CHARLES UNIVERSITY IN PRAGUE

FACULTY OF SOCIAL SCIENCES

Institute of Economic Studies

Diploma Thesis

2011 **Jakub Gleta**

CHARLES UNIVERSITY IN PRAGUE

FACULTY OF SOCIAL SCIENCES

Institute of Economic Studies

Jakub Gleta

Basel III: Evaluation and Impact in the Czech Republic

Diploma Thesis

Prague 2011

Author: **Bc. Jakub Gleta**

Supervisor: **PhDr. Petr Teplý, Ph.D.**

Year of defence: 2011

Bibliographic evidence

GLETA, Jakub. *Basel III: Evaluation and Impact in the Czech Republic*. Diploma Thesis (Mgr.) Charles University in Prague, Faculty of Social Sciences, Institute of Economic Studies, Prague, 2010, 97 pages.
Supervisor: PhDr. Petr Teplý, Ph.D.

Abstract

The thesis is focused on content and impact of the new Basel Capital Accord, commonly known as Basel III. These rules react to recent development in global financial markets and introduce some substantial changes into regulatory approach, which include changes to the definition and required amount of regulatory capital and presents new liquidity requirements. The thesis then assesses new rules form two points of view. First, a quantitative model is constructed that predicts the impact of new rules on capital adequacy of four major Czech banks based on default rates data. In the second part of the analysis, institutional impact of new regulation is stressed, namely the question of how new rules fit within the theoretical framework of optimal regulatory architecture and what pitfalls they have. The thesis is unique in the eclectic nature of its approach, whereby two seemingly disparate approaches oppose each other and an attempt at synthesis is presented.

Keywords

Banking regulation, Basel II, Basel III, capital adequacy, capital accords, regulatory impact analysis, credit risk

JEL classification

G21, G28

Abstrakt

Práce se zabývá obsahem a dopadem nové verze Basilejské dohody o kapitálové přiměřenosti, známé jako Basel III. Tato norma reaguje na nedávný vývoj na globálních finančních trzích a zavádí některé podstatné změny do regulatorního přístupu v oblasti definice regulatorního kapitálu, jeho požadovaného objemu a také představuje nové požadavky na likviditu regulovaných institucí. Diplomová práce se pak soustředí na hodnocení nových pravidel, a to ze dvou úhlů pohledu. Nejprve je představen kvantitativní model, který na základě dat o úvěrech v selhání odhaduje dopad nové regulace na kapitálovou přiměřenost čtyř největších českých bank. Ve druhé části analýzy je pak kladen důraz na institucionální rozměr regulace, totiž jak nová pravidla zapadají do konceptu optimální regulace a jaká úskalí se skrývají v jejich architektuře. Práce je unikátní svým eklektickým přístupem, kdy klade proti sobě zdánlivě nesourodé přístupy a snaží se o syntézu obou.

Klíčová slova

Bankovní regulace, Basel II, Basel III, kapitálová přiměřenost, kapitálové dohody, analýza dopadů regulace, úvěrové riziko

JEL klasifikace

G21, G28

Rozsah práce: 224 198 znaků

Declaration

I hereby declare that I have written this thesis myself, using solely sources listed in references.

Prague, 20th May 2011 Bc. Jakub Gleta

Acknowledgments

Hereby I would like to thank my supervisor, PhDr. Petr Teplý, Ph.D., for his valuable recommendations and advice throughout writing this thesis. His insight into the problematic of banking regulation helped me in identifying key areas to focus on.

Further, I would like to thank PhDr. Adam Geršl, Ph.D. of the Czech National Bank for providing me with extended data on corporate default rates and CNB methodology.

Last but not least, my gratitude goes to my closest ones for their unceasing support.

Master Thesis Proposal

Institute of Economic Studies
Faculty of Social Sciences
Charles University in Prague

Author:	**Bc. Jakub Gleta**	Supervisor:	PhDr. Petr Teplý, PhD.
E-mail:	Jakub.gleta@post.cz	E-mail:	teply@fsv.cuni.cz
Phone:	776 61 61 91	Phone:	
Specialization:	Finance, Financial Markets and Banking	Defence planned:	June 2011

Proposed Topic:

Basel III: Evaluation and Impact in the Czech Republic

Topic Characteristics:

We will examine the newly proposed and still underway capital adequacy requirements commonly described as „Basel III". This regulation addresses the problems that emerged during the recent crisis and aims to avoid them in future. Based on data from Bankscope and probabilities of defaults (PDs), we will simulate the impact of the transition to the new standards on banks using the measures proposed and discuss their fitness and appropriateness. We will seek to assess and where possible, quantify the impact of the new proposal on capital adequacy of the banks. In particular, we will focus on Czech banks and try to assess the impact in specific Czech conditions.
In addition to that, we shall examine Basel III from the theoretical perspective, namely whether it is another victim of regulatory capture. We will employ methodology of neo-proceduralist school and extend their analysis of Basel process until present time. We shall also devote our attention to the broader issue of limits of human knowledge in modern society and how these affect regulatory process and outcomes. Overreliance on quantitative methods has serious drawbacks. We will point out most salient ones and show what repercussion they have in real world. We shall also try to present a synthesis of approaches to regulation that, in our opinion, shall make banking sector more robust to adverse shocks.
The core part of the thesis will be preceded by a brief outline of the theory of financial intermediation, i.e. why banks exist in the first place, which in turns gives several motives for their regulation. We will discuss how the new standards fit within the theoretical framework and how they react to recent development in it.

Hypotheses:

1. Basel III is another example of regulatory capture.
2. Basel III will have a smaller procyclical impact, as opposed to its predecessor.
3. Basel III requirements will lead to a tightening of credit conditions, as banks will have to adjust their capital ratios, particularly in countries where bank credit is the predominant source of funding.
4. In specific Czech environment, Basel III will have only limited direct impact on adequacy and profitability of banks. This should be attributed to their different business model and customer behavior.

Methodology:

In the quantitative part of the thesis, we will employ the Bankscope data to assess the impact of the new proposal and evaluate the possible reaction of banks. Since this is an empirical approach, few constraints and assumptions are necessary. We will try to replicate the behaviour of banks and test the proposed regulation for robustness with respect to procyclicality.
In the institutional part of the thesis, we will discuss the proposal from a broader perspective. In particular, we want to assess whether the proposed measures react to recent development from the risk assessment point of view. There has been a strong call for non-quantitative measures of risk. We shall devote our attention to the limits of our knowledge of risk and uncertainty and draw some conclusions for the banking risk assessment architecture.

Outline:

1. Introduction
2. Theory of financial intermediation
3. Theory of banking regulation
4. Basel I and Basel II – achievements and failures
5. Evaluating Basel III
6. Institutional discussion
7. Conclusion

Core Bibliography:

Reinhart, C., Rogoff, K., *This Time is Different: Eight Centuries of Financial Folly,* Princeton University Press, 2009
Dewatripont, Mathias, and Jean Tirole. 1993. The Prudential Regulation of Banks. Cambridge, Massachusets: The MIT Press.
Quantitative Impact Studies of the Bank for International Settlements
Černohorská, L., Diviš, K. and Teplý, P.: *Implications of the New Base Capital Accord for European Banks,* E+M Journal, Czech Republic, 1/2007
Freixas, Xavier, and Jean-Charles Rochet. 1994. Microeconomics of Banking. Cambridge, Massachusets: MIT Press.
Kahneman, D. and Tversky, A (eds): Judgment Under Uncertainty: Heuristics and Biases, Cambridge University Press, New York, 1982

Author

Supervisor

List of Abbreviations

ACB – America's Community Bankers
ASF – American Securitization Forum
BCBS – Basel Committee on Banking Supervision
BIS – Bank for International Settlements
CDS – Credit Default Swap
CEE – Central Eastern Europe
CET1 – Common Equity Tier 1
CNB – Czech National Bank
CP – Commercial Paper
CSU – Czech Statistical Office
CPI – Consumer Price Index
CVA – Credit Valuation Adjustment
CZK – Czech Koruna
DTA – Deferred Tax Assets
DSGE – Dynamic Stochastic General Equilibrium
EAD – Exposure at Default
EC – European Commission
ECAI – External Credit Assessment Institution
ECB- European Central Bank
EL – Expected Loss
ESF – European Securitization Forum
EUR - Euro
FI – Financial Intermediary
FSA – Financial Services Authority
FSB – Financial Stability Board
G-10 – Group of Ten
G-20 – Group of Twenty
GDP – Gross Domestic Product
GHOS – Governors and Heads of Supervision
GSE – Government Sponsored Enterprise
IIF – Institute of International Finance
IMF – International Monetary Fund
IRB – Internal Ratings-Based
IRB-A – Internal Ratings-Based Advanced
ISDA – International Swaps and Derivatives Association
LCR – Liquidity Coverage Ratio
LGD – Loss Given Default
MAG – Macroeconomic Assessment Group
MLE – Maximum Likelihood Estimator
MSR – Mortgage Servicing Rights
MTN – Medium-Term Note
NSFR – Net Stable Funding Ratio
OBS – Off-Balance Sheet
OLS – Ordinary Least Squares
OTC – Over the Counter
PD – Probability of Default
PPI – Producer Price Index
PRIBOR – Prague Interbank Offer Rate
QIS – Quantitative Impact Study
RWA – Risk Weighted Assets
SEC – Securities and Exchange Commission
SIFI – Systemically Important Financial Institution
SPV – Special Purpose Vehicle
VaR – Value at Risk
VAR – Vector Autoregression
VECM – Vector Error Correction Model

List of figures and tables

Table of contents

Preface

Banking sector was the source of a number of problems during recent crisis. Structured finance, generous lending, low policy rates and relaxed marked standards have created an explosive and toxic mixture that paralyzed global financial markets and caused the worst recession since the Great Depression. Banking regulation has been blamed to have a share on this by failing to force the banks to maintain sufficient capital buffers to absorb the losses and to prevent them from running risky operations that are incompatible with financial stability and the privileged role of banks as routers and transformers of capital flows in the economy.

In this thesis, one of the most important regulatory reforms adopted lately is discussed. The third version of Basel Capital Accords, commonly known as Basel III, is presented and analyzed form the quantitative, as well as institutional points of view. This reform proposal, drafted and adopted in record time, introduces some revolutionary changes into banking regulation. Its impact is, however, far from clear – especially liquidity proposals are subject to a lot of critique and uncertainty both on the part of the industry and national supervisors.

This thesis presents an eclectic type of analysis that combines a quantitative approach to regulatory impact estimation with institutional analysis. Its core contribution lies in the institutional part where a unique approach to rules assessment is extended until present time. Using the method of process-tracing, we examine Basel III enactment process and find that it is not a victim of regulatory capture, as opposed to its predecessor. On the other hand, we find that new rules will likely be watered down due to the lengthy transitional period and the fact that a significant portion of provisions are subject to supervisory review process over the years. In addition to that, we point to the inherent problem of quantitative risk assessment, namely the fundamental limitations to our ability to infer true properties of the world we live in from observations. Consequently, we propose a new, eclectic approach to banking regulation that should, in our opinion, render global financial system more robust to negative shocks. This contributes to our final assertion that although a step in the direction, Basel III will fail to meet its objectives due to reasons outlined herein.

The thesis is organized as follows. Chapter 1 presents a brief overview of the theory of financial intermediation, namely what are theoretical justifications of existence of financial intermediaries.

Chapter 2 discusses motives for and means of financial regulation and how they evolved over time. Further, it presents recent regulatory failure to contain the impact of the sub-prime

crisis. A brief outline of what happened is given, followed by presentation of reform proposals that arose as a result of the failure.

Chapter 3 is devoted to Basel Accords. Overview of historical development is given, together with a discussion of Basel II shortcomings and imperfections. After that, Basel III reform proposal is presented, together with transitional arrangements. In the end, impact assessment studies are discussed, both of the Basel Committee on Banking Supervision and the industry.

Chapter 4 is devoted to an attempt at quantitative impact assessment of Basel III on major Czech banks. Based on default rates obtained from the Czech National Bank, we estimate a model for corporate and default rates and devise three stress scenarios to assess the possible impact of Basel III on capital adequacy of major Czech banks. We assume Basel III rules to be enforceable instantly, without any transitional period, to be able to compare new rules to the existing ones. Our analysis shows that Basel III will not be of significant impact on capital adequacy because of strong capital position of these banks. Only in the case of recession return would the banks on aggregate find themselves below the 10.5% total capital adequacy level, including the 2.5% capital conservation buffer, reporting 9.5% capital adequacy ratio.

In the penultimate chapter, we present a complementary approach to quantitative study, namely the institutional discussion of new rules. We believe that understanding the institutional context of the environment in which regulation is drafted and adopted, together with implications for the behaviour of market participants, is of utmost importance. To this end, we try to extend the analysis of Ranjit Lall until present time. We find that Basel III represents a significant improvement in terms of regulatory capture, compared to Basel II. On the other hand, we argue that Basel III will fail to meet its objectives due to very long transitional period and possible changes to some provisions during this period. After that, we discuss some challenges faced by the Basel Committee on Banking Supervision that could further undermine regulatory efforts. In the end of the chapter, we present a synthesis of alternative proposals that have in common the aim of robust financial sector and the economy in general. Our central idea is that we live in an increasingly complex, interconnected and unpredictable world. Hence, we have to reassess our regulatory mindset towards more a system more robust against unpredictable negative shocks.

Chapter 6 concludes.

1. Theory of financial intermediation

We begin with an exposition of existing literature on the theory of financial intermediation. This is motivated by the fact that the existence of banks and other intermediaries, albeit being widely perceived as natural and self-evident, has caused an expense of significant effort on the part of academics in order to ground it in theory.

In classical theory of financial markets and economic behaviour, it is difficult to justify the existence of financial intermediaries. Complete and perfect information, together with rationality of players, ensure that the socially optimal amount of lending and risk sharing is achieved without the need for an intermediary between the borrower and the lender. A security market without transaction costs does at least as well as an intermediated economy (Jacklin 1987). But as soon as one introduces indivisibilities and non-convexities in the transaction technology, there opens space for financial intermediaries who transform securities and contracts (Freixas and Rochet 1994, p. 15).

Financial intermediaries (FIs) can therefore be seen as coalitions of individuals who exploit the economies of scale and scope in the transaction technology (Freixas and Rochet 1994, p. 16). However, with the progress in information technologies, this approach has lost some ground. There has been a need to rationalize the existence of FIs through some more fundamental nature of transaction costs. Informational asymmetry between the lender and the borrower has been a frequent denominator of these models. Whether ex-ante (adverse selection), interim (moral hazard) or ex-post (costly state verification), it creates specific transaction costs that are difficult, if not impossible, to overcome without a specific institution in between. We will now turn to some of the most prominent models of financial intermediation.

1.1. Liquidity insurance

A very natural way to explain the existence of FIs (here: depository institutions) is seeing them as pools of liquidity that protect the depositors against idiosyncratic shocks to their liquidity demands. If these shocks are not perfectly correlated, a coalition of N depositors can maintain a lower cash reserve, which grows less than proportionally with N. This is well known as the fractional reserve system, where a fraction of deposits can be used to finance illiquid, but more profitable investments.

This approach has been put forth by (Bryant 1980) and later by (Diamond and Dybvig 1983). They assume a continuum of consumers in a one-good, three-period economy.

Consumers are endowed with one unit of a perfectly divisible good at $t = 0$ and they learn at $t = 1$ whether they will have to consume early at $t = 1$ or late at $t = 2$. The good can be invested in an illiquid technology at $t = 0$ yielding $R > 1$ at $t = 2$, but only $L < 1$, if liquidated prematurely at $t = 1$.

The authors show that under autarky, each consumer will maximize his expected utility denoted by

$$U = \pi_1 u(C_1) + \pi_2 \rho u(C_2),$$

where π_1 (π_2) is the probability of being the type 1 (type 2) consumer that has to consume early (late) and $\rho < 1$ is a discount rate, subject to two constraints:

$$C_1 = 1 - I + LI \leq 1$$

if he has to consume early, with equality only if $I = 0$. On the other hand, if he has to consume late, he obtains

$$C_2 = 1 - I + RI \leq R$$

with equality only when $I = 1$.

Welfare improves if agents are allowed to trade. We open a financial market at $t = 1$ in which agents can trade the consumption good against a riskless bond that promises to return some quantity of the consumption good at $t = 2$. In this setup, the equilibrium allocation of the market economy is $C_1^M = 1$ and $C_2^M = R$ and the corresponding investment level is $I^M = \pi_2$. This allocation Pareto dominates the autarky allocation, but is nonetheless suboptimal.

From an ex-ante viewpoint, there is a unique, symmetric Pareto optimal allocation (C_1^*, C_2^*) that satisfies the first-order condition

$$u'(C_1^*) = \rho R u'(C_2^*)$$

and they show that the market allocation can be Pareto improved by increasing C_1^M and decreasing C_2^M. This proves that market economy is incapable of providing perfect liquidity insurance and therefore, efficient resource allocation. However, this Pareto optimal allocation can be attained by introducing a financial intermediary that will offer deposit contracts stipulated as follows: for a deposit of a unit of good at $t = 0$, the consumer gets either C_1^* at $t = 1$ or C_2^* at $t = 2$. To meet this obligation, the FI stores exactly $\pi_1 C_1^*$ and invests the rest in the illiquid technology. Unfortunately, this model is incapable of explaining the simultaneous existence of financial market and the intermediary, which is a serious drawback of the model.

Another way to achieve the desired result would be to employ deposit insurance. In such a setting, the depositors are not concerned with potential availability of withdrawals at $t = 2$, which serves as a prevention of bank runs. This is an essential argument in favour of deposit insurance and we will come back to it in the next chapter. Nevertheless, deposit insurance,

despite being able to prevent runs and stabilize the industry, poses some serious moral hazard problem due to altering the incentives of both the depositors and the managers. Once the investors know that their deposits are insured, they lose an incentive to care about the quality of the loan portfolio and the performance of their bank. The manager of the bank, on the other side, is alleviated of the threat of withdrawal in case of poor performance and loses, at least partially, the incentive to perform well. Deposit insurance, despite being a good servant, is a bad master in itself and needs to be implemented carefully, with full awareness of the drawbacks and incentive changes it brings about.

1.2. Information-sharing coalitions

A common trait of the models belonging into this category is the assumption that entrepreneurs are better informed about the quality of their projects and possess an informational advantage over the investors. This adverse selection paradigm has been given an extensive treatment in literature, starting with the famous "*Market for Lemons"* by George Akerlof (Akerlof 1970), and has found applications in many areas of study. In our context, the adverse selection paradigm generates economies of scale in the lending-borrowing activity and justifies the existence of FIs, explaining them as information sharing coalitions.

Seminal contribution in this area is due to Leland and Pyle (Leland and Pyle 1977) who assume the entrepreneurs to invest certain part of their wealth into the projects to signal their quality and get external financing. Each project has an expected return θ, which is entrepreneur's private information but its distribution of returns in the population is common knowledge, and variance σ^2 common for all projects. If all entrepreneurs are indistinguishable, there will be only one price P for their projects they can obtain in the market and only those with lower expected return will issue equity, leading to a well-known adverse selection problem as described in (Akerlof 1970). The equilibrium price in the capital market will be such that only projects with expected return below certain cut-off level obtain external financing, a generally inefficient outcome, since investors are assumed to be risk-neutral, whereas entrepreneurs risk-averse.

In order to overcome this effect, the entrepreneurs can decide to signal the quality of their project by self-financing a fraction α of it and issue equity for the remainder. If this fraction is sufficiently high to deter those endowed with low quality projects from mimicking them, deciding to partially self-finance will signal to the outside investors that their project is sufficiently good to obtain external financing. This is the famous result of Leland and Pyle that when the level of self-financing is observable, there is a continuum of signalling

equilibria parameterized by α with a low price of equity $P_1 = \theta_1$ for low quality projects and $P_2 = \theta_2$ for high quality projects partially financed by the entrepreneurs. However, this is associated with some costs - "informational cost of capital", which is increasing in α and the lowest possible value of this informational cost of capital is associated with the Pareto dominating equilibrium.

An extension of this model, due to (Diamond 1984), shows that coalitions of borrowers can do better than individuals. If N borrowers of type θ_2 jointly issue securities to finance their projects and their returns are not perfectly correlated, the expected return is still θ_2 but the variance decreases to $\frac{\sigma^2}{N}$ due to diversification. Since the informational cost of capital is decreasing in variance, the utility attained in this case is strictly higher than in the previous case.

1.3. Financial intermediation as delegated monitoring

In his seminal paper (Diamond 1984) Douglas Diamond has tackled the question of existence of financial intermediation from the perspective of costly information gathering and verification. In his approach, the intermediary (such as a bank) is delegated the task of monitoring the loan contracts with borrowers on behalf of the lenders-depositors. Monitoring is understood as having three aspects: screening projects *(a priori)*, preventing opportunistic behaviour (*moral hazard)* and auditing, as in (Krasa and Villamil 1992), or punishing, as in (Diamond 1984).

The bank is assumed to have a competitive advantage over dispersed depositors in collecting the information about the borrowers, since alternatively, either multiplication of effort arises if each lender monitors, or a free-rider problem occurs, when no lender monitors. The investors are also assumed to have only limited capacity compared to the size of the project, so a several investors are needed to finance each project. Furthermore, the delegation cost of monitoring the FI itself has to be less than the surplus gained from the delegation.

