

Univerzita Karlova v Praze

Fakulta sociálních věd

Institut ekonomických studií

Diplomová práce

2007

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Fakulta sociálních věd**

Institut ekonomických studií

DIPLOMOVÁ PRÁCE

**Regulation of Bank Capital and Behavior of Banks:
Assessing the US and the EU-15 region Banks in the
2000-2005 period**

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Akademický rok: 2006/2007**

Prohlášení

Prohlašuji, že jsem diplomovou práci vypracoval samostatně a použil pouze uvedené prameny a literaturu.

Hereby I declare that I compiled this master thesis independently, using only the listed literature and resources.

Prague, May 8, 2007

Milan Matejašák MSc.

Acknowledgments

I would like to express my gratitude to my consultant Petr Teplý (Charles University) for supervising my work on this thesis. Then I would like to thank to Gray Krueger (KPMG Czech Republic) for proofreading and to all my friends who gave me a lot of useful comments and advice. Last but not least, I want to thank to my family for supporting and encouraging me during my whole studies. **Thank you!**

Abstract

In recent years, regulators have increased their focus on the capital adequacy of banking institutions to enhance their stability, hence the stability of the whole financial system. The purpose of this master thesis is to assess and compare how American and European banks adjust their level of capital and portfolio risk under capital regulation, whether and how they react to constraints placed by the regulators. In order to do this, we estimate a modified version of the simultaneous equations model developed by Shrieves and Dahl. This model analyzes adjustments in capital and risk at banks when they approach the minimum regulatory capital level. The results indicate that regulatory requirements have the desired effect on bank behavior. Both American and European banks that are close to minimum requirements increase their capital. In addition, the US banks decrease their portfolio risk taking.

Key words: banking, capital adequacy, capital regulation, Basel I, Basel II

Abstrakt

V posledom období regulátori zvýšili pozornosť na kapitálovú primeranosť bánk aby tak zaistili stabilitu bánk a tým vlastne zaistili stabilitu celého finančného systému. Cieľom tejto diplomovej práce je vyhodnotiť a porovnať, ako americké a európske banky prispôsobujú svoj kapitál a riziko pri regulácii kapitálu, či a ako reagujú na obmedzenia uložené regulátormi. Na to použijeme modifikovanú verziu Shrieves a Dahlovho modelu simultánnych rovníc. Tento model analyzuje, ako banky prispôsobujú svoj kapitál a riziko, keď sa blížia minimálnym kapitálovým požiadavkom. Naše výsledky ukazujú, že požiadavky regulátorov prinášajú žiadaný efekt. Americké aj európske banky, ktorých kapitál sa blíži minimálnej hranici, zvýšia svoj kapitál. Americké banky navyše znížia riziko svojich portfólií.

Kľúčové slová: bankovníctvo, kapitálová primeranosť, regulácia kapitálu, Basel I, Basel II

1. Introduction	3
2. Background to the banks' capital regulation.....	5
2.1 Reasons and history of capital regulation.....	5
2.2 The Basel Committee on Banking Supervision.....	6
3. Basel I (or Basel Accord)	9
3.1 The bank's capital decomposition	9
3.2 The risk-weighted assets.....	11
3.3 Off-balance Sheet items.....	12
3.4 A target ratio.....	13
3.5 Amendment to the Basel I to incorporate market risks	14
4. Basel II (or New Basel Capital Accord).....	16
4.1 Pillar 1: Capital requirements	17
4.1.1 Credit risk	17
4.1.2 Operational risk	23
4.2 Pillar 2: Supervision	25
4.3 Pillar 3: Market discipline	26
4.4 Basel II criticism.....	27
4.5 QIS 5 and expectations from Basel II.....	31
4.6 Preparations for Basel II and its future.....	36
5. Building a model.....	40
5.1 Theory review.....	40
5.2 Model specification	43
5.2.1 Definitions of capital and risk	45
5.2.2 Variables affecting changes in banks' capital and risk.....	46
5.2.3 Modeling regulatory pressure.....	49
5.2.4 Specification	54
5.3 Data.....	55
5.4 Methodology.....	59

6. Empirical results	61
6.1 “Gap magnitude method” - empirical results	61
6.2 “Advanced gap magnitude method” - empirical results.....	65
6.3 “Capital volatility approach” - empirical results	66
6.4 Comparison with other findings	69
7. Conclusion	71
8. List of used abbreviations	73
9. References	74
10. Appendix	83
11. Master thesis project	88

1. Introduction

This thesis has got two objectives - a major one and a minor one. The minor one is to present background to bank capital regulation and present the related Basel accords. The major one is to assess the behavior of American and European banks, to analyze their reaction to regulatory pressure.

We try to answer two key questions: Does regulatory pressure induce the American and the European banks to increase their capital? Does strengthening of capital requirements induce them to increase or decrease their portfolio riskiness?

The *second chapter* provides an insight into capital regulation. We briefly explain the history and reasons leading to bank regulation. In the *third* and *fourth chapter* we present two core-papers related to this issue, the Basel I accord and the new and fresh Basel II accord. At the end of the fourth chapter we present criticism put on Basel II, from both bankers and researchers. Finally, we discuss expectations from implementing Basel II.

The empirical part of the thesis starts in *chapter five*. To our knowledge, we are the first to test and compare the capital and risk behavior of the American and European banks. At first, we present different theories related to our research and their rivaling predictions.

To answer the key questions we estimate a modified version of the simultaneous equations model developed by Shrieves and Dahl. In the model, regulatory pressure is one of the explanatory variables and the dependent variables are changes in risk and capital. The model is modified in two main aspects; we use more advanced approaches towards the regulatory pressure variable (we model the regulatory pressure variable in three different ways) and we include also year dummy variable to capture year-specific effects.

There are many methods that can be used to estimate the model; we have chosen the method of two-stage least squares (2SLS) and three-stage least squares (3SLS) estimates in order to test for the robustness of the results. A more detailed discussion about the advantages and disadvantages of particular econometric procedures is at the end of chapter five.

Data were obtained from BankScope, a database which has statement data on more than 11 000 banks worldwide. We take into consideration panel data for 1 240 American and European banks from the 2000-2005 period.

In *chapter six* we present the empirical results of our research. We compare our results with predictions of the theories mentioned at the beginning of chapter five and we compare our results with the findings of other authors.

Finally, chapter *seven* is devoted to conclusions.

2. Background to the banks' capital regulation

2.1 Reasons and history of capital regulation

Increased regulation of bank capital, when compared to other entrepreneurship entities stems basically from the fact that a bank balance sheet differs significantly from a balance sheet of a common company. The main difference is that bank capital¹ represents just a small portion of assets while the portion of liabilities to assets is large. This is because the majority of a bank's sources² are comprised of outside resources, mainly from customer deposits and deposits from banks. On the other hand, bank assets are composed mainly of loans, leases to customers, and securities. From this, it follows that a bank is more vulnerable when compared to a company since it has a higher share of liabilities. Therefore, unexpected losses which a bank may face may not be well covered by its capital if it is too low. This is why regulators force banks to increase their capital to a minimum level so the banks can cover their potential losses and this risk is not transferred to bank customers.

Financial services, especially banking, play an important role in the economy of every country. It is natural then to regulate the financial risks because a bank's failure may affect the entire country's economy. The main aim of bank regulation is to avoid failures and protect all bank customers in order to secure a stable and healthy banking system and thus also secure a stable currency.

It is banks' main duty to keep the rules of capital adequacy and liquidity and the rules that prevent banks from being highly engaged with just one customer. Banks also have to regularly provide information about their financial situation to the public and to keep to international rules and standards in order to avoid illegal actions, such as money laundering. In some countries they also have to keep compulsory minimum reserves.

Until the mid 70s there was no international institution which would coordinate domestic and international bank regulation. As the amount of international financial flows grew and the number of banks with worldwide activities also grew, the need for international cooperation became greater than ever. As banks tried to access foreign markets, the question arose: Who

¹ Here we have on our mind a firm's value which is equal to assets minus liabilities.

² Total sources are composed from shareholders' equity and total liabilities.

was to be responsible for bank regulation and bank policy? Was it the rules of a “parent” country or a host country? The transnational banking system was becoming more interconnected and different dangers arose as a result of different legal requirements. For example, when there was a country which imposed less restriction on the domestic banks with international activities, it could be a danger for the second country with more restriction if a bank from the first country came to this second country. The stability of the financial system with stricter policy was exposed to more risks than before and it became more vulnerable.³

2.2 The Basel Committee on Banking Supervision

A fundamental step in the evolution of international regulation was taken in 1975 when a standing committee was formed under the auspices of the Bank for International Settlements⁴ (BIS). Called the Basel Committee on Banking Supervision⁵, the committee comprised representatives from central banks and regulatory authorities.

The Committee does not possess any formal supranational supervisory authority and its conclusions do not have legal force. It rather formulates broad supervisory standards, guidelines, and it recommends statements of best practice in the expectation that individual authorities will take steps to implement them through detailed arrangements which are best suited to their own national systems.⁶ Today more than one hundred countries follow the recommendations of the Committee.

Initially the Committee aimed just to close supervisory gaps and to improve understanding and the quality of banking supervision among countries. Two basic principles were important: no foreign bank establishment should escape supervision and supervision should be adequate. In 1983 the Committee finalized a document called *Principles for the Supervision of Banks' Foreign Establishments*. This document “set down the principles for sharing supervisory responsibility for banks' foreign branches, subsidiaries and joint ventures

³ Štěpánek, J., 2005, Kapitálová přiměřenost bank podle Basel II, Vysoká škola ekonomická v Praze, Praha, p. 5.

⁴ The BIS was established in 1930. It is the world's oldest international financial institution and remains the principal centre for international central bank cooperation. The BIS was established in the context of the Young Plan (1930) which dealt with the issue of the reparation payments imposed on Germany by the Treaty of Versailles following the First World War.

⁵ The present Chairman of the Committee is Mr Nout Wellink, President of the Netherlands Bank. Its Vice-Chairman is Mr Nicholas Le Pan, Superintendent of Financial Institutions, Canada.

⁶ www.bis.org/bcbs/history.htm (September 2, 2006)

between host and parent (or home) supervisory authorities.”⁷ This paper was just a revised version of the paper called *Concordat* that was published in 1975. Some principles of the *Concordat* were also reformulated in 1992 and these are known as *Minimum Standards*.

Over time the range of the Committee objectives widened. It was not just to ensure that international banks or bank holding companies do not escape comprehensive supervision by a home regulatory authority, but also to promote uniform capital requirements so banks from different countries could compete with each other on a “level playing field”.⁸ Capital adequacy became the topic towards which the Committee devoted more and more of its time. This was because capital ratios of the main international banks were getting smaller, so the Committee decided to halt the erosion of capital standards in the banking system and to work towards greater convergence in the ways of measuring capital adequacy. This resulted in the consensus that the different risks of a bank should be weighted and also that off-balance sheet⁹ should be taken into consideration.¹⁰

There was a growing need for a multinational accord which would strengthen the stability of the international banking system and also remove the competitive disadvantages arising from different national capital requirements. Thus, in 1988 the Committee released a paper concerning the capital measurement system and it is often referred to as the Basel Accord (Basel I). This document was a major milestone in the history of bank regulation; it provided a framework with a minimum capital standard of 8 percent. Since 1988 this requirement has not only been implemented in the Committee member countries, but also in many other countries with internationally active banks.

The 1988 framework was not intended to be static but to evolve over time. The Committee published many amendments to the Basel I in the following years. For example, in 1991

⁷ Basel Committee, 2004, History of the Basel Committee and its Membership, Basle: Bank for International Settlement, p. 2.

⁸ www.riskglossary.com/link/basle_committee.htm (September 2, 2006)

⁹ Off-balance sheet includes those activities of a bank that generally do not involve booking assets (loans) and taking deposits. Off-balance sheet activities normally produce liabilities or assets that are deferred and thus do not appear on the institution's balance sheet until they become actual assets or liabilities with a value or cost that can be determined. Examples include guarantees substituting the institution's own credit for a third party, such as in standby letters of credit, interest rate swaps, foreign exchange forward options, etc. www.investordictionary.com/definition/off-balance+sheet+activities.aspx (September 2, 2006)

¹⁰ Basel Committee, 2004, History of the Basel Committee and its Membership, Basle: Bank for International Settlement, p. 2.

greater precisions were given to the definitions included in the paper, and in 1996 new risks¹¹ were incorporated, etc.

In 1999, due to many amendments, the Committee issued a proposal for a new capital adequacy framework that would replace the old Basel I. These efforts culminated in the release of the New Basel Capital Accord in 2004, also called Basel II. The new framework consists of three pillars: minimum capital requirements which seek to develop and expand on the standardized rules set forth in the 1988 Accord; a supervisory review of an institution's capital adequacy and an internal assessment process; and the effective use of market discipline to strengthen disclosure and encourage safe and sound banking practices. These three elements are the essential pillars of an effective capital framework. The Basel II is designed to improve the way regulatory capital requirements reflect underlying risks and to better address the financial innovation that has occurred in recent years. Its implementation began in the beginning of 2007.

¹¹ Namely market risks. For more information, see the following subchapter 3.5.

3. Basel I (or Basel Accord)¹²

As already mentioned, Basel I was published in 1988 and started to be implemented in the following years. This accord aims to provide international convergence of capital measurement and capital standards. It sets out the basics, such as credit risk.¹³ The document is divided into four parts:

1. The constituents of capital
2. The risk weights
3. A target standard ratio
4. Transitional and implementing arrangements

3.1 The bank's capital decomposition

Basel I suggests the following capital decomposition:

Tier 1 (Core capital):

(a) Paid-up share capital/common stock

(b) Disclosed reserves - these are reserves that are openly reported in the balance sheet of a bank.

Tier 2 (Supplementary capital):

(a) Undisclosed reserves - these are unpublished or hidden reserves. These reserves may be constituted in various ways according to differing legal and accounting regimes in member countries. Under this heading there are included only reserves which, though unpublished, have been passed through the profit and loss account and which are accepted by the bank's supervisory authorities. Many countries do not recognize undisclosed reserves.

(b) Asset revaluation reserves - some countries, under their national regulatory or accounting arrangements, allow certain assets to be revalued to reflect their current value, or something closer to their current value than historic cost, and the resultant revaluation reserves to be

¹² The source for the chapter 3, if not explicitly stated otherwise, is Basel I document: Basel Committee, 1988, International Convergence of Capital Measurement and Capital Standards, Basle: Bank for International Settlement.

¹³ Credit risk: "The possibility that a bond issuer will default, by failing to repay principal and interest in a timely manner. Bonds issued by the federal government, for the most part, are immune from default (if the government needs money it can just print more). Bonds issued by corporations are more likely to be defaulted on, since companies often go bankrupt. Municipalities occasionally default as well, although it is much less common. Also called default risk." Source: www.investorwords.com/1210/credit_risk.html (September 5, 2006)

included in the capital base. This is relevant mainly to those banks whose balance sheets traditionally include very substantial amounts of equities held in their portfolio at historic cost.

(c) *General provisions/general loan-loss reserves*

(d) *Hybrid (debt/equity) capital instruments* - a number of capital instruments fall into this category. These instruments combine certain characteristics of equity and certain characteristics of debt, for example, long-term preferred shares in Canada, titres participatifs in France, Genussscheine in Germany, etc.

(e) *Subordinated debt* - this is a borrowing in the form of an unsecured note, debenture or other debt instrument which, in the event of the debtor's bankruptcy, has a lesser claim to the assets of the debtor than other classes of debt.

Tier 1 is a core capital and it is the key element of capital on which the main emphasis is placed. For most banks Tier 1 capital is simply capital stock, surplus and undivided profits. This key element of capital is the only element common to all countries' banking systems. It is wholly visible in the published accounts and it has a crucial bearing on profit margins and a bank's ability to compete.

From Tier 1 capital the following items should be deducted:

- goodwill and other intangible items¹⁴
- investments in unconsolidated banking and financial subsidiary companies
- investments in the capital of other banks and financial institutions

Tier 2 capital is a secondary bank capital¹⁵ that includes items such as undisclosed reserves, general loss reserves, subordinated term debt, and more. To conclude, those forms of capital which best meet the essential capital characteristics are classified as Tier 1 and those which do not have all the characteristics but nevertheless contribute to the overall strength of a financial institution are included in Tier 2.

Total capital comprises the sum of Tier 1 and Tier 2 capital less any required deductions. To make the capital composition more clear, see figure 1. There are some restrictions on capital

¹⁴ Intangible asset: Something of value that can not be physically touched, such as a brand, franchise, trademark or patent.

Source: www.investorwords.com/2525/intangible_asset.html (September 5, 2006)

¹⁵ Primary bank capital is Tier 1.

volumes which have to be followed. For example, eligible Tier 2 capital may not exceed Tier 1 capital (in other words, Tier 1 must form at least 50 % of total capital). Subordinated term debt, which is included in Tier 2, is limited to a maximum of 50 % of Tier 1 elements. And there are even more restrictions.¹⁶

Figure 1: Bank's capital

Tier 1	Tier 2
Capital	Deductibles

3.2 The risk-weighted assets

Bank assets are classified and grouped into five categories according to credit risk, carrying risk weights of 0 % (for example home country sovereign debt), 10 %, 20 %, 50 %, and 100 % (most corporate debt). The decision rule is that the more risky the asset, the larger the risk weight. For example, the 0 % category includes cash while loans are generally in the 100 % category.¹⁷ Another decision rule is that a more favorable risk weight is given to the counterparty if it resides in OECD country. For example, 0 % risk weight is given on claims on OECD central banks while 100 % risk weight is given on claims to central banks in countries which are not OECD members.¹⁸

The risk weights suggested by the accord are the minimum risk weights, so banks can discretionally choose higher a level of risk for a specific asset. For example, the suggested risk weight for claims on banks in the OECD countries is 20 %, but a bank can choose 50% or even 100%.

¹⁶ The complete list of restrictions is beyond the scope of this thesis. For those interested, we refer to Basel I document.

¹⁷ For complete list of risk weights by category of on-balance-sheet asset we refer to attachments, table 27.

¹⁸ Even though accommodation of these rules may seem complicated, it is simple. The simplicity is best illustrated by the fact that virtually all claims on private sector are assigned the same 100 % weight.

More formally, the risk-weighted assets (RWA) are defined as:

$$RWA = \sum_{i=1}^n (A_i W_i)$$

where: A_i nominal value of an asset i

W_i risk weight for an asset

nnumber of assets¹⁹

The important thing is to assign proper risk weights to different groups and subgroups of assets.²⁰ From the construction of the risk-weighted asset indicator it follows that the structure of assets is really important. It can happen that when there are two banks (bank A and B) and one of them has larger assets (bank A) and the same (or even lower) capital, even though this bank (bank A) can be the “less risky one” bank because of its lower risk-weighted assets, hence the “less risky” structure of assets.²¹

3.3 Off-balance Sheet items

Not just on-balance sheet items but also off-balance sheet items are weighted for risk, with off-balance sheet items converted to balance sheet equivalents (using credit-conversion factors) before being allocated a risk weight. This is done because bank off-balance sheet activities are of growing importance. This inclusion of off-balance sheet business in capital calculations involves a two-step process:

¹⁹ If a bank choose to give 0 % risk weight to cash balances (as suggested in the Accord) and discretionally choose to give the maximum risk weight to all other assets (it means 100% risk weight), then it follows: $\sum_{i=1}^n (A_i W_i) < \sum_{i=1}^n (A_i)$.

It means that the sum of risk-weighted assets is smaller than total assets. This implies that:

$$\frac{\text{capital (Tier 1 + Tier 2)}}{\sum_{i=1}^n (A_i W_i)} > \frac{\text{capital (Tier 1 + Tier 2)}}{\sum_{i=1}^n (A_i)}$$

So the ratio of capital to risk-weighted assets is always higher than the

ratio of capital to assets. Source: Revenda, Z., 1999, Centrální bankovníctví, Management Press, Praha, p.484.

²⁰ Some questions arise. Claims on the private sector have 100 % risk weight while claims on banks have just 20 % risk weight. But it is at least questionable whether the private sector is five times more risky than banking sector.

²¹ Source: Osúch, M., 2004, Kapitálová primeranosť bánk a bazilejské dohody, Ekonomická univerzita v Bratislave, Bratislava, p.11.

1. All categories of off-balance sheet engagements are converted to credit risk equivalents by multiplying the nominal amounts by a credit conversion factor²², and
2. the resulting credit equivalent amounts are then weighted according to the nature of the counterparty.

By doing this, the risks that arise from off-balance sheet activities are also taken into account as these activities are growing in both absolute and relative²³ amounts.

3.4 A target ratio

The Committee agreed that a minimum standard should be set. The target standard ratio of capital to risk-weighted assets was set at 8 % (of which the core capital element, Tier 1, was to be at least 4 %).

Capital adequacy ratio (CAR):

$$CAR = \frac{\text{capital (Tier 1 + Tier 2)}}{\text{credit risk}} = \frac{\text{capital (Tier 1 + Tier 2)}}{\sum_{i=1}^n (A_i W_i)} \geq 0,08$$

This was expressed as a minimum standard which international banks in member countries should reach by the end of 1992, thus allowing a transitional period of four and a half years for any necessary adjustment.

If CAR is large enough, it means that banks capital is large enough to cover unexpected losses. The higher the CAR, the higher the amount of sources from banks' shareholders. The aim of regulators was to maximize the efforts of the shareholders to run a bank well because if a bank's capital is too low, then the shareholders losses are not so huge if the bank goes bankrupt.

