the 2nd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
constant	Constant	-1.283	0.8791	-1.460	0.1522
d_TCR	*Change of CR*	***-0.5474***	*0.2460*	*-2.225*	*0.0318* **
d_LACSTF	Change of liquidity ratio	-0.0096	0.012	-0.7536	0.4555
ld_SP	Return from the market portfolio	3.2219	3.009	1.071	0.2907

Source: Authors Calculations

Table 23: SK Results of the 2nd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
constant	*Constant*	***2.623***	*1.0257*	*2.557*	*0.0143* **
d_TCR	Change of CR	0.2931	0.3726	0.7867	0. 4360
d_LACSTF	*Change of liquidity ratio*	***-0.1752***	*0.0689*	*-2.544*	*0.0148* **
ld_SP	Return from the market portfolio	3.21	3.1	1.035	0. 3066

Source: Authors Calculations

The results of our second set of models provide us with more conclusive results than the first one. All of these regions share one common property, with positive change in the capital requirements ceteris paribus, the bank diminish the amount of its granted loans compared to the amount of its assets, ceteris paribus. Czech Republic is the only region, where is this coefficient insignificant, so the impact of the increase in capital ratios is uncertain. And when we move our attention to estimated coefficients of changes in the liquidity ratios, we may see that results are similar. In all of other cases, the more liquid assets the bank holds, the less it grants loans, ceteris paribus. This supports our second hypothesis. Another important estimate that is worth noting is positive coefficient of return from the market portfolio, which depicts the procyclical behaviour of the banking sector; in the good times the amount of loans granted is rising and vice versa.

4.9.3. **Results of the 3rd Hypothesis**

Now it is time to evaluate our third hypothesis. The procedure will be the same as in both previous cases. Firstly, we need to determine whether to use the random effect model or the fixed effect model. For this task, we will use the Breuch Pagan test, as in the previous cases.

Table 24 Breuch Pagan Test Statistics for the 3rd Hypothesis

CZ	LM = 0.0306359 with p-value = prob(chi-square(1) > 0.0306359) = 0.861055
PL	LM = 3.63435 with p-value = prob(chi-square(1) > 3.63435) = 0.0565986
HU	LM = 0.0174461 with p-value = prob(chi-square(1) > 0.0174461) = 0.894918
SK	LM = 0.158893 with p-value = prob(chi-square(1) > 0.158893) = 0.690177

Source: Authors Calculations

As we can see from the table above, the situation is kind a different in this case. This time, we will use three fixed effects models and only one random effects model for Polish banks.

Table 25: CZ Results of the 3rd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	0.0211	0.0201	1.050	0.2997
d_TCR	*Change of CR*	***0.0474***	*0.011*	*4.287*	*0.0001* ***
d_LACSTF	*Change of liquidity ratio*	***-0.0042***	*0.0018*	*-2.312*	*0.0257* **
ld_SP	Return from the market portfolio	0.0256	0.0818	0.3138	0.7553

Source: Authors Calculations

Table 26: PL Results of the 3rd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	-0.0139	0.0196	-0.7081	0.4812
d_TCR	*Change of CR*	***0.0319***	*0.0065*	*4.872*	*6.77e-06* ***
d_LACSTF	Change of liquidity ratio	-0.0007	0.002	-0.3654	0.7159
ld_SP	*Return from the market portfolio*	***0.1884***	*0.0594*	*3.169*	*0.0023* ***

Source: Authors Calculations

Table 27: HU Results of the 3rd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	-0.0139	0.0276	-0.5057	0.6159
d_TCR	Change of CR	0.0049	0.0077	0.6409	0.5252
d_LACSTF	*Change of liquidity ratio*	***0.0007***	*0.0004*	*1.906*	*0.0639* *
ld_SP	Return from the market portfolio	-0.0377	0.0946	-0.3986	0.6923

Source: Authors Calculations

Table 28: SK Results of the 3rd Hypothesis

Name	Representation	Coefficient	Std. Dev.	t-value	p-value
Constant	Constant	0.0116	0.0181	0.642	0. 5252
d_TCR	*Change of CR*	***0.0286***	*0.0074*	*3.855*	*0.0005* ***
d_LACSTF	*Change of liquidity ratio*	***-0.0024***	*0.0012*	*-2.01*	*0.0525* *
ld_SP	Return from the market portfolio	0.0683	0.0604	1.13	0.2664

Source: Authors Calculations

The results of our third regression seem to be in line with our third hypothesis. To be more specific, in each of these regions, the estimated coefficients for the change of capital requirements ratio is positive and in all but one case are also significant, Hungarian banks being the sole exception. Given this, we may claim that with rise in capital requirements, there should be increase in the banks´ stability. But before we will confirm our third hypothesis, we have to look at estimated coefficients for the change in liquidity ratio. These estimates are negative in three of our cases and positive in the case of Hungary. When it comes to confirmation of our third hypothesis, we must conclude that the result will depend on regional differences and the difference between magnitudes of strengthening cause by the change of regulatory capital and the occasional weakening caused by the introduction of liquidity ratios.