Central to this approach, and to others, as we have described above, is the informational asymmetry between the entrepreneur-borrower and the depositor-lender. The entrepreneur needs to raise capital for his risky projects, possessing information about its realized returns (ex-post informational asymmetry). As a result, moral hazard problem arises which can be solved either through monitoring the firm at cost K or by signing a debt contract with the investor specifying a non-pecuniary cost C, assuming $K < C$. If the number of lenders is large, these costs can be dramatic. An obvious thing to do is to delegate the monitoring activity on

one agent, the bank, which has an advantage in monitoring costs and acts as a delegated monitor of the firms.

The bank takes deposits in the form of debt contracts written with the depositors and promises to repay them with certain return. Depositors observe the payments they receive from the bank, but do not observe the outcomes of the projects themselves. Here the delegation costs arise and financial intermediation is only beneficial if the monitoring cost savings exceed the delegation costs associated with providing the right incentives to the bank.

Diamond shows that this is satisfied when the bank takes deposits from a large number of depositors and diversifies the loans among the entrepreneurs. Diversification is indispensable, since when returns of the projects are identically and independently distributed, the per entrepreneur delegation cost is a monotonically decreasing function of the number of entrepreneurs - the probability of average project return being in the lower tail is monotonically decreasing as well. The intermediary, nevertheless, must bear certain risks for incentive purposes – Diamond uses non-pecuniary bankruptcy penalties. Increasing returns to scale from delegation cost savings arise here and are the key result of Diamond's model. Financial intermediaries allow better contracts to be concluded and allow Pareto superior resource allocations.

2. Theory of banking regulation

There are a number of other models that further expand the theory of financial intermediation and coexistence of direct and intermediated lending. Some authors have presented very sophisticated models that capture and explain the motives for financial intermediation surprisingly well. However, it is outside the scope of this thesis to treat them in more detail. We shall rather accept the existence of FIs (hereinafter understood as banks) as given and study their *modus operandi*, in particular the motives for and way of their regulation.

One common trait of the models presented above is the fact that they allow only for debt, eventually inside equity financing structure, i.e. there is no need for external equity. Banks are viewed as entrepreneurial ones, meaning that they are financed by insiders who bear all the costs of entry and exit and that their failure has no systemic impact. Hence, there is neither need nor scope for regulation in these models.

This is in stark contrast with reality, as we can observe that medium and large banks are usually publicly listed and have a dispersed ownership structure. Moreover, recent crisis has once again reminded us of the fact how vulnerable financial system is to a failure of even one, systematically important bank, and how large the externalities generated by banks are. At first glance, we could ascertain that this fragility and externalities produced are substantial enough to justify the need for intervention and regulation, be it public or private.[1] But can we satisfy ourselves with such a fast and frugal argument without going a bit deeper into the nature of banking business?

2.1. Motivating regulation

In our evaluation of regulatory standards, we would like to begin from the seemingly simple point of asking why banks should be regulated in the first place.[2] In general, regulation and public intervention is justified by market failures resulting from 1) presence of market power, 2) externalities arising as a by-product and 3) asymmetric information between the parties involved (Freixas and Rochet 1994, p. 257). However, the "official" justification of politicians and other executive officials for regulating banks is the necessity of providing a safety for the depositors to protect them from the risk of failure of their bank and

[1] From now on, we will deal with public regulation and supervision, as all regulatory schemes in force or prepared at the moment are of public nature.

[2] We would like to note that this principle applies not only to banks but also to other FIs such as pension funds, insurance companies etc.

simultaneously, to prevent bank runs through the means of deposit insurance and solvency requirements. But, as we argue below, this justification is intertwined with the motives mentioned above.

The motive of depositors'[3] protection against failures of their bank and prevention of bank runs is an answer to the externalities arising in the course of banking business. But as some authors argue, there is no *qualitative* difference between the operations of a bank and a non-financial firm (Dewatripont and Tirole 1993) and between the failure of a bank and a non-financial firm (Freixas and Rochet 1994, p. 263). So there comes up an obvious question: What is so different about banks that they ought to be regulated?

One answer could be that banks (and FIs in general) are special in the sense that their creditors are also their customers (Freixas and Rochet 1994, p. 264) and they are dispersed, small and usually uninformed, which is contrary to non-financial firms, where creditors are usually well-informed professionals. Since banks are subject to substantial moral hazard and adverse selection problems, both vis-á-vis the depositors and the borrowers, their creditors-depositors need to constantly monitor their behaviour and performance. This is a very demanding task requiring expenditure of time, effort and resources that are often not possessed by small, unsophisticated depositors. Alike in the Diamond model above, this monitoring function is a natural monopoly in the sense that it is wasteful to duplicate these efforts. On the other hand, there exists a serious free-riding problem when thousands of depositors have no incentive to incur costs in order to gather information and take action from which all the customers of the bank benefit. Here arises the need for coordination of action of depositors by a public or private representative.

A general argument in this strain was put forth by Dewatripont and Tirole in the so-called *representation hypothesis* (Dewatripont and Tirole 1993). They argue that the regulator acts as a representative of the depositors, due to reasons outlined above, and should be empowered to intervene in the operation of a bank in case of bad performance. In their opinions, the regulator is the guarantor of order and stability in the banking sector. They justify this by noting that run is the individually optimal, but socially undesirable strategy to follow in case of bank distress. Hence, the regulator's task is to balance the protection of depositors with healthy competition and proper functioning of financial system, its effectiveness and market discipline. In other words, this means facing the trade-off between stability and safety on the one hand, and profit and efficiency maximization on the other.

[3] And bank's clients in general, since it may also be the case that bank's debtors develop valuable ties with their banks.

Another way is to approach the question from the other side and discuss solvency issues. Proponents of the free banking paradigm argue that there is no sense in setting the solvency ratios arbitrarily for privately owned and managed bank (Fama 1985). However, as has been famously argued by Jensen and Meckling, there are conflicts of interests inside a firm between the shareholders, debt holders and managers (Jensen and Meckling 1976). They show that different groups of stakeholders have different return patterns given the performance of the firm and, therefore, different incentives to act given the performance[4,5]. In particular, if a bank is managed by its owners, these owners-managers have a more risky appetite than what would be desired by the depositors. Since the depositors have a very limited capacity to act, as outlined above, their interests need to be represented and defended by an institution, leading to a form of delegated monitoring, be it deposit insurance company or a public regulator (Freixas and Rochet 1994, p. 264).

2.2. Tools

In theory, regulation of conduct is distinguished from regulation of structure. The former specifies what kind of behaviour is permitted; the latter defines the eligible players for a given type of activity (Freixas and Rochet 1994, p. 258). Both of these types are relevant for our study of banking regulation, since banking regulation takes form of both of aforementioned types – the Glass-Steagall Act representing regulation of structure, solvency ratios or reserve requirements being a typical regulation of conduct.

However, as far as banking sector is concerned, the similarities end here. The specificity of banking activities, as discussed above, render regulation of banking sector unique in several respects. As noted before, the prevalent aim of banking regulation, inter alia and most importantly, is the protection of depositors against bank failures and prevention of bank runs. These regulatory tools can be divided into five broad types and we will discuss them briefly one at a time (adapted from Freixas and Rochet 1994, ch. 9).

2.2.1. Deposit interest rate ceilings

Limiting the (nominal) rates that bank have to pay on deposits has been presumed to decrease lending rates by decreasing the cost of financing for the banks and make the bank credit more accessible, hence contributing to economic growth. Deposit interest rate ceilings,

[4] This is due to limited liability, a concept that we accept as given and expressly omit the question of its appropriateness and fitness.

[5] Moreover, the possibility of outside intervention excludes the irrelevance argument a la Modigliani and Miller (Dewatripont and Tirole 1993).

among other measures, have been introduced by the US Banking Act of 1933, commonly known as the Glass-Steagall Act, in the form of the so-called *Regulation-Q.*[6]

However, the effect on lending rates and amounts is not straightforward to assess. Ceilings on interest rates paid on deposits have been shown to decrease lending rates under certain conditions but to be irrelevant for lending rates under others (Freixas and Rochet 1994, p. 63). A general result follows due to (Chiappori, Perez-Castrillo, and Verdier 1995): under interest rate regulation, banks will offer tied-up[7] contracts with lower credit rates than in the unregulated case. Therefore, the regulation is welfare-improving. However, if tied-up contracts are prohibited, regulation is welfare-decreasing.

We will not deal with this issue in more detail, since this regulatory instrument has been abandoned by all of advanced economies and does not represent a concern for us.

2.2.2 Entry, branching, network and merger restrictions

Another important debate about banking regulation revolved around the question whether banks should be allowed to operate large branch networks or to restrict them to what has been called "unitary banking", when there is a large number of small, locally limited banks. Some interesting findings regarding this issue have been presented in the literature. They centre on the assumption of switching costs customers face when they change from one bank to another.

When switching costs and the (ex-ante) non-observable quality of banking services are assumed, the desired competition on the banking industry no longer looks so spectacular. If there is a large number of banks (i.e., a unitary banking system) competing for clients who face large enough switching costs, banks can behave as monopolists and offer the lowest possible level of service quality in the period after attracting depositors (Freixas and Rochet 1994, p. 74). Moreover, if deregulation enhances competition and unprofitable banks leave the market as a result, market concentration can increase in the industry (Freixas and Rochet 1994, p. 75).

2.2.3. Portfolio restrictions

Restricting the permissible set of instruments a bank is allowed to trade or issue has been a popular tool since the Great Depression. The Glass-Steagall Act prohibited a bank holding company to own another financial company and effectively introduced a division of banks into two broad categories, the commercial banks that were allowed to take deposits and grant

[6] In fact, Regulation Q prohibited paying interest on demand deposits altogether and led to the emergence of money market funds and similar instruments, through which banks were circumventing the regulation.

[7] This means that the customer obtains credit only if she deposits the money with the same bank.

credit, and investment banks that were allowed to underwrite securities and hold corporate equity. This is motivated by the conjecture that 1) equity holding may increase the risk exposure of the bank and 2) that there is a potential conflict of interest between taking deposits, underwriting equity and possibly provision of other financial services such as insurance (Freixas and Rochet 1994, p. 265).

This strict division lasted until 1999, when the Act was repealed by the Financial Services Modernization Act (also known as the Gramm-Leach-Bliley Act) and in effect reintroduced the universal banking concept that is common in Europe. In the light of recent crisis, the repeal has not been a particularly lucky decision. Some economists such as Joseph Stiglitz or Paul Krugman have argued that in the world of fractional-reserve banking, fiat money and deposit insurance, the Act has contributed to the sub-prime crisis and the following global recession.

2.2.4. Deposit insurance

In order to avoid bank runs and associated social costs, governments have introduced deposit insurance schemes. In this setting, a bank pays an insurance premium to a deposit insurance company, usually a government agency, and in exchange this agency insures the deposits, usually up to a fixed amount in case the bank fails. Deposit insurance has been again a reaction to the Great Depression and later spread throughout the world, taking on various modalities: complete or partial insurance, compulsory or voluntary, it may cover principal or principal plus interest (Freixas and Rochet 1994, p. 266).

In most settings, the insurance is public, i.e. eventual losses are paid from taxes collected by the sovereign. Some economists have argued in favour of private schemes. In their opinion, competition should provide incentives for accurate information extraction and accurate pricing. However, as we could observe during the recent crisis, in case a sufficiently large bank fails, the only entity able to satisfy the insured depositors is the sovereign state that is able to collect enough resources through taxation. In other words, private insurance schemes lack credibility unless there are explicit contingent guarantees by the government.

An important aspect of deposit insurance, be it public or private, is the moral hazard it entails. If bank managers know that depositors get their deposits back regardless of the performance of the bank and if insurance premium is flat, i.e. does not depend on the level of risk taken on by the bank, they are encouraged to take on more risk than optimal. Theory calls for risk-related insurance premia.

However, as has been shown by various authors, risk-related premia may not be feasible in the presence of asymmetric information between the bank and the insurer. Deposit insurance must be accompanied with supervision of the banks' activities and ability to act if they fail to meet regulatory criteria. Two of these instruments are discussed in the subsequent section.

2.2.5. Capital requirements

Let us now focus in more detail on the issue of capital structure of the banks and why it is so important for the regulator. Existing regulation tries to alter the shareholders' incentives to discipline managers through higher capital requirements (Dewatripont and Tirole 1993, p. 117). However, the entrepreneurial approach to banking business outlined in the models above cannot assign any role to outside equity due to the irrelevance of the financial structure in the presence of optimal managerial incentive schemes, as described in the famous Miller-Modigliani theorem (Miller and Modigliani 1958). Put in a different way, capital structure does not influence the behaviour of banks, which is entirely determined by managerial incentive schemes (Dewatripont and Tirole 1993, p. 116). Moreover, modern banks are dispersedly owned, and due to the argument made by Jensen and Meckling, the main conflict ought to be between the managers and the outside financiers (bondholders and shareholders). It is complicated then to see why the capital structure (capital-to-asset ratio) matters, since it should be a priori unrelated to the decisive dimension, namely managerial incentives.

However, as we noted above, regulation of banking industry puts emphasis on solvency and capital requirements, so there has to be a theoretical justification for the role of outside equity in banks' functioning and motives why banks are regulated.[8] This disparity between the role of capital structure and managerial incentives can be solved by introducing the incomplete contract paradigm. If no contract can be written that specifies the actions of the manager under all circumstances, the only way to discipline him is to threaten him with external intervention under certain circumstances (Freixas and Rochet 1994, p. 264). In other words, capital structure matters if it allows for external intervention in the internal management of the bank under certain conditions, i.e. if it affects the behaviour of outside claimholders (Freixas and Rochet 1994, p. 5). This will affect the incentives of the managers if they understand that poor performance on their part will result in intervention of outsiders and them possibly losing their jobs.

[8] Outside equity is relevant, since if banks were financed solely by inside equity, there would not arise the principal-agent problem that regulation tries to combat.

Two approaches can lead to assignment of a role for the capital structure. One is to allow for occasional involvement of shareholder in the management of a bank, which serves as a disciplining factor on the management, an approach discussed in more detail below, or to impose exogenous constraints on the managerial incentive schemes and make these compatible with the interests of the shareholders and depositors, á la Jensen and Meckling.

Since banks are managed by managers who own at most a small fraction of the capital, it is reasonable to focus on the incentives of these managers. But in that case, it is difficult to see why capital structure should matter, because there is no obvious relation between the financial structure and the performance of managers (Freixas and Rochet 1994, p. 275). However, this ambiguity vanishes when we introduce incomplete contracts between the manager and the shareholders, a phenomenon that is ubiquitous in contractual relations. When we consider contracts to be incomplete in the sense that an action is prescribed in every possible state of the world, there arises a role for capital structure. A contract can specify who is in control under which circumstances and when shareholders can intervene in the management of the bank. Dewatripont and Tirole (Dewatripont and Tirole 1993) offer a model of bank governance under incomplete contracts and draw interesting conclusions about the optimality of debt and equity. In particular, they show that this second-best decision rule (since first-best is not attainable due to the incompleteness of contracts) can be implemented using a combination of debt and equity.

2.3. Recent regulatory issues

From purely theoretical deliberations, we shall now turn our attention to recent development in the banking business in general and banking regulation in particular. We begin with mentioning two facts pivotal to this subchapter, namely that there have been several waves of deregulation and re-regulation in the past, and that one of the leading motives behind financial innovation is the desire to escape regulatory demands, hence lower the capital requirements and boost returns on equity.[9]

2.3.1. Some causes of regulatory failure

The reasons for regulatory failure to address the issues arisen during the recent crisis are several. First, we should mention the rather long period of financial markets deregulation over past three decades and globalization of the industry in recent years. As we could observe, regulation is rather procyclical. Politicians tend to adopt strict measures when things go

[9] And managerial remuneration, of course.

wrong and alleviate tight rules when everything is going smooth. This combination of conditions, together with other facts, allowed for emergence of internationally operating banks that were allowed to run business in both sectors, commercial and investment banking. The ensuing web of strong interconnectedness and mutual exposure has turned out to be detrimental to financial stability and economic growth.

Second, as has been mentioned in the first paragraph, financial innovation is often motivated by regulatory elusion. Financial securitization is an example *par excellence.* The *underwrite-and-distribute* strategy, although theoretically beneficial from the risk allocation and sharing perspective, creates perverse incentives for the managers of the banks. If they knew that they could divest a large share of their loan portfolio quite easily by establishing an off-balance sheet special purpose vehicle (SPV) and transferring the assets into it, their motivation to observe and assess the creditworthiness of the borrowers shrank to practically nil. It could be argued that this strategy would not be profitable if the buyers of the SPV tranches were rational. If they really were rational, there would a discount to the issue price equal to the expected loss, a result familiar due to Akerlof's market for lemons. Mortgage-related structured investment vehicles were a prominent example of "lemons". Apparently, either Akerlof's argument was false, or the buyers were not rational enough to capture the riskiness of the instruments. Taking into account the fact that various institutions throughout the financial industry were buying the instruments eagerly without virtually asking what is inside and incurring astronomical losses as a result of the market collapse, we severely doubt the hailed rationality of the market participants.

Third, supervision of the market players and their activities was clearly insufficient prior to the crisis. For example, investment banks managing $4,000 billion in assets were supervised by mere *seven* people at the Securities and Exchange Commission (SEC) (Dewatripont, Tirole, and Rochet 2010, p. 26). Furthermore, there has been a tremendous maturity mismatch between assets and liabilities. SPVs were borrowing in the money market by issuing commercial papers (CP) or medium term notes (MTN) and lending into long-term asset-backed securities. This strategy was profitable and sustainable as long as short term rates were below long term ones and borrowers (mostly mortgage borrowers) were able to meet their obligations. As soon as increasingly more borrowers went into default, the whole structure collapsed.

Fourth, solvency requirements of the Basel II framework turned out to be ill-equipped for prudential regulation of the banking industry. This can be best documented on the case of Northern Rock, which reported more than necessary capital adequacy on the eve of the run

and collapsing shortly afterwards. It is a prominent example of how the regulation failed to capture liquidity risk. More attention to the Basel accords will be given in the subsequent chapter.

Last but not least, credit rating agencies played an important role in magnifying the scale of the crisis by giving inadequately good ratings to structured vehicles. Investment grade ratings that were given to the most of the conduits allowed these to be purchased by a wide range of institutions, including pension funds, saving banks and local governments that were otherwise prohibited from acquiring lower-grade or speculative assets. As noted by various authors, there has been pronounced evaluation collusion between the credit rating agencies and the institutions they were supposed to assess. First, when a client is paying to get a rating, there is a large probability that the rating will be biased upwards, as there is likely to be strong pressure from the client on the rating agency to issue a good grade. Second, as it turned out, professionals at the investment banks were the brightest minds in the industry and it must be acknowledged that they did their jobs very well from the point of view of their employers. Credit rating agencies, let alone the regulators and most of the buyers, were often unable to disentangle the product and assess its riskiness correctly due to its enormous complexity and opacity.

All the facts named above have contributed to the meltdown by creating a huge market niche that escaped the reach of regulators *and* being too complex for the risk associated with it be assessed properly. Given the scale of financial globalization and interconnectedness of banks in 2007, only a minor spark was sufficient to light up a global financial cataclysm followed by a deep recession in real economy.

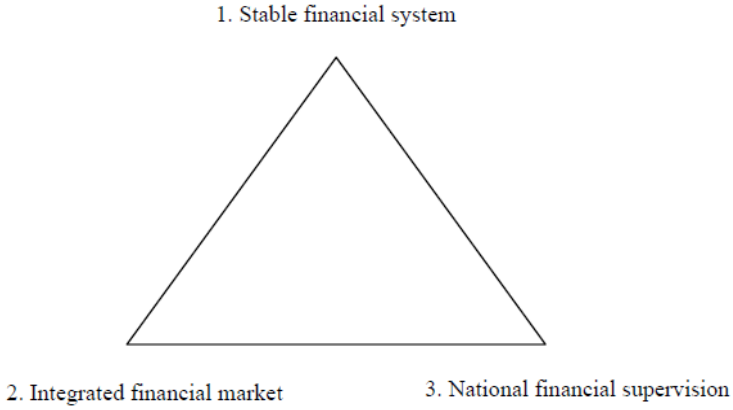
2.3.2. Reform proposals to global regulation

Having exposed some of the causes why banking regulation (and financial regulation in general) failed to contain the looming crisis, we shall now turn to some of the proposals put forth recently. Changes to banking regulation are the topic of this thesis and will be discussed in detail in the following chapter. Now, we would like to turn our attention to other proposals and points made by academicians that are believed to improve upon the *status quo*.

The crisis has fully revealed and made obvious to everybody the fact that any attempts at making the global financial system more resilient to turbulence in future have to be inherently global in nature and scope. Existence of a global financial system is incompatible with discretionary regulation, tax havens and offshore entities. Argument of a similar nature has been made by Schoenmaker and Oosterloo in 2007 (Schoenmaker and Oosterloo 2007),

following the well-known 'Holy Trinity' in macroeconomic policy (Rose 1996). They show that policymakers face three desirable but contradictory objectives of financial regulation: 1) stable financial system, 2) integrated financial system and 3) independent national financial supervision. One must decide which objective will be given upon, while making the other two mutually consistent.