On the other hand, it is also important to note that a CAR which is too high is not good either. This means that the shareholders' resources are not used in the most efficient way. Excessively high CAR basically means that much of the bank capital is just "lying" and there

²² For example, those terms which substitute for loans (e.g. financial guarantees for loans) carry a 100% credit risk conversion factor while short-term liabilities arising from the movement of goods (e.g. documentary credits collateralized by the underlying shipments) carry a 20% credit risk conversion factor.

²³ When compared to total assets.

are no returns from it. This decreases returns on equity (ROE) which is not favored by the banks' shareholders.²⁴

3.5 Amendment to the Basel I to incorporate market risks²⁵

Many amendments were made to the Basel I during the years after its publishing in 1988. Probably the most significant amendment was the one from January 1996 which aimed to take into account not only credit risk but also market risk. This amendment involves calculation of capital requirements to market risks incurred by banks, defined as 'the risk of losses in on- and off-balance sheet positions arising from movements in market prices'.²⁶ Every bank is exposed to these risks. They arise from bank trading activities. The risks covered by the proposed framework were: (a) the risks in the trading book of debt and equity instruments and related off-balance sheet contracts and (b) foreign exchange and commodities risk. The Committee outlines the methodology for the two alternative methods of calculating market risk: Internal Models Approach and Standardized Approach.

In this amendment the Committee also introduced a new capital component, so called Tier 3, which was formed by short-term subordinated debt. Hence, the eligible capital consisted of shareholders' equity and retained earnings (Tier 1), supplementary capital (Tier 2) as defined in the 1988 Accord, and short-term subordinated debt (Tier 3).

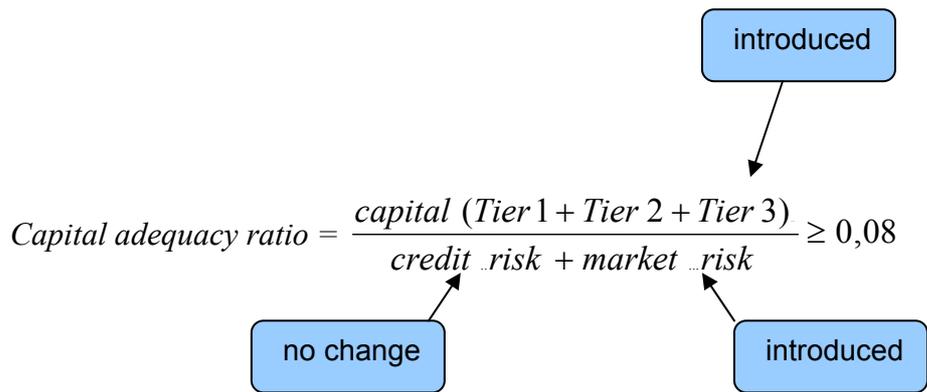
As in the case of Tier 1 and Tier 2, some restrictions were also placed on Tier 3. For example, Tier 3 was only eligible to cover market risk and it was limited to 250 % of the bank Tier 1. All countries had to continue to maintain the principle that the eligible Tier 2 was limited to a maximum of 100 % of the Tier 1 elements.

²⁴ Osúch, M., 2004, Kapitálová primeranosť bánk a bazilejské dohody, Ekonomická univerzita v Bratislave, Bratislava, p. 13.

²⁵ The source for the subchapter 3.5, if not explicitly stated otherwise, is: Basel Committee, 1996, Overview of the Amendment to the Capital Accord to Incorporate Market Risks, Basle: Bank for International Settlement.

²⁶ There are basically four standard market risk factors: equity risk (the risk of stock price changes), interest rate risk (the risk of interest rates change), currency risk (the risk of exchange rates change) and commodity risk (the risk of commodity price changes). Source: www.investordictionary.com (September 10, 2006)

After this amendment the new capital requirement was as follows:



4. Basel II (or New Basel Capital Accord)²⁷

In June 1999, the Basel Committee began the process of replacing the 11-year-old accord with a more up-to-date framework. Its adaptation began in the beginning of 2007.²⁸ The fundamental objective of the new framework was to further strengthen the soundness and stability of the international banking system.

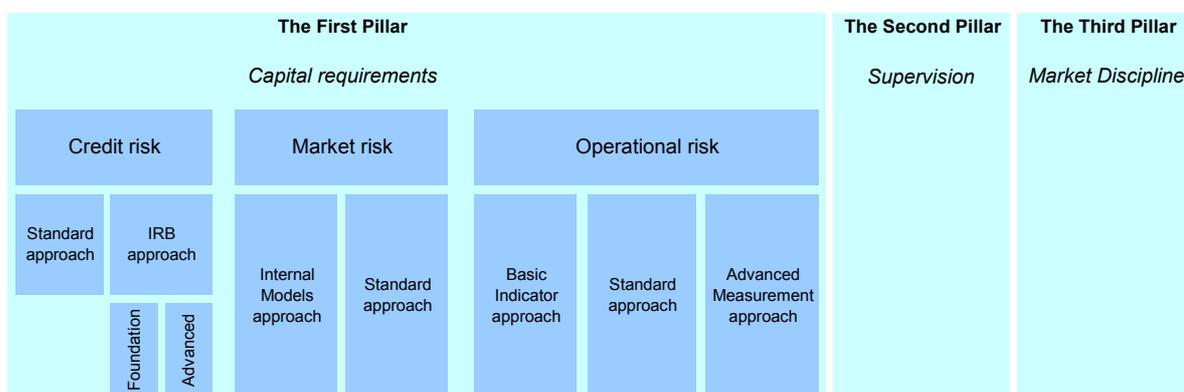
The Committee retained key elements of the 1988 capital adequacy framework; the general requirement for banks to hold total capital equivalent to at least 8 % of their risk-weighted assets; the basic structure of the 1996 Market Risk Amendment regarding the treatment of market risk; and the definition of eligible capital. The structure of the Basel II is as follows:

Pillar 1: Capital requirements: Capital requirements will be based on credit, market and operational risk.

Pillar 2: Supervision: Regulators will conduct qualitative supervision of internal process of risk control and capital assessment process.

Pillar 3: Market discipline: Active involvement of the financial markets, for example through disclosure requirements, will bring discipline to member institutions.

Figure 2: Basel II structure



These three pillars are interconnected with each other and they are all supposed to enhance the stability of financial systems. The Committee stresses the need to assert the requirements

²⁷ The source for the chapter 4, if not explicitly stated otherwise, is Basel II document: Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement.

²⁸ In the attachments, in table 28, you will find a chronological list of key steps regarding the preparation of Basel II.

from all the three pillars at once, and it plans to cooperate with the regulatory authorities to implement all aspects of the new framework.

4.1 Pillar 1: Capital requirements

The first pillar defines capital requirements. Within the new framework the capital requirement from the Basel 1 is maintained, i.e. the ratio of total capital to risk-weighted assets must be no lower than 8 %. The new framework better defines all the risks that a bank has to face and it also suggests more complex risk calculation methods. Specifically, regarding credit risk, its calculation was revised. Regarding market risk, based on the 1996 amendment to the Basel I, there was no change. A new item was the introduction of operational risk. So the new capital requirement was as follows:

$$\text{Capital adequacy ratio} = \frac{\text{capital (Tier 1 + Tier 2 + Tier 3)}}{\text{credit risk + market risk + operational risk}} \geq 0,08$$

Banks that want to increase their capital adequacy ratio in order to fulfill the regulatory requirement of supervisor or for other non-regulatory reasons can basically do so in two ways. They can increase their capital level or decrease their risk (or they can do both).

4.1.1 Credit risk

The new rules will reflect risks more significantly into debt costs. The main change will be in the assessment of current and potential debtors. Banks will be able to recognize more and less risky clients and offer better loan contracts to those less risky. The conditions of loan contracts, particularly the interest rate, will depend on the credibility of a client. This means that some clients can be offered less favorable terms of contract than others.

There are two suggested methods to measure credit risk. The first is the Standardized approach and the second is the Internal Ratings Based (IRB) approach. The IRB approach has two variants: the Foundation one (FIRB) and the Advanced one (AIRB). Banks which want to use the IRB approach to measure credit risk must ask for approval from their supervisor, which is usually their central bank.

Credit risk - Standardized approach

This approach is just a revision of the approach to credit risk in the Basel I from 1988. The risk-weighted assets in the Standardized approach are still calculated as a multiple of the nominal value of an asset category and its risk weight. Similar to Basel I, the risk weights are assigned according to the nature of a counterparty: sovereign, bank, corporation or other²⁹. The difference from Basel I is that it is not important whether the sovereign is an OECD member (in Basel I this meant lower risk weight)³⁰ or not. The Standardized approach relies on external credit assessments. So the External Credit Assessment Institutions³¹ (ECAI) start to play an important role. An ECAI must satisfy each of the following six criteria: objectivity, independence, transparency, disclosure, sufficient resources to carry out high quality credit assessments and credibility.

As Basel II is an extensively elaborated document, it is beyond the scope of this thesis to go into it in-depth. Therefore, just some types of claims and their risk weights are presented here.

Claims on sovereigns

There are two possibilities for risk weighting claims on sovereigns. The risk weights may be based on the basis of private rating institutions (ECAI), but supervisors also recognize the country risk scores assigned by Export Credit Agencies (ECA).³² The basic ECA advantage is that their ratings are available for more sovereigns than ratings from ECAI. Claims on sovereigns and their central banks will be risk-weighted as follows (the notation follows the methodology used by Standard & Poor's):

²⁹ One anonymous senior banker doubts about the rationale of this division. He argues: "In banking today, we measure the relative risk of an obligor and the value of collateral and guarantees to come up with the economic rationale for a transaction. The only time we divide credits into buckets like corporate, sovereign, or retail is for regulators. It is not simply the way we manage our business." Source: American Banker, October 6, 2006, Basel II Will Not Unify Global Rules on Capital

³⁰ See the appendix, table 16.

³¹ Such as Standard & Poor's, Fitch-IBCA, etc.

³² The Committee precisely defines the requirements and criteria for an ECA to be eligible for giving ratings. For example, an ECA must publish its risk scores and subscribe to the OECD agreed methodology.

Table 3: Claims on sovereigns as rated by External Credit Assessment Institution

Sovereign credit assessment	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Sovereign risk weight	0%	20%	50%	100%	150%	100%

Source: Basel Committee³³

ECA risk scores will correspond to risk weight categories as detailed below:

Table 4: Claims on sovereigns as rated by Export Credit Agency

ECA risk scores	0 - 1	2	3	4 - 6	7
Sovereign risk weight	0%	20%	50%	100%	150%

Source: Basel Committee³⁴

Because of similar characteristics, claims on central banks are assigned the same risk weight as claims on sovereigns. Claims on the Bank for International Settlements, the International Monetary Fund and the European Central Bank receive a 0 % risk weight.³⁵

Claims on non-central government public sector entities (PSEs)

Claims on domestic PSEs will be risk-weighted as claims on banks. These PSEs involve different institutions: regional governments, local authorities, non-commercial undertakings owned by the governments, etc. Claims on certain domestic PSEs may also be treated as claims on the sovereigns in which jurisdictions these PSEs are established.

Claims on banks

According to the Committee, there are two options for claims on banks. The rule is that no claim on an unrated bank may receive a risk weight which is below the risk weight applied to claims on its sovereign where the bank resides. In other words, the risk weight for any bank is either equal to or higher than the rate for the sovereign in which it resides.

³³ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 15.

³⁴ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 16.

³⁵ There are even more banks, Multilateral Development Banks, which will be eligible for a 0% risk weight, for example: the European Investment Bank, the Nordic Investment Bank, the Asian Development Bank, the African Development Bank, etc.

According to the first option, the same risk weight will be given to all banks that reside in one country and this risk weight will be one category less favorable than the one assigned to claims on the sovereign of that country. However, there exists an upper risk limit. No bank shall receive a higher risk weight than 100 % (except for those banks which reside in a country with sovereign rating lower than B-). This approach is characterized in the following table:

Table 5: Claims on banks under option 1

Sovereign credit assessment	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Bank risk weight	20%	50%	100%	100%	150%	100%

Source: Basel Committee³⁶

According to the second option, the risk weight given on claims on a bank will be based on the external rating of bank itself.

This second option is summarized in the following table:

Table 6: Claims on banks under option 2

Bank credit assessment	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Bank risk weight	20%	50%	50%	100%	150%	50%
Risk weight for short term claims ³⁷	20%	20%	20%	50%	150%	20%

Source: Basel Committee³⁸

Table 6 suggests that under the second option a bank can choose to apply preferential treatment to short term claims. However, there is a lower limit for this treatment of 20 %.

Claims on corporates

The following table illustrates the risk weighting on corporate claims. Unrated corporates³⁹ will be given risk weight 100 % and no claim on corporate can have weight preferential to that assigned to its sovereign of incorporation.

³⁶ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 18.

³⁷ Short term claims are the claims with effective maturity of three months or less.

³⁸ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 18.

³⁹ Disadvantage of the standardized approach is that in many countries there are just few corporates with rating. This means that most corporates will fall into 100 % risk weight category.

Table 7: Claims on corporates

Corporate credit assessment	AAA to AA-	A+ TO A-	BBB+ to BBB-	Below BB-	Unrated
Risk weight	20%	50%	100%	150%	100%

Source: Basel Committee⁴⁰

Credit risk - The Internal Ratings-Based Approach

In order to become eligible for the IRB approach a bank will be required to demonstrate that its internal rating system and processes are in accordance with the supervisory standards set by the Committee. Once a bank receives supervisory approval to use the IRB approach, it may rely on its own internal estimates of risk components in determining the capital requirement for a given exposure. The risk components of the IRB approach include basically four main risk elements: the obligor's *probability of default* (PD), the facility's *loss given default* (LGD), the *exposure at default* (EAD) and the *effective maturity* (M).

The Committee has made available two broad approaches: *the Foundation (FIRB)* and *the Advanced approach (AIRB)*. Under the foundation approach, as a general rule, banks provide their own estimates of PD and rely on supervisory estimates for other risk components. Under the advanced approach, banks provide their estimates of PD, LGD, EAD, and M, subject to meeting minimum standards.

The majority of banks in their methodology on customers' credit risk assessment focus on the risk of customers' default. PD is the probability that a borrower is not able to fulfill its contractual commitments. PD of a client is the main measurable figure on which the IRB approach is based. Estimates of PD can be based on a bank's historical experience or the PDs given from external credit ratings.

The LGD factor measures the loss incurred in the case of a borrower's default. This is the percentage of the loss that a bank sustains in relation to the amount of credit open at the time of default.

EAD represents the amount of credit that is exposed at the time of default and M is defined as the remaining effective maturity in years, and it is limited to be at least 1 year and not

⁴⁰ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 19.

more than 5 years. Thus in all cases, according to the formula proposed by the Committee, M will be between 1 and 5 years.

The derivation of risk-weighted assets then depends on estimates of the PD, LGD, EAD and M for a given exposure. The formulae for calculating risk-weighted assets vary for different asset groups.⁴¹

The following table compares the capital requirements under the Basel I, the Standard Approach of the Basel II and the IRB foundation for senior unsecured corporate exposures.

Figure 8: Comparison of capital requirements for a corporate under different approaches, in percent

Rating	Basel I	Basel II Standard approach	Basel II IRB foundation
AAA	8	1.6	1.13
AA	8	1.6	1.13
A	8	4.0	1.13
BBB	8	8.0	3.61
BB	8	8.0	12.35
B	8	12.0	30.96
CCC	8	12.0	47.04

*Source: Bank of England Quarterly Bulletin*⁴²

When comparing the standardized approach with the IRB approach, Federal Reserve Chairman Ben Bernanke favors the IRB approach. “The Basel II credit risk standardized approach is much less risk-sensitive than the Basel II advanced approach and does not make use of the most advanced management practices,⁴³” the Fed chairman said. As an example, he said the standardized approach would generally assign the same risk weight for all first-lien mortgages, non-mortgage retail loans and unrated corporate credits regardless of borrowers’ credit worthiness.

In another article he predicts: “I do not think you are going to see any large international sophisticated, complex banks, with all these different kinds of derivatives and off-balance-

⁴¹ It is not our intention to introduce the system of equations here as this is beyond the scope of this thesis. For those interested we recommend to read the Basel II accord.

⁴² Jackson, P., 2001, Bank capital standards: the new Basel Accord, Bank of England Quarterly Bulletin: Spring 2001, Bank of England, p. 56

⁴³ Dow Jones Capital Markets Report, September 5, 2006, Bernanke, in Letter, Defends Advanced Basel II Approach

sheet activities and operational risks – you are not going to see any of those on the standardized approach because they just do not accommodate the risks they are taking.”⁴⁴

On the other hand, the Standardized approach has also its supporters even though it gives less freedom to adjust risks assigned to certain assets. Large US banks are required by regulators⁴⁵ to adopt the more complex – and expensive – version of the Basel II. But four top US banking companies (JP Morgan Chase, Citigroup, Wachovia, and Washington Mutual) ask to use the standardized approach as it is similar to the Basel I in the way it places risks, and it is far simpler and less costly.⁴⁶ They also argue that using the more complex version of Basel II puts them at a competitive disadvantage against their rivals: foreign competitors and US investment banks as these two may use the simpler version of the accord so they are not subject to such restrictive gaps. European banks can choose which version to adopt, but most of the largest banks are also expected to adopt the complex version of the accord.⁴⁷

When comparing the net effect of the IRB approach, Jackson⁴⁸ reasons that for any bank, the net effect of the IRB approach on required capital “will depend on the risk profile of its particular book – high risk books will demand more capital than currently and low risk books less.”

4.1.2 Operational risk

In addition to capital requirements for credit exposures, the Basel II assigns a specific risk-based capital requirement for operational risk.⁴⁹ The Committee has defined the operational

⁴⁴ Dow Jones International News, July 19, 2006, Citi, JP Morgan, Others Seek Big Basel II Change

⁴⁵ In the US there are four regulators: the Fed, the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency (OCC) and the Office of Thrift Supervision (OTS). The OCC supervises some 2000 nationally chartered banks and the OTS regulates the nation’s savings and loan industry.

⁴⁶ American Banker, September 26, 2006, 4 Big Banks Detail Basel Objections

⁴⁷ Dow Jones International News, July 19, 2006, Citi, JP Morgan, Others Seek Big Basel II Change

⁴⁸ Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p.10

⁴⁹ Inclusion of this risk into capital requirements is indeed at its beginning and not many banks are prepared for that. The majority of banks in both Europe and the US have an operational risk statement either in development or bland or both. Some banks have a clear and well articulated operational risk. However, many are still at the very early stages of thinking about it and trying to articulate some program. Source: Global Risk Regulator, September 2006, Why operational risk appetite is not an oxymoron

risk as “the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.”⁵⁰ This definition also includes legal risk which includes “exposure to fines, penalties, or punitive damages resulting from supervisory actions, as well as private settlements.”⁵¹ This catch-all category of risks was understood to include risks such as employee errors, systems failures or even fire, floods or other losses to physical assets, fraud or other criminal activities. The following table lists the largest losses at banking organizations from operational risk during the period from 1992-2002. The total loss amounted to almost \$ 10 billion dollars!

Figure 9: Large losses from operational risk in 1992 – 2002

	Company	Description	Amount US \$ millions
1	National Australia Bank	HomeSide Lending \$ 2.2 billion Currency options fraud \$191 million	2 390
2	Barings PLC	Unauthorized trading	1 330
3	Daiwa Bank Ltd.	Unauthorized trading	1 110
4	JP Morgan Chase	Enron related litigation	900
5	First National Bank of Keystone	Internal fraud	770
6	Allied Irish Banks	Unauthorized trading	691
7	Morgan Grenfell Asset Management	Mutual fund/securities related	636
8	Republic Bank of New York	Securities related	611
9	Bank of America	Law suit	490
10	Standard Chartered Bank PLC	Securities related	440
11	Superior Bank	Accounting issues	440
	TOTAL		9 808

Source: Financial Management Association⁵²

The proposed rule would require banks to “establish and document a process to identify measure, monitor and control operational risks in bank products, activities, processes and systems.”⁵³ Banks must choose a value-at-risk methodology and produce an estimate of operational risk. Also, the methodology must cover operational loss, both expected and

⁵⁰ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 140

⁵¹ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 140

⁵² The article from Financial Management Association also examines the roles that corporate culture and moral hazard played in the losses from operational risk that banks experienced during 1992 – 2002. It argues that some of the losses involving frauds might have been prevented if proper internal controls and fair corporate structure were present, Said in a different way, the losses were caused by poor corporate governance; Source: Financial Management Association, 2004, Basel II: Operational risk, moral hazard, and corporate culture, Working paper, Financial Management Association, Italy

⁵³ International Financial Law Review, August 1, 2006, Getting Ready for Basel II

unexpected, unless the bank can show that the former is covered by offsets, such as operational risk reserves.

The Committee suggests three ways to measure operational risk: (i) the Basic Indicator Approach; (ii) the Standardized Approach; and (iii) the Advanced Measurement Approaches (AMA). The capital charge is then based on these calculations.

4.2 Pillar 2: Supervision

The second pillar, supervision, is the key complement to the first pillar. It is intended to bridge the gap between regulatory and economic capital requirements and gives supervisors (usually central banks) discretion to increase regulatory capital requirements if some weaknesses are found. The supervisors will be responsible for the banks assessment on how well they set and keep the capital requirements and how well they accommodate different kinds of risks. Pillar II requires supervisors to take action if a bank's profile is high relative to capital held.