5. Conclusion

Before we will start with the evaluation of our results, we should remind ourselves first of our hypotheses and why were chosen. The aim of the Basel III regulations is to make banking sector stronger and more resilient to possible future crisis. To do so, the Basel III suggests strengthening of banks' regulatory capital via making the definition of Tier 1 and Tier 2 capital more strict than in the case of Basel II. Another of the tools used is the introduction of countercyclical buffer, which should mitigate inherited procyclicality of banking sector, and the leverage ratio, which should constrain the build-up of leverage in the banking sector and to reinforce the risk based requirements with non risk based measure. Other innovative elements of the Basel III regulations are liquidity ratios, LCR and NSFR, which should ensure that the bank is able to sustain a short term episode of crisis and that it uses sound sources for its funding. All of these innovations require additional capital, either due to increase in ratios or due to more strict definitions of Tier 1 and Tier 2. If we look at the recent research concerning the issues regarding the implementation of Basel III, we may find that the expected capital shortfall of examined banks is higher than their yearly income, so they would have to find other sources of funding their regulatory capital. These unintended consequences were a basis for our hypotheses.

Our model consists of three hypotheses. The basis for one of our hypotheses is the aim of the Basel III, which should be the increased stability of the banking sector. But everything has two sides. As mentioned earlier in the text, apart from the strengthening of banking sector, there would be also consequences, some intended, some not. Our next two hypotheses have arose on the basis of these unintended consequences, one focusing on the impact on the interest rates, the latter on the impact on the amount of loans granted. These hypotheses were tested on banking data from banks of Visegrad Group region. Results, which we have obtained from our regressions, have shed some light on our hypotheses. The hypothesis stating that the implementation of Basel III regulations will lead to increase in interest rates was unconfirmed. This may be because of the fact that there are several other factors, which affect interest rates, for example the policy of respective central bank. Our second hypothesis, which is focused on the impact of implementation of Basel III regulations on the amount of loans granted, was confirmed. After several transformations and final regression, we have found out, that increase in regulatory capital and imposing of liquidity ratios will decrease the ratio of loans granted to total assets, so we may say that the amount of loans granted will decrease, ceteris paribus, thus confirming our second hypothesis. These results seem to be in

line with those of Cosimano and Hakura (2011); they also predict the decrease in loans and cross country variations. The last of our hypotheses was aimed at the main goal of the Basel III regulations that means the strengthening of the banking system. This hypothesis was partially confirmed, the increase in regulatory capital should strengthen the banking sector, but in the Czech Republic, Poland and Slovakia, the increase of liquidity ratios weakens the banking sector, so the overall result is uncertain. In the case of Hungary, the increase of liquidity ratios strengthens banks, so the Basel III implementation should have a positive effect on their banking sector.

The overall evaluation of proposed Basel III regulations is behind the scope of this thesis, but we may at least identify two fundamental issues concerning this regulation. Firstly, it should have a positive effect on the banking sector as changes proposed by the BCBS should strengthen the banking sector. The main tools that will be used to do this task will be the strengthening of reserve capital and inclusion of liquidity ratios. But the amount of capital needed for fulfilling these requirements is so immense, so the inclusion of the word 'should' is important, because there were opposite effects caused by Basel III regulations in some regions. On the other hand, Basel III regulations will, according to the confirmation of our second hypothesis, decrease the amount of loans granted, ceteris paribus. This may have a negative effect on the performance of economy and that doesn't seem as an appropriate outcome of Basel III.

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Data Sources

- OECD Stats Extracts
- Bankscope

7. Appendix 1: Banks Used in Empirical Analysis

Czech Republic
Modrá pyramida stavební spořitelna as
Hypoteční banka a.s.
Československá Obchodní Banka A.S.- CSOB
Česka Spořitelna a.s.
GE Money Bank as
Komerční Banka
Českomoravská Záruční a Rozvojová Banka a.s.-Czech Moravian Guarantee and Develpoment Bank
Unicredit Bank Czech Republic AS
PPF banka a.s.
Volksbank CZ as

Poland
Bank Handlowy w Warszawie S.A.
Bank Polska Kasa Opieki SA-Bank Pekao SA
Bank Zachodni WBK S.A.
BRE Bank SA
Bank Gospodarki Zywnosciowej SA-Bank BGZ
DZ Bank Polska SA
Bank Ochrony Srodowiska SA - BOS SA-Bank Ochrony Srodowiska Capital Group
SGB Bank SA
Bank Millennium
ING Bank Slaski S.A. - Capital Group
Kredyt Bank SA
Nordea Bank Polska SA