Figure 1: The Trilemma in Financial Supervision



Source: (Schoenmaker and Oosterloo 2007)

It becomes obvious immediately that a globalized financial system cannot be stable if supervision is to remain separate and independent. Without a unified supervision over global players we can only wish for a stable financial system that will be plagued by crisis similar or worse than the recent one, as the system is likely to get even more integrated.[10] In other words, there is a need for a much more powerful and independent (banking) supervisor (Dewatripont, Tirole, and Rochet 2010, p. 100). Without that, we have a very small, if any, chance of identifying potential problems in the banking sector before they materialize in future.

There is also a strong call for international burden sharing in case of distress and/or failure of a major, cross-border engaged bank. Today, large international banks are not limited by geographic borders and failure of such a bank can, and does, have significant spill over effects. This is most acute for the European Union, where the level of financial integration is very deep and where the economically most important countries have formed a monetary union. However, the crisis has revealed the truth that European policymakers have been ignoring for a long time: a monetary union, together with a deeply integrated financial system

[10] Or will get disintegrated as a result of a surge of protectionism and trade wars. In such case, our debate loses any sense.

with a few major banks accounting for a significant market share, is not viable without ex-ante rules on how to treat systematically important banks in distress. The best solution would obviously be fiscal union but one can only hope for one under current conditions. Hence, if a systematically important bank in the EU fails in near future, costs for taxpayers in home country can be enormous.[11] Put in a simple way, the temptation to leave the costs to be borne by another Member State in the home-host environment within the EU is too tempting for the Member States not to follow it.

Containing failures of systematically important institutions is an issue *per se*. It requires credible rules for crisis management and a greater degree of operational freedom for the supervisors, in similar scope as central banks are enjoying, backed by clear rules when the supervisor can intervene and in what scope (Dewatripont, Tirole, and Rochet 2010, p. 102). This would at least partially alleviate the time-inconsistency problem faced by the supervisors at the moment which creates enormous moral hazard on the part of bank managers. One must also think about what actually *needs* to be supervised and regulated. (Dewatripont, Tirole, and Rochet 2010)) argue that the clue is to regulate the exposure of the regulated sphere to the failure of unregulated sphere, precisely the core problem of recent crisis. Wasting scarce resources on marginal problems such as hedge funds is certainly foolish given the social costs of a failure of such an entity (Teply 2010).[12] To conclude this part, one must remember that it all comes down to the fundamental paradox of banking activity: *banks are private institutions that collectively manage a fundamental public good. The financial infrastructure thought to be of vital concern* (Dewatripont, Tirole, and Rochet 2010, p. 104). In this light, the need for a functioning and efficient banking regulation and supervision is of vital importance and the failure to reform current structure can have dire consequences when the next crisis comes.

[11] A the time of writing this (December 2010), it seems that the probability of such occurrence is quite high for the upcoming year, as several Member States of the EU are at the brink of sovereign default. Especially German banks will be severely hit if any of the endangered countries defaults, which could trigger further defaults.

[12] According to Teply, hedge funds account for 1% of global assets under management. In this light, attempts at blaming them for recent crisis seems to be sort of a witch hunt, whose aim is to disguise true causes and problems.

3. Basel accords

Before evaluating Basel III accords, we would like to begin with an overview of genesis and evolution of capital adequacy regulation commonly known as Basel capital accords. We believe that the knowledge of its history, motives behind its creation and failures of previous attempts can shed light onto current proposal and help us understand and evaluate it in a better way.

3.1. Basel I

Basel Committee on Banking Supervision (BCBS, "the Committee") was founded upon the initiative of the Group of Ten (G10), under the auspices of the Bank for International Settlements (BIS), following the collapse of the German bank Herstatt, in Basel in 1974. Its purpose was to establish and implement prudential rules of conduct applicable to all banks with significant international presence (Dewatripont, Tirole, and Rochet 2010, p. 78). During the 1980s, some of BCBS members were concerned with enormous growth of assets under management in Japanese banks. These were at a competitive advantage, being notoriously undercapitalized and enjoying an implicit guarantee from the Japanese government. In 1988, BCBC issued a set of rules aiming to 1) assure stability of the international financial system; and 2) eliminate competitive distortions arising from the subsidies (implicit or explicit) provided by the governments to some banks (especially in Japan) (Dewatripont, Tirole, and Rochet 2010, p. 78).

First Basel accords have been subject to much criticism, both on the part of commercial bankers and economists, and were progressively reformed, especially during the chairmanship of William McDonough in the early 1990s. It was during this time when the Committee accepted the so-called internal ratings-based approach to capital adequacy calculation. We will return to this issue further below.

Basel I capital accords stipulate the minimal amount of capital a bank should at all times hold in order to account for the losses arising in the course of banking business and are remarkably simple in nature. Capital is divided in to two categories – Tier 1, comprised of issues of equity and retained earnings, and Tier 2 comprising supplementary capital in the form of undisclosed reserves, revaluation reserves, general provisions and subordinated term debt. Tier 2 cannot exceed the amount of Tier 1 for the purpose of capital adequacy calculation. Bank's total capital is required to be equal to at least 8% of bank's total assets

weighted by coefficients reflecting the riskiness of the asset. The weights were extremely simple – Table 1 gives an overview of weights assigned to different borrower categories.

Table 1: Basel I Risk Weights

Risk weight	**0%**	**20%**	**50%**	**100%**
Borrower category	OECD members, cash	Banks from OECD countries, public institutions	Unsecured mortgage credit	All other receivables from private entities

Source: BIS

The regulation was legally binding in G10 by 1992 and a number of other countries voluntarily accepted the rules. Their first impact was a wide recapitalization of banks and reduction of competitive distortions in the respective countries (Jackson 1999). However, criticism soon ensued. Basel I was accused of prompting a credit contraction, as the banks had to amass a significant amount of funds and bind them due to regulatory requirements. For instance, banks rather bought a 10-year government bond for which no capital was required, than lend to private sector, where 100% risk weight meant an 8% capital cushion for the funds lent (Dewatripont, Tirole, and Rochet 2010, p. 80). It was obvious very soon that the weights adopted by BCBS were at odds with the way market was assessing risk at the time. In particular, they accounted for credit risk only, completely ignoring market risk, i.e. mainly movements in exchange and interest rates.

Another important issue is that Basel I (and its successors) relies on the assumption that the probabilities of losses are distributed in a certain way and that losses on different assets are not correlated. However, as has been iterated many times by many authors, this works relatively well only in good times. During an economic downturn, losses on loans to private sector are pretty much correlated. Moreover, returns on loans (and therefore bank equity) are usually heavily fat-tailed[13] (Mandelbrot 1997), meaning that an adverse shock can have disproportionately[14] large effect on the bank's profitability. A surge in delinquency rate can therefore find the bank ill-prepared and cause a lot of damage. Ultimately, it is the taxpayer who has to foot the bill of government bailouts.

[13] Technically, a distribution that is described to have a fat (or heavy) tail exhibits extremely large kurtosis in comparison to a standard normal distribution. In particular, for some distributions, variance does not exist (as is the case for the stable family of distributions with the exception of normal distribution). This means that estimating and predicting the behaviour of a random variable governed by a heavily-tailed distribution by the means of a normal distribution (or another well-behaved distribution) can severely underestimate the variance of that variable.

[14] Disproportionately large to what would be expected by standard risk model based on well-behaved variables.

3.2. Basel II

Following the criticism from various sides, BCBS amended the capital accords in 1996, adding measures for market risk, and prepared a thorough reform of the standards. These were adopted in 2004 and made effective of 2007, being referred to as Basel II.

As far as Basel I was fairly simple, Basel II introduced a number of changes that were very complicated and made the whole scheme rather opaque to an outsider. It is described by the 'three pillars' – capital adequacy ratios (the first pillar) are complemented by a strengthened role for the supervisor (supervisory review process, second pillar) and an enhanced market discipline through increased transparency requirements (third pillar). But was later turned out to be the worst, Basel II allowed the banks to employ their own, internal credit risk assessment models.[15] These were too complicated for the regulator to assess and allowed the sophisticated bank managers to set a significant percentage of assets out of the scope of regulation and enjoy the benefits of a higher leverage. When we consider the amount of resources, both monetary and human, large banks have at their disposal, this outcome seems to have been inevitable from the hindsight. In short, Basel II can be described as a prime example of regulatory capture (Dewatripont, Tirole, and Rochet 2010, p. 81). We will now in turn discuss briefly some of its characteristics.

3.2.1. Risk weighting

Basel II introduced the possibility for banks to choose from among three approaches to credit risk assessment. First, the simplified approach, intended for smaller credit institutions that were assumed not to have enough resource to develop internal models of credit risk calculation, where risk weights were fixed *ex-ante*. Under the second approach, banks were allowed to use external credit risk assessments from the external credit assessment institutions (ECAI) in their calculation of capital. And third, the so-called Internal Ratings-Based Approach (IRB), that is discussed in more detail below, which allowed sophisticated banks to develop their own, complete credit assessment models.

A very interesting and striking feature of Basel II was the decrease of some risk weights, despite its increased complexity and detail. For example, risk weights for mortgages were reduced by 30% (from 50% to 35%) in its basic version and even more under the IRB approach. From the hindsight, this has been a very unfortunate step. To give a clear picture of risk weights development across Basel I and Basel II, we introduce the following figure.

[15] As a result of a great pressure from banks on BCBS to adopt a provision allowing for such practices.

Figure 2: Basel I and Basel II Risk Weights

Risk Weights Under Basel I and Basel II (Pillar I), %

SECURITY	BASEL I	BASEL II Simplified Standardised	BASEL II Standardised based on External Ratings		BASEL II Advanced: Internal Ratings Based (IRB) 2004-05 QIS 4 Avg % chg in portf. MRC	2004-05 QIS 4 Median % Chg in portf. MRC	Basel II Advanced IRB
Most Government/central bank	0	0			0	0	Comes close to letting banks set their own **Pillar 1** capital, with supervisory oversight. Risk weights depend on internal estimates of a loan's probability of default; loss-given-default; exposure to loss. These are based on the banks' own complex risk models, relying on subjective inputs and often on unobservable (e.g. OTC illiquid securities) prices. **Pillar 2** provides for supervisory oversight. With stress testing, and guidance from supervisors, banks can be made to hold capital for risks not adequately captured under Pillar 1. **Pillar 3** is disclosure and market discipline which relies on some notion of market efficiency. Rational markets punish poor risk managers.
AAA to AA-			0				
A+ to A-			20				
BBB+ to BBB-			50				
BB+ to B- (& unrated)			100				
Below B-			150				
Other public (supervisors discretion)	0-50	0			0	0	
Claims on MDBs	20	0			-21.9	-29.7	
Most OECD Banks & Securities firms	20	20	<90days	Other	-21.9	-29.7	
AAA to AA-			20	20			
A+ to A-			20	50			
BBB+ to BBB- (& unrated)			20	50			
BB+ to B-			50	100			
Below B-			150	150			
Residential Mortgages-fully secured	50	35	35		-61.4	-72.7	
Retail Lending (consumer)	100	75	75		(-6.5 to -74.3)	(-35.2 to -78.6)	
Corporate & Commercial RE	100	100			(-21.9 to-41.4)	(-29.7 to -52.5)	
AAA to AA-			20				
A+ to A-			50				
BBB+ to BB- (& unrated)			100				
Below BB-			150				

Source: (Blundell-Wignall and Atkinson 2010)

3.2.2. The Internal Ratings-Based approach

During the consultative part of Basel II preparation (1998-2002), banks adopted a stance that BCBS does not have sufficient expertise and competence to draw up a system of rules for prudential regulation of credit risk and that it therefore had to rely on the banks themselves, having developed internal risk assessment models.

Calculation of capital requirements is obtained from the sum of three terms, linked to credit risk, market risk and newly, operational risk, respectively (Dewatripont, Tirole, and Rochet 2010, p. 82). The methodology relies on the Value at Risk approach (VaR) that estimates the losses on the basis of historical data. It states the maximum loss that can be suffered with a given probability (usually 99.9 or 99.5%) over a given time interval[16], conditional on the future resembling the past (i.e., the environment being stationary). Any truly prudential regulator should stop at this point and reject these accords as not reflecting the underlying, most basic characteristic of our world – its fundamental unpredictability and often erratic behaviour. This static approach fails to account for these fundamentals and is therefore necessarily flawed. Furthermore, as noted by Dewatripont and Tirole, it fails to account for

[16] Alternatively, this means that on 0.01 or 0.05% of times, respectively, the *minimum* loss suffered will be that given by VaR.

the fact that financial risks are not exogenous, another implicit assumption of the VaR methodology. Rather, they arise as a result of behaviour of economic agents, including banks themselves, and therefore the stationarity assumption is not valid.

The principal change brought about by Basel II is the way risk weights are calculated. Basel II gave the banks the possibility of developing and employing their own risk assessment models (subject to confirmation on the part of the regulator) as an alternative to the standard process in which the regulator imposes the weights directly (a mere refinement of Basel I). For the sake of illustration of its complexity, we introduce the formula here:

$$K = LGD \times N\left[\frac{G(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}} \times G(0.999)\right] - PD \times LGD$$

where *K* designates the risk weight attached to a particular asset (or asset class),

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} exp - \frac{t^2}{2} dt$$

is the cumulative distribution function of a standard normal distribution, *LGD* is the loss given default, $G(u) = N^{-1}(u)$is the quantile function of the standard normal distribution, *R* is the correlation between the loan portfolio and the macroeconomic risk factor and PD is the probability of default of the borrower on a given asset. The banks than can choose between the 'IRB Foundation' regime, in which case they estimate the PDs themselves, or the 'IRB Advanced', when the set of parameters PD, LGD and R is estimated in-house.

The approach outlined above suffers from a number of deficiencies. Firstly, it prevents anyone external to the relationship between the bank and the supervisor to judge whether the latter has done its job properly (Dewatripont, Tirole, and Rochet 2010, p. 84). It comprises several coefficients that are mutually dependant and evaluation of which is subject to distinct discretion. Moreover, it relies heavily on mathematical and statistical modelling of social phenomena that are inherently unpredictable. In particular, how can one macroeconomic risk factor capture the development of an internationally active institution, operating in a globalized world? Complex as it is, it is far too crude to provide the bank with a correct assessment of systemic risk and the supervisor with the probability that this bank will fail. Statisticians have often expressed serious doubts over the applications of their methods in

social sciences and their very weak predictive power.[17] Last but not least, the changes introduced in Basel II were merely changes to the calculation of risk weights. Solvency coefficients and credit-equivalent exposures remained unchanged. One can have doubts whether risk weights were the sole cause of Basel I failure, or whether there is some deeper issue in the framework.

3.2.3. Liquidity issues

Recent crisis has revealed another flaw of Basel II capital accords. The case of the British bank Northern Rock is particularly instructive in this respect. Basel capital accords were trying to provide the supervisor with a measure of riskiness of each bank's balance sheet in terms of market, credit and operational risk. However, recent crisis has shown that even a capitally adequate bank can fail in very short time if the liquidity structure of its assets does not match that of the liabilities.

Run on the Northern Rock bank has been the first run on a British bank since 1872 (Dewatripont, Tirole, and Rochet 2010, p. 87). Shortly before the event, the bank reported a more than sufficient capital ratio and paid out a handsome dividend to the shareholders. From the hindsight, the business model adopted by Northern Rock could not have been more risky. Investments in opaque, illiquid structured instruments were financed through uninsured, short-term deposits. In 2007, the Financial Services Authority (FSA) has approved the IRB approach of Northern Rock, allowing for £2.2 billion in equity against £113.4 billion in assets. Leverage of this scale (50 times) was only possible thanks to the favourable risk weighting under Basel II. The bank reported only £19 billion of risk-weighted assets, giving a regulatory capital of £1.52 billion. To illustrate the discrepancy between Basel II and true riskiness, British government had to inject £23 billion into the bank when its depositors panicked. Basel II was therefore unable to handle the risk of an individual bank failure (Dewatripont, Tirole, and Rochet 2010, p. 88).

We can therefore argue that Basel II has failed to address one important trait of almost every banking crisis, the flight to liquidity. Depositors and investors are willing to tie-up their money into long-term instruments, provided they perceive these safe enough. If a rapid deterioration of macroeconomic environment or a sudden surge in risk aversion occurs, fire sales or sudden withdrawals can easily bring an "otherwise solvent" bank on the verge of

[17] To illustrate this fact with an interesting example, recall the spectacular failure of the Long Term Capital Management in 1998 – Robert Merton, the founding father of the fund, described its failure as a 'ten-sigma event', roughly equal to occurring once every several lifetimes of the universe. Someone who makes such a claim is either deranged, or does not know what he is talking about (Taleb 2010). The blindness and deafness of economists is often very daunting.

collapse, as illustrated above. Nevertheless, one can ask whether this "otherwise solvent" bank is really solvent, or whether solvency measures and requirements are not fundamentally flawed and lead us to false conclusions about the bank's condition.

3.2.4. Procyclicality

Basel II has often been criticized as being largely procyclical. Procyclicality means that some variable reinforces the behaviour of another one; here regulation of bank capital reinforced the business cycles upswings and downturns. In a boom, banks were allowed to hold less capital by Basel II due to lower probabilities of default resulting from the macroeconomic environment and possibly contributing to an overheating of the economy. To the contrary, in a recession, Basel II prompted bank to cut on lending, hence worsening and deepening the recession by insufficient supply of credit to the private sector.

A good account of Basel II procyclicality is given for example in (Danielsson et al. 2001), who broadly examine the implications of Basel II from an academic point of view and present some stunningly accurate predictions, or (Kashyap and Stein 2003), who demonstrate the procyclicality of Basel II on three models of regulatory capital calculation and come to a conclusion that a time-invariant, one-size-fits-all risk curve that maps credit risk into capital charges is insufficient to account for the diversity of credit institutions and macroeconomic situation. Instead, they propose to have a family of risk curves that map specific macroeconomic and bank-level conditions into capital charges. This, in their opinion, should contribute to better risk assessment via improved risk sensitivity and more precise capital charges.

3.2.5. Shifting promises around the financial sector

A very unfortunate feature of Basel II that caused probably the most harm, coupled with other effects, has been the possibility of different treatment of promises by various institutions and on various levels of intermediation. For example[18], if Bank A that granted a loan to a non-financial company with a 100% risk weight, it would have to hold full 8% of the amount in capital. If Bank A then shifted the promise to Bank B by buying a credit default swap (CDS) from Bank B, thereby shorting the bond and passing the promise to redeem from the company to Bank B. Because B is a bank, only 20% risk weight applies and A is required to hold only 20% of 8%, or 1,6% of the original amount in capital. Bank B can pass the promise further

[18] Adapted from (Blundell-Wignall and Atkinson 2010)

onto, say, reinsurer. The promise to repay is now outside the banking system, hence the scope of capital requirements and Bank B effectively reduces its capital requirements.

This example illustrates how the Basel II rules enabled banks to avoid capital requirements and effectively reduced the prescribed risk weights to fractions of their nominal value. Moreover, this capital arbitrage mechanism is the precise cause of the tremendous growth of leverage in the banking sector. The extremely rapid expansion of CDS market prior to the crisis is an evidence of how successful banks were in doing so. Basel II allowed banks to raise leverage by the means described above to unprecedented levels, while simultaneously retaining enough *regulatory* capital on their balance sheets and, therefore, to appear well-capitalized. Treating promises evenly across the financial sector is yet another challenge to the policymakers. Without this demanding task being accomplished, we can only hope for a well-functioning regulatory and supervisory system where no regulatory arbitrage[19] would be possible.

3.3. Basel III

As a reaction to the crisis that has begun in 2007 and whose resolution is yet to come, BCBS has come with a proposal that addresses the issues raised during the crisis. In this part of the thesis, we shall give an overview of proposed measures and standards as well as present some impact assessments made by BCBS and the industry.

3.3.1. Genesis and overview

BCBS has begun efforts to improve existing structure of capital adequacy requirements in September 2009, when its oversight body, the Group of Central Bank Governors and Heads of Supervision (GHOS), issued the *Comprehensive Response to the Global Banking Crisis*[20], where it outlined the most important steps needed to be taken in order to strengthen banking regulation, supervision and risk management. BCBS believed that the proposed reform shall "*substantially reduce the probability and severity of economic and financial stress"*.[21] In this document, BCBS has noted that several steps are crucial in this area:

- *Raise the quality, consistency and transparency of the Tier 1 capital base. The predominant form of Tier 1 capital must be common shares and retained earnings.*
- *Introduce a leverage ratio as a supplementary measure to the Basel II risk-based framework.*

[19] Or, at least, not substantial enough to undermine the stability of the system as a whole.
[20] Available at http://www.bis.org/press/p090907.htm
[21] Ibidem

- *Introduce a minimum global standard for funding liquidity that includes a stressed liquidity coverage ratio requirement, underpinned by a longer-term structural liquidity ratio.*
- *Issue recommendations to reduce the systemic risk associated with the resolution of cross-border banks.*

In December 2009, first consultative document was issued, subject to comments being issued by April 16, 2010. GHOS later agreed on key design elements of the reform proposal at its July 2010 meeting. In September 2010, GHOS announced precise changes to the minimum capital requirements it had agreed upon earlier that year, setting the minimum to 7% of common equity to risk-weighted assets (RWA) and further 2.5% of countercyclical capital buffer, and made public the proposed timeline of transition to new requirements. Finally, in December 2010, BCBS published final version of the reform proposal, described colloquially as 'Basel III'.