The Committee has defined four key principles of supervisory review:

1. Banks should have a process for assessing their overall capital adequacy in relation to their risk profile and a strategy for maintaining their capital levels.
2. Supervisors should review and evaluate banks' internal capital adequacy assessments and strategies, as well as their ability to monitor and ensure their compliance with regulatory capital ratios. Supervisors should take appropriate supervisory action if they are not satisfied with the result of this process.
3. Supervisors should expect banks to operate above the minimum regulatory capital ratios and should have the ability to require banks to hold capital in excess of the minimum.
4. Supervisors should seek to intervene at an early stage to prevent capital from falling below the minimum levels required to support the risk characteristics of a particular bank and should require rapid remedial action if capital is not maintained or restored.

Supervisors must take care to carry out their obligations in a transparent and accountable manner. They should also make publicly available the criteria used to review banks' internal capital assessments.

Barth, Caprio and Levine⁵⁴ stress advantages of a high level of bank supervision. They explain: First, banks are costly and difficult to monitor. This leads to too little monitoring of banks which implies sub-optimal performance and stability. Official supervision can improve this market failure. Second, because of informational asymmetries, banks incline to contagious and socially costly bank runs. Supervision in such a situation serves a socially efficient role. Finally, there are many countries with deposit insurance schemes. This situation creates incentives for excessive risk-taking by banks and reduces the incentives for depositors to monitor banks. Strong supervision under such circumstances can help prevent banks from excessive risk-taking behavior and thus improve bank development, performance and stability.

On the other hand, Shleifer and Vishny⁵⁵, Djankov et. al.⁵⁶ and Quintyn and Taylor⁵⁷ explain that powerful supervisors may abuse their powers to benefit favored constituents, attract campaign donations and extract bribes. In such cases there will be less interest in overcoming market failures and more interest in seeking personal gain. Powerful supervision under these circumstances will not improve bank development, performance and stability as the supervision will be positively related to corruption.

4.3 Pillar 3: Market discipline

The purpose of Pillar 3, market discipline, is to complement the minimum capital requirements (Pillar 1) and the supervisory review process (Pillar 2). The Committee aims to encourage market discipline “by developing a set of disclosure requirements which will allow market participants to assess key pieces of information on the scope of application, capital, risk exposures, risk assessment processes, and hence the capital adequacy of the institution.”⁵⁸

⁵⁴ Barth, J.R., Caprio, G. and R. Levine, 2002, Bank Regulation and Supervision: What Works Best?.NBER Working Papers 9323, National Bureau of Economic Research, Inc., p. 8

⁵⁵ Shleifer, A. and R. Vishny (1998). The Grabbing Hand: Government Pathologies and their Cures, Cambridge, MA: Harvard University Press

⁵⁶ Djankov, S., R. La Porta, F. Lopez-de-Silanes and A. Shleifer, 2002, The Regulation of Entry, .Quarterly Journal of Economics, 117

⁵⁷ Quintyn, M. and M. Taylor, 2002, Regulatory and Supervisory Independence and Financial Stability, International Monetary Fund Working Paper No. 02/46, March.

⁵⁸ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 184.

To make it more clear, the basic aim of the third pillar is to force banks to make all key information⁵⁹ public on a regular basis. Banks should strengthen and increase their disclosure policy, and they should make public all the information which is relevant to market agents (investors, shareholders, clients...). This will help the market agents to get a better picture of banks' performance and thus to improve their decision making.

The third pillar precisely defines which information should be made public on an annual basis, which on a semi-annual basis and which on a quarterly basis. The information that provides a general summary of a bank risk management should be published annually while the information which is a subject to rapid change should be published on a quarterly basis.

No confidential information should be published. The Committee defines this information as "information (for example on products or systems), that if shared with competitors would render a bank's investment in these products/systems less valuable, and hence would undermine its competitive position."⁶⁰

4.4 Basel II criticism

Much criticism has been addressed to Basel II. Some authors state that Basel II fails to reach many of its objectives; it does not solve a number of key deficiencies in the global financial system and even creates some new potential threats.

For example, a group of authors from the London School of Economics in their Academic Response to Basel II⁶¹ present a couple of arguments: the proposed regulation in the new framework **fails to consider that the risk is endogenous**; no convincing argument for operational risk regulation has been made yet; and the **heavy reliance on external credit**

⁵⁹ The required disclosures are contained in a series of 14 tables at the end of the proposed rule. "The disclosures are both extensive and detailed. For example, with respect to a bank's assessment of credit risk for wholesale exposures, the bank is required to not only describe the definitions, method and data for estimation and validation of each of the risk parameters, it is required to provide, across a number of PD grades, total EAD, exposure weighted ELGD and LDG, and exposure-weighted capital requirements. It is also required to provide a comparison of risk parameter estimates against actual outcomes for both the preceding period and a longer period." Source: International Financial Law Review, August 1, 2006, Getting Ready for Basel II

⁶⁰ Basel Committee, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement, p. 186.

⁶¹ Keating, C., H. S. Shin, F. Muennich, C. Goodhart and J. Danielsson, 2001, An Academic Response to Basel II, FMG Special Papers sp130, Financial Markets Group.

rating agencies (which is necessary in credit risk calculation in the Standardized approach) is misguided as these agencies have been shown to give conflicting and inconsistent forecasts. They also point out that these rating agencies are not regulated.

Also Kraeussl⁶² has doubts about the usefulness of credit ratings in determining commercial banks' capital adequacy ratios. He predicts that this will lead to **more divergence rather than convergence** between investment-grade and speculative-grade borrowers. Moreover, banks can perform such substitutions in their assets that bank portfolio risk will increase but the risk weighted assets will remain the same. For example, claims on banks under option 1 have the same risk weight (100 %) for all banks rated from BBB+ to B-. So a bank can substitute a loan to BBB bank by a loan to a bank rated B- (credit risk will increase) and the risk weighted assets remain the same.

Furthermore, Roy⁶³ claims that the use of different combinations of credit rating agencies leads to significant differences in minimum capital requirements, these differences can reach up to 10 % of the banks' regulatory capital for loans to corporates, banks and sovereigns on average in the EMU.

On the other hand, Hakenes and Schnabel⁶⁴ argue that the banks' right to choose between the standardized and the IRB approach to credit risk unambiguously **hurts small banks** because they usually do not have enough funds to implement the more expensive IRB approach that usually leads to a lower requirement of capital. And even more importantly, this may also push small banks towards higher risk-taking due to fiercer competition. They conclude that this may lead to higher aggregate risk in the economy.

In addition, Majnoni, Liu and Giovanni⁶⁵ point out that the Basel II may also have a **negative effect on developing countries**. They show that linking banks' capital asset requirements to

⁶² Kraeussl, R., 2003, A Critique on the Proposed Use of External Sovereign Credit Ratings in Basel II, CFS Working Paper Series 2003/23, Center for Financial Studies.

⁶³ Roy, P.V, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA.

⁶⁴ Hakenes, H. and I. Schnabel, 2005, Bank Size and Risk-Taking under Basel II, Working Paper Series of the Max Planck Institute for Research on Collective Goods 2005_6, Max Planck Institute for Research on Collective Goods.

⁶⁵ Majnoni, G., L.-G. Liu and F. Giovanni, 2000, How the proposed Basel Guidelines on rating-agency assessments would affect developing countries, Policy Research Working Paper Series 2369, The World Bank.

external ratings can have undesirable effects for non-high-income countries. They explain that ratings of banks and corporations in developing countries are less common, so capital asset requirements are practically insensitive to improvements in the quality of assets and this actually widens the gap between banks of equal financial strength in higher and lower income countries.

Also Jones and Spratt⁶⁶ argue that the new accord will have **significant and broadly negative repercussions for the developing world**. They claim that: “Internationally, developing sovereigns, corporates and banks wishing to borrow in international markets will find the lending environment greatly worsened, as the major banks’ lending patterns are significantly changed by the adoption of internal ratings based approaches.”⁶⁷ They predict that under the New Accord there will be an increase in the quantity of loans to borrowers rated above BBB and a fall in loans to borrowers rated below BBB as adoption of the IRB foundation approach reduces capital requirements for borrowers rated BBB or above. Given that the majority of borrowers rated above BBB comes from developed countries, one major impact will be a sharp increase in the cost of international borrowing for much of the developing world and a reduction of overall lending to these countries from internationally active banks.⁶⁸

Ed Crooks, the Economic Editor of the Financial Times is worried that the new rules have **potential to amplify business cycles**. As he puts it: “...the effect of the capital requirements could be to encourage banks to lend more in the good times and discourage them from lending in hard times. That in turn could mean that economic cycles are more severe: the peaks of the booms will be higher, because credit is easy, and the troughs of the busts lower, because no one can borrow.”⁶⁹

⁶⁶ Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p. 1

⁶⁷ Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p. 1

⁶⁸ Banks may shy away from highly risk-weighted assets. In the early 1990s US banks shifted sharply from corporate lending to investing in government bonds. Many researchers have attributed this shift to the post Basel I system of capital requirements. Source: Dionne, G. and T.M. Harchaoui, 2003. Banks' Capital, Securitization and Credit Risk: An Empirical for Canada, Cahiers de recherche 0311, CIRPEE, p.5

⁶⁹ Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p. 12

Also Jones and Spratt⁷⁰ warn that “greater use of banks’ internal risk management systems seems likely to be inherently pro-cyclical and therefore likely to amplify the economic cycle, thus increasing frequency and scale of crises. As developing countries suffer disproportionately from financial crises - given the relatively small size of their economies vis-à-vis international capital flows, and the thinness of their markets - this is a cause for great concern.”⁷¹

The Basel Committee recognized this concern and argues as follows: “The Committee has also considered the argument that a more risk-sensitive framework has the potential to amplify business cycles. The Committee believes that the benefits of a risk-sensitive capital framework outweigh this concern.”⁷²

Another serious critic regards one of the main goals of Basel II: a common framework and language across banks from all around the world. Whalen⁷³ argues: “Unfortunately the language of Basel II will be slightly different for each participating bank and country, thus deflating the primary goal of unifying global bank capital measures.”⁷⁴ As an example of **not apples-to-apples comparison** he suggests the definition of a loan default which is different in the European Union and in the US. The Europeans are more conservative in the definition, charging off the loan’s full amount without considering offsets such as the value of collateral, as is the custom in the US. Then he concludes: “Until the global banking industry finds a way to bridge the gaps among risk management practices, accounting rules, and regulatory disclosure, the full promise and potential of Basel II will remain merely a hope.”⁷⁵

⁷⁰ Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p. 1

⁷¹ Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p. 1

⁷² Jones, S.G. and S. Spratt, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton, p. 12

⁷³ American Banker, October 6, 2006, Basel II Will Not Unify Global Rules on Capital

⁷⁴ American Banker, October 6, 2006, Basel II Will Not Unify Global Rules on Capital

⁷⁵ American Banker, October 6, 2006, Basel II Will Not Unify Global Rules on Capital

Danielsson (London School of Economics) and Jonsson⁷⁶ (Kaupthing Bank) stress that the primary purpose of financial regulation is financial stability, i.e., the ex ante prevention of excessive systematic risk and ex post containment of systematic risk episodes. But they believe that Basel II fails to address either because it **ignores liquidity risk** which is probably the most systematic of all risk categories. The authors present various negative implications that Basel II will bring for financial stability, monetary policy, small and medium sized enterprises, financial institutions, small open economies, emerging markets, etc. They conclude that Basel II has winners and losers. “We expect that the winners will be the largest banks, large corporations, consultants, some regulators and thought leaders including universities. The losers will be small and medium-sized banks, small and medium-sized enterprises, developing economies, perhaps even society,”⁷⁷ they say.

Klímeš⁷⁸ believes that Basel II will **deteriorate the companies’ payment solvency to suppliers** as companies will try to repay their payables to banks first and only then to their suppliers. The affected suppliers will also have to postpone their payments and at the same time they will appear to banks as more risky, which may make their future loans more expensive. Thus, Basel II on average will worsen the companies’ access to capital.

There are many more scientific and research papers that study costs and benefits of capital regulation and the potential effects (both negative and positive) of the new framework. For those who are interested in learning more about this issue, we refer to references at the end of this thesis.

4.5 QIS 5 and expectations from Basel II

The Basel Committee undertook worldwide tests to evaluate the effects of Basel II on capital levels. The final one, the fifth Quantitative Impact Study (QIS 5), included more than 350 banks in 31 countries. The report was published in June 2006 and they showed similar results as those obtained in the previous tests and those obtained in the US.

⁷⁶ Danielsson, J. and A. Jonsson, 2004, Does one size fit all? On the Impact of Capital Regulations, Working Paper, London School of Economics, London

⁷⁷ Danielsson, J. and A. Jonsson, 2004, Does one size fit all? On the Impact of Capital Regulations, Working Paper, London School of Economics, London, p. 9

⁷⁸ České tiskové přehledy, June 28 , 2006, Intrum Justitia: Basel II zhorší platební morálku na nebankovním trhu

The primary objective of the study was to evaluate the potential changes in capital levels under Basel II. In contrast to the previous impact studies, the QIS 5 included all recent changes to the Basel II Framework.

All G10 countries (except the US) and 19 non-G10 countries participated in the exercise. The Committee obtained data from 56 Group 1 banks located in G10 countries, 146 G10 Group 2 banks and 155 banks from other countries. Limited data from the US QIS 4 exercise (an additional 26 financial institutions) were also included where possible.

Group 1 banks are internationally active and diversified banks with Tier 1 capital of more than €3 billion while Group 2 banks are smaller banks.

In the QIS 5, the Committee considered three different country groupings:

- G10 which includes 13 Basel member countries
- Committee of European Banking Supervisors (CEBS) comprised of European countries which are either EU member states, EU accession candidates or members of the European Economic Area (EEA). In total, this group comprises 30 countries (both G10 and non-G10), 20 of which provided data for QIS 5
- Other non-G10 countries encompasses all non-G10 countries which are not part of the CEBS group.

The results of QIS 5 are summarized in the following table:

Figure 10: Change in minimum required capital relative to Basel I, in percent

	Standard Approach	Foundation IRB	Advanced IRB
G10 Group 1	1.7	-1.3	-7.1
G10 Group 2	-1.3	-12.3	-26.7
CEBS Group 1	-0.9	-3.2	-8.3
CEBS Group 2	-3.0	-16.6	-26.6
Other non-G10 Group 1	1.8	-16.2	-29.0
Other non-G10 Group 2	38.2	11.4	-1.0

Source: QIS 5⁷⁹

The results of the fifth study show that for the G10 countries the minimum required capital would decrease relative to the current Accord. The test produced an aggregate drop of 6.8%

⁷⁹ Basel Committee, 2006, Results of the fifth quantitative impact study (QIS 5), Basle: Bank for International Settlement, p.2

in minimum required capital for participating banks compared with existing capital requirements. The US test, the fourth quantitative impact study (QIS 4), carried out during 2004 and 2005, suggested that aggregate capital among big US banks implementing Basel II could drop by an unacceptably large 15.5%.

QIS 5 showed that for G10 banks from Group 1, among the two IRB approaches, the advanced approach shows more reduction in minimum required capital (-7.1%) than the foundation approach (-1.3%). The minimum required capital under the standard approach would increase by 1.7% for Group 1 banks. However, only very few banks from Group 1 are expected to adopt this approach. Group 2 banks show a larger reduction in the minimum required capital under both IRB approaches, and the minimum required capital would decrease by 1.3% under the standardized approach, in particular due to the higher proportion of retail exposures for those banks.

In general, the results from CEBS countries are similar to the figures obtained from G10 countries. For CEBS countries the minimum capital requirements would fall even more under all three approaches when compared with G10 countries. For example, for Group 1 under the Advanced IRB approach, the capital for G10 banks would drop by 7.1 % while for CEBS countries capital would drop by 8.3 %.

According to the report, results for banks in the rather small sample of other non-G10 countries showed substantial dispersion both within and between countries, largely due to the specialized business profile of certain banks and particularities of national implementation.

The committee concludes that: “Although data quality is an issue for some banks in other non-G10 countries, the results appear to be broadly in line with results for G10 banks to the extent that the risk profiles are similar.”⁸⁰

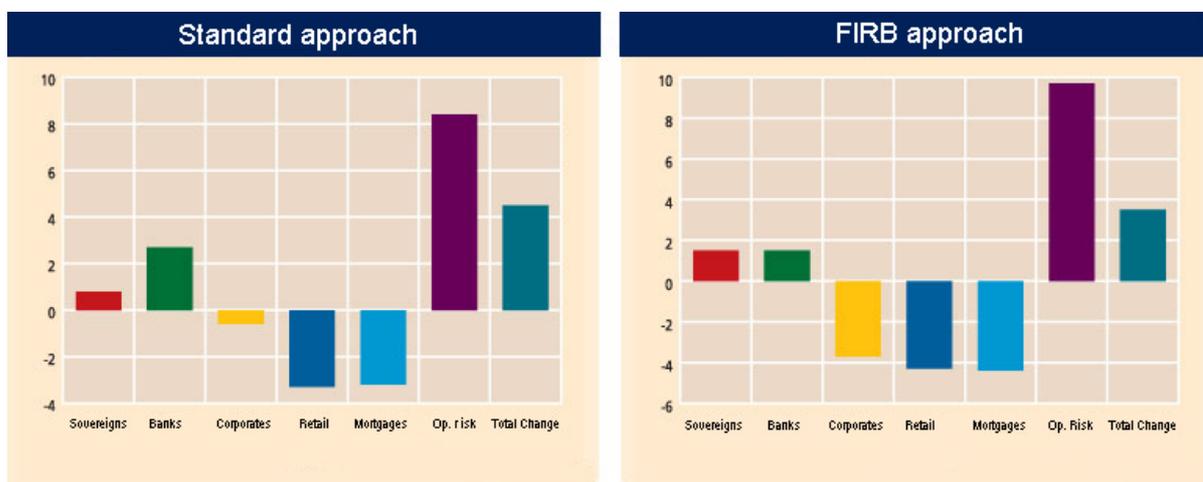
Additionally, when we look at the results table, it shows that the capital requirements provide an incentive for banks to move to the more advanced and sophisticated risk measurement techniques as these techniques require less capital.

⁸⁰ Basel Committee, 2006, Results of the fifth quantitative impact study (QIS 5), Basle: Bank for International Settlement, p.2

According to the Czech National Bank, Czech banks are prepared for Basel II.⁸¹ Based on the results from QIS 5 for the Czech Republic, regarding credit risk all the Czech banks filled in figures for the Standard Approach and some of them even the Foundation or the Advanced IRB Approach.

The result for those Czech banks⁸² which participated in QIS 5 indicate an increase in the minimum required capital by 4.5 % when using Standard Approach and 3.5 % increase when using the Foundation IRB approach when compared with the current required capital. However, the results are very different from bank to bank: in some cases there is a decrease in required capital while in others there is an increase in the range of 10 – 20 %. The major cause of this increase in required capital is a newly introduced need to cover operational risk. Regarding credit risk, the highest increase was in the portfolio of loans to central banks and sovereigns. This was caused by substitution of risk weights (usually 0 %) given to these counterparties by risk weights derived from rating of the counterparties. The increase in required capital was partially offset for three major reasons. First, the risk weight given to the portfolio of mortgages will decrease from 50 % to 35 %. Second, the risk weight given to retail loans will decrease from 100 % to 75 % and finally, the risk weights given to corporates will not have uniform 100 % but will depend on a borrower’s rating.

Figure 11: Changes in required capital when compared to existing requirements



Source: Czech National Bank⁸³

⁸¹ www.cnb.cz/www.cnb.cz/cz/pro_media/clanky_rozhovory/media_2006/cl_06_060825.html

⁸² The source of the QIS 5 results for Czech banks:

www.cnb.cz/www.cnb.cz/cz/pro_media/clanky_rozhovory/media_2006/cl_06_060825.html

www.cnb.cz/www.cnb.cz/cz/pro_media/clanky_rozhovory/media_2006/cl_06_061120.html

⁸³ www.bankovnictvi.ihned.cz (August 25, 2006)

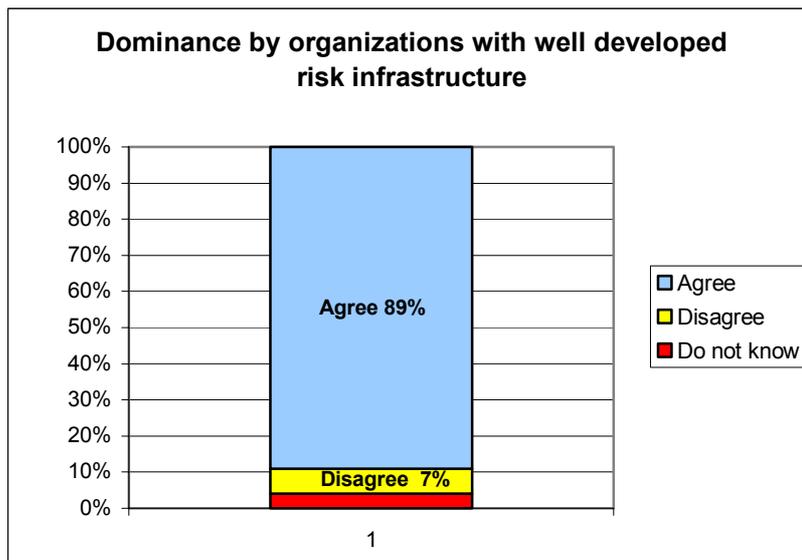
When comparing the basic and the advanced approach to credit risk for Czech banks, the more advanced approach “intensifies the effects of the Basel II”. This means that in those cases where implementation of Basel II leads to higher required capital, the IRB rules bring a higher increase than Standard rules. This also works the other way round; where the Standard rules lead to decrease in capital, the IRB approach leads to an even higher decrease.