Hungary
FHB Mortgage Bank Plc-FHB Jelzalogbank Nyrt.
UniCredit Bank Hungary Zrt
Bank of Hungarian Savings Cooperatives Limited-Magyar Takarekszövetkezeti Bank Rt - TAKAREKBANK
CIB Bank Ltd-CIB Bank Zrt
MFB Hungarian Development Bank Private Limited Company
MKB Bank Zrt
OTP Bank Plc
Erste Bank Hungary Nyrt

Slovakia
UniCredit Bank Slovakia a.s.
CSOB Stavebna Sporitelna
Vseobecna Uverova Banka a.s.
Slovenska sporitel'na as-Slovak Savings Bank
Tatra Banka a.s.
VOLKSBANK Slovensko, as
Istrobanka
Dexia banka Slovensko a.s.

8. Appendix 2: Results of the Empirical Analysis

1. Hypothesis 1

1.1 Breuch Pagan test

1.1.1. Czech Republic

Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: 0.079045 (0.051812) [0.13460]
d_TCR: 0.053861 (0.028512) [0.06580]
d_LACSTF: 0.0022887 (0.0047315) [0.63110]
ld_SP: 0.4865 (0.21087) [0.02605]

10 group means were subtracted from the data

Residual variance: 5.4367/(55 - 13) = 0.129445
Joint significance of differing group means:
F(9, 42) = 0.783641 with p-value 0.632451
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: 0.077219
unit 2: -0.042413
unit 3: -0.083693
unit 4: -0.045691
unit 5: -0.042237
unit 6: -0.046969
unit 7: 0.026613
unit 8: -0.15242
unit 9: 0.3465
unit 10: -0.049761

Breusch-Pagan test statistic:
LM = 0.734522 with p-value = prob(chi-square(1) > 0.734522) = 0.391421
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.00639577
within = 0.129445
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: 0.085726 (0.050481) [0.09557]
d_TCR: 0.032828 (0.024979) [0.19464]
d_LACSTF: 0.0032469 (0.0044019) [0.46413]
ld_SP: 0.37286 (0.19509) [0.06161]

Hausman test statistic:
H = 6.7663 with p-value = prob(chi-square(3) > 6.7663) = 0.0797315
(A low p-value counts against the null hypothesis that the random effects

model is consistent, in favor of the fixed effects model.)

1.1.2. Poland

Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: -0.053154 (0.057729) [0.36100]
d_TCR: 0.012736 (0.019638) [0.51918]
d_LACSTf: -0.0079375 (0.0062966) [0.21250]
ld_SP: 0.27056 (0.17335) [0.12402]

12 group means were subtracted from the data

Residual variance: 10.1892/(73 - 15) = 0.175676
Joint significance of differing group means:
F(11, 58) = 0.450362 with p-value 0.925538
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Breusch-Pagan test statistic:
LM = 2.08375 with p-value = prob(chi-square(1) > 2.08375) = 0.148874
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.0123077
within = 0.175676
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: -0.061709 (0.054736) [0.26348]
d_TCR: 0.014184 (0.018241) [0.43946]
d_LACSTf: -0.010149 (0.0057656) [0.08280]
ld_SP: 0.28117 (0.16524) [0.09333]

Hausman test statistic:
H = 1.8929 with p-value = prob(chi-square(3) > 1.8929) = 0.59493
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

1.1.3. Hungary

Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: -0.052147 (0.13235) [0.69567]
d_TCR: -0.02173 (0.037046) [0.56080]
d_LACSTF: 0.0059121 (0.0019345) [0.00398]
ld_SP: -0.069479 (0.45301) [0.87888]

9 group means were subtracted from the data

Residual variance: 28.973/(52 - 12) = 0.724325
Joint significance of differing group means:
F(8, 40) = 0.476203 with p-value 0.865633

(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:
unit 1: 0.14211
unit 2: 0.22269
unit 3: -0.050285
unit 4: -0.27108
unit 5: -0.076877
unit 6: 0.010453
unit 7: 0.059881
unit 8: 0.18578
unit 9: -0.86659

Breusch-Pagan test statistic:
LM = 2.1194 with p-value = prob(chi-square(1) > 2.1194) = 0.145443
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.0402246
within = 0.724325
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: -0.042995 (0.1261) [0.73463]
d_TCR: -0.020315 (0.033591) [0.54818]
d_LACSTF: 0.0057545 (0.001792) [0.00236]
ld_SP: -0.14605 (0.42548) [0.73290]

Hausman test statistic:
H = 2.61553 with p-value = prob(chi-square(3) > 2.61553) = 0.454773
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

1.1.4. Slovakia
Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: -0.063191 (0.072168) [0.38739]
d_TCR: -0.0051205 (0.029537) [0.86339]
d_LACSTF: 0.0025112 (0.0048749) [0.60979]
ld_SP: -0.47005 (0.24073) [0.05914]