The principles that were governing previous Basel accords remain largely unchanged, although with some minor refurbishments. BCBS is *"building on the three pillars of the Basel II framework*", whereby the reforms *"raise both the quality and quantity of regulatory capital base and enhance the risk coverage of the capital framework"* (BCBS 2010a). Basel III is still based on the notion of capital adequacy, measured as a ratio of capital (defined in a certain way) to risk-weighted assets, coupled with extended risk coverage using very similar techniques to those employed in Basel II. Nevertheless, there are some substantial differences to the definition of capital, which is also divided into different categories than before. Eligible instruments that may count into various categories have also been changed as a reaction to crisis development, when a lot of previously incorporated instruments turned out to be illiquid or unsuitable to perform their buffer function. Last, as an answer to the procyclicality critique, Basel III contains an explicit countercyclical buffer

The scope of regulation remains unchanged compared to Basel II regulation. Although being a preliminary assessment on our part, this is not a step in the right direction, since global crisis has emphasized the need for a more comprehensive and unified regulation. Extending capital requirements and oversight to entities such as insurance and reinsurance companies, government-sponsored enterprises (GSEs), and other financial intermediaries whose failure might be systemically important, or towards which banks' exposure could potentially become systemically important, would greatly enhance the stability of the global financial system. What has been changed is the extent of risk explicitly covered. We have one more risk added to the list next to credit, market, and operational risk, namely the liquidity

risk. This is explicitly modelled using two related measures of liquidity exposure over short term (30 days) and medium term (one year). There is also a leverage ratio included in the reform package that aims to limit nominal leverage taken on by banks. In the following paragraphs, we will give an overview of the individual measures, together with transitional arrangements.

3.3.2. Basel III provisions

Capital standards

The most important aim of Basel III is to strengthen banks against turbulences in financial markets via enhanced capital base. As the crisis demonstrated, banks entered the crisis severely undercapitalized and had to issue significant amounts during the downturn. Moreover, write-downs accrued mostly to common equity and retained earnings. Definition of capital has also been inconsistent across jurisdictions. This is the motivation behind BCBS's shift of capital composition towards common equity and retained earnings as its core components. Basel III presupposes the following capital structure:

1. **Tier 1 Capital** (going-concern capital which is thought to be used to cover losses in due course of business to ensure further operation of the bank without the need to liquidate it)
   a) Common Equity Tier 1
   b) Additional Tier 1
2. **Tier 2 Capital** (gone-concern capital that is expected to ensure that depositors' and senior secured creditors' claims are satisfied in a case of bank's liquidation)

Tier 3 capital, present in Basel II framework, has been eliminated, as it served to cover only market risk and BCBS wants to ensure that *"market risks are met with the same quality of capital as credit and operational risks"* (BCBS 2009, p. 15).

Limits and minima

- **Common Equity Tier 1** must, at all times, amount to at least **4.5%** of RWA.
- **Tier 1** capital must be at least **6%** of RWA at all times.
- **Total Capital** (Tier 1+2) must be at least **8%** of RWA at all times

In the following table, we present an overview of capital requirements and buffers, which are described in turn further below.

Table 2: Capital Framework Overview

Calibration of the capital framework

Capital requirements and buffers (all numbers in percent)

	Common Equity Tier 1	Tier 1 Capital	Total Capital
Minimum	4.5	6.0	8.0
Conservation buffer	2.5		
Minimum plus conservation buffer	7.0	8.5	10.5
Countercyclical buffer range*	0 - 2.5		

* See explanation in the body of text

Source: BCBS (2010)

Common Equity Tier 1

Common Equity Tier 1 (CET1) is defined, apart from other, rather marginal components, as common shares issued by the bank, share premium and retained earnings. CET1 is thought to represent the most junior claim that absorbs losses in first instance and to the full extent.

Additional Tier 1

Additional Tier 1 capital forms the remainder of Tier 1 capital base. It can be composed solely from instruments issued by the bank, plus the premium associated with them, that are unsecured, subordinated to all other claims, safe for CET1, to which no non-discretionary dividend payments or coupons are attached and which has no specified maturity, and may be callable by the issuer after five years of issue at the earliest.

Tier 2 capital

Tier 2 capital consists of instruments issued by the bank, plus the associated premium, that meet the following criteria: subordinated to depositors, general creditors of the bank, unsecured minimum original maturity of five years, may be callable at the initiative of the issuer after five years at the earliest and whose dividend and coupon payments are restricted by the regulation and cannot be discretionary as such.

Risk weighting and coverage

Changes to the way risk is measured are central to Basel III reform proposal. The lesson that crisis gave us was that the way risk was measured under Basel II was ill-fitted and did not manage to capture relevant on- and off-balance sheet risks, as well as risks related to derivative exposures, that were at the heart of destabilization caused by the recent crisis.

Basel III enhances the coverage of counterparty credit risk, in particular credit risk related to the holding of derivative instruments, repo operations and securities trading. Revisions concern the way internal risk models are calibrated and back tested and require banks using the IRB approach to calibrate the model using at least three years of historical data that include a period of stress. We can also consider liquidity proposals to be a specific approach to treat liquidity risk, yet another addition to the spectrum of risk covered in the Basel framework, as illustrated in the following picture.

Figure 3: Risk Coverage in Basel Framework

Source: (Teply 2010)

Moreover, banks will be subject to a capital charge for potential mark-to-market induced losses - credit valuation adjustment (CVA) risk associated with deterioration of creditworthiness of counterparty. Basel III also introduces explicit treatment of securitized products and assigns specific haircuts according to residual maturity and issuer rating. Furthermore, it requires banks to have credit rating methodologies to assess credit risk associated with exposures to individual borrowers or counterparties, as well as at the portfolio level, in order to decrease their reliance on ECAIs, which proved detrimental to overall stability.

3.3.3. Addressing procyclicality

Basel II rules proved to be very destabilizing through their procyclical amplification of financial shocks. It led banks to accelerate lending during expansionary part of the business cycle, when accumulation of reserves for worse times would be a preferable action, and severely cut on lending in contraction, where the opposite ought to be done to revive the

economy by funding profitable projects. Moreover, what we could witness at the onset of the crisis were banks distributing large amounts of profits in dividend payments, share buybacks and generous compensations, although their position was deteriorating. Following a wide response from the academia and policymakers, BCBS has decided to address these issues by introducing specific provisions that deal with procyclical nature of capital adequacy requirements. In short, they take form of limiting discretionary profit distributions to some \extent, to the benefit of strengthening the capital base, when bank does not meet specific criteria. These measures have the following objective (BCBS 2010a):

- Dampen any excess cyclicality of the minimum capital requirement
- Promote more forward looking provisions
- Conserve capital to build buffers at individual banks and the banking sector

Capital conservation buffer

A capital conservation buffer of 2.5%, consisting of CET1, is established over the regulatory minimum capital requirement.[22] Banks shall be subject to limitations when capital adequacy falls within this range. Nevertheless, the constraints consider only profit distributions, not the operations of the banks. Of course, the bank is allowed to replete the buffer by raising fresh capital in the market.

Capital conservation buffer has been designed to ensure that banks build up substantial capital buffers during calm periods that will be used up to dampen adverse shocks and absorb losses during periods of stress. It is based on simple rules to avoid breaches of minimum capital requirements. When buffers have been drawn down, the bank's discretionary profit distributions are limited. The scope of distribution limitation is the wider, the larger share of capital conservation buffer has been drawn down. The following table illustrates the point.

[22] CET1 components must first be used to satisfy the minimum capital requirements, before it can contribute to the capital conservation buffer.

Table 3: Capital Conservation Buffer

Individual bank minimum capital conservation standards

Common Equity Tier 1 Ratio	Minimum Capital Conservation Ratios (expressed as a percentage of earnings)
4.5% - 5.125%	100%
>5.125% - 5.75%	80%
>5.75% - 6.375%	60%
>6.375% - 7.0%	40%
> 7.0%	0%

Source: (BCBS 2010a))

For example, a bank that reports CET1 ratio between 5.75% to 6.375% is required to conserve 60% of its annual profit in the subsequent financial year, i.e., to distribute no more than 40% of earnings. Moreover, the mechanism of computation is such that the CET1 ratio includes resources used to meet the minimum CET1 requirement, but excludes any amounts used to meet the 6% Tier 1 or 8% Total Capital ratios. That is, a bank with 8% CET1 ratio but zero Additional Tier 1 or Tier 2 capital would be subject to 100% distribution restrictions, as it would have a zero capital conservation buffer. Items subject to distribution restrictions include dividend payments, share buybacks, discretionary payments on other Tier 1 instruments and discretionary bonus payments to staff. In total, the capital conservation buffer should provide the banks with sufficient reserve to cover unexpected short-term losses before it can better adjust its position and exposures to account for potential further shocks to the capital base if a worse crisis hits.

Countercyclical buffer

Losses incurred in the banking sector can be extremely large when the downturn is preceded by a period of excessive credit growth (BCBS 2010a, p. 57). Such losses can have detrimental effect on the stability of the whole banking sector and spark a recession in the real economy, as banks are forced to cut on lending, which further worsens the situation in real sector, resulting in a vicious circle of lending cuts and increasing delinquency rates. As argued by BCBS, this interaction highlights the need for banks building up additional reserves during periods of good performance for periods of risk of system-wide shocks

The countercyclical buffer has been created bearing in mind the need to align capital requirements with macroeconomic situation in a better way. It will be deployed by national regulators when excess credit growth is judged to pose a threat to overall stability and build-

up of system-wide risk. National authorities shall measure credit growth and other indicators in their jurisdictions that may signal build-up of systemic risk. Should the situation be evaluated as threatening overall stability, the regulator will be empowered to levy additional countercyclical capital buffer requirement on all banks in its jurisdiction. This shall be declared off when the threat dematerializes.

The countercyclical buffer requirement shall vary between 0% and 2.5%, depending on the judgment of the respective authority. The countercyclical buffer requirement shall extend the size of the capital conservation buffer. This means that banks will be obliged to meet the buffer by increasing their CET1 or other fully loss-absorbing capital. Furthermore, banks will be subject to the same distribution restrictions if they do not meet the requirement as in the case of capital conservation buffer. To illustrate this setup, we include the following table:

Table 4: Conservation Ratios for Banks Subject to 2.5% Countercyclical Buffer

Individual bank minimum capital conservation standards, when a bank is subject to a 2.5% countercyclical requirement

Common Equity Tier 1 Ratio (including other fully loss absorbing capital)	Minimum Capital Conservation Ratios (expressed as a percentage of earnings)
4.5% - 5.75%	100%
>5.75% - 7.0%	80%
>7.0% - 8.25%	60%
>8.25% - 9.5%	40%
> 9.5%	0%

Source: BCBS (2010)

Forward looking measures

BCBS has also endorsed stronger provisioning practices through, among others, change in accounting standards towards the expected loss (EL) approach. In this setup, banks shall report expected losses on their loan portfolios to better capture its development and limit the procyclical bias of current *ex-post*, incurred loss approach. This should, in the opinion of BCBS, enhance usefulness, transparency and accurateness of accounting reports to stakeholders.

The design of countercyclical measures is such that they ought to complement each other. Countercyclical buffer shall account for unexpected losses incurred during extraordinary events, whereas EL accounting should cover expected losses on the loan portfolio *before* they materialize.0020

3.3.4. Leverage ratio

The crisis has demonstrated a profound weakness in current banking regulation, namely the absence of leverage in estimation of banks' fitness and strength. As has been argued before, banks could build up excessive on- and off-balance sheet leverage while simultaneously reporting higher-than-required risk-based capital adequacy. Consequently, deleveraging from such high levels entailed enormous downward pressure on asset prices, which further triggered mark-to-market write-downs, exacerbating the positive feedback between losses, worsening capital adequacy, declining prices and decreasing credit availability.

As a result, BCBS has decided to introduce a non-risk based leverage ratio that should capture the amount of leverage present in the banking sector. In BCBS's opinion, the leverage ratio should (BCBS 2010a, p. 61):

- Limit the build-up of leverage in the banking sector, helping avoid destabilizing deleveraging which can damage the whole financial system; and
- Reinforce the risk based capital requirements with a simple, non-risk based "backstop" measure.

Capital measure for the leverage ratio shall be based on the new definition of Tier 1 capital, as described above, including all potential deductions and adjustments made to Tier 1 to ensure consistency in capital measure calculation. Exposures shall be measured net of any specific provisions, CVAs, guarantees, financial or physical collateral or credit risk mitigation instruments purchased. These provisions and instruments are therefore not allowed to reduce on-balance sheet exposure. Furthermore, BCBS has proposed that off-balance sheet items shall be included in the calculation of the leverage ratio applying a 100% credit conversion factor as a reaction to crisis development, when off-balance sheet (OBS) items where a source of significant additional leverage.

3.3.5. Liquidity measures

It has been reiterated many times that recent crisis began as a liquidity crisis, when banks and their OBS spawns were unable to refinance short-term liabilities, and, subsequently, were forced to fire-sell assets to satisfy their liquidity needs. Excessive credit growth and abundant, cheap liquidity that preceded the crisis has caused an enormous maturity mismatch between assets and liabilities used to finance them. Eventually, central banks were forced to function as the lender of last resort and substitute money markets in liquidity provision.

In response to the crisis, the Committee has published the *Principles for Sound Liquidity Risk Management and Supervision* in 2008.[23] These provided detailed guidance on liquidity risk management and supervision. To complement these principles, BCBS has further enhanced the liquidity framework by introducing two minimum standards for funding liquidity. They have been developed to achieve two separate, yet complementary objectives (BCBS 2010b, p. 1):

1. *Promote short-term resilience of bank's liquidity profile by ensuring it has sufficient high-quality liquid assets to survive a significant stress scenario lasting for one month. The Committee has developed the Liquidity Coverage Ratio (LCR) to this end; and*
2. *Promote resilience over a medium-term horizon by creating additional incentives for banks to fund their activities with more stable sources of funding on an ongoing basis. The Net Stable Funding Ratio has a horizon of one year and has been developed to provide a sustainable maturity structure of assets and liabilities.*

Liquidity Coverage Ratio

The objective of LCR is to ensure that banks maintain a sufficient level of high-quality, unencumbered assets that can be converted into cash should a sudden surge in liquidity needs occur. Important fact about the LCR is that it takes into account sponsored conduits/SPVs that shall be consolidated for the purposes of LCR calculation. Banks shall be required to hold sufficient amount of these assets to cover liquidity needs over a 30-day horizon under significant liquidity stress scenario. Banks are expected to meet the standard on a continuous basis. The standard is defined in the following way:

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

The stress scenario proposed by the Committee is a rather severe one, similar to what has been observed during the recent crisis. In particular, it includes a part of depositors withdrawing their deposits, partial loss of secured and unsecured wholesale funding, increases in market volatilities that impact the quality of collateral and other (BCBS 2010b, p. 4). This stress test should be viewed as a *minimum* requirement for banks. Banks are expected to assess their liquidity position on a continuous basis and construct their own stress scenarios.

[23] Available at www.bis.org/publ/bcbs144.htm

In general, if the proposal enters into force in its current extent, this requirement shall cause a great deal of effort on the part of banks in addition to changes in capital adequacy measures.

Let us have a closer look at the proposed measure. The numerator of LCR is the "stock of high-quality liquid assets" that, in the opinion of BCBS, should have, among others, the following characteristics:

- Be liquid in the markets during periods of stress.
- Ideally, be central bank eligible.
- Have low credit and market risk.
- Exhibit low correlation with risky assets; and
- Flight to quality – these assets proved to be a safe haven in turbulent periods in the past.

Considering all of these conditions, only assets that really *are* liquid even during a severe crisis can be converted into cash any time and be included in the numerator of LCR. Furthermore, these assets are divided into two categories. Level 1 assets can represent an unlimited share of liquid assets and consists of cash, central bank reserves, marketable securities representing claims on sovereigns, central banks, BIS, International Monetary Fund (IMF) and others that satisfy certain pool of criteria (BCBS 2010b, p. 8). Level 2 assets can amount to a maximum of 40% of liquid assets. A 15% haircut is applied to current market value of Level 2 assets, which comprise assets similar to Level 1, but of slightly lower credit quality.

The denominator of LCR, total net cash outflows, is defined as the total expected cash outflows less total expected cash inflows in the respective stress scenario for the following 30 calendar days. Expected cash outflows are calculated by multiplying the balances of various categories of liabilities, on- and off-balance sheet, with rates at which they are believed to become due or drawn down. The same applies to cash inflows, with the exception that total expected cash inflows are capped at 75% of total cash outflows. This effectively requires banks to hold 25% of expected outflows in high-quality, liquid assets on a *continuous basis*, disregarding their cash inflow profiles.

$$Total\ net\ cash\ outflows\ over\ next\ 30\ days = outflows - Min\{inflows;\ 75\%\ of\ outflows\}$$

Net Stable Funding Ratio

As far as LCR intends to promote better short-term liquidity of banks, the Net Stable - Funding Ratio (NSFR) aims to enhance medium-term stability of funding by setting a minimum enforcement standard. This metric establishes a minimum plausible stable funding amount based on liquidity profile of a bank's assets and liabilities over a one year horizon and accompanies the LCR in promoting a more resilient approach to liquidity risk management and more stable funding of business activities. In particular, NSFR aims to support funding of long-term assets with at least a minimum amount of stable liabilities and to limit the reliance on short-term funding that can quickly evaporate, as we could witness recently. The standard is defined in the following way:

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

Available stable funding (ASF) is defined as a total of a bank's:

- Capital;
- Preferred stock with maturity of equal to or greater than one year;
- Liabilities with effective maturity of one year or more; and
- Parts of deposits and wholesale funding with maturities less than one year that are expected to stay with the institution even in a period of an idiosyncratic stress event.

The goal of the standard is to ensure stable funding on an ongoing basis over one year, under and extended, firm-specific stress scenario, where a bank and its stakeholders encounter a significant drop in profitability or solvency, potential downgrade of debt or material events that might take under scrutiny the creditworthiness of the institution. Note that central bank lending is not allowed in the calculation of this standard, in order to avoid over-reliance on central bank debt as a source of funding.

The amount of required stable funding (RSF) required by supervisors shall be calculated using supervisory assumptions on liquidity risk profiles of a bank's assets, OBS activities and other selected activities. RSF amount shall be calculated as a weighted sum of values of assets held by the institution that the supervisor believes need to be funded from stable sources. Assets that are more liquid and can be converted into cash more readily in a period of stress receive a lower RSF weights than assets less liquid, for which a larger amount of stable funding shall be required.

The weights assigned to various assets reflect the portion of that asset's value that could *not* be monetized through sale or use as collateral in secured borrowing on an extended basis during a liquidity stress event lasting one year. Under NSFR, this amount is expected to be funded with ASF to ensure that the institution does not face a situation of liquidity drain. Again, we believe that this standard poses a serious challenge for the banks and could cause a number of them to reshuffle their business models, as resources used for NSFR calculation cannot be used for lending. We turn back to these issues in the evaluation part of the thesis.

3.3.6. Transitional arrangements

The Committee is introducing transitional arrangements that warrant gradual implementation of new standards to ensure that banking sector has enough time to adjust its capital position through progressive earnings retention and capital raising, while simultaneously keeping on fulfilling its role of maturity transformation and real sector financing. Capital requirements will be phased in beginning in January 2013 and fully effective of January 2019. Liquidity standards are subject to an observation period commencing in January 2011, with LCR introduced as the minimum standard in January 2015, followed by NSFR in January 2018. Following table summarizes the transitional arrangements.

Table 5: Transitional Arrangements

	2011	2012	2013	2014	2015	2016	2017	2018	As of January 1 2019
Leverage Ratio	Supervisory monitoring		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015					Migration to Pillar I	
Minimum Common Equity Capital Ratio			3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital Conservation Buffer						0.625%	1.25%	1.875%	2.5%
Minimum common equity plus capital conservation buffer			3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
Phase-in of deductions from CET1 (including amounts exceeding the limit for DTA, MSRs and financials)				20%	40%	60%	80%	100%	100%
Minimum Tier 1 Capital			4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum Total Capital			8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum Total Capital plus conservation buffer			8.0%	8.0%	8.0%	8.625%	9.25%	9.875%	10.5%
Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital	Phased out over 10 year horizon beginning 2013								
Liquidity coverage ratio	Observation period begins				Introduce minimum standard				
Net stable funding ratio	Observation period begins							Introduce minimum standard	

Note: shaded areas indicate transition periods. All dates as of 1st January.

Source: (BCBS 2010a, 69)

But there is no fundamental change to the way risk is actually measured and translated into capital charges, changes introduced are of rather cosmetic nature and react to a particular failure brought about by recent crisis.

3.3.7. Impact assessment

Publication of new standards has excited a great deal of discussion, what the impact of new standards on banks, and the whole economy, might be. The Macroeconomic Assessment Group (MAG) at BCBS has issued three reports in this area, the first two being the Interim and Final Report Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements, respectively (MAG 2010b). These documents were aimed at

macroeconomic impact of new regulation. In particular, the authors simulated the impact of increased capital adequacy requirements into gross domestic product (GDP) growth via lending transmission channels. Third paper presented by BCBS is the comprehensive Quantitative Impact Study (QIS) that has been conducted by individual banks, submitted to their respective regulators and consolidated by the Committee. QIS is aimed at banking sector and tries to assess the impact of new regulation on capital adequacy, assuming instant and full implementation of standards. There has also been an important contribution to the discussion about Basel III impact made by the Institute of International Finance (IIF 2010), an influential industry organization associating the world's largest and most powerful banks. Unsurprisingly, documents submitted by BCBS and IIF differ in their estimated impacts to a large extent. We will discuss them in turn now.