When making a cross country comparison, the Czech National Bank states that the Czech figures are “slightly worse” than the European average. The Czech figures are close to the figures for Greece, Malta and Cyprus. However, it is worth noting that the increase in required capital when using the Standard approach to credit risk was even higher in Poland and Hungary and from some developed countries, including Belgium, Italy and Luxemburg.

Another survey regarding Basel II (Global Basel II survey⁸⁴) was carried out by Ernst & Young in 2006 among 307 banks from all around the world. Its objective was to evaluate bankers’ attitudes towards the new framework and what they expected from it. It showed that senior banking executives had a rather positive attitude towards Basel II. They were beginning to appreciate the long term business impacts of Basel II on their organizations and the banking industry as a whole. Key anticipated benefits included more dynamic portfolio management, greater use of hedging and derivatives and increased use of risk-based pricing. 89 % believed that banks with robust risk infrastructures would have a competitive advantage over others. “There will be winners and losers”, said Patricia Jackson, partner at Ernst & Young, UK.

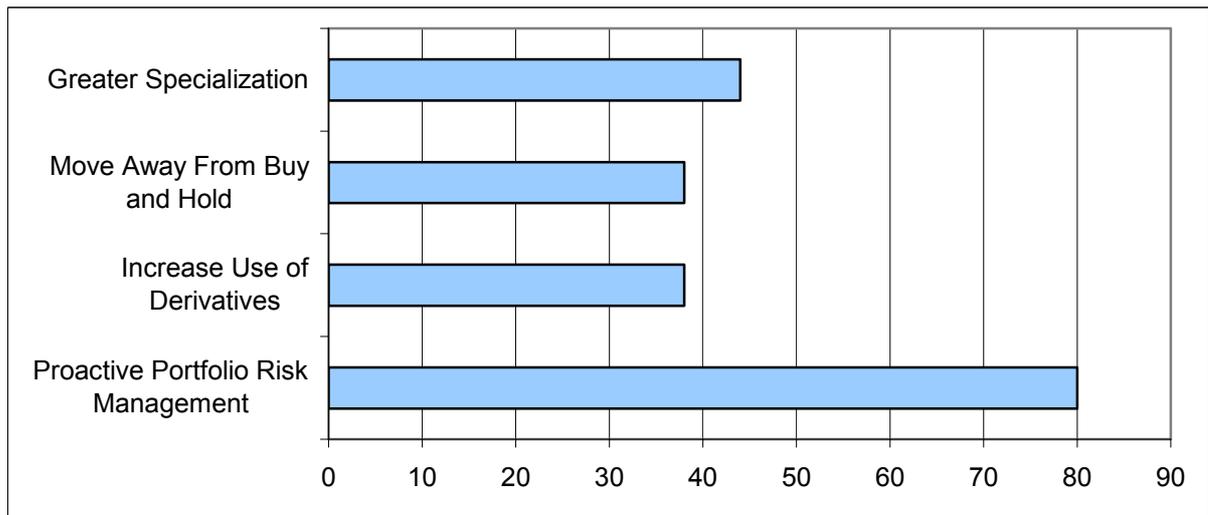
⁸⁴ Ernst & Young, 2006, Global Basel II Survey: Basel II: The Business Impact, Ernst & Young, United Kingdom

Figure 12: Anticipated Benefits as a Result of Basel II



Source: Ernst & Young⁸⁵

Figure 13: Anticipated Benefits of Basel II by Credit Risk Officers, in %



Source: Ernst & Young⁸⁶

4.6 Preparations for Basel II and its future

The schedule for Basel II adoption is different in the US and the EU. In the US, only the largest banks (with total assets of \$250 billion or more, the list includes Citigroup, Washington Mutual, JP Morgan Chase, Wachovia, etc.) must implement Basel II and only the advanced approaches will be allowed for operational and credit risk. Another 10-20 internationally active banks (with \$10 billion or more in foreign assets) are expected to “opt

⁸⁵ Ernst & Young, 2006, Global Basel II Survey: Basel II: The Business Impact, Ernst & Young, United Kingdom, p. 4

⁸⁶ Ernst & Young, 2006, Global Basel II Survey: Basel II: The Business Impact, Ernst & Young, United Kingdom, p. 3

in” and implement those most advanced approaches. For the remaining more than 8000 US banks, Basel I capital rules will continue to apply, but they will be allowed to use a modernized version of the existing standards – the so-called Basel 1A which is still being written⁸⁷ and which makes their capital requirements more risk focused but stops short of the Basel II complexity. Basel II is scheduled to be phased in for US banks beginning in 2008, thus one year after the EU. The US public had a chance to submit comments until the end of January 2007⁸⁸ on the pending capital standards.⁸⁹

In the EU, and hence the Czech Republic as well, Basel II is to be effective from January 1, 2007. In contrast to the US, European banks have a choice which credit risk measurement methods to adopt, but most of the largest banks are expected to adopt the complex version of the Accord. European banks are allowed to use more advanced approaches after their supervisors approve them from the beginning of 2008.

Figure 14: Timetable for Basel II in the EU and USA



Source: Ernst & Young⁹⁰

In Asia⁹¹ most of the countries will adopt the simplest and intermediate measurement options for credit risk and for operational risk in 2007. The advanced internal rating based approach for credit (AIRB) and the advanced measurement method (AMA) for operational risk, which requires development of risk models, are due to be implemented in 2008.

⁸⁷ As of October 10, 2006. Source: American Banker, October 10, 2006, Why Big Banks' Basel Tactics May Not Work

⁸⁸ Dow Jones International News, September 25, 2006, Regulators Want Basel II Public Comments By Jan 23, by Damian Paletta

⁸⁹ For more information on the progress of implementing Basel II in the US, see: KPMG International, 2006, Basel Briefing 11, KPMG International, Switzerland, p. 2

⁹⁰ Ernst & Young, 2006, Global Basel II Survey: Basel II: The Business Impact, Ernst & Young, United Kingdom, p. 5

⁹¹ Source of information on Basel II implementation in Asian countries: Global Risk Regulator, June 2006, Japan banks may not pick advanced options at outset, Volume 4, Issue 6

No overall capital reduction is expected to occur in Asia due to Basel II implementation. In some countries, especially in emerging ones where risk profiles are higher, capital requirements may rise slightly, but in the more developed Asian countries there is likely to be modest relief, particularly if the banks apply a more advanced approach to credit risk.

There is a concern in Asia whether the risk weights embodied in the new Basel capital rules framework are entirely appropriate for some Asian countries and whether they should be rather more conservative in some cases. For example, under the Standard approach to credit risk, Basel II gives risk weights of 35 % for mortgages, but it seems to be rather low for emerging countries in Asia where delinquencies reached very high levels after the 1997 regional financial crisis, and even now this figure remains at 10 % in some countries. Further, risk weight of 75 % to retail loans may be too low for South Korea where bad loan charge-offs reached 30 % for some lenders in 2003.

Despite these examples, supervisors in the emerging Asian countries are not willing to set tighter rules for domestic banks as this would place a competitive handicap on them compared to international peers.

In Japan there is a concern about the Basel II implementation schedule. It is doubtful whether Japanese banks will be ready for the advanced methods in 2008. According to Global Risk Regulator⁹², there are increasing signs that even Japan's largest banks will have difficulty in meeting the demands of the advanced credit and operational measurement options by the end March 2008, the start date for banks that wish to apply for them. March 2009 seems more probable. Most of the banks have not decided yet which of the possible risk measurement options they will adopt.

⁹² Global Risk Regulator, June 2006, Japan banks may not pick advanced options at outset, Volume 4, Issue 6

Figure 15: Asia's Basel II official schedule for credit risk options

	2007	2008	2009	2010
Hong Kong	Standard/FIRB ¹	AIRB		
Singapore	Standard/FIRB	AIRB		
Japan	Standard/FIRB	AIRB		
Korea	Standard/FIRB ²	AIRB		
Taiwan	Standard/FIRB ³			
Thailand		Standard/FIRB ⁴	AIRB	
Malaysia		Standard		FIRB
India	Standard		FIRB/AIRB	
Indonesia		Standard		FIRB
China				FIRB
Philippines	Standard			FIRB/AIRB

Source: Global Risk Regulator⁹³

Footnotes:

- 1) Likely actual start date for F-IRB in Singapore is 2008
- 2) From end-2007, start 2008
- 3) A-IRB is not yet an option for Taiwanese banks
- 4) End-2008 and end-2009. Local Thai banks are unlikely to move to IRB before 2010

Basel II is just another step in capital regulation. Work is apparently already underway on a new framework – Basel III. Alan Greenspan once said, “Lest you believe that when this is concluded you will sit down or go on sabbatical, forget it. Basel III is really out there.”⁹⁴

⁹³ Global Risk Regulator, June 2006, Japan banks may not pick advanced options at outset, Volume 4, Issue 6

⁹⁴ www.securitization.net/pdf/Basel2_Presentation_Feb04/Basel2_Feb04_files/frame.htm (October 10, 2006)

5. Building a model

5.1 Theory review

Regulation of bank capital is motivated primarily by the assumption that banks commit moral hazard. As noted by Santos⁹⁵, deposit insurance schemes have proven successful in protecting from bank runs, but at a cost that this leads to moral hazard. By offering a guarantee that depositors are not subject to loss, the providers of deposit insurance bear the risk that they would otherwise have borne. As a result, it diminishes depositors' incentive to monitor banks and to demand an interest payment adequate to the risk profile of a bank. Further, when the insurance scheme charges to banks a flat rate premium, the banks then do not fully internalize the full cost of risk and therefore it has an incentive to take on more risk. Then there is a concern that a bank may hold less capital than is socially optimal relative to the risks that the bank takes.⁹⁶ This may endanger bank stability. Hence, regulation plays an important role in preserving financial stability.

There is much literature dealing with the capital and risk relationship; we can find a number of different theories giving conflicting predictions of whether more stringent capital regulation curtails or promotes bank performance and stability.

One branch of literature introduces the stabilizing effects of capital requirements. The stabilizing effects are based on the option-pricing model. In this model, an unregulated bank takes excessive portfolio and leverage risks in order to maximize its shareholder value at the expense of deposit insurance (see Furlong and Keeley⁹⁷, Keeley and Furlong⁹⁸). While capital requirements cannot eliminate these moral hazard incentives, they can reduce them by forcing banks to absorb a larger part of potential losses. Therefore, the value of the deposit insurance option decreases and the incentives for excessive risk taking diminish. Thus, **capital regulation leads to more capital and less risk taking**, and hence to **lower**

⁹⁵ Santos, J.A.C., 2000, Bank capital regulation in contemporary banking theory: a review of the literature, BIS Working papers 90, Bank for International Settlements, p. 8

⁹⁶ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, p. 793

⁹⁷ Furlong, F. T. and M. C. Keeley, 1989, Capital Regulation and Bank Risk-Taking: A Note, *Journal of Banking and Finance* 13, p. 883-891.

⁹⁸ Keeley, M.C. and F.T. Furlong, 1990, A reexamination of mean-variance analysis of bank capital regulation, *Journal of Banking and Finance* 14, p. 69-84.

probability of a bank default. In addition, Bichsel and Blum⁹⁹ note that capital represents the stake a bank has to lose in case of insolvency. Therefore, the bank has an incentive to incur lower risks and a higher amount of capital. Hence, this incentive effect reinforces the banks' stability. Under these conditions, **changes in capital and risk will be negatively correlated.** In addition, Jacques and Nigro¹⁰⁰ argue that there is a negative relationship between changes in risk and capital. They claim that an undercapitalized bank can meet the risk-based requirement by raising capital, reducing portfolio risk, or both while a well capitalized bank may decrease capital or increase risk.

Another branch of literature gives different predictions. Kim and Santomero¹⁰¹, Koehn and Santomero¹⁰² agree with the above theory that more stringent capital requirements force banks to **increase their level of capital**, but they argue that capital is very costly. Using the maximizing mean-variance framework they formally show that more stringent capital requirements **lead to an increase in risk taking** as the forced increase in expensive capital financing reduces the expected rate of return. To counter this, the bank tries to increase its rate of return by investing into riskier assets. Thus, when the increase in risk overcompensates the increase in capital, increased regulatory capital standards may have the unintended effect of causing utility-maximizing banks to increase portfolio risk, and hence **increasing the probability of bank default.**¹⁰³ Under these conditions, **changes in capital and risk will be positively correlated.**

Shrieves and Dahl¹⁰⁴ give a different rationale why banks that have built up capital have, at the same time, also increased their risk. They argue this is consistent with a number of hypotheses (bankruptcy cost avoidance, managerial risk aversion, etc) which are not mutually exclusive, meaning that each may underlie capital and risk decisions at any point in

⁹⁹ Bichsel, R. and J. Blum, 2002, The Relationship Between Risk and Capital in Swiss Commercial Banks: A panel study, Working Paper, Swiss National Bank, Zurich, Switzerland, p. 2

¹⁰⁰ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, *Journal of Economics and Business* 49, p. 542.

¹⁰¹ Kim, D. and A. M. Santomero, 1988, Risk in Banking and Capital regulation, *Journal of Finance* 43, p. 1230.

¹⁰² Koehn, M. and A. M. Santomero, 1980, Regulation of bank capital and portfolio risk, *Journal of Finance* 35, p.1243.

¹⁰³ Kim and Santomero also point out that risk-based capital standards can eliminate risk-taking incentives if risk weights are correctly chosen. Source: Kim, D. and A. M. Santomero, 1988, Risk in Banking and Capital regulation, *Journal of Finance* 43, 1219-1233.

¹⁰⁴ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 442-444.

time in some subset of banks. The “Bankruptcy cost avoidance” hypothesis states that expected bankruptcy costs are an increasing function of the probability of a bank default. Therefore, banks tend to increase their capital if there is an increase in their portfolio risk and vice versa. Alternatively, the “managerial risk aversion” hypothesis states that bank managers, as agents of stockholders, may have an incentive to reduce the risk of bank insolvency more than is desired by stakeholders, since managers have a great deal to lose personally in the event of a bank’s insolvency. Thus, managers whose banks have increased their portfolio risk may compensate it by setting a high capital level, thus giving rise to a positive relationship between changes in capital and risk.

On the other hand, Heid, Porath and Stolz¹⁰⁵ from Deutsche Bundesbank argue that the assumptions of the above theories are not realistic, as these theories abstract from rigidities and adjustment costs. However, the reality is somewhat different from the theory because banks may not be able to instantaneously adjust capital or risk due to adjustment costs or illiquid markets.¹⁰⁶ They also note that breaking the minimum regulatory requirements may be very costly for a bank. The breach of the rules may lead to repeated regulatory penalties and in some cases even to a closure of a bank. As noted by Lindquist¹⁰⁷, a poorly capitalized bank runs the risk of losing its reputation and confidence from customers. Hence, Heid, Porath and Stolz¹⁰⁸ conclude that banks have a rather strong incentive to obey the rules. To decrease the probability of breaking the rules, banks hold more capital than is required. They hold a “capital buffer” which serves as an insurance against violating the minimum capital requirement. The authors add that the incentive to hold a “capital buffer” increases as the probability of breaking the regulatory minimum increases. For example, the probability of breaking the rules increases with higher capital ratio volatility. Finally, in contrast to the above theories, the “capital buffer theory” predicts that **the capital and risk adjustments depend on the size of the capital buffer**. The banks with a high capital buffer will try to

¹⁰⁵ Heid, F., D. Porath and S. Stolz, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics, p.2.

¹⁰⁶ In the absence of adjustment costs in the capital ratio, banks never hold more capital than desired by the regulators. In practice, adjusting capital ratio may be costly. Equity issues may in the case of information asymmetry convey negative information to the market on bank’s economic value. Source: Myers, S.C. and N. S. Majluf, 1984, Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have, NBER Working Papers 1396, National Bureau of Economic Research, Inc.

¹⁰⁷ Lindquist, K.-G., 2003, Banks’ buffer capital: How important is risk, Central Bank of Norway, Norway, p. 4

¹⁰⁸ Heid, F., D. Porath and S. Stolz, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics, p.2.

maintain it on a safe level, while the banks with a small capital buffer are more likely to break the minimum rules, so they will try to increase their capital buffer until it reaches a safe level. Hence, the “capital buffer theory” predicts capital and risk adjustments will be positively related for banks with high capital buffers, while capital and risk adjustments will be negatively related for banks with low capital buffer.

More recently, Jeitschko and Jeung¹⁰⁹ presented a new unified approach to investigate the relationship between bank risk taking and bank capital. They introduced a model that incorporates the incentives of three agents; the deposit insurer, the manager and the shareholder. Their results show that a bank’s risk can either increase or decrease with capitalization. The final effect depends on the relative forces of the three agents.

An increasing number of papers have tried to test the above theories in order to find the empirical relationship between capital and risk adjustments. For a summary of findings we refer to chapter 6.4 where we compare our results with the results of other authors.

5.2 Model specification

To our knowledge, we are the first to test and compare the capital and risk behavior of US and EU banks. We base our analysis of US and European banks’ capital behavior on the simultaneous equations model developed by Shrieves and Dahl¹¹⁰. This model is used to assess how banks react to requirements placed by the regulator on their capital. An important aspect of the model is that it recognizes that changes in both risk and capital have endogenous (i.e. discretionary) and exogenous components. In the model, observed changes in capital and risk levels include the two components: a discretionary adjustment and a change caused by factors exogenous to the bank. When talking about exogenous changes to capital, these can be the result of enforced increases in capital required by regulators or unanticipated changes in earnings caused by fluctuations in income. With respect to risk, exogenous changes include unanticipated shocks to the national or local economy, such as the changing characteristics of a bank loan portfolio or volatility of loan collateral such as real property. Hence, the model looks like:

¹⁰⁹ Jeitschko, T.D. and S.D. Jeung, 2004, Incentives for risk taking in banking – a unified approach, *Journal of banking and Finance* 28, p. 78-86

¹¹⁰ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

$$\Delta CAP_{j,t} = \Delta^d CAP_{j,t} + E_{j,t} \quad (1)$$

$$\Delta RISK_{j,t} = \Delta^d RISK_{j,t} + S_{j,t} \quad (2)$$

where $\Delta CAP_{j,t}$ and $\Delta RISK_{j,t}$ are the observed changes in capital and risk levels respectively for bank j in period t . The variables $\Delta^d CAP_{j,t}$ and $\Delta^d RISK_{j,t}$ are the discretionary changes in capital and risk while $E_{j,t}$ and $S_{j,t}$ are random shocks.

Following Shrieves and Dahl, the discretionary changes in capital and risk, $\Delta^d CAP_{j,t}$ and $\Delta^d RISK_{j,t}$, are modeled using the partial adjustment framework, thereby recognizing that banks may not be able to adjust their desired capital ratio and risk levels instantaneously. In this framework, the discretionary changes in capital and risk are proportional to the difference between the target levels and the observed levels in period $t-1$:

$$\Delta^d CAP_{j,t} = \alpha (CAP^*_{j,t} - CAP_{j,t-1}) \quad (3)$$

$$\Delta^d RISK_{j,t} = \beta (RISK^*_{j,t} - RISK_{j,t-1}) \quad (4)$$

where $CAP^*_{j,t}$ and $RISK^*_{j,t}$ are bank j 's target capital and risk level, respectively.

Substituting equations (3) and (4) into equations (1) and (2), the observed changes in capital and risk can be written as:

$$\Delta CAP_{j,t} = \alpha (CAP^*_{j,t} - CAP_{j,t-1}) + E_{j,t} \quad (5)$$

$$\Delta RISK_{j,t} = \beta (RISK^*_{j,t} - RISK_{j,t-1}) + S_{j,t} \quad (6)$$

This means that the observed changes in capital in period t is a function of the target capital in period t (variable $CAP^*_{j,t}$), the capital in period $t-1$ (variable $CAP_{j,t-1}$) and random shocks $E_{j,t}$. The observed changes in risk in period t is a function of the target risk level in period t (variable $RISK^*_{j,t}$), the risk level in period $t-1$ (variable $RISK_{j,t-1}$) and random shocks $S_{j,t}$. The target capital ratio and the risk level are not directly observable, but are assumed to be dependent on some set of observable variables describing the bank's financial condition and the state of the economy in each country. Aggarwal and Jacques¹¹¹ give an example of

¹¹¹ Aggarwal, R. and K. Jacques, 2001, The Impact of FDICIA and Prompt Corrective Action on Bank Capital and Risk: Estimates Using Simultaneous Equations Model, Journal of Banking and Finance 25, p. 1145.

exogenously determined random shock to the bank that can influence its capital level: a change in the bank's macroeconomic environment.

5.2.1 Definitions of capital and risk

Shrieves and Dahl¹¹², Heid, Porath and Stolz¹¹³, Godlewski¹¹⁴ and others used the following definition of capital (CAP); the ratio of total regulatory capital to total assets in book values (RCTA). Total capital represents total regulatory capital. It measures Tier 1 and Tier 2 capital which include subordinated debt, hybrid capital, loan loss reserves and the valuation reserves.

In this study we will follow Jacques and Nigro¹¹⁵, Murinde and Yaseen¹¹⁶ and others. We will use alternative definition of capital; the ratio of total regulatory capital to risk-weighted assets (RCRWA). This definition has become more popular since the introduction of risk-weighted assets. As mentioned above, total capital represents total regulatory capital; it includes Tier 1 and Tier 2.