8 group means were subtracted from the data

Residual variance: 5.86985/(45 - 11) = 0.172643
Joint significance of differing group means:
F(7, 34) = 0.907543 with p-value 0.512303
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: -0.33593

unit 2: 0.09126
unit 3: 0.16267
unit 4: 0.10783
unit 5: 0.10246
unit 6: -0.12934
unit 7: -0.02779
unit 8: -0.083915

Breusch-Pagan test statistic:
LM = 0.0490681 with p-value = prob(chi-square(1) > 0.0490681) = 0.824693
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.0279269
within = 0.172643
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const:	-0.066533	(0.070758)	[0.35258]
d_TCR:	-0.0049746	(0.025707)	[0.84752]
d_LACSTF:	0.0014596	(0.0047539)	[0.76038]
ld_SP:	-0.50671	(0.21389)	[0.02263]

Hausman test statistic:
H = 3.67152 with p-value = prob(chi-square(3) > 3.67152) = 0.299188
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

1.2. Results

1.2.1. Czech Republic

Model 3: Random-effects (GLS), using 55 observations
Included 10 cross-sectional units
Time-series length: minimum 3, maximum 7
Dependent variable: d_NIM

coefficient	std. error	t-ratio	p-value	
const	0.0857259	0.0504810	1.698	0.0956 *
d_TCR	0.0328281	0.0249787	1.314	0.1946
d_LACSTF	0.00324687	0.00440189	0.7376	0.4641
ld_SP	0.372860	0.195092	1.911	0.0616 *

Mean dependent var 0.095818 S.D. dependent var 0.356935
Sum squared resid 6.349644 S.E. of regression 0.349440
Log-likelihood -18.67092 Akaike criterion 45.34185
Schwarz criterion 53.37118 Hannan-Quinn 48.44685

'Within' variance = 0.129445
'Between' variance = 0.00639577

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 0.734522
with p-value = 0.391421

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 6.7663
with p-value = 0.0797315

1.2.2. Poland

Model 3: Random-effects (GLS), using 73 observations
Included 12 cross-sectional units
Time-series length: minimum 6, maximum 7
Dependent variable: d_NIM

coefficient	std. error	t-ratio	p-value	
const	-0.0617089	0.0547359	-1.127	0.2635	
d_TCR	0.0141843	0.0182409	0.7776	0.4395	
d_LACSTf	-0.0101488	0.00576560	-1.760	0.0828	*
ld_SP	0.281175	0.165242	1.702	0.0933	*

Mean dependent var -0.001781 S.D. dependent var 0.406825
Sum squared resid 11.05951 S.E. of regression 0.397483
Log-likelihood -34.70085 Akaike criterion 77.40170
Schwarz criterion 86.56354 Hannan-Quinn 81.05285

'Within' variance = 0.175676
'Between' variance = 0.0123077

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 2.08375
with p-value = 0.148874

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 1.8929
with p-value = 0.59493

1.2.3. Hungary

Model 2: Random-effects (GLS), using 52 observations
Included 9 cross-sectional units
Time-series length: minimum 2, maximum 7
Dependent variable: d_NIM

coefficient	std. error	t-ratio	p-value	
const	-0.0429949	0.126104	-0.3409	0.7346	
d_TCR	-0.0203150	0.0335915	-0.6048	0.5482	
d_LACSTF	0.00575451	0.00179202	3.211	0.0024	***
ld_SP	-0.146052	0.425479	-0.3433	0.7329	

Mean dependent var -0.086346 S.D. dependent var 0.869440
Sum squared resid 31.73240 S.E. of regression 0.804736
Log-likelihood -60.94326 Akaike criterion 129.8865
Schwarz criterion 137.6915 Hannan-Quinn 132.8788

'Within' variance = 0.724325
'Between' variance = 0.0402246

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 2.1194
with p-value = 0.145443

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 2.61553
with p-value = 0.454773

1.2.4. Slovakia

Model 6: Fixed-effects, using 45 observations
Included 8 cross-sectional units
Time-series length: minimum 3, maximum 7
Dependent variable: d_NIM

	coefficient	std. error	t-ratio	p-value	
const	-0.0631906	0.0721677	-0.8756	0.3874	
d_TCR	-0.00512053	0.0295366	-0.1734	0.8634	
d_LACSTF	0.00251121	0.00487491	0.5151	0.6098	
ld_SP	-0.470050	0.240730	-1.953	0.0591	*

Mean dependent var -0.100667 S.D. dependent var 0.431232
Sum squared resid 5.869848 S.E. of regression 0.415503
R-squared 0.282615 Adjusted R-squared 0.071619
F(10, 34) 1.339433 P-value(F) 0.249955
Log-likelihood -18.02347 Akaike criterion 58.04695
Schwarz criterion 77.92024 Hannan-Quinn 65.45551
rho -0.360440 Durbin-Watson 2.206652