MAG's Interim Report

MAG has issued its Interim Report in September 2010. Its aim was to estimate the impact of a 1% increase in target capital ratios on GDP growth. MAG have estimated a median impact of one percentage point increase in the target ratio of tangible common equity to risk-weighted assets to be -0.19% of GDP after four and a half years, equivalent to a reduction in annual growth rate of 4 basis points over this period. These results apply to any increase in target ratios, be it due to regulatory minima, buffers, leverage ratio etc.

The methodology employed was a two-step approach that consisted of estimating the impact of increased capital requirements into lending spreads in the first place, and increased lending spreads into real economy via standard transmission channels. MAG has applied a variety of scenarios over different transitory periods to predict how banks will adjust their lending spreads. The second step took these estimates as inputs into standard macroeconomic forecasting models used by national regulators and central banks to estimate the impact into usual macroeconomic variables. Results obtained are therefore heterogeneous to some extent, in the sense that they were estimated using different models with slightly different assumptions (DSGE models, reduced-form VAR etc).

MAG's Final Report

In December 2010, MAG published the Final Report. Comparing it to the Interim Report, there have been extensions along two dimensions. First, a transition period of eight years is assumed. Second, results here are presented in the form of cumulative impact of increase in bank capital that will be needed to meet the new requirements. In doing so, it draws on the

results obtained in the QIS published earlier that month and compares the amounts of capital present in the banking sector at the end of 2009 to what will be needed under new regulation. There has been no new work on liquidity measures compared to the interim Report.

According to a median estimate across 97 simulations, MAG estimates that increasing global capital adequacy to satisfy new capital minimum and conservation buffer would result in a 0.22% decrease relative to a baseline scenario, occurring after 35 quarters, translated into 3 basis points decrease in annual growth rates against the baseline. Maximum impact is reached significantly later in this case than in the Interim report (four and a half years), with impact on annual growth rates being correspondingly lower.

There are some caveats to these estimates, however, both to the upside and downside. MAG has argued in the Interim Report that the actual impact might well be *smaller* than predicted. For example, banks might raise additional capital in the market in new issues or through retained earnings. There are also possibilities on the cost reduction side. On the other hand, estimated impact might as well be *greater* than estimated because of earlier implementation on the part of banks, for instance. We argue that the impact might be greater due to limited availability of fresh capital in the market and/or profits that could be retained. Despite the probability is rather low, it could well happen that at least some major banks will not be profitable enough in the post-crisis landscape, with mounting sovereign debt issue, and will not be able to attract fresh capital.

Quantitative Impact Study

The Committee carried out the Quantitative Impact Study aimed at Basel III at the end of 2010 to evaluate the impact of strengthened capital requirements on banks. Results were submitted by individual banks to their respective regulators on a confidential and voluntary basis, totalling 263 banks from 23 BCBS jurisdictions. Data submitted were consolidated as of 31st December 2009, with some additional follow-ups to reflect the 26th July and 12th September GHOS agreements.

QIS carried out in December 2010 reflected a number of issues:

- Changes to the definition of capital, deductions and changes to eligibility criteria;
- Increases in risk-weighted assets;
- International leverage ratio;
- Capital conservation buffer; and
- Liquidity standards introduced.

It must be noted that the estimates assume full implementation of the standards and changes listed herein *instantly.* No assumptions have been made regarding banks' profitability or behavioural responses. Banks have been divided into two groups, according to their capita base and geographical scope. Group 1 comprises banks that have Tier 1 capital in excess of €3 billion, are well diversified and internationally active; all other banks are considered to be Group 2 banks.

Assuming full implementation, average decrease for Group 1 banks has been estimated at 5.4%, from 11.1% CET1 ratio to 5.7 percentage points. Group 2 reveals an average decline from 10.7% to 7.8%, 2.9% percentage points, which is notably less than among Group 1 banks. Calculated on the same basis, the absolute capital shortfall of Group 1 banks has been estimated around €165 billion for the 4.5% minimum requirement and €577 billion for the CET1 target level of 7%, had the Basel III requirements been in place at the end of 2009. For the sake of illustration, the sum of profits of Group 1 banks has been €209 billion in 2009. The same figures are considerably lower for the Group 2 banks. We have to be careful in interpretation, nonetheless, as it is likely that institutions with large shortfalls might have been excluded from the analysis due to data issues.

Considering percentage changes to capital and capital ratios, CET1 capital for Group 1 banks would fall by 41.3% for Group 1 and by 24.7% for Group 2 banks. The Tier 1 ratio would on average decrease from 10.5% to 6.3%, while total capital ratio would go down from 14.0% to 8.4% for Group 1 banks. Taking into account the changes to risk weighting of assets, total risk weighted assets would increase by 23% for Group 1 banks, main drivers being the changes to the trading book and counterparty credit risk exposures. Overall, changes in risk-weighted assets have a less pronounced impact than changes to the definition of capital. In general, the impact on Group 2 banks is significantly smaller than on those in Group 1.

Leverage ratio has been estimated to be 2.8% for Group 1 and 3.8% for Group 2, corresponding to a leverage of 35.7 and 26.3, respectively. Last but not least, liquidity standards' impact has also been estimated, with the following results: LCR of 83% and 98% for Group 1 and 2, respectively, and NSFR of 93% and 103%, in the same order.

Note the disproportionate estimated effect on large, internationally active banks and other banks. One could imply that given the disproportionate effect Basel II had on banks of different size, with largest international banks being able to circumvent the rules the best, this is a welcome shift towards a more level playing field in the banking business. Clearly, the most damage has been caused by the interconnectedness and 'too-big-to-fail' nature of these

banks. Strengthening the capital requirements, together with an add-on factor for systematically important institutions has to be judged as a step in the right direction in this perspective.

IIF's response

The Institute for International Finance (IFF), an influential industry organization chaired by Josef Ackermann, the head of Deutsche Bank, released its *Interim Report* (IIF 2010) in June 2010 to present its own estimate of what it dubbed "costs worth paying" for banking reform. In general, this assessment is based on rather extreme assumptions about regulatory impact and puts the IIF's estimates at the ceiling of potential impact of Basel III. IIF themselves acknowledge that *"These assumptions may well turn out to be incorrect and, possibly, too excessive. They do not reflect industry positions on appropriate levels"* (IIF 2010, 5). IIF advocate a *"cautious approach to reform, given the fragility of the current expansion in the mature economies".*[24] In evaluating it, we have to keep the motivation of the authors in mind-IIF serves largely as a lobbying platform of large banks against regulation that potentially lowers their profitability. The assessment is based on the December 2009 reform proposal.

IIF estimate is based on comparing the impact of two scenarios into GDP growth, one called "base", with no significant changes into regulatory framework beyond those already introduced as of June 2010 and using neutral assumptions about inflation path and GDP growth, and the other being the "regulatory reform", where a series of regulatory changes that reflect the key Basel III proposals are put in place and enforced. The cumulative impact is then the difference between these two scenarios.

IIF have estimated that given the assumed implementation timeframe, Basel III would mean an annual decrease of 0.6% in GDP growth over the period 2011-2015, and an average decrease of 0.3% in GDP growth over the full ten year period 2011-2020 in the USA, Euro Area and Japan. IIF argue that the *"long run effects of these measures are probably relatively modest, but that the transition costs could be significant"* (IIF 2010, p. 5). Moreover, they argue that this could reinforced by the fact that during the period of the most intense regulatory change (2011-2014), sovereign states will not be able to ease the banks by loosening monetary policy or expanding fiscal policy, as both are more or less exhausted in current situation and with current outlooks (IIF 2010, p. 7). Interestingly, IIF do not discuss any potential benefits of increased bank resilience, capital strength and increased

[24] Available at http://www.iif.com/regulatory/article+831.php.

creditworthiness of the banking sector, with governments not playing the role of the lender of last resort to the banks, indicative of their inclination towards short-term objectives. As Stephen Cecchetti, chief economist of BIS, put it, *"they have assumed no changes in dividends, compensation policies and operational efficiency, nor have they taken account of the benefits coming from a more resilient financial system, including the lower funding premia that safer banks need to pay"* (Financial Times 2010b).

4. Quantitative assessment

The quantitative part of the thesis is aimed at assessing the possible impact of new rules on bank portfolios with respect to capital adequacy. In this part, we establish a regression model for probabilities of default, proxied by default rates published by the Czech National bank (CNB), and produce out-of-sample predictions, based on several scenarios. Using these predicted probabilities of default, we will estimate capital charges based on aggregate data for four major Czech banks (Česká spořitelna, ČSOB, Komerční banka and UniCredit Bank) and compare it to a static case when Basel II rules would still be in place to see whether Basel III represents a noticeable impact on regulatory capital adequacy of major CZ banks. In our estimation, we focus on credit risk, as it is the most important risk factor for banks in general, as judged from figures on credit risk charges in major Czech banks balance sheets.

We come up with three scenarios for economic development in the rest of 2011 to see how severe a shock would be needed to bring major Czech banks on the capital adequacy minimum threshold. Based on our findings, only a very severe and sudden return of recession would force major Czech banks to raise new equity or retain earnings in order to meet the requirements. Once again, we point to the fact that we assume instant and full implementation of Basel III rules, including the capital conservation buffer that is otherwise to be phased in over several years. To complete the picture, we have to note that we would need more data on household default rates, as the series is rather short and can therefore limit the predictive power of the model, despite the good fit obtained.

4.1. Motivation and methodology

In our research, we would like to answer the question whether Basel III rules will have any impact on major Czech banks, in terms of increased capital charges forced by new regulation. That is, will Basel III force major Czech banks to raise new equity or retain more earnings to meet regulatory minima? Or are Czech banks sufficiently capitalized that new requirements will not be of any impact? In particular, we would like to identify key factors that influence credit risk and see how vulnerable major Czech banks are to credit risk increase, which will answer our initial question of Basel III impact. We believe that this question is of utmost importance to the regulator and the banking sector in general, since Basel rules have far-reaching consequences for both the banking sector and the economy as a whole, as we could witness recently.

In our analysis, we assume full and instant implementation of Basel III capital requirements. This is a standard assumption that has been used in QIS and MAG Report discussed above, as well as in numerous industry estimates. This means that minimum capital requirement is raised from 8% to 10.5%, assuming full implementation of the capital conservation buffer of 2.5 percentage points. Further, we take last available data on bank capital and capital adequacy from their 2010 annual reports.

In model estimation, we partially follow methodology of Petr Jakubík and Christian Schmieder (Jakubík and Schmieder 2008) who analyze and compare credit risk determinants for Czech and German economies and stress-test banking sector for adverse credit risk development. They estimate separate models for corporate sector and households using maximum likelihood estimation (MLE) to arrive at a model for default rates of an aggregate loan portfolio. In contrast with them, however, we will estimate the model using logistic transformation and apply ordinary least squares (OLS) to transformed data. We apply logistic model, since the data is assumed to be generated by a continuous process with domain in real numbers and range spanning the closed interval$\langle 0; 1 \rangle$. This relatively simple non-linear model can better capture the complexities of economic reality, which are most likely non-linear in the real world. In this setup, default rates are assumed to be in the form:

$$df_t = \frac{e^y}{1 + e^y}$$

Where df_t denotes the 12-month default rate published by the CNB and y denotes the dependent variable in the regression model of the following form:

$$ln\left(\frac{df_t}{1 - df_t}\right) = y_t = \beta_0 + \sum_i \beta_i x_i + \varepsilon_t$$

where β_0 denotes constant, x_i is i-th explanatory variables, β_i is i-th regression coefficient and ε_t is an error term. We intentionally omit time subscripts for regressors, as relevant time lags need to be determined. To achieve this, our *modus operandi* will be backward stepwise regression that starts with a saturated model and stepwise eliminates regressors that turn out to be insignificant for the model. To ensure it is robust and unbiased, we must test the obtained residuals for autocorrelation and normality, as well as test the choice of regressors for multicollinearity, which is done in the Appendix.

Unfortunately, we cannot interpret obtained coefficients as elasticities of impacts of changes in certain explanatory variables due to logistic transformation. This is because of the fact that changes to variables at different absolute levels will have different, non-linear impact on the outcome due to the non-linear character of logistic transformation. Nevertheless, we can still evaluate absolute impact on default probabilities for certain changes in explanatory values. In addition, the sign of regression coefficients corresponds to the sign of the impact on response variable, as natural logarithm is monotonically increasing function, although its magnitude differs along the regression curve.

We estimate a very similar model to that in Jakubík and Schmieder for the period 2007-2010 to identify key variables that influence default rates. We use these as proxies for probabilities of default used by banks. We assume that although default rates may overestimate actually observed PDs, this bias is of the same magnitude as the bias in banks' predicted PDs relative to observed PDs. As we argue in the institutional part of the analysis below, there is a fundamental limitation to our ability to infer true properties from observations of random variables. In this light, we are convinced that it is not of decisive importance whether we have true data from banks or a proxy default rate since the degree of error is of the same magnitude due to factors mentioned in Chapter 6. Therefore, using default rates as a proxy for PDs allows us to produce predictions that are potentially of the same order of bias or inaccurateness as those using actual PDs.

Next step is scenario analysis, in which we predict explanatory variables for three distinct cases: *baseline, debt crisis* and *double-dip recession*. An in-depth overview of these scenarios is given below. We use these predictions as inputs into the estimated model to obtain out-of-sample predictions of default rates that, in turn, serve as inputs into capital charges calculation based on the Basel II/III formulas. Having obtained these, we compare the figures to last observed capital adequacy levels and infer conclusions for the impact of Basel III on four major Czech banks.

4.2. Data

Initially, our aim was to collect real PDs from at least one major Czech bank. Unfortunately, no bank expressed willingness to cooperate, even under strict anonymity and non-disclosure promises. Therefore, we had to resort to publicly available data sources. Ultimately, we have collected default rates published by the CNB in its annual Financial Stability Report (CNB 2010). These historical figures stem from the Loan Register maintained by the CNB and capture real aggregate loan portfolio development. Unfortunately,

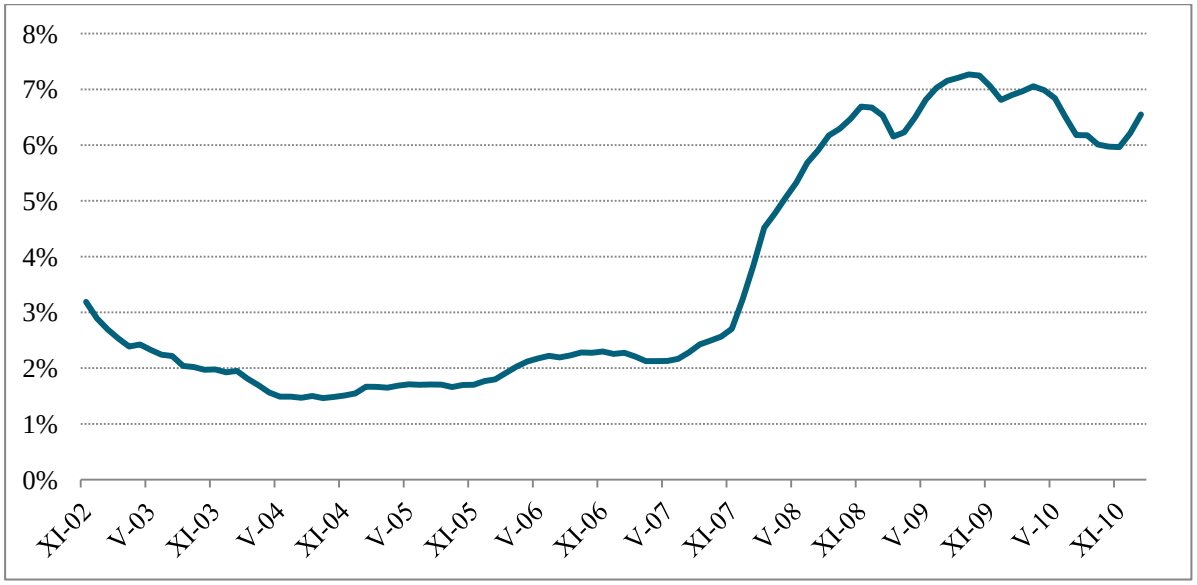
this register is not publicly available, so we could not use the data contained therein in our model to predict default rates.

Corporate default rates are for the period 11/2002 to 3/2011, household default rates series is much shorter, spanning 8/2007 to 3/2011, with default rates from 4/2010 to 3/2011 being preliminary default rates subject to revision in the upcoming Financial Stability Report. According to CNB (CNB 2010, p. 80), these default rates actually overestimate the probabilities of default reported and used by banks, due to a wider definition of default in calculating default rates and different ways to calculate PDs employed by banks. Data on aggregate bank loan portfolios and their composition, together with additional macroeconomic data, were downloaded from the ARAD database of the CNB. Data for individual banks come from respective annual reports, all for the calendar year 2010.

First, let us have a look at our dependent variable. The 12-month default rates reported by CNB are divided into corporate and household default rates that further split into consumption and mortgage default rates. Following graphs illustrate the dataset and its evolution over observation period.

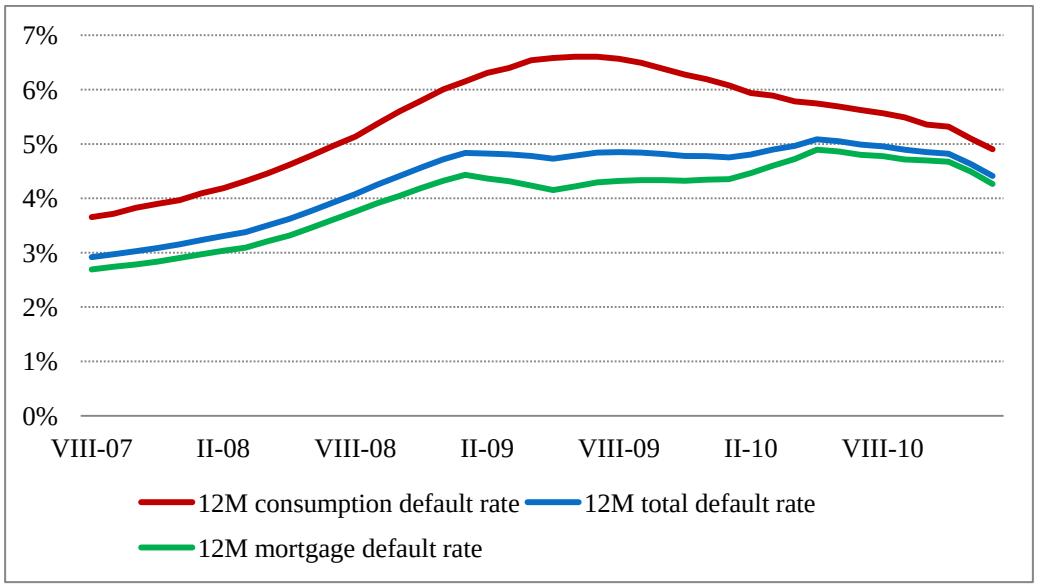
Household default rates have remained persistently lower than corporate loans during the crisis and were much less volatile. We attribute this to relatively low share of consumption loans in aggregate loan portfolio. Consumption loans are very sensitive to economic cycle and quickly respond to adverse economic shocks. On the other hand, the relative stability of mortgage default rates is very interesting. After initial surge in default rate, this has stabilized around 4.5% and remained there for two and a half years. This relative stability of mortgage loan portfolio could be attributed to banks' prudential lending policy prior to the crisis, when mortgages were granted predominantly to prime clients, with a low share of sub-prime mortgages.

Figure 4: Corporate Default Rates



Source: CNB

Figure 5: Household Default Rates



Source: CNB

Explanatory variables were downloaded from the ARAD database of CNB. All data are quarterly, with percentage figures for indices always relating to the same period previous year. We have included real GDP growth, producer price index (PPI) for corporates, consumer price index (CPI) for households, CZK/EUR exchange rate and 1-year Prague Interbank Offer Rate (PRIBOR). Further, we have calculated the loan-to-GDP value in nominal terms and 1-year real exchange rate, based on the simplified Fisher equation. This

ratio used corporate and household loans in numerator in each specific case, respectively. In addition to that, unemployment rate and index of consumer spending in real terms, with 2000 value=100%, have been included among regressors in the household default rate model. Following tables summarize explanatory variables for corporate and households:

Table 6: Descriptive Statistics of Macroeconomic Variables for Corporate Sector

Variable	Notation	Mean	Std. deviation	Min	Max
Producer Price Index (%)	*PPI*	2.03	3.22	-5.4	7.8
PRIBOR (%)	*PRIBOR_1Y*	2.72	0.78	1.75	4.4
Real Effective Exchange Rate	*REER*	103.4	7.22	90.93	117.13
Exchange Rate	*CZK_EUR*	28.31	2.64	24.31	32.98
Loans to GDP (%)	*loans_GDP*	15.9	2.01	13.17	19.14
GDP Growth (%)	*GDP*	3.45	3.42	-5.1	7.6
Real 1-Year Interest Rate (%)	*Real_IR_1Y*	0.37	1.33	-2.86	2.76

Source: ARAD, author's calculations

Table 7: Descriptive Statistics of Macroeconomic Variables for Households

Variable	Notation	Mean	Std. deviation	Min	Max
Consumer Price Index (%)	*CPI*	3.06	2.42	0	7.1
PRIBOR (%)	*PRIBOR_1Y*	3.005	1.05	1.78	4.4
Exchange Rate	*CZK_EUR*	25.74	0.97	24.31	27.57
Unemployment (%)	*unemp*	7.42	1.67	5	9.7
Loans to GDP (%)	*loans_GDP*	23.9	3.01	18.67	27.98
GDP Growth (%)	*GDP*	0.99	3.75	-5.1	5.7
Consumer Spending Index (%)	*cons_spend_i*	132.77	1.34	129.7	134.3
Real 1-year Interest Rate (%)	*Real_IR_1Y*	0.06	1.65	-2.42	2.86

Source: ARAD, author's calculations

4.3. Credit risk model for corporate sector

First, we shall estimate a model for corporate default rates. The series is much longer compared to household default rates series, so the resulting model should have a stronger predictive power, *ceteris paribus*.