The definition of bank risk (RISK) is quite problematic and the literature suggests a number of alternatives, all of which are subject to some criticism. In this study we opt for the ratio of risk-weighted assets to total assets. This measure is in line with the standard work in this area. It was proposed by Shrieves and Dahl¹¹⁷ and used subsequently by Jacques and Nigro¹¹⁸, Rime¹¹⁹, Aggarwal and Jacques¹²⁰, Heid, Porath and Stolz¹²¹, Roy¹²² and many

¹¹² Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

¹¹³ Heid, F., D. Porath and S. Stolz, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics.

¹¹⁴ Godlewski, C., 2004, Capital Regulation and Credit Risk Taking : Empirical Evidence from Banks in Emerging Market Economies, Finance 0409030, Economics Working Paper Archive EconWPA.

¹¹⁵ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, *Journal of Economics and Business* 49, 533-547.

¹¹⁶ Murinde, V. and H. Yaseen, 2004, The Impact of Basle Accord Regulations on Bank Capital and Risk Behaviour: 3D Evidence from the Middle East and North Africa (MENA) Region, University of Birmingham

¹¹⁷ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

¹¹⁸ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, *Journal of Economics and Business* 49, 533-547.

¹¹⁹ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, 789-805.

others. The rationale for using this arbitrary measure is that portfolio risk is primarily determined by the allocation of assets across the different risk categories. A clear advantage of RWA, as Rime¹²³ suggests, is that it reflects decisions of a bank on risk-taking with appropriate timeliness. Support for this measure can be also found in Avery and Berger¹²⁴. They have shown that this ratio is positively correlated with risky behavior. However, as Rime¹²⁵ notes, the reliance on this indicator supposes that the risk weightings correctly reflect the economic risk of the different asset categories which might not be necessarily valid in practice. However, it should be pointed out that alternative (and probably even better) measures of risk (such as value at risk, economic capital or the volatility of the market price of bank assets) were not available for the sample banks during the observed period, hence it was not possible to test for robustness of the results with respect to different definitions of risk.

5.2.2 Variables affecting changes in banks' capital and risk

The partial adjustment model presented in equations (5) and (6) in chapter 5.2 predicts that changes in capital in period t are a function of the target capital, the lagged capital and any exogenous factors while changes in risk in period t are a function of the target risk, the lagged risk and any exogenous shocks. In the following section we will introduce the possible explanatory variables that are proxies for the target capital and risk levels and their expected impact on banks' capital and risk. All these variables have been used by Shrieves and Dahl¹²⁶, with the exception of the profitability indicator, emphasized by Rime¹²⁷ and

¹²⁰ Aggarwal, R. and K. Jacques, 2001, The Impact of FDICIA and Prompt Corrective Action on Bank Capital and Risk: Estimates Using Simultaneous Equations Model, *Journal of Banking and Finance* 25, 1139-1160.

¹²¹ Heid, F., D. Porath and S. Stolz, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics, p.2.

¹²² Roy, P.V., 2005, The impact of the 1988 Basel Accord on banks' capital ratios and credit risk-taking: an international study, Finance 0509013, Economics Working Paper Archive EconWPA, p.13.

¹²³ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, 789-805.

¹²⁴ Avery, R.B. and A. N. Berger, 1990, Risk-based capital and deposit insurance reform, Working Paper 9101, Federal Reserve Bank of Cleveland

¹²⁵ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, 789-805.

¹²⁶ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

¹²⁷ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, 789-805.

Roy¹²⁸, and the year dummy variable, proposed by Heid, Porath and Stolz¹²⁹ and used also by Godlewski¹³⁰ or Roy¹³¹. The explanatory variables are bank size (SIZE), profitability indicator (ROA), regulatory pressure (REG), current loan losses (LLOSS), changes in risk ($\Delta RISK$) and capital (ΔCAP) and year dummy variable (dy2001 – dy 2005).

Size (SIZE)

Shrieves and Dahl¹³², Rime¹³³ and others state that size may influence target risk and capital levels due to its relationship with risk diversification, the nature of bank investment opportunities or the bank ownership characteristics and access to equity capital. As Shrieves and Dahl note, “access to equity capital may affect the relative importance of bankruptcy cost avoidance or managerial risk aversion theories”.¹³⁴ Aggarwal and Jacques¹³⁵ pointed out that larger banks may be willing to hold less capital owing to the fact that they have better ability to increase capital if needed when compared to other banks. In addition, as noted by Roy¹³⁶, large banks carry out a wider range of activities which should increase their ability to diversify their portfolio, and hence to reduce their credit risk. Thus, we will include the SIZE variable in the capital and in the risk equations to capture size effects. SIZE will be measured as the natural log of bank total assets. SIZE variable is supposed to be inversely related to changes in risk and capital.

¹²⁸ Roy, P.V, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA, p.14.

¹²⁹ Heid, F., D. Porath and S. Stolz, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics.

¹³⁰ Godlewski, C., 2004, Capital Regulation and Credit Risk Taking : Empirical Evidence from Banks in Emerging Market Economies, Finance 0409030, Economics Working Paper Archive EconWPA.

¹³¹ Roy, P.V, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA.

¹³² Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, Journal of Banking and Finance 16, p. 448.

¹³³ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, Journal of Banking and Finance 25, p.11.

¹³⁴ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, Journal of Banking and Finance 16, p. 448.

¹³⁵ Aggarwal, R. and K. Jacques, 2001, The Impact of FDICIA and Prompt Corrective Action on Bank Capital and Risk: Estimates Using Simultaneous Equations Model, Journal of Banking and Finance 25, 1139-1160.

¹³⁶ Roy, P.V., 2005, The impact of the 1988 Basel Accord on banks' capital ratios and credit risk-taking: an international study, Finance 0509013, Economics Working Paper Archive EconWPA, p.14.

Profitability indicator (ROA)

Rime¹³⁷, Roy¹³⁸ and others argue that current profits (which are measured here as return on assets, ROA) may have a positive effect on a banks' capital as profitable banks may prefer to increase capital through retained earnings. Banks have to rely mainly on retained earnings to increase capital. The bank's return on assets (ROA) is included in the capital equation with an expected positive effect on capital.¹³⁹

Current loan losses (LLOSS)

Loan loss provisions represent funds that banks set aside to cover bad loans. We will follow the definition of Roy¹⁴⁰, which was also used, by Aggarwal and Jacques¹⁴¹, and approximate these losses (LLOSS) with the ratio of loan loss provisions to total assets. We can consider this ratio as a proxy for asset quality. Banks with lower asset quality (higher LLOSS) are expected to have higher risk. Therefore, we will include LLOSS in the risk equation with an expected positive effect on risk.

Changes in risk ($\Delta RISK$) and capital (ΔCAP)

The theories discussed in section 5.1 suppose that capital and risk decisions are interdependent and determined simultaneously which suggests the inclusion of $\Delta RISK$ in equation (7) and ΔCAP in equation (8). Following Shrieves and Dahl¹⁴², we will include these two variables in the right part of the model in order to allow for the different relationships between them. By this inclusion we can find out whether changes in bank capital and asset risk are positively or negatively related one to another (or whether there is

¹³⁷ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, 789-805, p.11.

¹³⁸ Roy, P.V., 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA, p.14.

¹³⁹ All the authors predict positive effect of ROA on capital, however Murinde and Yaseen, using exactly the same argument as for example Rime, predict negative coefficient of ROA. See: Murinde, V. and H. Yaseen, 2004, The Impact of Basle Accord Regulations on Bank Capital and Risk Behaviour: 3D Evidence from the Middle East and North Africa (MENA) Region, University of Birmingham

¹⁴⁰ Roy, P.V., 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA, p.14.

¹⁴¹ Aggarwal, R. and K. Jacques, 2001, The Impact of FDICIA and Prompt Corrective Action on Bank Capital and Risk: Estimates Using Simultaneous Equations Model, *Journal of Banking and Finance* 25, 1139-1160.

¹⁴² Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, p.449.

no relationship at all). Thus, at the end we can support one of the theory branches mentioned in section 5.1.

Table 16: Expected signs of bank characteristic variables

Name of Variable	Change in Capital	Change in Risk
SIZE	-	-
LLOSS		+
ROA	+	
REG	+	?

Year dummy variables (dy2001 – dy 2005)

Heid, Porath and Stolz¹⁴³, Roy¹⁴⁴ and others used also year dummy variable to capture further year specific effects. We will include this variable in the risk and capital equation as well. We will cover the five year period from 2000 to 2005¹⁴⁵. We will assign a dummy variable for each reference period, except for year 2000 in order to avoid perfect collinearity. These dummy variables are added to the model specification in order to take account of macroeconomic shocks (for example changes in the volume or in the structure of loan demands) that can systematically impact bank capital and credit risk ratios.

5.2.3 Modeling regulatory pressure

The main emphasis of this study is on the regulatory pressure variable (REG). This variable is meant to capture the impact of the Basel capital requirements (the response of banks to the 8 % risk-based capital standard) as it describes the behavior of the banks that fell short of the regulatory standards. Moral hazard theory predicts that a bank approaching the regulatory minimum capital ratio may have an incentive to boost capital and reduce risk in order to avoid the regulatory costs triggered by a breach of the capital requirements. However, others argue that poorly capitalized banks may be tempted to take more risk in the hope that higher expected returns will help them to increase their capital. We expect that regulatory pressure has a positive impact on changes in capital. Its impact on changes in risk is the question.

¹⁴³ Heid, F., D. Porath and S. Stolz, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics, p.9.

¹⁴⁴ Roy, P.V, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA, p.17.

¹⁴⁵ Different authors cover different period lengths. For example, Shrieves and Dahl cover three years period (1984-1986), Godlewski six years period (1996-2001) while Murinde and Haadel cover eight years period (1995-2002).

i) REG – “The simple method”

The regulatory pressure can be evaluated in several ways. Shrieves and Dahl¹⁴⁶ adopt a simple approach wherein the regulatory pressure variable is unity if the bank’s capital is below the minimum 8 % level and zero otherwise.

ii) REG – “Prompt Corrective Action method”

Aggarwal and Jacques¹⁴⁷ measure regulatory pressure using a more advanced approach: the Prompt Corrective Action (PCA) that classifies between adequately capitalized and undercapitalized institutions. Within the PCA based approach, they build a first regulatory variable PCAU, which is unity for banks with a CAR less than 8 % and zero otherwise, and a second regulatory pressure variable PCAA, which is unity for banks with CAR comprised of between 8 and 10 % (included), and zero otherwise. To clarify, REG is replaced by two regulatory variables PCAU and PCAA and the following applies:

$$\begin{aligned} PCAU &= 1 && \text{if } CAR < 8 \% \\ &= 0 && \text{otherwise} \\ PCAA &= 1 && \text{if } 8 \% \leq CAR \leq 10 \% \\ &= 0 && \text{otherwise} \end{aligned}$$

iii) REG – “Gap magnitude method”

The previous two methods emphasize one aspect; there is a certain level below which a bank should be regarded as undercapitalized and hence influenced by capital adequacy rules. Some authors¹⁴⁸ criticize such approaches because they create just a simple dummy variable that is equal to one when capital adequacy ratios are below the stated minimum level and zero otherwise. Godlewski¹⁴⁹ and others take into account more information. They also take into consideration the second characteristic of supervisory pressure – the magnitude of regulatory pressure experienced by the bank, the gap between the bank’s capital ratio and

¹⁴⁶ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

¹⁴⁷ Aggarwal, R. and K. Jacques, 2001, The Impact of FDICIA and Prompt Corrective Action on Bank Capital and Risk: Estimates Using Simultaneous Equations Model, *Journal of Banking and Finance* 25, 1139-1160.

¹⁴⁸ For example Roy, P.V, 2005, Credit ratings and the standardized approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA, p.15.

¹⁴⁹ Godlewski, C., 2004, Capital Regulation and Credit Risk Taking : Empirical Evidence from Banks in Emerging Market Economies, Finance 0409030, Economics Working Paper Archive EconWPA.

minimum capital level. The need to take this information into account leads us to adopt the use of the following regulatory pressure variable:

$$REG = \begin{cases} THR - CAR & \text{if } CAR < THR \\ 0 & \text{otherwise} \end{cases}$$

where CAR stands for capital adequacy ratio and THR represents the threshold level. This approach was suggested by Roy¹⁵⁰ and we will adopt it. We opt THR to represent 8 %. Thus, supervisory pressure is positive whenever $CAR < 8\%$, but decreasing as CAR approaches 8 percent from below. Banks with a CAR above 8 percent are considered to be unaffected by capital adequacy regulation.

iv) REG – “Advanced gap magnitude method”

Jacques and Nigro¹⁵¹ used a more advanced approach. Similar to the PCA approach, the regulatory pressure was divided into two variables (REGA and REGB) in order to recognize that banks with total risk-based capital ratios above and below the 8 % regulatory minimum may react to the standards in different ways.

REGA equals the difference between the inverse of individual bank capital ratio (CAR) and the inverse of the regulatory minimum risk-based ratio of 8 %. Hence, REGA equals $(1/CAR - 1/8)$ for all banks with risk-based ratios of less than or equal to 8 %, and 0 for all banks with a total risk based ratio above the required minimum. This measure is used to recognize the non-linear relationship between the regulatory capital and either change in portfolio risk or capital ratios. These banks are under considerable regulatory pressure to increase their capital ratios as they do not meet the regulatory minimum standards.

REGB measures “distance to default” from above. It equals the difference between the inverse of the regulatory minimum risk-based ratio of 8 % and the inverse of individual bank capital ratio (CAR). Hence, REGB equals $(1/8 - 1/CAR)$ for all banks with risk-based ratios greater than or equal to 8 %, and 0 otherwise. Although banks with capital ratios in excess

¹⁵⁰ Roy, P.V, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA.

¹⁵¹ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, Journal of Economics and Business 49, 533-547.

of 8 % are not explicitly constrained by the regulatory minimum, they may increase their risk of portfolio assets or reduce their capital ratios. Alternatively, as noted by Furlong¹⁵² or Jacques and Nigro¹⁵³, these banks may increase their capital ratios as a buffer against shocks to equity¹⁵⁴. Because banks must meet the minimum regulatory standards on a continuous basis, the risk-based standards may cause these banks to increase their capital ratios or decrease portfolio risk as insulation against any uncertainty regarding whether the banks meet the regulatory minimum. In addition, increasing capital ratios and decreasing risk for these banks may serve as a signal to both market and bank regulators that these banks are in compliance.

v) *REG – “Capital volatility approach”*

This approach to regulatory pressure has one significant advantage when compared to the previous methods. Let us assume that we have two banks, A and B, both having the same capital ratio. The difference is that bank A’s capital is more volatile than bank B’s capital. Hence, the probability of possible violation of the regulatory minimum is higher for bank A than for bank B, even though both have the same capital buffers. To capture this effect we define regulatory pressure as a dummy variable which is unity if a bank’s capital ratio is below the threshold level which is equal to the minimum capital requirement plus one standard deviation of the bank’s own capital adequacy ratio, zero otherwise.

$$REG = 1 \quad \text{if } CAR < (8 \% + \text{bank-specific standard deviation of } CAR)$$

$$= 0 \quad \text{otherwise}$$

Although the choice of one standard deviation is somehow arbitrary, the rationale for using this measure is that banks build a buffer above the regulatory minimum for precautionary reasons and the amount of this buffer depends on the volatility of capital ratio, so this

¹⁵² Furlong, F. T., 1993, Capital Regulation and Bank lending, Economic Review, Federal Reserve Bank of .San Francisco 3, p. 23-33.

¹⁵³ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, Journal of Economics and Business 49, 533-547.

¹⁵⁴ There are also other reasons for which a bank may hold capital above the required minimum, for example Orgler and Taggard discussed tax considerations. Source: Orgler, Y.E. and R.A. Taggard, 1983, Implications of corporate capital structure theory for banking institutions, Journal of Money, Credit and Banking 15, p. 212-221.

approach utilizes more information than previous methods as it utilizes also volatility of CAR. This approach was suggested by Roy.¹⁵⁵

Because the regulatory pressure is of our prime interest, we will estimate the model using the last three measures of regulatory pressure, the “Gap magnitude method”, the “Advanced gap magnitude method” and finally “Capital volatility approach”. Especially the “Advanced gap magnitude method” and “Capital volatility approach” have significant advantages when compared to the simple methods: the “Simple method” and “Gap magnitude method” completely leave out banks that are above the threshold but may get below if their results deteriorate. Those are actually interesting cases. Although under the PCA approach these banks are included (those are defined as banks with CAR between 8 % and 10 %), this approach does not fully utilize the variability of available data as it transforms a continuous variable (CAR) into three groups.

The advantage of the “Gap magnitude approach” is that it utilizes the magnitude of pressure, while the advantage of the “Advanced gap magnitude approach” is that it also utilizes information on banks which are above the threshold; it measures distance to default. Last but not least, the “Capital volatility approach” utilizes volatility of CAR.

¹⁵⁵ Roy, P.V., 2005, The impact of the 1988 Basel Accord on banks' capital ratios and credit risk-taking: an international study, Finance 0509013, Economics Working Paper Archive EconWPA.

5.2.4 Specification

On the basis of the previous analysis, the model defined by equations (5) and (6) is specified as follows:

$$\Delta CAP_{j,t} = \alpha_0 + \alpha_1 REG_{j,t-1} + \alpha_2 ROA_{j,t} + \alpha_3 SIZE_{j,t} + \alpha_4 \Delta RISK_{j,t} + \alpha_5 CAP_{j,t-1} + \alpha_6 dy2001 + \dots + \alpha_9 dy2005 + \varepsilon_{j,t} \quad (7)$$

$$\Delta RISK_{j,t} = \beta_0 + \beta_1 REG_{j,t-1} + \beta_2 LLOSS_{j,t} + \beta_3 SIZE_{j,t} + \beta_4 \Delta CAP_{j,t} + \beta_5 RISK_{j,t-1} + \beta_6 dy2001 + \dots + \beta_9 dy2005 + v_{j,t} \quad (8)$$

where REG represents regulatory pressure defined:

(i) under the “Gap magnitude” approach used by Roy¹⁵⁶ and others as:

$$REG = \begin{cases} 8\% - CAR & \text{if } CAR < 8\% \\ 0 & \text{otherwise} \end{cases}$$

(ii) under the “Advanced gap magnitude” approach used by Jacques and Nigro¹⁵⁷, REG is replaced by two regulatory pressures variables REGA and REGB and the following applies:

$$REGA = \begin{cases} (1/CAR - 1/8) & \text{if } CAR \leq 8\% \\ 0 & \text{otherwise} \end{cases}$$

$$REGB = \begin{cases} (1/8 - 1/CAR) & \text{if } CAR \geq 8\% \\ 0 & \text{otherwise} \end{cases}$$

(iii) under the “Capital volatility” approach:

$$REG = \begin{cases} 1 & \text{if } CAR < (8\% + \text{bank-specific standard deviation of } CAR) \\ 0 & \text{otherwise} \end{cases}$$

¹⁵⁶ Roy, P.V, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA

¹⁵⁷ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, Journal of Economics and Business 49, 533-547.

5.3 Data

Data on the EU 15 and US banks were obtained from BankScope, a database of bank account figures. The database is a joint product of Fitch Ratings (a major rating agency) and Bureau Van Dijk (publisher of financial databases).

Banks that did not report their total capital ratio for at least two consecutive years were omitted from the data set. To obtain a homogenous sample, banks with capital ratio above 100 % were treated as outliers and excluded from the sample. However, those banks that disappeared through mergers and acquisitions do remain part of the sample because their assets and liabilities appear on the balance sheet of the acquiring bank. The figures are measured on a yearly basis which represents the highest periodicity for which data is systematically available.

All the variables used in this study were available on BankScope, except for the RISK variable. Therefore, the total capital level $K = (\text{Tier 1} + \text{Tier 2})$, total assets (A) and the capital adequacy ratio (CAR) was extracted from the database in order to compute the RISK variable in two steps. In the first step risk-weighted assets were calculated (RWA) and in the second step the RISK variable was calculated.

$$1) \text{ As } CAR = \frac{K}{RWA} \text{ then } RWA = \frac{K}{CAR}$$

$$2) RISK = \frac{RWA}{A}$$

The final sample consists altogether of 5 237 observations on 1 240 banks operating between 2000 and 2005.

Table 17: Basic Sample Characteristic

	Number of banks	Number of Observations
EU 15	564	2 065
USA	676	3 172
TOTAL	1 240	5 237

The European sample consists of 2 065 observations on 564 commercial banks from all EU 15 countries while sample for US banks consists of 3 172 observations on 676 commercial banks from the USA. We can conclude that we have obtained a sufficiently large sample of banks.

Regarding the size of the banks in the sample, most are small banks (both in the USA and EU 15) with total assets below 25 USD billion¹⁶⁰.