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(7, 34) = 0.907543
with p-value = P(F(7, 34) > 0.907543) = 0.512303

2. Hypothesis 2
2.1. Breuch Pagan
2.1.1. Czech Republic
Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: 0.62157 (0.60288) [0.30844]
d_TCR: -0.14514 (0.33176) [0.66399]
d_LACSTF: -0.3729 (0.055056) [0.00000]
ld_SP: 1.8963 (2.4537) [0.44395]

10 group means were subtracted from the data

Residual variance: 736.103/(55 - 13) = 17.5263
Joint significance of differing group means:
F(9, 42) = 3.06807 with p-value 0.0064712
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: 6.465
unit 2: 0.92182
unit 3: -1.3572
unit 4: -0.35459
unit 5: 3.2923
unit 6: 0.3599
unit 7: -5.2102
unit 8: -0.44257
unit 9: -0.40874
unit 10: -1.3033

Breusch-Pagan test statistic:
LM = 9.78452 with p-value = prob(chi-square(1) > 9.78452) = 0.00175987
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 13.752
within = 17.5263
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: 0.80053 (1.1545) [0.49120]
d_TCR: -0.12504 (0.31314) [0.69133]
d_LACSTF: -0.37219 (0.052777) [0.00000]
ld_SP: 1.8234 (2.3431) [0.44005]

Hausman test statistic:
H = 0.235422 with p-value = prob(chi-square(3) > 0.235422) = 0.971678
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

2.1.2 Poland
Fixed effects estimator

allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: 1.3478 (0.73363) [0.07123]
d_TCR: -0.75901 (0.25618) [0.00439]
d_LACSTf: -0.2886 (0.076326) [0.00037]
ld_SP: 0.066861 (2.261) [0.97651]

12 group means were subtracted from the data

Residual variance: 1764.54/(74 - 15) = 29.9075
Joint significance of differing group means:
F(11, 59) = 0.361931 with p-value 0.965644
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Breusch-Pagan test statistic:
LM = 2.77916 with p-value = prob(chi-square(1) > 2.77916) = 0.0954981
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 1.80702
within = 29.9075
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: 1.3177 (0.693) [0.06136]
d_TCR: -0.80832 (0.23561) [0.00101]
d_LACSTf: -0.29457 (0.070464) [0.00008]
ld_SP: 0.036511 (2.1386) [0.98643]

Hausman test statistic:
H = 1.2159 with p-value = prob(chi-square(3) > 1.2159) = 0.749194
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

2.1.3. Hungary
Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: -1.2831 (0.87911) [0.15222]
d_TCR: -0.5475 (0.24607) [0.03179]
d_LACSTF: -0.0096838 (0.01285) [0.45549]
ld_SP: 3.2219 (3.009) [0.29069]

9 group means were subtracted from the data

Residual variance: 1278.29/(52 - 12) = 31.9572
Joint significance of differing group means:
F(8, 40) = 1.49783 with p-value 0.188741
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: -2.3545
unit 2: 1.5992
unit 3: -1.8406
unit 4: 0.36649
unit 5: 1.3245
unit 6: -6.7455
unit 7: 1.0315
unit 8: 2.6101
unit 9: 3.5806

Breusch-Pagan test statistic:
LM = 0.0071339 with p-value = prob(chi-square(1) > 0.0071339) = 0.932689
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 1.95277
within = 31.9572
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: -1.3921 (0.91241) [0.13363]
d_TCR: -0.32518 (0.24305) [0.18723]
d_LACSTF: -0.011171 (0.012966) [0.39321]
ld_SP: 4.4521 (3.0785) [0.15462]

Hausman test statistic:
H = 12.2863 with p-value = prob(chi-square(3) > 12.2863) = 0.00646402
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

2.1.4. Slovakia
Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: 2.6854 (1.1035) [0.02036]
d_TCR: 0.44684 (0.45165) [0.32948]
d_LACSTF: -0.18408 (0.074544) [0.01872]
ld_SP: 4.8013 (3.6811) [0.20088]

8 group means were subtracted from the data

Residual variance: 1372.52/(45 - 11) = 40.3681
Joint significance of differing group means:
F(7, 34) = 0.323503 with p-value 0.93801
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: -2.2996
unit 2: 2.7295
unit 3: 0.17675

unit 4: 0.43492
unit 5: -0.69259
unit 6: 1.0041
unit 7: 0.17046
unit 8: -2.2449

Breusch-Pagan test statistic:
LM = 2.45067 with p-value = prob(chi-square(1) > 2.45067) = 0.117475
(A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 2.03478
within = 40.3681
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const:	2.6231	(1.0257)	[0.01435]
d_TCR:	0.29315	(0.37265)	[0.43600]
d_LACSTF:	-0.1753	(0.068913)	[0.01483]
ld_SP:	3.2101	(3.1005)	[0.30658]

Hausman test statistic:
H = 1.54404 with p-value = prob(chi-square(3) > 1.54404) = 0.672143
(A low p-value counts against the null hypothesis that the random effects model is consistent, in favor of the fixed effects model.)