Having performed the stepwise backward regression, we have arrived at the following specification of the model, with subscripts indicating number of quarterly lags of respective variables:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 * PPI_t + \hat{\beta}_2 * CZK\_EUR_{t-1} + \hat{\beta}_3 * loans\_GDP_{t-4} + \hat{\beta}_4 * Real\_IR\_1Y_t$$

The table below summarizes estimated parameters, their significance levels and standard errors:

Table 8: Corporate Credit Risk Model

Variable	Notation	Lag	Coefficient	Std. error	p-value	Significance
Constant	*const*		-5.64395	0.760262	<0.00001	***
Producer price index $(\widehat{\beta_1})$	*PPI*		-2.10932	0.886071	0.02558	**
Nominal exchange rate $(\widehat{\beta_2})$	*CZK_EUR_1*	-1	-0.05136	0.016624	0.00501	***
Ratio of corporate loans to GDP $(\widehat{\beta_3})$	*loans_GDP_4*	-4	23.7945	2.08848	<0.00001	***
Real interest rate $(\widehat{\beta_4})$	*Real_IR_1Y*		-8.13634	2.37913	0.00225	***

Note: ***: Significant at 1% level; **: Significant at 5% level

Source: Author's calculations

Growing producer prices lower default rates in our model. This is rather counterintuitive, as we would expect growing prices of inputs to cut margins and make it more difficult for an increasing number of producers to meet their debt obligations. One possibility for an explanation would be that firms are successful at passing through increased costs onto customers. Or it could be the case that firms can actually sell at higher prices, increasing their revenues. Anyhow, further research would be necessary to shed more light on this issue.

As we can see, CZK/EUR exchange rate lagged by one quarter has been found significant in our model. It is negatively correlated with default rates, in line with our expectations. Czech economy is export-oriented and decisive majority of export goes into the Eurozone. Increasing nominal exchange rate means exporting firms receive more in terms of domestic currency, enhancing their debt service ability. Further, growing indebtedness increases default rate, all else equal. This is not surprising, given the effect of adverse selection when credit becomes easily available during expansion. When economic environment worsens, those borrowers that were just able to meet their debt obligations are forced into default, as they do not have sufficient buffer to withstand a period of increased stress on their cash flow position. We have this effect to be significant with four quarters lag, indicating that this effect takes time to manifest itself and that firms usually have some short-term reserve for debt service, in line with prevailing banking practice. And although we cannot interpret the coefficients as elasticities, we can see how large the coefficient for indebtedness is – we can expect that

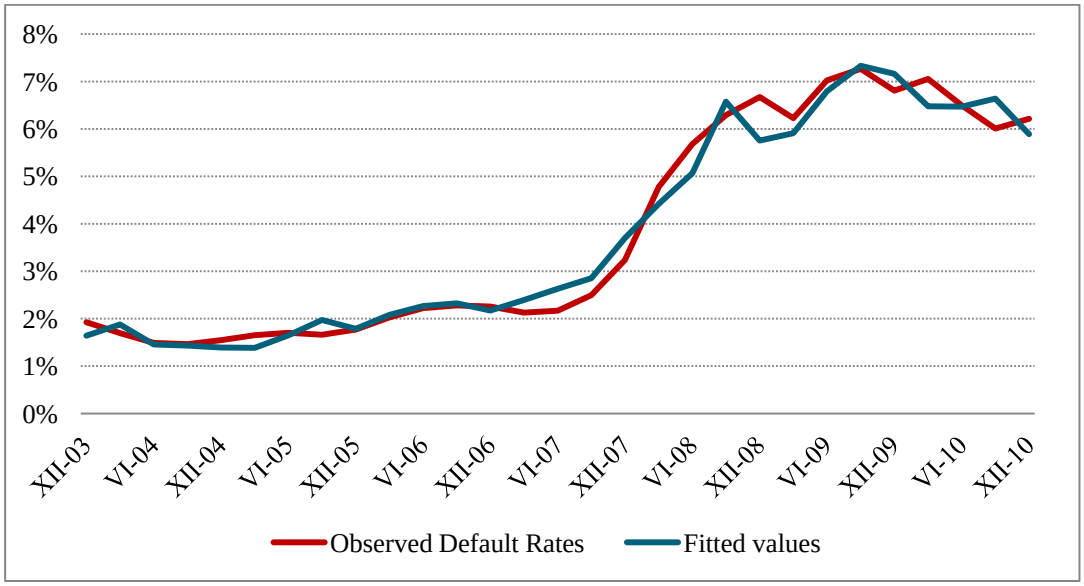
indebtedness level is the decisive variable influencing default rate development, at least in the medium-term.

The influence of real interest rate is interesting. In our model, real interest rate growth forces more firms into default. Real interest rate is a product of two variables, price inflation and nominal interest rates, linked by the Fisher equation in theory. In our model, default rates should grow with decreasing real interest rate. This happens when either inflation grows or nominal interest rates decline. This result is counterintuitive in the sense that growing real interest rate should force more debtors into default, when either nominal rate grows, causing higher debt service, or declining inflation cuts cash inflows.

A possible approach to identify individual effects would be to run a vector autoregression (VAR) and vector error correction model (VECM) on the time series. Unfortunately, there is no scope to try to disentangle these two effects in this thesis. It is, however, of no substantial significance for us, which effect prevails at the moment. Deeper research is needed, however, to see whether this effect is a real trait of Czech economy or is it due to a misspecified model.

Other variables were found to be insignificant in general. Despite certain variables showed some degree of significance individually, their contribution to the model's predictive power was marginal. Following Occam's razor, we decided not to include them in our model specification. Furthermore, when we included more variables, there arose the problem of multicollinearity. Specific tests of model assumptions can be found in the Appendix. Comparison of observed vs. fitted values follows to illustrate the fit obtained in the model:

Figure 6: Observed vs. Fitted Values, Corporate Sector



Source: Author's calculations

4.4. Credit risk model for households

In this part, we will estimate a model for the household sector. Unfortunately, household default rate series is quite short, spanning only 14 full quarters between 9/2007 and 12/2010. Therefore, we expect to obtain a fit that will be less robust than the one obtained for corporate default rates, simply due to lower number of observations. In addition to that, the predictive power of the model might be hindered by this fact, although not necessarily.

Some specific factors have to be taken into account when constructing a model for household default rates. We have to look not only at general macroeconomic conditions but also take into account specific microeconomic influences. In particular, household income is crucial for household default rates. The amount of disposable income determines the ability of households to meet their obligations. We approximated disposable income with consumer spending figures published by the Czech Statistical Office (CSU). Further, we included unemployment rates as a common sense factor influencing payment morale of debtors.

The household default rate estimated model is of the following form:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 * loans\_GDP_t + \hat{\beta}_2 * GDP\_growth_t + \hat{\beta}_3 * cons\_spend\_i_t$$

Table 9: Household Credit Risk Model

Variable	Notation	Lag	Coefficient	Std. deviation	p-value	Significance
Constant	*const*		-10.1528	1.50159	0.00005	***
Ratio of household loans to GDP $(\widehat{\beta_1})$	*loans_GDP*		3.59351	0.517422	0.00004	***
GDP growth $(\widehat{\beta_2})$	*GDP_growth*		-1.51806	0.376222	0.00238	***
Index of consumer spending $(\widehat{\beta_3})$	*cons_spend_i*		4.67282	1.1734	0.00259	***

Note: ***: Significant at 1% level

Source: Author's calculations

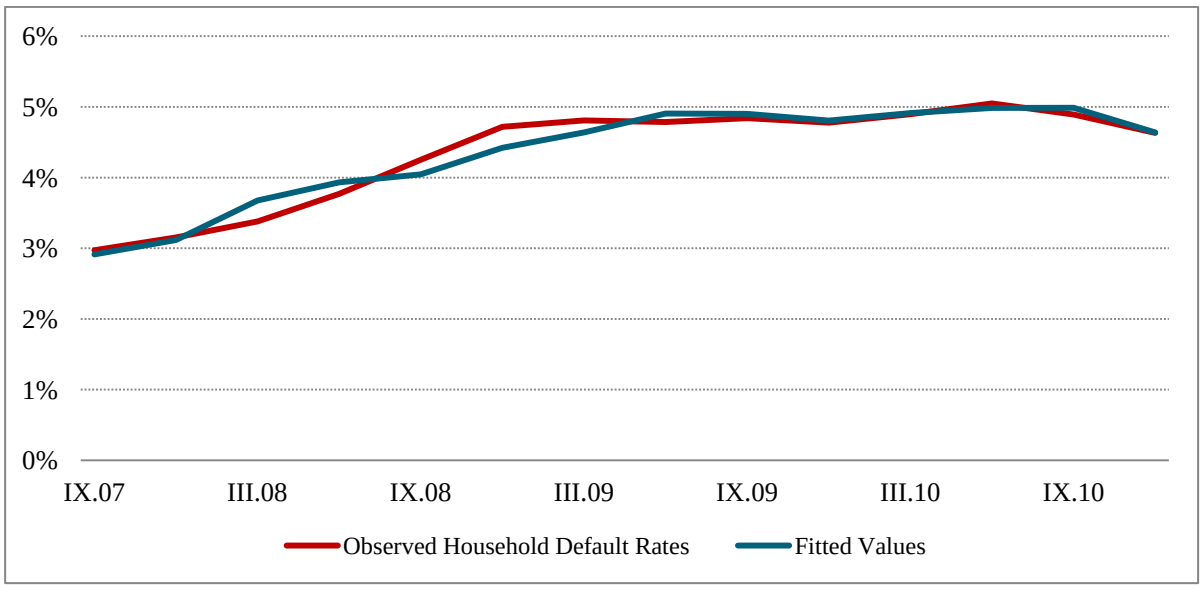
As we can see, the ratio of household loans to GDP is a significant factor influencing household default rates. As for the corporate sector, growing household indebtedness increases the number of households in default. This is result is not surprising and perfectly in line with economic common sense.

In line with that, GDP growth is negatively correlated with default rates. Again, its explanation is straightforward, as increasing household income renders debt service easier to meet.

Last significant factor in our model is consumer spending, with a somewhat surprising positive coefficient. At the first glance, we would expect that if households increase their spending, their do so only after meeting their debt obligations, i.e. they increase their after-debt service spending. Apparently, as it might be the case, households increase their pre-debt service spending with increasing income. This might in fact result in *diminishing* ability to repay debt, a rather surprising and counterintuitive effect. On the other hand, this is precisely what happened in the United States prior to the crisis. Deeper research in this problematic is needed to ascertain whether this effect is true, but judged from the very good fit we obtained in our model, there could be some correlation.

When evaluating the model, however, we must be careful about its robustness. As said above, further research is necessary. We have not checked further than two quarterly lags back for significance in this case. This is caused by the fact that we had a very limited number of observations at hand and each additional lag decreased the amount of information that could be used to estimate the model. Therefore, the obtained fit could be worse than what it could have been, had we had a larger number of observations at hand. Model output is summarized in the Appendix, model fit is illustrated below:

Figure 7: Observed vs. Fitted Values, Household Sector



Source: Author's calculations

4.5. Stress testing

Credit risk stress testing is an important regulatory tool that helps regulators to assess the banking sector stability and resilience to negative shocks. It is also an obligatory metric used in Basel II and further widened and enhanced in Basel III, where it now includes not only credit and market risk, but also liquidity risk stress tests of the two proposed liquidity measures. Stress tests are obligatory under both Pillars I and II, whereby banks must choose *"meaningful*" and *"reasonably conservative"* scenarios that represent *"mild recession"*, but not necessarily a *"worst case scenario."* Anyhow, *"the bank's stress test in this context should consider at least the effect of mild recession scenarios."* (BCBS 2006, para 435). In this part of the thesis we will employ the above estimated models to various stress scenarios and predict the development of default rates in these scenarios. These, in turn, serve as an input into capital adequacy calculation of major Czech banks.

4.5.1. Stress scenarios

A key challenge for any stress testing scenario is the appropriate choice of scenarios. *Ideally, a stress testing exercise begins with an assumed adverse macroeconomic event that is endogenously translated into a credit risk scenario in terms of different risk factors* (Jakubik and Schmieder, p. 22). We can, however, doubt that commercial banks have sufficient personal resources to carry out such complicated and comprehensive regulatory exercises on a continuous basis. Instead, we would expect banks to use a mixture of historical simulations, sensitivity analysis and ad-hoc scenarios based on current situation and outlooks.

Here, we will describe three scenarios that we deem plausible for the rest of 2011, given our current state of knowledge. These are the *baseline* scenario that assumes current forecasts of key macroeconomic variables as published by the CNB, the *debt crisis* scenario, in which countries from the periphery of the EU face debt restructuring or other form of default on their obligations, and finally, a *double-dip recession* scenario, in which persisting high oil and commodity prices, together with mounting sovereign debt problems curb the rather fragile global economic recovery and precipitate global economy into recession again. Henceforth, all figures are understood as forecasts for the end of 2011.

Baseline

In our baseline scenario, we expect the economy to develop in line with current forecasts of the CNB. That is, GDP is assumed to grow by 1.5% in 2011, inflation measured as annual changes to CPI is expected to reach 2.2%, 1Y PRIBOR amounts to 2%, exchange rate of 23.4

CZK/EUR is assumed and unemployment is expected to reach 8%. Finally, consumer spending is assumed to grow by 0.6% (CNB 2011).

Moreover, we have to estimate two additional variables, namely the ratio of loans to GDP for the household sector and PPI evolution for the corporate sector, that serve as inputs to our prediction of default rates. This is done by running a regression on the respective time series. Model specifications and model output summary can be found in the Appendix. Following table summarizes the baseline scenario forecast:

Table 10: Baseline Scenario

	Households	Corporates
Loans to GDP	31.45%	17.33%
GDP growth	1.50%	-
Consumer spending index	132.16%	-
PPI	-	1.26%
CZK/EUR	-	24.10
Real 1-year i.r.	-	-0.70%
Default rate	**5.187%**	**6.138%**

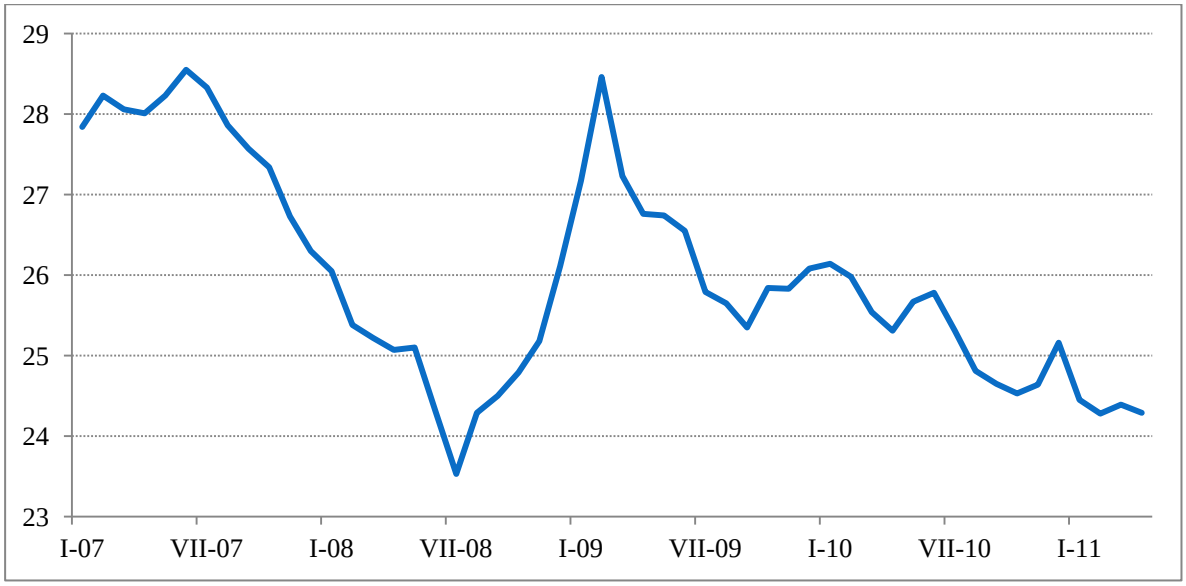
Source: Author's calculations

Debt crisis

In this scenario, we assume some sort of debt restructuring in European Union (EU) members that currently have the most serious problems meeting their debt obligations (Greece, Ireland, and Portugal). We expect this to have a marginal direct effect on Czech economy and banking sector as such, give the very limited exposure of Czech banks to sovereign debt of the aforementioned countries. In the last Financial Stability Report, CNB estimated this exposure to be around CZK 46.3 billion, or 1% of bank assets (CNB 2010).

Nevertheless, we expect this to have some effect on exchange rate and interbank market. In particular, we expect a sharp short-term depreciation of Czech Koruna, due to the inability of the foreign exchange market to distinguish among emerging markets countries that are structurally sound. This has been demonstrated during the crisis, as can be illustrated by the volatility of the CZK-EUR pair over last three years. Our forecast for this scenario is that the exchange rate climbs to 26 CZK/EUR at the end of 2011.

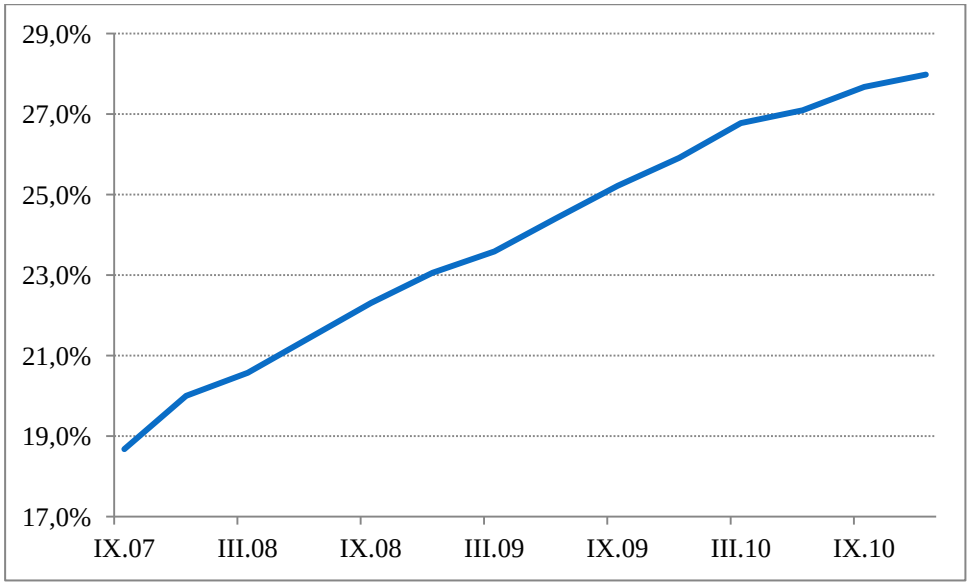
Figure 8: CZK/EUR Exchange Rate Development



Source: ARAD

In addition to that, an increase in interbank interest rates is assumed, which is a short-term reaction to decreased confidence among banks. We assume the 1Y PRIBOR to increase by 50% to levels around 2%. Real interest rate is then calculated using the CNB forecast and Fisher equation and amounts to 0% p.a. PPI is expected to decline by 3% compared to baseline scenario. We justify this by the fact that wholesale prices of industrial inputs such as energy react rather fast to economic news. Debt restructuring on the periphery of the EU could trigger sharp declines in electricity and oil prices caused by negative outlooks for EU economy, following some sovereign default. Loan-to-GDP ratio is lagged by four quarters in our model for corporate default rates; hence we take the figure for Q4 2010 as input into corporate default rate calculation. Household loan-to-GDP is estimated according to the model specified in the Appendix but we assume that growth is not linear, but rather concave, as can be seen from the household sector indebtedness evolution below.