Figure 18: Histogram of EU 15 banks in sample according to average total assets (2000-2005)

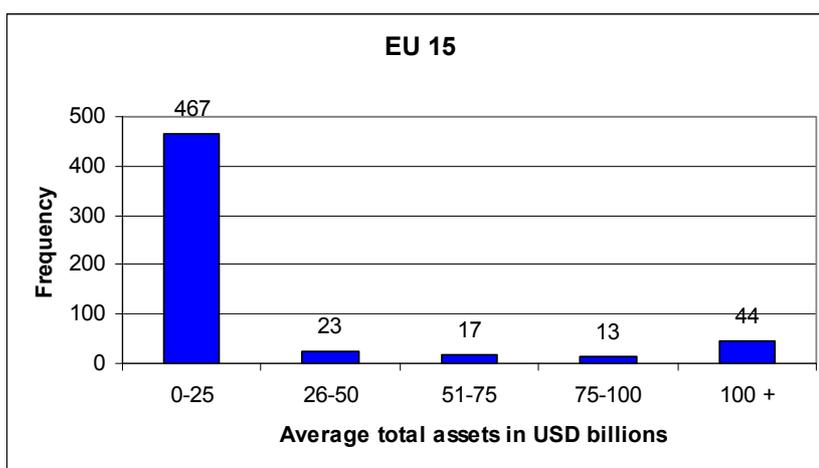
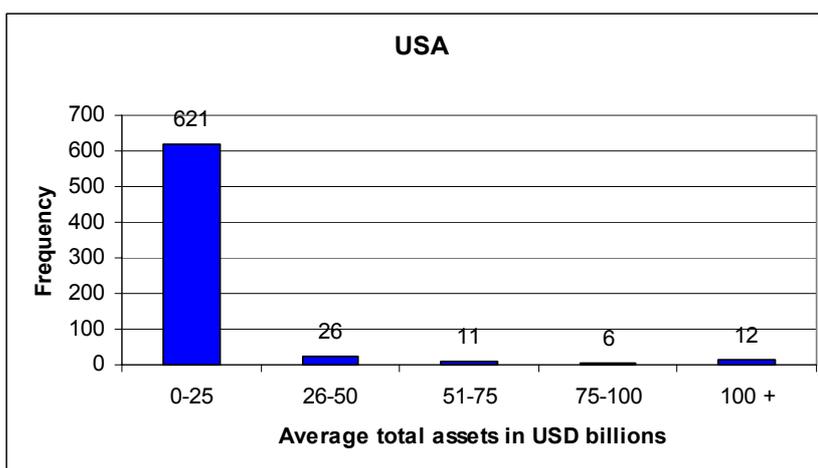


Figure 19: Histogram of US banks in sample according to average total assets (2000-2005)



The following table shows the mean values of the sample for some bank characteristics for both American and European banks for each of the six sub-periods.¹⁶¹ The table also includes changes in risk and capital.

¹⁶⁰ A billion in this whole thesis means 1 000 000 000.

Table 20: Means of bank characteristics, by year

	2000		2001		2002		2003		2004		2005		Grand average
	EU 15	USA	EU 15	USA	EU 15	USA	EU 15	USA	EU 15	USA	EU 15	USA	
CAR %	13.9	14.7	14.7	15.0	14.9	15.3	15.1	15.2	14.6	15.0	14.6	15.0	14.9
SIZE t	8.2	7.5	7.5	7.6	7.6	7.6	7.9	7.7	8.2	7.9	8.8	7.9	7.8
ROA t	0.7	1.0	0.7	1.1	0.6	1.2	0.8	1.2	0.9	1.2	1.0	1.2	1.0
LLOSS t	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.002	0.001	0.002	0.003
RISK t	0.65	0.66	0.66	0.67	0.66	0.66	0.67	0.67	0.67	0.68	0.63	0.69	0.67
Δ CAP t	-0.15	-0.38	0.19	0.20	-0.09	0.47	-0.16	0.13	-0.39	-0.47	-0.15	-0.11	-0.05
Δ RISK t	0.018	0.013	-0.003	-0.003	-0.002	-0.011	0.016	0.007	0.005	0.014	-0.006	0.016	0.006
No. of obs.	344	619	417	602	420	568	423	529	406	448	55	406	

For instance, the table shows that the average CAR of both US and European banks is around 15 %. Although this figure is relatively far above the required 8 % threshold, to make a well-funded statement whether the banks are sufficiently capitalized or not, one would need to run a more thorough analysis, including stress tests, which is beyond the scope of this thesis. Indeed, it is not the aim of this study to analyze whether the banks are sufficiently capitalized.

Regarding the development in European banks, in 2000 the average CAR was 13.9 percent with a corresponding risk-weighted ratio of 65 percent. Over the period the average CAR has witnessed a small increase to 14.6 percent and the risk-weighted assets ratio recording a slight decrease to 63 percent in 2005. Likewise, the average ROA has witnessed an increase from 0.7 percent in 2000 to 1.0 percent in 2005, meaning that the profitability of the European banks increased during the examined period.

In the case of US banks, the average CAR ranged between 14.7 and 15.3 percent and average ROA ranged between 1.1 and 1.2 percent. When profitability is measured by ROA, we can conclude that for every year American banks were more profitable than their European counterparts, but the difference in profitability diminishes in time. This may also be explained by the fact that the average risk-weighted assets ratio of US banks was higher or equal to the risk in EU banks in every year of the examined period. US risk-weighted ratio increased during the examined period from 66 percent in 2000 to 69 percent in 2005.

Simple correlations among variables including relevant first differences are presented in the following table:

¹⁶¹ For more descriptive statistics we refer to Appendix, table 29.

Table 21: EU 15 - Correlations among the variables

	Δ CAP t	CAP t	Δ RISK t	RISK t	SIZE t
Δ CAP t	1				
CAP t	0.352	1			
Δ RISK t	-0.363	-0.146	1		
RISK t	-0.135	-0.314	0.340	1	
SIZE t	-0.018	-0.452	-0.036	-0.219	1

Based on the pooled sample of 2 065 observations.

Table 22: USA - Correlations among the variables

	Δ CAP t	CAP t	Δ RISK t	RISK t	SIZE t
Δ CAP t	1				
CAP t	0.272	1			
Δ RISK t	-0.376	-0.089	1		
RISK t	-0.086	-0.521	0.221	1	
SIZE t	0.004	-0.275	-0.068	0.171	1

Based on the pooled sample of 3 172 observations

Correlations are based on the pooled sample. For the case of US banks, the correlation matrix is similar to the matrix for the EU 15 banks. The matrices show a positive correlation between RISK variable and changes in RISK (0.340 for European banks and 0.221 for US banks). This indicates that the riskier banks increase their risk behavior more than other banks.

The correlation matrices show that there is a negative size effect on capital for both US and European banks (-0.275 and -0.452 respectively) meaning that large banks hold in general less capital than smaller banks. For a summary of theories explaining this finding we refer to chapter 5.1 where we in detail discuss the reasons of negative size effect on capital.

The interesting part here is that we can observe a negative cross sectional correlation between levels of CAP and RISK for both European and US banks (-0.314 and -0.521 respectively). Shrieves and Dahl¹⁶² argue that the negative correlation between CAP and RISK levels is due to cross-sectional variation in risk preferences: banks with high risk aversion choose high capital ratios and low risk, whereas banks with low risk aversion choose low capital ratios and high risk.

¹⁶² Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, Journal of Banking and Finance 16, p.455.

5.4 Methodology

To solve the model, we estimate the system of simultaneous equations defined by (7) and (8) using both, a two-stage least squares (2SLS) procedure and three-stage least-squares (3SLS) procedure. Both techniques are used in order to test for robustness of the results.

2SLS framework allows us to take account of the simultaneity of banks' adjustments in capital and risk. It recognizes the endogeneity of changes in capital and risk, so it is preferable to single equation models that assume either risk or capital to be an exogenous variable to the bank. 2SLS, unlike ordinary least squares (OLS), provides consistent parameter estimates.

3SLS technique also recognizes the endogeneity of changes in capital and risk. Thus, unlike OLS, it provides consistent estimates of the parameters. Moreover, it is preferable to two-stage least squares (2SLS) because 3SLS is a full information technique which estimates all parameters simultaneously. In addition, 3SLS takes into account the cross-equation correlations, so in using this technique we get estimates that are asymptotically more efficient than under 2SLS estimates. However, as noted by Intrilligator¹⁶³, 3SLS may be sensitive to misspecification or measurement errors. This suggests the comparison of the 2SLS and 3SLS results.

2SLS, as the name suggests, is done in two steps. In the first step we estimate the reduced form equations using OLS and save the fitted values for the dependent variables. This step is done to obtain consistent parameter estimates. In the second step we estimate the structural equation using OLS but replace all endogenous variables with their fitted values from the first stage.¹⁶⁴

3SLS method provides one additional step in the estimation procedure. This extra step allows for non-zero covariance between the error terms. It is asymptotically more efficient than

¹⁶³ Intrilligator, M.D., 1978, *Econometric Models Techniques and Applications*, Prentice-Hall, Englewood Cliffs, NJ, USA, p. 465

¹⁶⁴ From the structural equations one can derive the reduced-form equations and the associated reduced form coefficients. A reduced-form equation expresses the endogenous variable solely in terms of exogenous variables and the stochastic disturbances. For the derivation we refer to the Econometric literature listed in References.

2SLS since the latter ignores any information that may be available as the errors across equations may be correlated.¹⁶⁵

The 2SLS and 3SLS procedure¹⁶⁶ were run with the SAS software package.

¹⁶⁵ Zellner, A., 1962, An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias, *J. Amer. Statist. Assoc.* 57, p. 357.

¹⁶⁶ For mathematical formalism on 2SLS and 3SLS we refer to e.g. Greene, W.H., 2003, *Econometric Analysis – Fifth Edition*, Prentice Hall, New York, USA, ISBN 0-13-066189-9.

6. Empirical results

Estimation of simultaneous equations (7) and (8) using 2SLS produces essentially the same results as 3SLS. Therefore, the latter is retained for the remainder of the study as the 3SLS estimation method is more efficient.¹⁶⁷

6.1 “Gap magnitude method” - empirical results

We first present the empirical results for the model based on the “Gap magnitude” approach towards the REG variable. Under this approach, REG is defined as the difference between the regulatory minimum and bank capital adequacy ratio for all banks that were undercapitalized, zero otherwise. The model results are shown in the following table:

Table 23: “Gap magnitude approach”

Estimation method	EU 15				USA			
	Δ CAP _t		Δ RISK _t		Δ CAP _t		Δ RISK _t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	0,0979	1,31			0,4481 ***	8,89		
SIZE _t	-0,4556 ***	-9,49	-0,0042 ***	-4,71	-0,1365 ***	-3,00	-0,0012 *	-1,67
LLOSS _t			2,2580 ***	5,05			0,4504 ***	4,96
REG _{t-1}	1,2763 *	1,84	-0,0014	-0,09	2,1363	1,23	-0,0545 *	-1,95
RISK _{t-1}			-0,2110 ***	-15,24			-0,1043 ***	-12,09
CAP _{t-1}	-0,3726 ***	-19,92			-0,1629 ***	-13,49		
Δ RISK _t	11,3001 ***	3,46			23,1693 ***	4,23		
Δ CAP _t			0,0005	0,52			0,0023 *	1,89
Dum 2001	0,4801	1,35	-0,0197 ***	-2,76	0,8880 ***	3,69	-0,0155 ***	-4,14
Dum 2002	0,4309	1,21	-0,0182 **	-2,55	1,3464 ***	5,12	-0,0244 ***	-6,29
Dum 2003	0,3291	0,94	-0,0011	-0,16	0,6201 ***	2,63	-0,0063	-1,64
Dum 2004	0,2766	0,78	-0,0054	-0,75	-0,0407	-0,17	0,0031	0,78
Dum 2005	0,7733	1,10	-0,0175	-1,23	0,2251	0,89	0,0056	1,35
Sys.weight. R ²	0,17				0,10			
No. Obs.	2 065				3 172			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

Before analyzing the regulatory pressure and the overall relationship between capital and risk, we discuss the signs of the remaining variables and we start by presenting the results which are essentially the same for both US and EU banks.

Banks with lower asset quality (higher LLOSS) had greater risk. SIZE has a negative and significant impact on capital, indicating that large American and European banks increased their capital less than other banks. One possible explanation is that these banks compete on

¹⁶⁷ For comparison of 2SLS and 3SLS results for both EU 15 and US banks we refer to appendix, see tables 30 – 35.

international markets where they have to face fiercer competition with international banks that are in general less capitalized.¹⁶⁸ Roy¹⁶⁹ states that large banks have easier access to capital markets and therefore they can operate with lower amounts of capital. Alternatively, as noted by Roy¹⁷⁰ or Lindquist¹⁷¹, this may be due to a diversification effect. The argument is that portfolio diversification reduces the probability of experiencing a large drop in the capital ratio. And the diversification increases with bank size. Lindquist¹⁷² also explains that large banks may feel less regulatory pressure due to a “too big to fail” effect. If large banks expect support from the government in the event of difficulties, while this is not, to the same extent, expected by small banks, we should expect large banks to hold lower capital buffers.

The parameter estimates on lagged capital ratios were negative and significant with the parameter estimates of -0.37 for the EU banks and -0.16 for the US banks. The parameter estimates on lagged risk ratios were also negative and significant (-0.21 for EU banks and -0.10 for US banks.). In general, these values imply adjustments of bank capital ratios and risk to desired levels. Looking at the amplitude of the estimates we can observe that European banks are quicker in adjustment of both capital and risk to desired levels.

The difference between US and European banks is that for the American banks current earnings (ROA) have a significant and positive impact on changes in capital. This means that profitable US banks can more easily increase their capital through retained earnings.

The primary purpose of this study was to assess the impact of regulatory pressure on the behavior of banks, especially how it affects banks' risk taking and levels of capital. The problem of the “Gap magnitude approach” and even the “Advanced gap magnitude approach” is the very low number of officially undercapitalized institutions; this may have reduced the reliability of parameter estimates based on this approach. There are just 38 cases in the sample for European banks that actually had capital below the regulatory minimum

¹⁶⁸ Rime, B., 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, *Journal of Banking and Finance* 25, p. 797

¹⁶⁹ Roy, P.V., 2005, The impact of the 1988 Basel Accord on banks' capital ratios and credit risk-taking: an international study, Finance 0509013, Economics Working Paper Archive EconWPA, p. 20

¹⁷⁰ Roy, P.V., 2005, The impact of the 1988 Basel Accord on banks' capital ratios and credit risk-taking: an international study, Finance 0509013, Economics Working Paper Archive EconWPA, p.14.

¹⁷¹ Lindquist, K.-G., 2003, Banks' buffer capital: How important is risk, Central Bank of Norway, Norway, p. 5

¹⁷² Lindquist, K.-G., 2003, Banks' buffer capital: How important is risk, Central Bank of Norway, Norway, p. 5

(see appendix, table 29). This represents just 2 percent of the European sample. This problem exaggerates even more for US banks where the results under this approach are driven just by four cases out of 3 172.

This problem led us to more advanced approaches to the definition of REG pressure, especially to the “Capital volatility approach” for the results of which we refer to chapter 6.3.

Bearing in mind the mentioned limitation, we have estimated the model for both European and American banks. Surprisingly, for the undercapitalized European banks we get the expected results. The regulatory pressure has a positive and significant impact on capital. This indicates that undercapitalized European banks improve their capital adequacy by increase in their capital. *Ceteris paribus*, European banks that were under regulatory requirement increased their capital by 1.28 % percentage points more than other banks. However, the risk equation for European banks indicates that regulatory pressure is not significant. This implies that European banks under the threshold do not decrease their risk. Put together, European banks that face regulatory pressure prefer to increase their capital rather than decrease their risk.

On the other hand, the REG estimates obtained for the American banks indicate a “mirror situation”; the regulatory pressure is significant in the risk and not significant in the capital equation.¹⁷³ In the risk equation, the regulatory pressure has a negative impact on bank risk taking which indicates that American banks below the regulatory minimum decreased their risk-weighted assets in their portfolio. This means that banks might have shifted their asset portfolio out of heavily weighted risky assets such as corporate bonds into zero weighted riskless assets such as government bonds. Put together, American banks that face regulatory pressure prefer to decrease their risk rather than increase their capital.

We can conclude that the regulatory pressure brought about by Basel I standards was effective; undercapitalized European and US banks increased their capital or decreased their risk behavior.

¹⁷³ This is rather surprising result as the REG variable shows little variability in the US sample as virtually all US observations were above the threshold.

We observe a predominantly positive relationship between changes in capital and risk. Table 23 illustrates that in the case of US banks, an increase of 1 percentage point in capital increased the risk by a very small amount (0.002 percentage point) while a similar increase in risk led to an increase in capital by 23.2 percentage points. In the case of European banks, increase in capital had no significant impact on risk while 1 percentage point increase in risk led to an increase of capital by 11.3. Hence, it appears that both European and US banks raise their risk and capital simultaneously.

If we look back in chapter 5.1, we find out that this result is consistent with the predictions of Kim and Santomero¹⁷⁴, Koehn and Santomero¹⁷⁵, Shrieves and Dahl¹⁷⁶ and others.

Kim and Santomero¹⁷⁷, Koehn and Santomero¹⁷⁸ argue that more stringent capital regulation will cause utility, maximizing banks to increase their risk. They state that a forced increase in expensive capital financing reduces the expected rate of return. To counter this, banks try to increase their rate of return by investing into riskier assets. However, our results indicate that additions to capital overcompensate the additions to risk, so the regulatory standards do not have the unintended effect of increasing the probability of bank default. Alternatively Shrieves and Dahl¹⁷⁹ argue that the positive relationship between changes in risk and capital is consistent with a number of non mutually exclusive hypotheses, including bankruptcy cost avoidance and managerial risk aversion hypothesis.

Finally, the time dummies are significant in the risk equation for 2001 and 2002 for both European and American banks, so we can conclude the existence of further macroeconomic shocks which resulted in decrease of bank risk taking in these two years. Time dummies in the capital equation are all insignificant for the European sample, which suggests that target capital levels were relatively constant across years during the examined period. On the other hand, the target capital levels in the USA increased in 2001, 2002 and 2003.

¹⁷⁴ Kim, D. and A. M. Santomero, 1988, Risk in Banking and Capital regulation, *Journal of Finance* 43, p. 1230.

¹⁷⁵ Koehn, M. and A. M. Santomero, 1980, Regulation of bank capital and portfolio risk, *Journal of Finance* 35, p.1243.

¹⁷⁶ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 442-444.

¹⁷⁷ Kim, D. and A. M. Santomero, 1988, Risk in Banking and Capital regulation, *Journal of Finance* 43, p. 1230.

¹⁷⁸ Koehn, M. and A. M. Santomero, 1980, Regulation of bank capital and portfolio risk, *Journal of Finance* 35, p.1243.

¹⁷⁹ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 442-444.

These first results should be deepened; therefore we turn to the second type of REG definition.

6.2 “Advanced gap magnitude method” - empirical results

The results and conclusions from the “Advanced gap magnitude approach” are similar to the “Gap magnitude approach”; for both US and EU banks we observe similar coefficient estimates and identical signs. For the interpretation of control variables, see the previous section.

Table 24: “Advanced Gap magnitude approach”

Estimation method	EU 15				USA			
	ΔCAP_t		ΔRISK_t		ΔCAP_t		ΔRISK_t	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	0,0535	0,70			0,4646 ***	7,67		
SIZE _t	-0,4080 ***	-8,40	-0,0056 ***	-4,55	-0,1419 ***	-3,08	-0,0013 *	-1,73
LLOSS _t			2,3100 ***	5,11			0,4631 ***	4,64
REGA _{t-1}	54,9098 *	1,93	0,1552	0,27	115,8782	1,26	-3,2284 **	-2,21
REGB _{t-1}	39,3652 ***	4,04	-0,2583	-1,64	-7,9955	-1,00	-0,0567	-0,48
RISK _{t-1}			-0,2173 ***	-14,99			-0,1073 ***	-10,16
CAP _{t-1}	-0,4899 ***	-14,03			-0,1407 ***	-6,03		
ΔRISK_t	9,6567 ***	3,02			24,2619 ***	4,43		
ΔCAP_t			-0,0016	-1,14			0,0016	0,88
Dum 2001	0,5158	1,47	-0,0197 ***	-2,83	0,9034 ***	3,75	-0,0151 ***	-4,00
Dum 2002	0,4594	1,31	-0,0182 ***	-2,63	1,3763 ***	5,22	-0,0237 ***	-5,84
Dum 2003	0,3562	1,04	-0,0007	-0,10	0,6354 ***	2,69	-0,0059	-1,49
Dum 2004	0,2464	0,71	-0,0048	-0,69	-0,0330	-0,13	0,0033	0,84
Dum 2005	0,5743	0,83	-0,0151	-1,09	0,2259	0,89	0,0060	1,43
Sys.weight. R ²	0,16				0,10			
No. Obs.	2 065				3 172			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

The added value of this model is the inclusion of the extra regulatory variable REGB that examines the banks that are above the threshold as this variable measures the distance to threshold. We will focus on this extra variable.

For the American banks we observe that REGB has no significant impact on both capital and risk, but the examination of the table 24 brings rather interesting results for the European banks. The variable REGB is likewise the variable REGA positive and significant in the capital equation. This implies that banks, which had capital ratios in excess of the requirements, behave in the same way as the banks below the threshold; they increase their capital ratios. But the parameter estimate on REGB suggests that banks with capital ratios

significantly above the threshold experienced smaller increases in capital than banks that were below the threshold. This means that banks below the threshold want to rebuild their capital while the banks above the threshold want to maintain their capital buffer. This conclusion is consistent with the finding of Haubrich and Wachtel¹⁸⁰ who suggest that Basel I standards were effective in raising capital ratios of all banks – banks that were below the threshold, but also banks that were already in compliance with the minimum risk based standards. This result may be interpreted as “cautionary behavior”. Jacques and Nigro¹⁸¹ state that very well capitalized banks have stronger desire to maintain bigger capital buffers, so this is a signal to regulators and the market that they do not only meet, but clearly exceed the minimum standards. Alternatively, Furlong¹⁸² argues that well capitalized banks may increase their capital ratios because they want to build a buffer against shocks to equity¹⁸³. Because banks must meet the minimum regulatory standards on a continuous basis, these buffers are used as insulation against any uncertainty regarding whether the banks meet the regulatory minimum.