2.2. Results

2.2.1. Czech Republic

Model 5: Random-effects (GLS), using 55 observations
Included 10 cross-sectional units
Time-series length: minimum 3, maximum 7
Dependent variable: d_NLTA

coefficient std. error t-ratio p-value
---
const 0.800530 1.15448 0.6934 0.4912
d_TCR -0.125038 0.313136 -0.3993 0.6913
d_LACSTF -0.372193 0.0527767 -7.052 4.50e-09 ***
ld_SP 1.82338 2.34310 0.7782 0.4401

Mean dependent var 2.000909 S.D. dependent var 6.484549
Sum squared resid 1223.019 S.E. of regression 4.849701
Log-likelihood -163.3396 Akaike criterion 334.6792
Schwarz criterion 342.7085 Hannan-Quinn 337.7842

'Within' variance = 17.5263
'Between' variance = 13.752

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 9.78452
with p-value = 0.00175987

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 0.235422
with p-value = 0.971678

2.2.2. Poland

Model 5: Random-effects (GLS), using 74 observations
Included 12 cross-sectional units
Time-series length: minimum 6, maximum 7
Dependent variable: d_NLTA

coefficient std. error t-ratio p-value
---
const 1.31770 0.692998 1.901 0.0614 *
d_TCR -0.808321 0.235606 -3.431 0.0010 ***
d_LACSTf -0.294567 0.0704640 -4.180 8.29e-05 ***
ld_SP 0.0365106 2.13860 0.01707 0.9864

Mean dependent var 2.501892 S.D. dependent var 6.147785
Sum squared resid 1883.614 S.E. of regression 5.150706
Log-likelihood -224.7661 Akaike criterion 457.5322
Schwarz criterion 466.7485 Hannan-Quinn 461.2087

'Within' variance = 29.9075
'Between' variance = 1.80702

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 2.77916
with p-value = 0.0954981

Hausman test -
Null hypothesis: GLS estimates are consistent

Asymptotic test statistic: Chi-square(3) = 1.2159
with p-value = 0.749194

2.2.3. Hungary

Model 7: Fixed-effects, using 52 observations
Included 9 cross-sectional units
Time-series length: minimum 2, maximum 7
Dependent variable: d_NLTA

coefficient	std. error	t-ratio	p-value	
const	-1.28312	0.879110	-1.460	0.1522	
d_TCR	-0.547496	0.246072	-2.225	0.0318	**
d_LACSTF	-0.00968376	0.0128497	-0.7536	0.4555	
ld_SP	3.22193	3.00900	1.071	0.2907	

Mean dependent var -0.696154 S.D. dependent var 5.962620
Sum squared resid 1278.290 S.E. of regression 5.653074
R-squared 0.295007 Adjusted R-squared 0.101134
F(11, 40) 1.521649 P-value(F) 0.161909
Log-likelihood -157.0377 Akaike criterion 338.0754
Schwarz criterion 361.4903 Hannan-Quinn 347.0521
rho -0.225735 Durbin-Watson 2.090877

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 40) = 1.49783
with p-value = P(F(8, 40) > 1.49783) = 0.188741

2.2.4. Slovakia

Model 9: Random-effects (GLS), using 45 observations
Included 8 cross-sectional units
Time-series length: minimum 3, maximum 7
Dependent variable: d_NLTA

coefficient	std. error	t-ratio	p-value	
const	2.62305	1.02572	2.557	0.0143	**
d_TCR	0.293151	0.372653	0.7867	0.4360	
d_LACSTF	-0.175297	0.0689132	-2.544	0.0148	**
ld_SP	3.21008	3.10054	1.035	0.3066	

Mean dependent var 3.408667 S.D. dependent var 6.222351
Sum squared resid 1463.931 S.E. of regression 5.903854
Log-likelihood -142.2021 Akaike criterion 292.4043
Schwarz criterion 299.6309 Hannan-Quinn 295.0983

'Within' variance = 40.3681
'Between' variance = 2.03478

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 2.45067
with p-value = 0.117475

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 1.54404
with p-value = 0.672143

3. Hypothesis 3

3.1. Breuch Pagan Test

3.1.1 Czech Republic

Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: 0.021118 (0.020113) [0.29972]
d_TCR: 0.047447 (0.011068) [0.00010]
d_LACSTF: -0.0042472 (0.0018367) [0.02573]
ld_SP: 0.025682 (0.081856) [0.75526]