Figure 9: Household Indebtedness Growth



Source: ARAD, author's calculations

We therefore assume that indebtedness grows with diminishing speed and reaches 30.5% of GDP at the end of 2011. Consumer spending is expected to decrease by 0.5% as a result of increased interest rates and hence lower accessibility of credit. Taken together, this scenario assumes the following:

Table 11: Debt Crisis Scenario

	Households	Corporates
Loans to GDP	30.45%	17.33%
GDP growth	1.50%	-
Consumer spending index	131.50%	-
PPI	-	-1.74%
CZK/EUR	-	26.00
Real 1-year i.r.	-	0.00%
Default rate	**5.037%**	**5.633%**

Source: Author's calculations

We can see that default rates in the debt crisis scenario are actually lower than in the baseline case, especially in the corporate sector. Although counterintuitive at the first glance, there is some economic logic behind this effect. In the household sector, cuts to consumer spending are the decisive factor for default rate decrease. Czech households have always been rather conservative in consumption and if the effect described above truly holds, then decreased consumption levels can really cause households to have more money to cover debt

service and therefore decrease the default rate. As noted before, this is a very interesting finding and more research is needed to be able to decide on this with a greater degree of certainty.

In corporate sector, default rate declines mainly due to exchange rate effect. Depreciation in an open, export-oriented economy always helps the exporters and Czech economy is a prime example thereof. On the other hand, we are rather sceptic about real default rate decline this would cause, as export price contracts are usually hedged for some period of time, so a sudden depreciation (or appreciation, for that matter) would not manifest itself as fast in real economy as it is assumed here[25].

Double-dip recession

In our final scenario, we assume the economy to revert to recession, caused by external factors such as decreasing German output and rising commodity prices. In general, we assume that Czech economy descends into 2% recession at the end of 2011. Although not very plausible from the current point of view, this scenario serves as a benchmark against which we test banks' resilience to adverse economic development. Despite this scenario is not likely for 2011, we are from discarding it for 2012 or 2013, as ongoing recovery is rather fragile and can be quickly curtailed by mounting sovereign debt issues and ensuing rise in distrust in financial markets that can quickly manifest itself in real economy.

In addition to that, we correlate LGD with economic development. In this particular case, we follow the methodology of CNB (CNB 2010, p. 78) where each percentage point of GDP decline against the baseline scenario translates into five percentage points LGD increase for corporate loans. We assume this to hold for household loans as well and estimate capital requirements using this higher LGD that amounts to 62.5% in the Double-dip recession scenario.

In this scenario, we further assume consumer spending to remain at end-2010 values. Loan-to-GDP ratio for household sector is assumed to be the same as in the baseline scenario, as household credit is not as sensitive to economic development as corporate credit. The same applies to corporate credit due to the fact that banks are not expected to be able to reclaim financing as early as end of 2011. Nevertheless, Koruna is expected to depreciate towards 25 CZK/EUR as a result of recession return. PPI is forecasted using the regression model described in Appendix and amounts to -0,9% for 2011. As a consequence of recession return,

[25] Although we estimated the exchange rate to be significant with a one quarter lag, we are convinced the momentum of change is longer. Again, this is an avenue for further research.

central bank is expected to lower its policy rates to 1% that translates into -1% real interest rate for 2011. Table below summarizes the Double-dip recession scenario:

Table 12: Double-Dip Recession Scenario

	Households	Corporates
Loans to GDP	30.45%	17.33%
GDP growth	-2.00%	-
Consumer spending index	131.37%	-
PPI	-	-0.86%
CZK/EUR	-	25
Real 1-year i.r.	-	-1.00%
LGD	62.50%	62.50%
Default rate	**5.268%**	**6.271%**

Source: Author's calculations

4.5.2. Impact on major Czech banks

Final stage of our quantitative analysis is the projection of stressed default rates onto real bank portfolios. We will assess the impact of increased default rates in terms of increase in regulatory capital requirements for credit risk, measured as Value-at-Risk for a one-year horizon on a confidence level of 99.9% and compare it to a static case when capital adequacy remained unchanged over the test period. In particular, we will seek to establish an answer to our research question whether Basel III rules will become binding for Czech banks in case of a negative shock defined herein.

Bank loan portfolios

We collected data on loan portfolio composition from banks' annual statements for 2010. One minor problem arose here, namely the fact that banks do not report in the same fashion, resulting in somewhat inconsistent data. Nevertheless, we reconciled the data in a way that gives a relatively consistent picture of banks' portfolios. Following tables present loan and capital adequacy figures as of the end 2010:

Table 13: Bank Loan Portfolios, 2010

CZK mil.	**ČS**	**ČSOB**	**KB**	**UniCredit**
Total loans	**459 975**	**402 505**	**399 901**	**178 300**
Mortgage loans	176 108	144 880	108 773	-
Corporate loans	119 409	139 437	216 600	121 254
Household loans	97 917	90 151	74 528	24 027

Source: Banks' annual statements

Table 14: Capital Adequacy, 2010

CZK mil.	**CS**	**CSOB**	**KB**	**UniCredit**
RWA	**450 410**	**319 124**	**343 189**	**187 385**
Tier 1 capital	57 071	45 583	49 363	28 849
Tier 2 capital	11 338	12 564	6 000	0
Adjustments	-4 721	-626	-2 958	-44
Capital	63 688	57 521	52 405	28 805
Credit risk charge	*30 136*	*21 564*	23 252	*14 991*
Market risk charge	*542*	*613*	719	*327*
Operational risk charge	*5 356*	*3 354*	3 487	*1 007*
Total capital charge	36 035	25 531	27 458	16 325
CAR	**14.1%**	**18.0%**	**15.3%**	**14.1%**
Tier 1 ratio	**12.7%**	**14.3%**	**14.0%**	**14.1%**

Source: Banks' annual statements

We can see the strong position of major Czech banks in terms of capital adequacy ratio (CAR). All four safely maintain capital adequacy with Tier 1 capital. Interesting is the fact that major Czech banks do not rely very much on Tier 2 capital, reflecting the large amounts of retained earnings accumulated over past decade of profitability.

Regulatory capital calculation

First, a few assumptions regarding loan portfolios must be made. In order to be able to employ the Basel II/III IRB formulas for credit risk charges, we must assume that the portfolios are homogenous in terms of PDs and LGDs within the household and corporate sectors. Moreover, we must assume that loan portfolios are well-diversified geographically and, in the case of corporate lending, across sectors to be able to use Basel methodology. One possible effect of these assumptions is that the obtained results might underestimate true capital charges when loan portfolios are not as perfectly diversified and homogenous as required and therefore lie on the lower bound of actual capital requirements. Clearly, for a more concentrated and heterogeneous portfolio the impact of a negative shock would correspond to the effect of the shock on individual niches that constitute the portfolio.

Having calculated default rates that serve as proxies for PDs, we must now determine other parameters of the Basel formula. First, we have to ascertain LGD for our portfolios. LGD figures can either be modelled separately, as is the case under IRB-A approach, or we can accept the figures proposed by the regulator. In this case, we will satisfy ourselves with accepting the 45% LGD suggested by the CNB in (CNB 2008) (the "Decree"), as it is outside the scope of this thesis to devise a separate model for LGD[26]. Maturity (M) is set at 2.5 years for corporate loans, in line with CNB as well. Exposure at default (EAD) is assumed to be equal to the book value of loan portfolio. Below we list the formulae used for credit risk charge calculation, taken from the Decree.

Correlation parameter ρ^i is estimated according to the following:

For corporate exposures, correlation parameter for small and medium-sized enterprises (SMEs):

$$\rho^C = 0.12 * \frac{1 - e^{-50PD}}{1 - e^{-50}} + 0.24 * \left(1 - \frac{1 - e^{-50PD}}{1 - e^{-50}}\right)$$

Households are assumed to obey the formula for retail exposures defined as follows:

$$\rho^H = 0.03 * \frac{1 - e^{-35PD}}{1 - e^{-35}} + 0.16 * \left(1 - \frac{1 - e^{-35PD}}{1 - e^{-35}}\right)$$

For mortgage exposures, correlation factor is equal to 0.15.

Furthermore, there is maturity adjustment applicable to corporate loans:

$$b = (0.11852 - 0.05478 * \ln(PD^c))^2$$

Together, these inputs enter the following risk weight formulae:

Households and mortgages

$$\mathrm{r^H} = \left(LGD^H * \Phi\left(\frac{\Phi^{-1}(PD)}{\sqrt{1-\rho^H}} + \Phi^{-1}(0.999) * \sqrt{\frac{\rho^H}{1-\rho^H}}\right) - PD^H * LGD^H\right) * 12.5 * 1.06$$

[26] With the exception of the Double-Dip Recession scenario, where LGD is correlated with GDP decline.

Firms

$$r^c = \left(LGD^c * \Phi\left(\frac{\Phi^{-1}(PD)}{\sqrt{1-\rho^c}} + \Phi^{-1}(0.999) * \sqrt{\frac{\rho^c}{1-\rho^c}} \right) - PD^c * LGD^c \right) * \frac{1}{1-1.5*\mathrm{b}} * (1 + (\mathrm{M} - 2.5) * \mathrm{b}) * 12.5 * 1.06$$

Risk weights are then used to calculate risk weighted exposure (RWE):

$$RWE^j = E^j * r^j$$

Finally, capital charge for credit risk is calculated by multiplying the risk-weighted exposure with Basel III capital requirement of 10.5%:

$$Capital\ charge\ for\ credit\ risk = 0.105 * \sum RWE^j$$

Predicted capital adequacy summed across the banks and according to stress scenarios give the following results:

Table 15: Capital Adequacy Prediction

CZK mil.	**Actual**	**Baseline**	**Debt crisis**	**Double-dip**
CAR	15.6%	13.3%	13.6%	9.5%
Tier 1	13.9%	11.9%	12.1%	8.5%
Capital Shortfall	0	4 194	3 006	36 508
RWA	1 300 108	1 524 004	1 491 964	2 128 775
Corporate default rate	6.21%	6.14%	5.63%	6.27%
Household default rate	4.63%	5.19%	5.04%	5.27%

Source: Author's calculations

In addition to that, we present estimates of capital charges and their comparison to both 2010 actual figures and existing Basel II rules.

Table 16: Capital Charges Prediction

CZK mil.	**Actual**	**Baseline**		**Debt crisis**		**Double-dip**	
		Basel II	Basel III	Basel II	Basel III	Basel II	Basel III
Total capital charge	105 349	137 326	175 426	139 811	172 123	192 750	238 927
Credit risk charge	89 943	121 920	160 020	124 405	156 717	177 345	223 521
Change against 2010	0%	30%	67%	33%	63%	83%	127%
Change against Basel II	0%	0%	28%	0%	23%	0%	24%

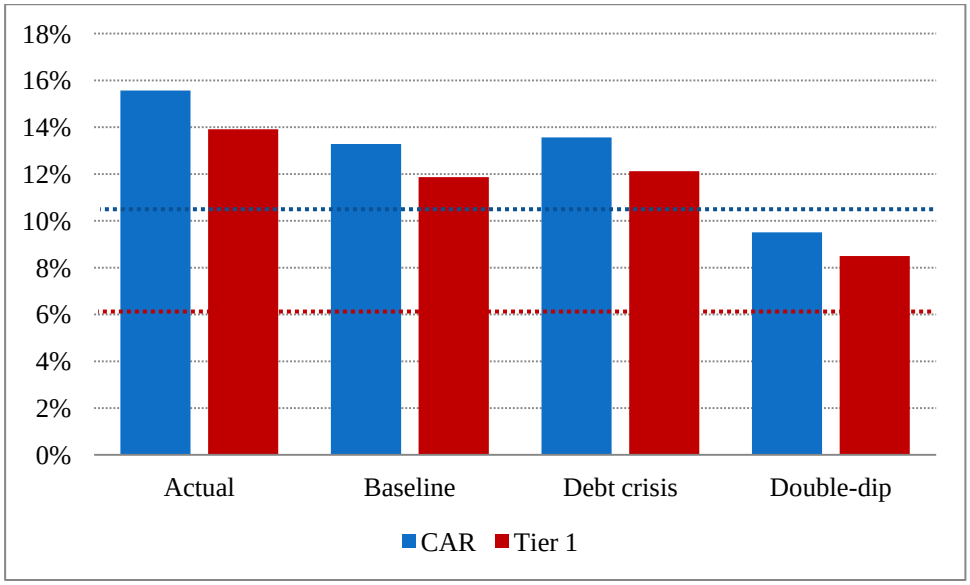
Source: Author's calculations

Evaluation

First, let us comment on default rate predictions. We can see that default rates in debt crisis scenario are actually lower than in baseline, especially in corporate sector. As was noted above, this is caused by the particular model specification where some variables have counterintuitive sign and influence the response in an opposite direction than what would be dictated by the common sense. On the other hand, as we further expand on in the institutional part of the thesis, common sense can give us seriously deceptive guidance easily. In order o be able to tell more, more research is needed. It is, in fact, possible that we have omitted some important variables or idiosyncratic shocks in our specification and the good fit that we obtained might be just a coincidence. Anyhow, because we are still talking about predictions, and these are inherently difficult to make, we can satisfy ourselves with what we obtained for the purpose of capital position assessment, in our opinion.

Let us turn to our core question now. We want to ascertain whether Basel III capital adequacy rules will have any impact on major Czech banks. As we can judge from our figures, Basel III rules would only force major Czech banks into raising new equity or earnings retention in case of a sudden return of recession, when GDP would decline by 2% at the end of 2011 year-on-year, and the requirement itself would be of roughly 1% of RWA. Following graph summarizes capital adequacy ratios (total CAR and Tier 1 ratio) under Basel III rules across scenarios. Let us remind ourselves that the limits are 10.5% for total capital, including the capital conservation buffer, and 6.0% for Tier 1 capital, both values being highlighted in the graph:

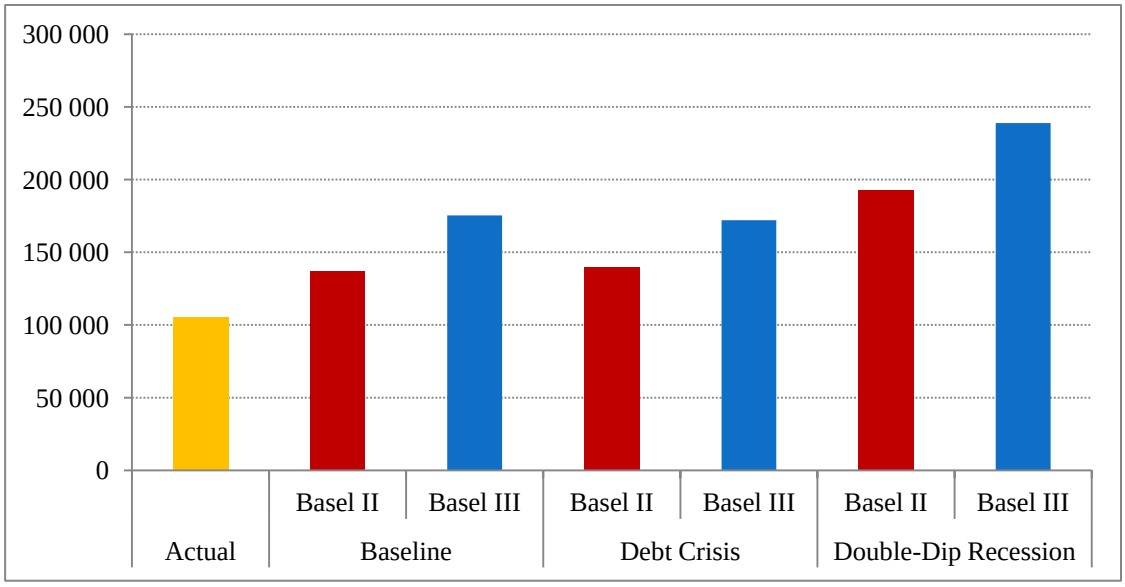
Figure 10: Capital Adequacy Ratios under Basel III



Source: Author's calculations

To complete the picture, we add a graph illustrating capital charges increase across scenarios and regulatory frameworks:

Figure 11: Capital Charges Prediction, CZK mil.



Source: Author's calculations

As we can see, only in the case recession returned would the banks fall to 9.5% CAR and be forced to raise additional equity or retain earnings to meet regulatory capital requirements, and this only in the case capital conservation buffer applied fully and instantly. Otherwise,

given the strong capital position of these banks, Basel III rules concerning capital requirements will not be of any noticeable impact on major Czech banks. We can see that major Czech banks are capitally strong enough to withstand even a serious economic downturn. In addition to that, we have to bear in mind the fact that default rates calculated by the CNB actually overestimate realized default rates observed and reported by banks so our estimates of capital charges and capital adequacy might be somehow conservative. Nevertheless, this confirms sector's robustness and resilience.

To conclude and summarize the chapter, let us give a more general remark. In our opinion, for major Czech banks, Basel III essentially amounts to piling-up additional capital buffers atop Basel II edifice, if we omit changes to definition of capital and counterparty credit risk that are not significant in our conditions. What we wanted to show here is that Basel III does not mean an improvement in preparation to adverse development for capitally strong banks. In this sense, Basel III will not be structurally important for Czech banking sector as such. To the contrary, it does not bring any fundamental change to the risk assessment approach and as we argue in the following chapter, retains all the flaws of its predecessor in terms of overreliance on quantitative measures and risk misperception.

5. Institutional analysis

Having examined Basel III from the empirical perspective, we shall now turn our attention to a broad issue of institutional impact of new rules. In our opinion, it is at least as important to know the impact on behaviour of market participants and the general market conditions as knowing the impact on profitability and GDP growth. In other words, one must take into account both the quantitative *and* qualitative impacts of any set of rules, a lesson learnt hard in Central Eastern Europe (CEE) during transition in 1990's, since qualitative impacts of new rules materialize in profitability and GDP growth *indirectly* and with a time lag of different and hard to predict length. Unfortunately, this topic does not attract attention it deserves, both in the media and in the academia, because of the lack of clear-cut, easy to comprehend answers and figures and uneasy and difficult to implement nature of solutions and recommendations it offers.

Nevertheless, we think it is absolutely crucial to understand possible institutional implications of any reform proposals, as these can often have very undesired side effects the originator might have never conceived of when building up the framework. To this end, we present in the following part of the thesis an eclectic overview of some of the approaches to this question. One is an overview and expansion of an analytical approach in the spirit of the neo-proceduralist school. Then, we present a 'simple regulation' approach advocated by Karim Pakravan of the Chicago school. The author suggests some remarkably simple guidelines that banking regulation should follow. Comparing these to current Basel II framework, it is obvious how cumbersome and complicated the system has become and even more obvious is the need for a more fundamental reform than merely adding new elements atop current edifice. After that, we focus on a broad topic of the problem of induction and how it affects our ability to construct models and infer from them. Mankind faces some fundamental limitations to its cognitive ability and we tend to forget that. This is reflected in our reliance on complicated mathematical models used in wrong places. Predictive ability of these models is hence necessarily very limited. In the end, we propose a new approach to banking regulation that is not based on quantitative measures and that we believe could greatly enhance the stability and robustness of the banking sector.

5.1. Neo-proceduralist analysis

In his seminal paper (Lall 2009), the author argues that the primary cause of the failure of Basel II lies in regulatory capture of regulatory agencies by regulated institutions. In short, he

argues, Basel II is a prime example of regulatory capture. Large international banks were able to systematically manipulate the process and outcomes of Basel II, effectively transferring wealth to themselves at the expense of their smaller competitors and, above all, the society and systemic financial stability (Mattli and Woods 2009, p. 10). Basel II hence failed to attain its declared objectives of promoting safety and soundness in financial sector, constituting a more comprehensive approach to risk management and promoting competitive equality in the sector.

Departing point for his analysis is the *neo-proceduralist* approach to regulation, developed recently by Walter Mattli and Ngaire Woods (Mattli and Woods 2009, p. 10). It has much in common with the emerging field of global administrative law, which represents the core of the proceduralist approach to global regulation (Kingsbury, Krisch, and Stewart 2005). These scholars identify public interest with a certain type of due process that meets certain standards (Lall 2009, p. 10). As Mattli and Woods put it, *"regulation is said to be in the public interest if it is arrived at through a deliberation process that allows everyone likely to be affected by it to have a voice in its formation"* (Mattli and Woods 2009, p. 13).

Nevertheless, similarities with proceduralists end here. Mattli and Woods discard the idea that improvements on the institutional side alone are sufficient to secure optimal, common interest regulation. Neo-proceduralists emphasize two types of conditions that must be met to produce an optimal result. The first are the so-called *supply side* conditions, concerning the institutional conditions in which any regulation is being drafted and implemented, and the *demand side* conditions encompassing the extent and intensity of societal pressure for efficient and effective regulation. In their opinion, these demand side conditions make the difference. They argue that, first, constituencies adversely affected by regulatory status quo must be aware of and have proper information about the social cost of capture and international regulatory agenda. Where large market players have information monopoly, it is likely that they reach their preferred outcomes at the expense of the less-informed. Second, these constituencies must be supported by public or private agents that facilitate technical expertise, financial resources and an organizational platform for them. Finally, and crucially for the success of these alliances, is a shared set of ideas about how to regulate that serves as a departing point in deliberations (Lall 2009, p. 10).