6.3 “Capital volatility approach” - empirical results

We have estimated our model using the “Capital volatility approach”. Within this approach, the REG is a dummy variable that is unity if the bank’s capital ratio is below the minimum level plus one bank-specific standard deviation, zero otherwise. If REG is defined in this way, we find that there were 271 European cases (13 percent of the EU sample) and 123 American cases (4 percent of the US sample) that were under regulatory pressure (see Appendix, table 29).

¹⁸⁰ Haubrich, J.G. and P. Watchel, 1993, Capital Requirements and Shifts in Commercial Bank Portfolios, Economic Review, Federal Reserve Bank of Cleveland, p. 12

¹⁸¹ Jacques, K. and P. Nigro, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, Journal of Economics and Business 49, p. 543.

¹⁸² Furlong, F. T., 1993, Capital Regulation and Bank lending, Economic Review, Federal Reserve Bank of San Francisco 3, p. 23-33.

¹⁸³ There are also other reasons for which a bank may hold capital above the required minimum, for example Orgler and Taggard discussed tax considerations. Source: Orgler, Y.E. and R.A. Taggard, 1983, Implications of corporate capital structure theory for banking institutions, Journal of Money, Credit and Banking 15, p. 212-221.

Table 25: "Capital volatility approach"

Estimation method	EU 15				USA			
	Δ CAP _t		Δ RISK _t		Δ CAP _t		Δ RISK _t	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	0,1011	1,36			0,4187 ***	8,68		
SIZE _t	-0,4558 ***	-9,48	-0,0042 ***	-4,61	-0,1032 **	-2,28	-0,0015 **	-2,08
LLOSS _t			2,2561 ***	5,05			0,4537 ***	4,97
REG _{t-1}	0,6683 *	1,96	-0,0013	-0,18	3,1327 ***	7,59	-0,0477 ***	-6,71
RISK _{t-1}			-0,2109 ***	-15,18			-0,1029 ***	-11,76
CAP _{t-1}	-0,3663 ***	-18,98			-0,1501 ***	-12,93		
Δ RISK _t	11,5107 ***	3,52			22,3755 ***	4,24		
Δ CAP _t			0,0006	0,54			0,0034 ***	2,65
Dum 2001	0,4683	1,31	-0,0197 ***	-2,76	0,8566 ***	3,64	-0,0159 ***	-4,16
Dum 2002	0,3908	1,10	-0,0181 **	-2,54	1,3273 ***	5,17	-0,0254 ***	-6,43
Dum 2003	0,3125	0,90	-0,0011	-0,15	0,6615 ***	2,86	-0,0076 *	-1,92
Dum 2004	0,2749	0,77	-0,0054	-0,75	-0,0316	-0,13	0,0030	0,73
Dum 2005	0,8317	1,18	-0,0177	-1,24	0,1900	0,77	0,0058	1,38
Sys.weight. R ²	0,17				0,11			
No. Obs.	2 065				3 172			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

The results of the analysis for the control variables apart from REG variable are materially similar in both capital and risk equations to the "Gap magnitude approach" for both American and European banks. To illustrate, SIZE has a negative impact on capital suggesting that large banks increased their ratio of capital to risk-weighted assets less than other banks, LLOSS has positive and significant impact on risk which means banks with lower asset quality (higher LLOSS) had greater risk. For the case of US banks current profits (ROA) have significant and positive impact on capital indicating that profitable US banks easily improve their capitalization using retained earnings.

Table 25 shows that this approach led to significant estimates of the regulatory pressure in the capital equation for European, but also for US banks. Ceteris paribus, banks within one standard deviation of the threshold increase their capital more than other banks.

European banks close to minimum regulatory requirements increased their capital to risk-weighted assets ratio by 0.7 percentage points more than other European banks. When compared to US banks, the impact of regulatory pressure is even greater in the USA. The US banks that were below the minimum requirement plus one standard deviation increased their capital to risk-weighted assets ratio by 3.1 percentage points more than other US banks. Thus, the impact of the regulatory pressure is larger in amplitude for US banks than for EU banks. One possible explanation is that European banks may have greater difficulties in

adjusting their capital or that US regulators have a stricter attitude towards undercapitalized banks so that US banks fear breaking the rules more than their European counterparties.

In the risk equation, nothing new occurs; the regulatory pressure has a significant and negative impact only for US banks.

In conclusion, our findings provide basic evidence that Basel I standards have a positive effect on both US and European banks' capital adequacy ratios. Second, if under regulatory pressure, both European and US banks increase their capital. In addition, the US banks also decrease their risk.

6.4 Comparison with other findings

As presented in chapter 5.1, theory provides rather rivaling predictions on the relationship between capital and riskiness of banks. As shown in the following table, the empirical studies on the issue do not provide any clear conclusions either.

Table 26: Comparison with other findings

	Year	Sample and Period	Impact of regulatory pressure on CAP	Impact of regulatory pressure on RISK	Relationship between CAP and RISK
this study	2007	580 European banks and 683 US banks over 6 years (2000 - 2005)	+ for B (EU banks) 0 and + for B (US banks)	0 for B (EU banks) - for B (US banks)	+ for B
Rime	2001	154 Swiss banks over 8 years (1989-1996)	0 for A + for U	0 for A 0 for U	0
Murinde and Yassen	2004	98 banks in 11 contries during 8 years (1995-2002)	- and + for B	- and 0 for B	- and 0
Abhiman and Ghosh	2004	27 Indian banks over 7 years (1996-2001)	-for B	- for B	- for B
Heid, Porath and Stolz	2003	570 German savings banks over 8 years (1993-2000)	- and 0 for B	+ and 0 for B	0
Shrieves and Dahl	1992	1,800 US banks over 3 years (1984-1986)	+ for B	- for B	+ for B
Aggarwal and Jacques	2001	1,685 US banks (with assets over \$100 million) over 6 years (1991-1996)	+ for A in 91 for U in 91 0 for A in 92 0 for U in 92 0 for A in 93-96 0 for U in 93-96	+ + for A in 91 for U in 91 0 for A in 92 0 for U in 92 - for A in 93-96 - for U in 93-96	+ + and - in 91 + and - in 92 + in 93-96
Note: + significantly positive, - significantly negative, 0 insignificant A adequately capitalized banks, U undercapitalized banks, B banks as a whole					

Although all of the authors listed in the above table based their analyses of bank behavior to large extent on the Shrieves and Dahl¹⁸⁴ model, the results and conclusions differ significantly.

Our results are similar to the findings of Shrieves and Dahl¹⁸⁵ who analyzed the behavior of 1800 US banks over 3 years, from 1984 until 1986, just before the Basel I requirements were implemented. Our results are similar to theirs in the key conclusions: there is a significant positive impact of regulatory pressure on capital and a negative and significant impact on risk levels; changes in risk and capital levels are positively related.

¹⁸⁴ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 442-444.

¹⁸⁵ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 442-444.

The empirical findings of other research papers go in opposing directions. Table 26 shows that some authors find that regulatory pressure positively influences capital ratios in banks, while others find a negative relationship. When it comes to the impact of regulatory pressure on risk levels, their conclusions also differ considerably. Some authors find a positive relationship while others find a negative relationship. Alternatively, some authors find no relationship.

Finally, the conclusions also differ significantly when it comes to the question of the relationship between changes in risk and capital, as already mentioned in chapter 5.1. The studies suggest that it can be positive, negative or there can be no relationship.

7. Conclusion

Bank capital requirements play a prominent role in sustaining financial stability. There are different theories that have rivaling predictions about how banks adjust their risk and capital behavior to imposed regulatory constraints.

To our knowledge, we are the first to test and compare the capital and risk behavior of US banks and banks from the EU 15 region. Using the freshest data from 2000 – 2005 period we have estimated a modified version of the simultaneous equation model developed by Shrieves and Dahl¹⁸⁶. The model is modified in two main aspects; we use more advanced approaches towards the regulatory pressure and we include also year dummy variable to capture year-specific effects.

We find that capital regulation has a significant impact on capital and risk taking for both US and EU 15 banks in several respects. We find that both European and US banks close to the minimum regulatory threshold tend to increase their capital adequacy by increasing their capital. American banks in addition reduce their risk-taking. These findings indicate that expected penalties implied by possible breach of capital obligations have the desired effect on bank behavior and that bank capital regulation is effective in binding excessive risk taking.

Moreover, we find empirical evidence that even well capitalized EU banks try to maintain their capital on a safe level. This may relate to “cautionary behavior”.

Finally, we observe a positive and significant relationship between capital levels and risk exposure for both US and EU banks. This means that banks raise their risk and capital simultaneously. Hence, we contribute to the literature by providing empirical support to the theories provided by Shrieves and Dahl¹⁸⁷, Kim and Santomero¹⁸⁸, Koehn and Santomero¹⁸⁹ who all predict a positive relationship between risk and capital adjustments.

¹⁸⁶ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

¹⁸⁷ Shrieves, R. E. and D. Dahl, 1992, The relationship between risk and capital in commercial banks, *Journal of Banking and Finance* 16, 439-457.

¹⁸⁸ Kim, D. and A. M. Santomero, 1988, Risk in Banking and Capital regulation, *Journal of Finance* 43, p. 1230.

¹⁸⁹ Koehn, M. and A. M. Santomero, 1980, Regulation of bank capital and portfolio risk, *Journal of Finance* 35, p.1243.

However, our results indicate that additions to capital over-compensate the increase in risk, so the regulatory standards do not have the unintended effect of increasing the probability of bank default.

8. List of used abbreviations

AIRB Advanced Internal Ratings Based Approach (for credit risk)

AMA - Advanced Measurement Approach (for operational risk)

BIS - Bank for International Settlements

CAR - Capital adequacy ratio

ECAI - External Credit Assessment Institution

ECA - Export Credit Agencies

FIRB - Foundation Internal Ratings Based Approach (for credit risk)

IRB - Internal Ratings Based (for credit risk)

PSE - Public Sector Entity

9. References

- Abhiman, D. and S. Ghosh**, 2004, The Relationship Between Risk and Capital: Evidence from Indian Public Sector Banks, Industrial Organization 0410006, Economics Working Paper Archive EconWPA.
- Aggarwal, R. and K. Jacques**, 2001, The Impact of FDICIA and Prompt Corrective Action on Bank Capital and Risk: Estimates Using Simultaneous Equations Model, Journal of Banking and Finance 25, 1139-1160.
- Altunbas, Y., Carbo, S., Gardener, E. and P. Molyneux**, 2004, Examining the Relationships between Capital, Risk and Efficiency in European Banking, Centre for Banking and Financial Studies, University of Wales, United Kingdom.
- Avery, R.B. and A. N. Berger**, 1990, Risk-based capital and deposit insurance reform, Working Paper 9101, Federal Reserve Bank of Cleveland.
- Barth, J.R., Caprio, G. and R. Levine**, 2002, Bank Regulation and Supervision: What Works Best?, NBER Working Papers 9323, National Bureau of Economic Research, Inc.
- Basel Committee**, 1988, International Convergence of Capital Measurement and Capital Standards, Basle: Bank for International Settlement.
- Basel Committee**, 1996, Overview of the Amendment to the Capital Accord to Incorporate Market Risks, Basle: Bank for International Settlement.
- Basel Committee**, 2004, History of the Basel Committee and its Membership, Basle: Bank for International Settlement.
- Basel Committee**, 2005, International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basle: Bank for International Settlement.
- Basel Committee**, 2006, Results of the fifth quantitative impact study (QIS 5), Basle: Bank for International Settlement.
- Bhattacharya, K.**, 2003, How good is the BankScope database? A cross-validation exercise with correction factors for market concentration measures, BIS Working Papers No. 133, Basle: Bank for International Settlement.

- Bichsel, R. and J. Blum**, 2002, The Relationship Between Risk and Capital in Swiss Commercial Banks: A panel study, Working Paper, Swiss National Bank, Zurich, Switzerland.
- Boyd, J.H. and G.D. Nicolo**, 2003, Bank Risk Taking and Competition Revisited, The International Monetary Fund.
- Chami,R. and T. Cosimano**, 2003, The Nature of Capital Adequacy Constraints Under the Basel Accord, IMF Working Paper 01/151, IMF Institute, Washington, USA.
- Danielsson, J. and A. Jonsson**, 2004, Does one size fit all? On the Impact of Capital Regulations, Working Paper, London School of Economics, London.
- Dionne, G. and T.M. Harchaoui**, 2003. Banks' Capital, Securitization and Credit Risk: An Empirical for Canada, Cahiers de recherche 0311, CIRPEE.
- Djankov, S., R. La Porta, F. Lopez-de-Silanes and A. Shleifer**, 2002, The Regulation of Entry, Quarterly Journal of Economics, 117, p. 1-37.
- Ediz, T., Michael, I. and W. Perraudin.**, 1998, The Impact of Capital Requirements on UK Bank Behaviour, Economic Policy Review, Federal Reserve Bank of New York Economic Policy Review, p. 15-22.
- Ernst & Young**, 2006, Global Basel II Survey: Basel II: The Business Impact, Ernst & Young, United Kingdom.
- Feess, E. and U. Hege**, 2004, The Basel II Accord: Internal Ratings and Bank Differentiation, CFS Working Paper Series 2004/25, Center for Financial Studies.
- Financial Management Association**, 2004, Basel II: Operational risk, moral hazard, and corporate culture, Working paper, Financial Management Association, Italy.
- Furfine, C.**, 2000, Evidence on the Response of US banks to changes in Capital Requirements, BIS Working Papers No. 88-2000, Bank for International Settlement, Switzerland.
- Furlong, F. T.**, 1993, Capital Regulation and Bank lending, Economic Review, Federal Reserve Bank of San Francisco 3, p. 23-33.

- Furlong, F. T. and M. C. Keeley**, 1989, Capital Regulation and Bank Risk-Taking: A Note, Journal of Banking and Finance 13, p. 883-891.
- Georges, D. and T.M. Harchaoui**, 2003, Banks' Capital, Securitization and Credit Risk: An Empirical for Canada, Cahiers de recherche 0311, CIRPEE.
- Godlewski, C.**, 2004, Capital Regulation and Credit Risk Taking : Empirical Evidence from Banks in Emerging Market Economies, Finance 0409030, Economics Working Paper Archive EconWPA.
- Greene, W. H.**, 2003, Econometric Analysis – Fifth Edition, Prentice Hall, New York, USA, ISBN 0-13-066189-9.
- Gujarati, D.**, 2002, Basic Econometrics, 4th international edition, McGraw-Hill international editions, Boston, MA, USA.
- Hajko, A.**, 2004, Kapitálová primeranosť v obchodných bankách, Ekonomická univerzita v Bratislave, Bratislava, Slovakia.
- Hakenes, H. and I. Schnabel**, 2005, Bank Size and Risk-Taking under Basel II, Working Paper Series of the Max Planck Institute for Research on Collective Goods 2005_6, Max Planck Institute for Research on Collective Goods.
- Haubrich, J.G. and P. Watchel**, 1993, Capital Requirements and Shifts in Commercial Bank Portfolios, Economic Review, Federal Reserve Bank of Cleveland, p. 2-15.
- Heid, F., D. Porath and S. Stolz**, 2003, Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks, Working Papers 1192, Kiel Institute for World Economics.
- Illing, M. and G. Paulin**, 2004, The New Basel Capital Accord and the Cyclical Behavior of Bank Capital, Working Papers 04-30, Bank of Canada.
- Intrilligator, M.D.**, 1978, Econometric Models Techniques and Applications, Prentice-Hall, Englewood Cliffs, NJ, USA.

- Jackson, P.**, 2001, Bank capital standards: the new Basel Accord, Bank of England Quarterly Bulletin: Spring 2001, Bank of England, p. 55-63.
- Jacques, K. and P. Nigro**, 1997, Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach, Journal of Economics and Business 49, 533-547.
- Jacobson, J.T. and K. R. Lindé**, 2004, Credit Risk Versus Capital Requirements Under Basel II: Are SME Loans and Retail Credit Really Different?, Departmental Working Papers 199, Tor Vergata University, CEIS.
- Jeitschko, T.D. and S.D. Jeung**, 2004, Incentives for risk taking in banking – a unified approach, Journal of Banking and Finance 28, p. 78-86.
- Jones, S.G. and S. Spratt**, 2001, Will the proposed new Basel Capital Accord have a net negative effect on developing countries?, Institute of Development Studies, University of Sussex, Brighton.
- Keating, C., H. S. Shin, F. Muennich, C. Goodhart and J. Danielsson**, 2001, An Academic Response to Basel II, FMG Special Papers sp130, Financial Markets Group.
- Keeley, M.C. and F.T. Furlong**, 1990, A reexamination of mean-variance analysis of bank capital regulation, Journal of Banking and Finance 14, p. 69-84.
- Kim, D. and A. M. Santomero**, 1988, Risk in Banking and Capital regulation, Journal of Finance 43, 1219-1233.
- Kirová, M.**, 2005, Meranie finančných rizík a primeranosť vlastných zdrojov, Ekonomická univerzita v Bratislave, Bratislava, Slovakia.
- Koehn, M. and A. M. Santomero**, 1980, Regulation of bank capital and portfolio risk, Journal of Finance 35, p.1235-1244.
- KPMG International**, 2006, Basel Briefing 11, KPMG International, Switzerland.
- Kraeussl, R.**, 2003, A Critique on the Proposed Use of External Sovereign Credit Ratings in Basel II, CFS Working Paper Series 2003/23, Center for Financial Studies.

- Lindquist, K.-G.**, 2003, Banks' buffer capital: How important is risk, Central Bank of Norway, Norway.
- Maddala, M.**, 2001, Introduction to Econometrics, 3rd edition, John Wiley and Sons, Hoboken, NJ, USA.
- Majnoni, G., L.-G. Liu and F. Giovanni**, 2000, How the proposed Basel Guidelines on rating-agency assessments would affect developing countries, Policy Research Working Paper Series 2369, The World Bank.
- Matejasak, M.**, 2006, Regulation of Bank Capital and Behavior of Banks, Assessing the Slovak Banks, 2000-2004, Umea University.
- Marcus, A. J.**, 1983, The bank capital decision: A time series cross-section analysis, Journal of Finance 38: 1217-1232.
- Milne, A.**, 2001, Minimum capital requirements and the design of the new Basel Accord, City University Business School, London.
- Murinde, V. and H. Yaseen**, 2004, The Impact of Basle Accord Regulations on Bank Capital and Risk Behaviour: 3D Evidence from the Middle East and North Africa (MENA) Region, University of Birmingham.
- Myers, S.C. and N. S. Majluf**, 1984, Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have, NBER Working Papers 1396, National Bureau of Economic Research, Inc.
- Orgler, Y.E. and R.A. Taggard**, 1983, Implications of corporate capital structure theory for banking institutions, Journal of Money, Credit and Banking 15, p. 212-221.
- Pelizzon, L. and S. Schaefer**, 2005, Pillar 1 vs. Pillar 2 Under Risk Management, NBER Working Papers 11666, National Bureau of Economic Research, Inc.
- Powell, A.**, 2004, Basel II and developing countries : Sailing through the sea of standards, Policy Research Working Paper Series 3387, The World Bank.

- Prescott, E.S.**, 2004, Auditing And Bank Capital Regulation, Working Papers wp2004_0412, CEMFI.
- Quintyn, M. and M. Taylor**, 2002, Regulatory and Supervisory Independence and Financial Stability, International Monetary Fund Working Paper No. 02/46, March.
- Revenda, Z.**, 1999, Centrální bankovníctví, Management Press, Praha, Czech Republic.
- Rime, B.**, 2001, Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland, Journal of Banking and Finance 25, 789-805.
- Rochet, J.C.**, 1992, Capital requirements and the behavior of commercial banks, European Economic Review 36, p. 1137-1178.
- Roy, P.V.**, 2005, Credit ratings and the standardised approach to credit risk in Basel II, Finance 0509014, Economics Working Paper Archive EconWPA.
- Roy, P.V.**, 2005, The impact of the 1988 Basel Accord on banks' capital ratios and credit risk-taking: an international study, Finance 0509013, Economics Working Paper Archive EconWPA.
- Santos, J.A.C.**, 2000, Bank capital regulation in contemporary banking theory: a review of the literature, BIS Working papers 90, Bank for International Settlements.
- Shleifer, A. and R. Vishny** 1998, The Grabbing Hand: Government Pathologies and their Cures, Cambridge, MA: Harvard University Press.
- Shrieves, R. E. and D. Dahl**, 1992, The relationship between risk and capital in commercial banks, Journal of Banking and Finance 16, 439-457.
- Studený, P.**, 2005, Kapitálová primeranosť slovenských bánk, Ekonomická univerzita v Bratislave, Bratislava, Slovakia.
- Štěpánek, J.**, 2005, Kapitálová přiměřenost bank podle Basel II, Vysoká škola ekonomická v Praze, Czech Republic.

Osúch, M., 2004, Kapitálová primeranosť bánk a bazilejské dohody, Ekonomická univerzita v Bratislave, Bratislava, Slovakia.

Ullah, A., A. Wan and T.K. Chaturvedi, 2002, Handbook of applied econometrics and statistical inference, 1st edition, Marcel Dekker, New York, USA.

Zellner, A., 1962, An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias, J. Amer. Statist. Assoc. 57, p. 348–368.