10 group means were subtracted from the data

Residual variance: 0.819237/(55 - 13) = 0.0195056
Joint significance of differing group means:
F(9, 42) = 1.14829 with p-value 0.352122
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: 0.14927
unit 2: -0.056583
unit 3: -0.065803
unit 4: -0.0029572
unit 5: 0.031609
unit 6: -0.051222
unit 7: 0.029958
unit 8: -0.01954
unit 9: 0.031561
unit 10: -0.01994

Breusch-Pagan test statistic:
LM = 0.0306359 with p-value = prob(chi-square(1) > 0.0306359) = 0.861055
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.00461382
within = 0.0195056
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: 0.02438 (0.021856) [0.26987]
d_TCR: 0.046725 (0.010017) [0.00002]
d_LACSTF: -0.0035648 (0.0017468) [0.04647]
ld_SP: 0.018201 (0.077392) [0.81501]

Hausman test statistic:
H = 2.59367 with p-value = prob(chi-square(3) > 2.59367) = 0.458599
(A low p-value counts against the null hypothesis that the random effects
model is consistent, in favor of the fixed effects model.)

3.1.2. Poland

Model 6: Pooled OLS, using 73 observations
Included 12 cross-sectional units

Time-series length: minimum 6, maximum 7
Dependent variable: d_l_z

coefficient	std. error	t-ratio	p-value	
const	-0.0139453	0.0196929	-0.7081	0.4812	
d_TCR	0.0319738	0.00656270	4.872	6.77e-06	***
d_LACSTf	-0.000758028	0.00207435	-0.3654	0.7159	
ld_SP	0.188414	0.0594509	3.169	0.0023	***

Mean dependent var -0.002460 S.D. dependent var 0.168904
Sum squared resid 1.431561 S.E. of regression 0.144039
R-squared 0.303060 Adjusted R-squared 0.272758
F(3, 69) 10.00141 P-value(F) 0.000015
Log-likelihood 39.92431 Akaike criterion -71.84862
Schwarz criterion -62.68678 Hannan-Quinn -68.19747
rho -0.164234 Durbin-Watson 1.893148

Excluding the constant, p-value was highest for variable 14 (d_LACSTf)

3.1.3. Hungary
Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: -0.013984 (0.027654) [0.61587]
d_TCR: 0.0049612 (0.0077408) [0.52523]
d_LACSTF: 0.00077024 (0.00040422) [0.06392]
ld_SP: -0.037733 (0.094655) [0.69228]

9 group means were subtracted from the data

Residual variance: 1.26495/(52 - 12) = 0.0316237
Joint significance of differing group means:
F(8, 40) = 1.08012 with p-value 0.396398
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: 0.090846
unit 2: 0.024498
unit 3: -0.0029194
unit 4: -0.013143
unit 5: 0.0079398
unit 6: -0.096102
unit 7: -0.12627
unit 8: 0.045649
unit 9: 0.14191

Breusch-Pagan test statistic:
LM = 0.0174461 with p-value = prob(chi-square(1) > 0.0174461) = 0.894918
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.00393084
within = 0.0316237
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: -0.017323 (0.027764) [0.53562]
d_TCR: 0.0088012 (0.0073958) [0.23989]
d_LACSTF: 0.00057846 (0.00039455) [0.14913]
ld_SP: -0.011758 (0.093677) [0.90064]

Hausman test statistic:
H = 5.27662 with p-value = prob(chi-square(3) > 5.27662) = 0.152627
(A low p-value counts against the null hypothesis that the random effects model is consistent, in favor of the fixed effects model.)

3.1.4. Slovakia
Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

const: 0.011642 (0.018133) [0.52515]
d_TCR: 0.028606 (0.0074215) [0.00049]
d_LACSTF: -0.0024616 (0.0012249) [0.05245]
ld_SP: 0.068354 (0.060487) [0.26636]

8 group means were subtracted from the data

Residual variance: 0.370584/(45 - 11) = 0.0108995
Joint significance of differing group means:
F(7, 34) = 2.45869 with p-value 0.0373811
(A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favor of the fixed effects alternative.)

Means of pooled OLS residuals for cross-sectional units:

unit 1: -0.047366
unit 2: 0.14464
unit 3: 0.020283
unit 4: 0.025344
unit 5: 0.0086071
unit 6: -0.016646
unit 7: -0.040112
unit 8: -0.13475

Breusch-Pagan test statistic:
LM = 0.158893 with p-value = prob(chi-square(1) > 0.158893) = 0.690177
(A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favor of the random effects alternative.)

Variance estimators:
between = 0.000785759
within = 0.0108995
Panel is unbalanced: theta varies across units

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

const: 0.0092208 (0.020029) [0.64768]

d_TCR:	0.022667	(0.0072766)	[0.00335]
d_LACSTF:	-0.0023466	(0.0013456)	[0.08868]
ld_SP:	-0.012432	(0.060543)	[0.83832]

Hausman test statistic:
H = 20.0153 with p-value = prob(chi-square(3) > 20.0153) = 0.000168509
(A low p-value counts against the null hypothesis that the random effects model is consistent, in favor of the fixed effects model.)

3.2. Results

3.2.1. Czech Republic

Model 8: Fixed-effects, using 55 observations
Included 10 cross-sectional units
Time-series length: minimum 3, maximum 7
Dependent variable: d_l_z

coefficient	std. error	t-ratio	p-value	
const	0.0211182	0.0201126	1.050	0.2997	
d_TCR	0.0474474	0.0110678	4.287	0.0001	***
d_LACSTF	-0.00424717	0.00183669	-2.312	0.0257	**
ld_SP	0.0256823	0.0818557	0.3138	0.7553	

Mean dependent var 0.025293 S.D. dependent var 0.170366
Sum squared resid 0.819237 S.E. of regression 0.139663
R-squared 0.477302 Adjusted R-squared 0.327959
F(12, 42) 3.196023 P-value(F) 0.002573
Log-likelihood 37.64306 Akaike criterion -49.28612
Schwarz criterion -23.19078 Hannan-Quinn -39.19484
rho -0.462116 Durbin-Watson 2.519026

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(9, 42) = 1.14829
with p-value = P(F(9, 42) > 1.14829) = 0.352122

3.2.2. Poland

Model 7: Random-effects (GLS), using 73 observations
Included 12 cross-sectional units
Time-series length: minimum 6, maximum 7
Dependent variable: d_l_z

coefficient	std. error	t-ratio	p-value	
const	-0.0139453	0.0196929	-0.7081	0.4812	
d_TCR	0.0319738	0.00656270	4.872	6.77e-06	***
d_LACSTf	-0.000758028	0.00207435	-0.3654	0.7159	
ld_SP	0.188414	0.0594509	3.169	0.0023	***

Mean dependent var -0.002460 S.D. dependent var 0.168904
Sum squared resid 1.431561 S.E. of regression 0.143007
Log-likelihood 39.92431 Akaike criterion -71.84862
Schwarz criterion -62.68678 Hannan-Quinn -68.19747

'Within' variance = 0.023523
'Between' variance = 0.000566597

Breusch-Pagan test -
Null hypothesis: Variance of the unit-specific error = 0
Asymptotic test statistic: Chi-square(1) = 3.63435
with p-value = 0.0565986

Hausman test -
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(3) = 2.10013
with p-value = 0.551887

3.2.3. Hungary

Model 9: Fixed-effects, using 52 observations

Included 9 cross-sectional units
Time-series length: minimum 2, maximum 7
Dependent variable: d_l_z

coefficient std. error t-ratio p-value
---
const -0.0139838 0.0276544 -0.5057 0.6159
d_TCR 0.00496120 0.00774076 0.6409 0.5252
d_LACSTF 0.000770243 0.000404218 1.906 0.0639 *
ld_SP -0.0377327 0.0946552 -0.3986 0.6923

Mean dependent var -0.023918 S.D. dependent var 0.181386
Sum squared resid 1.264948 S.E. of regression 0.177831
R-squared 0.246133 Adjusted R-squared 0.038820
F(11, 40) 1.187251 P-value(F) 0.326408
Log-likelihood 22.83672 Akaike criterion -21.67345
Schwarz criterion 1.741477 Hannan-Quinn -12.69672
rho -0.295516 Durbin-Watson 1.717640

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(8, 40) = 1.08012
with p-value = P(F(8, 40) > 1.08012) = 0.396398

3.2.4. Slovakia
Model 11: Fixed-effects, using 45 observations
Included 8 cross-sectional units
Time-series length: minimum 3, maximum 7
Dependent variable: d_l_z

coefficient std. error t-ratio p-value
---
const 0.0116422 0.0181331 0.6420 0.5252
d_TCR 0.0286064 0.00742147 3.855 0.0005 ***
d_LACSTF -0.00246164 0.00122489 -2.010 0.0525 *
ld_SP 0.0683539 0.0604866 1.130 0.2664

Mean dependent var -0.010085 S.D. dependent var 0.132095
Sum squared resid 0.370584 S.E. of regression 0.104401
R-squared 0.517317 Adjusted R-squared 0.375352
F(10, 34) 3.643964 P-value(F) 0.002229
Log-likelihood 44.13288 Akaike criterion -66.26577
Schwarz criterion -46.39248 Hannan-Quinn -58.85721
rho -0.225089 Durbin-Watson 1.812847

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(7, 34) = 2.45869
with p-value = P(F(7, 34) > 2.45869) = 0.0373811