Zicchino, L., 2005, A model of bank capital, lending and the macro economy: Basel I versus Basel II, Bank of England working papers 270, Bank of England.

Woolbridge, J.M., 2003, Introductory Econometrics – A Modern Approach, 2nd edition, South-Western/Thomson Learning, Ohio, USA.

Wyatt, K., 2003, Basel II's New Standardized Approach: Possible Effects of Implementation, Finance 0304010, Economics Working Paper Archive EconWPA.

Newspapers:

American Banker, October 6, 2006, Basel II Will Not Unify Global Rules on Capital, by Christopher Whalen

American Banker, September 26, 2006, Banks Chafe At Proposed Basel II Rules, by Chris Grier

American Banker, September 26, 2006, 4 Big Banks Detail Basel Objections, by Steven Sloan

American Banker, October 10, 2006, Why Big Banks' Basel Tactics May Not Work, by Steven Sloan

České tiskové přehledy, January 7, 2005, Basel II zavedou velké banky od roku 2007

České tiskové přehledy, June 28, 2006, Intrum Justitia: Basel II zhorší platební morálku na nebankovním trhu

Dow Jones Capital Markets Report, September 5, 2006, Bernanke, in Letter, Defends Advanced Basel II Approach, by Campion Walsch

Dow Jones Capital Markets Report, October 6, 2006, Fed Cole: Still A Lot To Be Done On Basel II In US, by Laurence Norman

Dow Jones International News, July 19, 2006, Citi, JP Morgan, Others Seek Big Basel II Change, by Damian Paletta

Dow Jones International News, September 25, 2006, Regulators Want Basel II Public Comments By Jan 23, by Damian Paletta

Financial Express, October 11, 2006, Banking sector divided over Basel II deadline

Global Banking News, September 6, 2006, US bank regulators propose modified Basel II rules

Global Risk Regulator, June 2006, Japan banks may not pick advanced options at outset, Volume 4, Issue 6

Global Risk Regulator, September 2006, Bankers call for risk sensitive EU rules on large exposures, Volume 4, Issue 9, by Melvyn Westlake

Global Risk Regulator, September 2006, Advanced Basel II option backed by Bernanke, Volume 4, Issue 9

Global Risk Regulator, September 2006, Why operational risk appetite is not an oxymoron, Volume 4, Issue 9, by Oonagh Leighton

Hospodářské noviny, August 28, 2006, Čekají i vaši firmu od příštího roku dražší úvěry ?

International Financial Law Review, August 1, 2006, Getting Ready for Basel II, by Gary Rice

The Wall Street Journal, September 1, 2006, FDIC May Seek Basel II Input

US Banker, September 1, 2006, Basel II: Responding to a Whole New World Of Risk, by Jiterna Sharma, Vol. 116, No. 9

US Fed News, October 11, 2006, Gov. Bies Speaks at British Bankers' Association

Internet sources:

www.bankovnictvi.ihned.cz (August 25, 2006)

www.bis.org/bcbs/history.htm (The homepage of The Bank for International Settlements, September 2, 2006)

www.bis.org/dcms/fl.jsp?aid=7&pmdid=3&smdid=14&tmdid=0&fmdid=0&tid=22 (The homepage of The Bank for International Settlements, October 10, 2006)

www.cnb.cz/www.cnb.cz/cz/pro_media/clanky_rozhovory/media_2006/cl_06_060825.html (The homepage of Czech National Bank, December 10, 2006)

www.cnb.cz/www.cnb.cz/cz/pro_media/clanky_rozhovory/media_2006/cl_06_061120.html (The homepage of Czech National Bank, December 10, 2006)

www.infoplease.com/ipa/A0763206.html (January 10, 2007)

www.investordictionary.com (Web Dictionary, September 10, 2006)

www.investorwords.com/384/bad_debt.html (Web Dictionary, September 5, 2006)

www.investorwords.com/1210/credit_risk.html (Web Dictionary, September 5, 2006)

www.investorwords.com/2525/intangible_asset.html (Web Dictionary, September 5, 2006)

www.nbs.sk (The homepage of The National Bank of Slovakia, October 20, 2006)

www.riskglossary.com/link/basle_committee.htm (Web Dictionary, September 2, 2006)

<http://riskinstitute.ch> (International Financial Risk Institute home page, September 25, 2006)

www.securitization.net/pdf/Basel2_Presentation_Feb04/Basel2_Feb04_files/frame.htm (Finance web, October 10, 2006)

10. Appendix

Table 27: Basel I risk weights by category of on-balance-sheet asset

0%	Cash Claims on central governments and central banks denominated in national currency and funded in that currency Other claims on OECD central governments and central banks Claims collateralised by cash of OECD central-government or guaranteed by OECD central governments
0, 10, 20 or 50% (at national discretion)	Claims on domestic public-sector entities, excluding central government, and loans guaranteed by such entities
20%	Claims on multilateral development banks and claims guaranteed by, or collateralized by securities issued by such banks Claims on banks incorporated in the OECD and loans guaranteed by OECD incorporated banks Claims on banks incorporated in countries outside the OECD with a residual maturity of up to one year and loans with a residual maturity of up to one year guaranteed by banks incorporated in countries outside the OECD Claims on non-domestic OECD public-sector entities, excluding central government, and loans guaranteed by such entities Cash items in process of collection
50%	Loans fully secured by mortgage on residential property that is or will be occupied by the borrower or that is rented
100%	Claims on the private sector Claims on banks incorporated outside the OECD with a residual maturity of over one year Claims on central governments outside the OECD Claims on commercial companies owned by the public sector Premises, plant and equipment and other fixed assets Real estate and other investments (including non-consolidated investment participations in other companies) Capital instruments issued by other banks (unless deducted from capital) All other assets

Source: Basel Committee¹⁹⁰

Table 28: Process of Basel II preparation - key steps

31.12.2006	implementation of Basel II in individual countries and full application of new rules ¹⁹¹
Jun 2004	published final version of Basel II: International Convergence of Capital Measurement and Capital Standards: a Revised Framework
Apr 2003	published third consultative paper (CP 3) of Basel II: The New Basel Capital Accord
Sep 2002	published working paper about operational risk (CP 2.5): Working Paper on the Regulatory Treatment of Operational Risk
Jan 2001	published second consultative paper (CP 2) of Basel II: The New Basel Capital Accord
Jun 1999	published first consultative paper (CP 1) of Basel II: A New Capital Adequacy Framework

¹⁹⁰ Basel Committee, 1988, International Convergence of Capital Measurement and Capital Standards, Basle: Bank for International Settlement, p. 21-22.

¹⁹¹ This deadline is shifted to 31.12.2007 for the banks that will choose to use more advanced approaches, for example IRB approach regarding calculation of market risk.

Table 29: Descriptive statistics for Model Variables

	EU 15	USA	Total
Average of Total Assets - billions USD	36	13	22
Max of Total Assets - billions USD	1 591	1 082	1 591
Min of Total Assets - billions USD	0.002	0.016	0.002
Average of ROA - %	0.73	1.13	0.97
Average of CAP t	14.7	15.0	14.9
Average of RISK t	0.66	0.67	0.67
Average of Δ CAP t	-0.12	-0.01	-0.05
Average of Δ RISK t	0.01	0.01	0.01
Count of REG t (Gap magnitude approach)	38	4	42
Count of REG t (Capital volatility approach)	271	123	394
No. of obs.	2 065	3 172	5 237

Table 30: Comparison of 2SLS and 3SLS results for EU 15 banks - "Gap magnitude approach"

Estimation method	2SLS				3SLS			
	Δ CAP t		Δ RISK t		Δ CAP t		Δ RISK t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA t	-0,1101	-1,29			0,0979	1,31		
SIZE t	-0,4504 ***	-9,38	-0,0039 ***	-4,35	-0,4556 ***	-9,49	-0,0042 ***	-4,71
LLOSS t			3,3280 ***	6,76			2,2580 ***	5,05
REG t-1	1,2656 *	1,82	-0,0017	-0,12	1,2763 *	1,84	-0,0014	-0,09
RISK t-1			-0,2010 ***	-14,37			-0,2110 ***	-15,24
CAP t-1	-0,3619 ***	-19,22			-0,3726 ***	-19,92		
Δ RISK t	8,8085 ***	2,67			11,3001 ***	3,46		
Δ CAP t			-0,0002	-0,22			0,0005	0,52
Dum 2001	0,4116	1,15	-0,0198 ***	-2,77	0,4801	1,35	-0,0197 ***	-2,76
Dum 2002	0,3429	0,96	-0,0191 ***	-2,68	0,4309	1,21	-0,0182 **	-2,55
Dum 2003	0,3188	0,92	-0,0020	-0,29	0,3291	0,94	-0,0011	-0,16
Dum 2004	0,2628	0,74	-0,0056	-0,78	0,2766	0,78	-0,0054	-0,75
Dum 2005	0,7604	1,08	-0,0156	-1,09	0,7733	1,10	-0,0175	-1,23
Adj. R ²	0,16		0,10					
Sys.weight. R ²					0,17			
No. Obs.	2 065				2 065			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

Table 31: Comparison of 2SLS and 3SLS results for EU 15 banks - "Advanced gap magnitude approach"

Estimation method	2SLS				3SLS			
	ΔCAP_t		ΔRISK_t		ΔCAP_t		ΔRISK_t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	-0,1244	-1,48			0,0535	0,70		
SIZE _t	-0,4044 ***	-8,32	-0,0053 ***	-4,24	-0,4080 ***	-8,40	-0,0056 ***	-4,55
LLOSS _t			3,2039 ***	6,63			2,3100 ***	5,11
REGA _{t-1}	54,7966 *	1,93	0,1351	0,24	54,9098 *	1,93	0,1552	0,27
REGB _{t-1}	38,7157 ***	3,97	-0,2366	-1,50	39,3652 ***	4,04	-0,2583	-1,64
RISK _{t-1}			-0,2084 ***	-14,28			-0,2173 ***	-14,99
CAP _{t-1}	-0,4788 ***	-13,69			-0,4899 ***	-14,03		
ΔRISK_t	7,5479 **	2,34			9,6567 ***	3,02		
ΔCAP_t			-0,0020	-1,45			-0,0016	-1,14
Dum 2001	0,4564	1,30	-0,0197 ***	-2,84	0,5158	1,47	-0,0197 ***	-2,83
Dum 2002	0,3835	1,09	-0,0190 ***	-2,74	0,4594	1,31	-0,0182 ***	-2,63
Dum 2003	0,3469	1,01	-0,0015	-0,21	0,3562	1,04	-0,0007	-0,10
Dum 2004	0,2350	0,67	-0,0050	-0,72	0,2464	0,71	-0,0048	-0,69
Dum 2005	0,5666	0,82	-0,0137	-0,99	0,5743	0,83	-0,0151	-1,09
Adj. R ²	0,17		0,11					
Sys.weight. R ²					0,16			
No. Obs.	2 065				2 065			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

Table 32: Comparison of 2SLS and 3SLS results for EU 15 banks - "Capital volatility approach"

Estimation method	2SLS				3SLS			
	ΔCAP_t		ΔRISK_t		ΔCAP_t		ΔRISK_t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	-0,1088	-1,27			0,1011	1,36		
SIZE _t	-0,4507 ***	-9,37	-0,0039 ***	-4,26	-0,4558 ***	-9,48	-0,0042 ***	-4,61
LLOSS _t			3,3306 ***	6,75			2,2561 ***	5,05
REG _{t-1}	0,6535 *	1,92	-0,0014	-0,19	0,6683 *	1,96	-0,0013	-0,18
RISK _{t-1}			-0,2008 ***	-14,31			-0,2109 ***	-15,18
CAP _{t-1}	-0,3558 ***	-18,33			-0,3663 ***	-18,98		
ΔRISK_t	8,9967 ***	2,72			11,5107 ***	3,52		
ΔCAP_t			-0,0002	-0,17			0,0006	0,54
Dum 2001	0,3994	1,12	-0,0198 ***	-2,76	0,4683	1,31	-0,0197 ***	-2,76
Dum 2002	0,3028	0,85	-0,0191 ***	-2,67	0,3908	1,10	-0,0181 **	-2,54
Dum 2003	0,3025	0,87	-0,0020	-0,28	0,3125	0,90	-0,0011	-0,15
Dum 2004	0,2612	0,73	-0,0056	-0,78	0,2749	0,77	-0,0054	-0,75
Dum 2005	0,8175	1,16	-0,0157	-1,10	0,8317	1,18	-0,0177	-1,24
Adj. R ²	0,16		0,10					
Sys.weight. R ²					0,17			
No. Obs.	2 065				2 065			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

Table 33: Comparison of 2SLS and 3SLS results for US banks - "Gap magnitude approach"

Estimation method	2SLS				3SLS			
	ΔCAP_t		ΔRISK_t		ΔCAP_t		ΔRISK_t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	0,4136 ***	6,00			0,4481 ***	8,89		
SIZE _t	-0,1356 ***	-2,98	-0,0011	-1,61	-0,1365 ***	-3,00	-0,0012 *	-1,67
LLOSS _t			0,2778 **	2,07			0,4504 ***	4,96
REG _{t-1}	2,0533	1,18	-0,0508 *	-1,81	2,1363	1,23	-0,0545 *	-1,95
RISK _{t-1}			-0,1041 ***	-12,07			-0,1043 ***	-12,09
CAP _{t-1}	-0,1655 ***	-13,14			-0,1629 ***	-13,49		
ΔRISK_t	23,4454 ***	4,27			23,1693 ***	4,23		
ΔCAP_t			0,0024 **	1,98			0,0023 *	1,89
Dum 2001	0,8929 ***	3,71	-0,0154 ***	-4,11	0,8880 ***	3,69	-0,0155 ***	-4,14
Dum 2002	1,3567 ***	5,16	-0,0243 ***	-6,28	1,3464 ***	5,12	-0,0244 ***	-6,29
Dum 2003	0,6269 ***	2,66	-0,0064 *	-1,67	0,6201 ***	2,63	-0,0063	-1,64
Dum 2004	-0,0357	-0,15	0,0029	0,73	-0,0407	-0,17	0,0031	0,78
Dum 2005	0,2278	0,90	0,0053	1,29	0,2251	0,89	0,0056	1,35
Adj. R ²	0,07		0,07					
Sys.weight. R ²					0,10			
No. Obs.	3 172				3 172			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

Table 34: Comparison of 2SLS and 3SLS results for US banks - "Advanced gap magnitude approach"

Estimation method	2SLS				3SLS			
	ΔCAP_t		ΔRISK_t		ΔCAP_t		ΔRISK_t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	0,4143 ***	5,99			0,4646 ***	7,67		
SIZE _t	-0,1359 ***	-2,94	-0,0013	-1,68	-0,1419 ***	-3,08	-0,0013 *	-1,73
LLOSS _t			0,2983 **	2,16			0,4631 ***	4,64
REGA _{t-1}	114,6114	1,24	-3,0353 **	-2,07	115,8782	1,26	-3,2284 **	-2,21
REGB _{t-1}	-0,5545	-0,06	-0,0552	-0,47	-7,9955	-1,00	-0,0567	-0,48
RISK _{t-1}			-0,1071 ***	-10,14			-0,1073 ***	-10,16
CAP _{t-1}	-0,1641 ***	-5,86			-0,1407 ***	-6,03		
ΔRISK_t	23,5567 ***	4,28			24,2619 ***	4,43		
ΔCAP_t			0,0017	0,94			0,0016	0,88
Dum 2001	0,8945 ***	3,71	-0,0151 ***	-3,98	0,9034 ***	3,75	-0,0151 ***	-4,00
Dum 2002	1,3589 ***	5,14	-0,0237 ***	-5,83	1,3763 ***	5,22	-0,0237 ***	-5,84
Dum 2003	0,6282 ***	2,65	-0,0060	-1,52	0,6354 ***	2,69	-0,0059	-1,49
Dum 2004	-0,0351	-0,14	0,0031	0,78	-0,0330	-0,13	0,0033	0,84
Dum 2005	0,2278	0,90	0,0057	1,37	0,2259	0,89	0,0060	1,43
Adj. R ²	0,06		0,07					
Sys.weight. R ²					0,10			
No. Obs.	3 172				3 172			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

Table 35: Comparison of 2SLS and 3SLS results for US banks - "Capital volatility approach"

Estimation method	2SLS				3SLS			
	ΔCAP_t		ΔRISK_t		ΔCAP_t		ΔRISK_t	
Variables	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ROA _t	0,3795 ***	5,63			0,4187 ***	8,68		
SIZE _t	-0,1020 **	-2,25	-0,0015 **	-2,06	-0,1032 **	-2,28	-0,0015 **	-2,08
LLOSS _t			0,4171 ***	3,05			0,4537 ***	4,97
REG _{t-1}	3,1427 ***	7,61	-0,0474 ***	-6,64	3,1327 ***	7,59	-0,0477 ***	-6,71
RISK _{t-1}			-0,1031 ***	-11,77			-0,1029 ***	-11,76
CAP _{t-1}	-0,1531 ***	-12,60			-0,1501 ***	-12,93		
ΔRISK_t	22,6989 ***	4,29			22,3755 ***	4,24		
ΔCAP_t			0,0034 ***	2,66			0,0034 ***	2,65
Dum 2001	0,8620 ***	3,67	-0,0158 ***	-4,15	0,8566 ***	3,64	-0,0159 ***	-4,16
Dum 2002	1,3387 ***	5,20	-0,0254 ***	-6,43	1,3273 ***	5,17	-0,0254 ***	-6,43
Dum 2003	0,6693 ***	2,89	-0,0076 *	-1,93	0,6615 ***	2,86	-0,0076 *	-1,92
Dum 2004	-0,0260	-0,11	0,0030	0,72	-0,0316	-0,13	0,0030	0,73
Dum 2005	0,1928	0,78	0,0057	1,36	0,1900	0,77	0,0058	1,38
Adj. R ²	0,08		0,08					
Sys.weight. R ²					0,11			
No. Obs.	3 172				3 172			

*** indicates significance at the 1 % level

** indicates significance at the 5 % level

* indicates significance at the 10 % level

11. Master thesis project

Thesis (working) title: Regulation of Bank Capital and Behavior of Banks: Assessing the US and the EU-15 region Banks in the 2000-2005 period

Thesis author: Milan Matejašák MSc.

Thesis supervisor: PhDr. Petr Teplý

Thesis defense: June 2007

The aim of this thesis is to have an insight into bank capital regulation issue - especially the behavior of American and European banks when they approach the minimum required level of capital. Based on data from the 2000–2005 period we will try to find out how increased regulatory pressure on bank capital affects banks' portfolio risks and their level of capital. We will use a modified version of Shrieves and Dahl econometric model developed in 1992 which is a simultaneous equations model. Using the model we will be able to analyze the relationship between the risk based capital standards, bank capital and bank portfolio risk. Hence, we will be able to confirm or deny the following hypotheses:

Hypothesis:

- i) Increased regulatory pressure induces the American and European banks to increase their capital when they approach the minimum regulatory level.

- ii) Increased regulatory pressure induces the American and European banks to decrease their portfolio risk when they approach the minimum regulatory level.

Thesis content:

The thesis will basically consist of two balanced parts: “a theoretical (descriptive) one” and “an empirical (analytical) one”.

Part one: “...the theoretical one...”

1. History and the role of regulation
2. Introduction of capital regulation standards - Basel Capital Accord
 - New Basel Capital Accord

Part two: "...the empirical one..."

1. Descriptive analysis of data
2. Estimation of Shrieves and Dahl econometric model of for the case of American and European banks
3. Model results

Work Methods:

In this thesis we will use panel data on the American and European banks for the 2000-2005 period from the BankScope database. In the empirical part we will use statistic software for estimation of the simultaneous equations model and we will opt for two-stage least squares (2SLS) and three-stage least squares (3SLS) procedure in order to test for the robustness of our results.

Bibliography:

Basel Committee on Banking Supervision: *Basel II: International Convergence of Capital Measurement and Capital Standards: a Revised Framework*, Basle, 2004.

Basel Committee on Banking Supervision: *Capital requirements and bank behaviour: the impact of the Basel Accord*, Basle, 1999.

Basel Committee on Banking Supervision: *International convergence of capital measurement and capital standards*, Basle, 1988.

Bertrand, R.: *Bank Capital Behavior: Empirical Evidence for Switzerland*, Swiss National Bank, Zürich, 2000.

Heid, F., D. Porath and S. Stolz: *Does Capital Regulation Matter for Bank Behavior? Evidence for German savings banks*, Working Papers 1192, Kiel Institute for World Economics, 2003.

Koehn, M. and A. M. Santomero: *Regulation of bank capital and portfolio risk*, Journal of Finance 35, 1980, p.1235-1244.

Rime, B.: *Capital Requirements and Bank Behavior: Empirical Evidence of Switzerland*, Journal of Banking and Finance 25, 2001, p.789-805.

Revenda, Z.: *Centrální bankovníctví*, Management Press, Praha, 1999, ISBN 80-85943-89-1.

Revenda, Z., Mandel, M., Kodera, J., Musílek, P., Dvořák, P., Brada, J.: *Peněžní ekonomie a bankovníctví*, Fourth edition, Management Press, Praha, 2005, ISBN 80-7261-031-7.

Santos, J.A.C.: *Bank Capital Regulation in Contemporary Banking Theory*. Bank for International Settlements, Basle, 2000.

Shrieves, R. E, and Dahl, D.: *The relationship between risk and capital in commercial banks*, Journal of Banking and Finance, Volume 16, Issue 2, 1992, p.439-457.

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