To clarify the approach, let us distinguish between regulatory change that serves vested interests of a narrow group and that beneficial for the whole society. Mattli and Woods draw up broad conditions under which different outcomes are expected to occur in international regulatory framework, indicating a plausible set of hypotheses about the factors facilitating

capture in the regulatory process (Lall 2009, p. 9). To be able to tell when one outcome is more likely than the other, they argue, we must assess the 'supply-side' institutional context in which new regulation is prepared, implemented and enforced (Lall 2009, p. 10). An 'extensive' institutional context, characterized by open forums for debates, multiple-stakeholder and proper oversight, is less likely to produce outcomes that serve one particular interest group and which shows signs of being captured than a 'limited' context that is exclusive, closed and secretive (Lall 2009). It is only when both supply and the aforementioned demand conditions are met, however, that the process can generate desired results – a claim made by Mattli and Woods that extends the original proceduralist approach. A mere extensive forum without wider societal input in the form of desire for change is not enough, in their opinion. In addition to that, constituencies affected by the change must have proper information. This can be labelled as an attempt to bring politics back into proceduralism - regulatory outcomes are thus defined not only in terms of the procedure that generates them but also by the range of societal input into it (Lall 2009, p. 10).

5.1.1. Temporal contextualization

By identifying an important condition for the regulatory process to produce desired results, Mattli and Woods have made a significant step forward in the study of international regulatory process. Nevertheless, as Lall argues, they have failed to account for a key variable that influences the outcome in their comparative-static analysis – the *temporal* dimension. As Lall puts it, we must conceive of regulatory capture as a cumulative, gradual process that unfolds over time. Recognizing that processes and their outcomes are rooted in a particular temporal context enables us to notice key causal effects and draw conclusions that we would not be able to see or make from an ahistorical, snapshot perspective (Pierson 2004).

The benefit we gain from extending the framework over time is enormous. By recognizing that regulatory process unfolds over time we get a better understanding of how agents with informational advantage may turn this into specific regulatory outcomes. In particular, these actors can claim a 'first-mover advantage' – they are able to arrive at the decision-making table first and employ significant leverage in later stages, since decisions made early tend to be self-reinforcing (Lall 2009, p. 12). As Paul Pierson argues, *"If early competitive advantages may be self-reinforcing, then relative timing may have enormous implications...groups able to consolidate early advantages may achieve enduring superiority"* (Pierson 2004, p. 71).

Lall further extends this argument by adding that early participation matters *only if* negotiators have little or none accountability to domestic constituencies. That is, in a limited institutional context where decisions do not have to be endorsed by domestic bodies such as parliament, regulator or other similar bodies. Clearly, when an agreement is to be endorsed by a wide domestic constituency, a first-mover advantage does not facilitate outcomes desired by the interest group having it. In this context, Lall argues, the framework allows us to expect that banks arriving first at negotiations of Basel II were able to gain significant first-mover advantage and shape decisions in a way that was favourable for them and at the same time, increasingly more difficult to change in later stages. He further argues that *"the question of who arrives first is not a matter of chance, but a function of the distribution of information among actors"* (Lall 2009, p. 12). Clearly, large international banks had to be the best informed, given their wide scope of actions and a global network. Moreover, informal connections play an enormously important role. Again, large international banks had the best informal connections to their benefit and utilized this privileged status during the Basel II process to a large extent, as will be described in the next section.

5.1.2 Results

Ranjit Lall uses a method he calls 'process-tracing' to identify key points when regulators made concessions to large international banks and, in doing so, have jeopardized the stability of financial system. He examines and compares closely various press releases, statements, official documents and interview transcripts to assess whether there is evidence for his hypothesis that the Basel Committee, and Basel II as a consequence, was captured by large international banks.

He starts by identifying BCBS to have *"one of the worst records of all international standard-setters in terms of transparency, representation and accountability. The Committee's meetings, which occur four times a year, are closed to the public, with no record of who was present or what was discussed."* (Lall 2009, p. 12). BCBS further breaks down into four policy groups in charge of fourteen subcommittees, where most of the technical work is done, usually in close cooperation with industry experts. We have no illusions as to which institutions these experts come from and in whose interest they act. Seen from the outside, BCBS is a rather opaque institution that is not accountable to any national or supranational body, the European Commission (EC) and European Central Bank (ECB) having only an observer status. BCBS is only accountable to a group of G10 central bank

governors and among these, only a few are responsible for banking regulation in their home country (Lall 2009, p. 13).

Internal Ratings-Based Approach

Turning to particular results, we mention the most salient feature of Basel II regulatory capture first, namely the inclusion of the so-called *Internal Ratings-Based* approach into approaches eligible for capital charges calculation. IIF has lobbied for recognition of IRB at least since November 1997 (Lall 2009, p. 14). In IIF's opinion, the method was not only more sensitive to risks than Basel I's arbitrary risk weights, but had the crucial advantage of being already in use by banks (IIF 1997). The proposal was initially met with scepticism, with Bank of England staff making a statement that there were *"significant hurdles to using internal systems to set capital requirements"* (Jackson, Nickell, and Perraudin 1999, p. 100). The first consultative paper issued by BCBS contained no mention of any internal rating system whatsoever (BCBS 1999). Two years later, in spite of the initial opposition from regulators, the June 2001 second Consultative Paper from BCBS contained a full specification of the IRB approach (BCBS 2001). The question is: what has changed between the initial proposal and final endorsement?

To answer this, Lall examines closely personal occupancy of IIF and BCBS and linkages among their members. What he discovers is that BCBS has enjoyed a long history of close cooperation with IIF, based on personal connections in national regulatory agencies. For example, Lall identifies BCBS's first and longest serving Chairman Peter Cooke to be one of the founding members of IIF. Chairman of BCBS's work on Basel II, the Federal Reserve Bank of New York's William McDonough, had a 22-year career at the National Bank of Chicago before chairing BCBS. In addition to that, a number of BCBS's members were previously employed at some of IIF's members, resulting in IIF having a privileged access to BCBS agenda from the very beginning (Lall 2009, p. 14). Persistent lobbying of IIF caused the Committee to endorse its proposals and to begin working with IIF on an informal basis to incorporate IIF's internal ratings into the capital adequacy standards (Lall 2009, p. 15).

By the time small banks realized what was looming for them, negotiations at BCBS were at such an advanced stage that a reversal was practically impossible (Lall 2009, p. 15). This opinion was most clearly voiced by America's Community Bankers (ACB), a group associating community bankers across the United States, which made a statement that *"the Accord will benefit only the most complex and internationally active banks, saddling the vast*

majority of financial institutions in the US with a cumbersome and expensive capital regulatory scheme".[27]

Trading book, market risk and securitization

Basel II treated banks' trading books in a very light way. To trace the cause of this, Lall goes back to the consultative part of regulatory process and identifies players that were able to exert significant lobbying pressure on BCBS and, in effect, to secure very favourable conditions for themselves. Most importantly, as it later turned out, BCBS decided to drop its decision for an additional capital charge for credit derivatives, after strong lobbying from the International Swaps and Derivatives Association (ISDA), the largest global financial trade organization. As one of the former BCBS member admitted, *"We went too far on capital relief for the trading book. We were convinced by the industry that instruments in the trading book needed a lower capital charge because they were more liquid...In good times, it is hard to go against the banks"* (Lall 2009, p. 16). The rest of the story is history – the liquidity argument has been shown to be fatally flawed in recent crisis, with banks incurring the heaviest losses on opaque, over-the-counter (OTC) derivative instruments.

Another issue that documents regulatory capture is the treatment of market risk in Basel II. Following a period of relaxing international capital controls and deregulation of interest rates, BCBS proposed measures to incorporate market risk into the capital adequacy framework. In 1993, the Committee has proposed a methodology whereby capital requirements were calculated on the basis of certain features of securities and derivatives, such as credit rating, maturity and category of borrower (BCBS 1993). These proposals were met with a strong opposition from IIF, arguing that they do not reflect recent progress in market risk assessment and do not incorporate the most sophisticated market risk measurement techniques – VaR – already in use (IIF 1993). IIF was soon joined by the Group of Thirty, an association of senior bankers based in Washington, which backed VaR models as *"much more rigorous than the old rules of thumb that bankers used to use"* (Lall 2009, p. 17). The Committee soon accepted these demands, consulting the use of banks internal VaR models throughout 1994, and officially recognizing them in April 1995 (BCBS 1995). Once again, consequences were dire – following the Asian and ensuing Russian financial crisis in 1997 and 1998, respectively, banks were reporting widespread losses on Russian government

[27] Available at http://www.bis.org/bcbs/ca/amcobare.pdf P.2, para 2.

bonds, entirely unanticipated by their VaR models[28]. Despite widespread criticism and numerous cases of failure, VaR models were not questioned in 1999 consultative document and in later stages of Basel II process, being still in use today.

Asset securitization has been initially given much attention in initial phases of Basel II drafting. Banks were taking advantage of the 'originate and distribute' model to escape capital charges under Basel I. Despite that, the Committee's initial stance was gradually weakened by numerous interest groups lobbying in favour of conserving *status quo.* The earliest arrivers, which worked closely with the Committee's working group on asset securitization, were the European Securitization Forum (ESF), the American Securitization Forum (ASF) and the ISDA (Lall 2009, p. 17). Banks and the mentioned forums were advocating securitization as a means of prudential and efficient risk management and a source of safe and stable income assets.

As a result of lobbying pressure, the Committee has substantially weakened capital requirements for securitized products from its first proposal in 1999 until final approval in 2004. In the first draft in 1999, BCBS proposed to link capital charges for various tranches directly to external credit ratings. In this setup, tranches rated AAA to AA- would carry a 20% risk weight, A+ TO A- a 50% weight, BBB+ to BBB- 100%, BB+ to BB- 150% and B+ or lower a deduction from capital (BCBS 2004). In 2001, following lobbying by ESF, BCBS allowed the A-IRB banks to use their internal credit risk assessment models to infer probabilities of default for unrated exposures. Further on, BCBS even allowed IRB approach for liquidity facilities extended to conduits in 2004 (Lall 2009, 18). In the end, credit risk weights reached appallingly low levels – senior positions of tranches rated AAA were assigned a 7% weight, AA 8%, A+ 10%, A 12%, BBB+ 35% and BB 60% (Lall 2009, p. 19). Risk weights for rated tranches under the standardized approach remained the same as in the initial 1999 proposal, giving banks using the A-IRB approach a substantial competitive edge against smaller ones. Both of these measures allowed sophisticated banks to further gamble on capital and substantially weakened the overall stability of the sector, as recent sub-prime crisis and ensuing recession so painfully unveiled.

Taken together, Lall shows us very strong evidence of regulatory capture of Basel II. On the demand side, as he shows, comparative informational advantage of large international banks gave them privileged access to regulatory agenda. They were able to utilize this advantage to their benefit very well and gain a significant competitive edge, while

[28] The well-known 'ten-sigma' stumbled upon once again. Interesting how often these 'rare events' occur over such a short span as a few decades.

simultaneously gambling with liquidity and solvency, as it turned out recently. Other players arrived at the decision/making table too late, while this problem was further exacerbated by a limited institutional context of the Committee. As a result, Lall summarizes, Basel II missed the declared aims and was one of the underlying causes of the crisis.

5.1.3. Implications for the fate of Basel III

What can this approach tell us about the possible fate of Basel III? Based on his state of knowledge and available information[29], Lall does not offer an optimistic perspective. He shows us how bankers and other influential industry players have once again been trying to dictate the direction and magnitude of change to the way they are being regulated, from the very beginning. As he puts it, *"despite the immense political will behind an overhaul of the global financial system, it is once again large international banks that have seized control of the regulatory process, potentially closing the window of opportunity for a far-reaching reform"* (Lall 2010, p. 31).

At the beginning, Lall acknowledges post-crisis development in global approach to regulatory issues. The Group of Twenty (G-20) has taken on the role of moderator and stressed the need for reform repeatedly during the crisis. As Lall argues, G-20 fulfils the condition if the supply-side 'extensive' forum, with well-publicized agenda and open environment. On the demand side, it is a forum where agreements that were endorsed need to be ratified on the national level subsequently. Since any deal reached in this forum can later be revoked at national level, early participation in negotiations does not constitute comparative advantage. In this setup, the comparative-static demand and supply factors described by Mattli and Woods play the key role in shaping outcomes.

Let us examine the timeline of regulatory development after the spill over of the crisis into the real economy following the collapse of Lehman Brothers in September 2008. Two months after the collapse, the G-20 has voiced the need for international standard setters to improve and enhance capital requirements for banks engaged in securitization and structured finance at their Washington, DC summit in November 2008. As a reaction to this, BCBS has published enhancements to Basel II trading book framework in July 2009, which has been first action taken by BCBS since the onset of the crisis (Lall 2010, p. 32). G-20 has further highlighted the need for reform at the Pittsburgh Summit in September 2009, where ordered the Committee to include, among other things, an international leverage ratio, countercyclical capital buffers, surcharges for 'systemically important' institutions and a more stringent

[29] R. Lall published his analysis as of April 2010, before final version of Basel III has been adopted.

definition of eligible capital. In December 2009, BCBS has published a preliminary set of reform proposals, subject to comments and discussions during 2010. In July 2010, the Committee has published a consultative document concerning the countercyclical capital buffer, followed by an agreement of GHOS on the BCBS capital and liquidity reform package from December 2009[30]. In September 2010, GHOS announced increased minimum capital requirements and leverage ratio, together with transitional arrangements. Finally, in December 2010, the Committee has published final version of the reform proposal, which has been described above.

Lall argues that despite G-20 is an appropriate forum for reform proposals and endorsement, it will not reach its aim. A public demand for change weakens with economic recovery throughout the world, his argument goes, there is a risk that the Committee will once again fall victim to regulatory capture on the part of large international banks. In his opinion, sequencing will regain significance in the decision-making process (Lall 2010, p. 33), conferring the decisive power on the best informed. He gives a number of industry professionals' quotes and interview excerpts, indicating that lobbying from IIF and the like had been extremely intensive until April 2010. His main point is that regulatory proposals will have been significantly watered down by the time of final approval, as large international banks have again regained control of the Basel process (Lall 2010, p. 41).

5.1.4. Extension of the analysis

The prospects presented by Mr. Lall seem very grim. In this part of the thesis, we will apply his methodology and extend the analysis until present time[31], trying to find evidence for his hypothesis that Basel III will be yet another case of regulatory capture. In doing so, we will gather information from various publicly available sources, such as the Risk magazine, Financial Times or Reuters, as well as compare and analyze the individual stages of Basel III reform proposals to see if there is evidence in favour or against the hypothesis. In our opinion, it can give us a very valuable insight into the problematic of regulatory capture, how it evolves over time, what are its symptoms and what repercussions it may have in future.

Basel III evolution

Let us examine the wording of Basel III *per se* and how it evolved over time. As hase been mentioned before, BCBS has published a preliminary version on Basel III in December 2009, subject to comments until April 2010, with final version made public in December

[30] Available at http://www.bis.org/press/p100726.htm
[31] Spring 2011

2011. We shall now turn our attention to the time interval between April and December 2010 to see if, and how, effective individual lobbying groups were at influencing the Committee, and find evidence for or against the hypothesis that Basel III is an example of regulatory capture. Firstly, we will examine the individual parts of Basel III reform package in detail. Later, we shall turn to the broader issue of regulatory process, namely whether the recent Basel III process meets the criteria of an extensive forum that is immune to interest groups' lobbying efforts.

Capital, capital ratios and counterparty credit risk

In general, the Committee retained most of the proposals set out in December 2009. There have been, however, certain concessions made to the definition of capital. As the Committee put it, *"certain deductions could have potentially adverse consequences for particular business models and provisioning practices, and may not appropriately take into account evidence of realisable valuations during periods of extreme stress"*(BCBS 2010a). The Committee allowed for partial recognition of the minority interest supporting the risk of a subsidiary that is a bank. This means that banks that report minority interest of a party on their consolidated balance sheets can deduct that portion of capital required by the regulator attributable to the minority party from their capital requirement, in proportion to the minority share.

In addition to minority interest, the Committee has also announced changes to the treatment of:

- deferred tax assets (DTA) that arise from timing differences,
- significant investments (more than 10% of the issued share capital) in unconsolidated financial institutions; and
- mortgage servicing rights (MSR).

Instead of a full deduction, these items receive a limited recognition capped at 10% of bank's common equity for each item and 15% aggregate over the items. The amount that by which the sum of the three exceeds 15% must be deducted from bank's CET1.

Formerly DTA could rely on estimates of future profitability of a bank. In Basel III, DTA will be recognized only if they stem from timing differences, such as allowances for credit losses. All other assets that could be carried forward as unused tax losses or tax credits will be deducted in full from CET1. These changes can be viewed as a reaction to banking sector characteristics in certain countries. Historically, banks in Japan have relied on deferred tax assets, counting prior year's losses as capital on the account of potentially increasing after-tax

earnings in future. According to estimates, these practices were so widespread that Japanese banks would be well below regulatory minima, had not it been for the recognition of deferred tax assets. In 2002, DTA accounted for *60%* of major banks' equity (Skinner 2008, p. 2). Given the recent crisis, Japanese banks' reliance on DTA has certainly not diminished and the pressure on the Committee to recognize at least a part of DTA as common equity component must have been enormous.

The decision to remove DTA in their previous form from CET1 capital is certainly a step in the right direction. Nevertheless, in our opinion, retaining them even in a limited scope is at odds with prudential regulation. DTA are by definition not readily available for loss absorption. Recognition of DTA in its current form is based on the notion of postponed cash realization. Hence, for the bank to make use of DTA, it must wait until cash inflow occurs, which take too long a time in period of distress and therefore cannot contribute to loss absorption. In our opinion, DTA should be moved to Tier 2 capital, if not eliminated from regulatory capital altogether.

The question of mortgage servicing rights is particularly important for US banks. MSR represent a contractual agreement between the mortgage lender and the servicing entity that performs all servicing functions i.e. collects payments and distributes interest and principal repayments, taxes etc. The market for MSR is a multi-billion industry in the USA and they have represented a significant portion of banks' income prior to the crisis.

The problem with MSR is that they are very difficult, if not impossible, to attach a reasonable value to. There exists no liquid market for MSR, being traded solely OTC. Banks can essentially attach any value to them. This depends on the creditworthiness of mortgage borrower, open market value of collateral property, the willingness to refinance when interest rates decline and many other factors that are difficult to predict. The regulator has therefore no reliable clue to confront bank's estimates of MSR value with economic reality. In our opinion, this is the reason why MSR should be eliminated from the list of eligible capital of any level, since their value is far too volatile and impalpable to be included in the loss-absorbing capital. MSR retention on the list of eligible capital instruments can therefore be viewed as a concession to US banks that use them to enhance their capital position.

In the area of counterparty credit risk, the Committee has retained most of the proposal. Nevertheless, it made change to the asset value correlation adjustment. It kept the 1.25 multiplier of asset value correlation for exposures to other financial entities, but raised the threshold from $25 billion to $100 billion of assets for regulated entities. We have found no evidence that this was due to lobbying, but the probability of being so is very high – lower

threshold would mean significantly higher capital charges for large banks, which are heavily interconnected and have large mutual exposures via OTC instruments.

Leverage ratio

Leverage ratio has been watered down rather significantly. Initial proposals have been met with strong opposition from the industry, calling it redundant, insensitive to different business models and excessive. Despite this critique, BCBS retained leverage ratio in final version of Basel III, although some concessions have been made along the way. The most important is timing. Leverage ratio will enter into an observation period, starting January 2011, when supervisors will develop tools to track and evaluate the ratio. The parallel run period commences January 2013 and runs until January 2017. During this time, the Committee will closely monitor the behaviour of the leverage ratio in relation to other regulatory measures. Based on the results from the parallel run period, the Committee will make final adjustments to it in the first half of 2017, *"with a view to migrating to a Pillar 1 treatment in January 2018, based on appropriate review and calibration"* (BCBS 2010b, p. 63). In our opinion, this prolonged review and calibration period will contribute to leverage ratio not being binding, or being significantly diluted in the end. Seven years is a long period – many things can change and banks can exert quiet but steady pressure on the Committee to change the rules to their benefit. IIF lobbied for the ratio to be implemented as a part of Pillar II guidance, being at national supervisors' discretion (Financial Times 2010a). Concessions made to implementation timing are suggestive of partially successful lobbying from the industry.

Liquidity measures

Liquidity measures have also experienced changes during 2010. These can be divided into three categories. First, certain adjustments have been made to numerical values of run-off rates, availability and required factors for stable funding calculation and haircuts to market values of assets in the stock of liquid assets. These are quite noticeable in some instances, such as lowering the minimum required credit rating for some assets held in the stock of liquid assets. On the other hand, the definition of Level 1 assets is now more limiting than in the original proposal.

Second, original proposal contained no distinction between Level 1 and Level 2 liquid assets. Final proposal adds this division, reflecting the industry's call for a wider scope of

eligible assets. Given our current state of knowledge, the judgment whether this division is an example of regulatory capture would amount to pure speculation.

Third, the timeline of implementation. Observation period commences in January 2012 for both standards. Any revisions to LCR must be made until mid-2013. LCR will be introduced in January 2015, including any revisions. NSFR can undergo changes until mid-2016, being enforceable as a minimum standard from January 2018. Again, as in the case of leverage ratio, the industry has succeeded in postponing the binding power of liquidity ratios until well into the future. This can give banks enough space to influence the Committee and try to influence the final shape of regulation.

Timeline of implementation

In our opinion, concessions made to the timeline of implementation of changes introduced by Basel III are the most serious among dilutions made to Basel II. In effect, despite the fact that final version of Basel III contains most of the originally proposed measures, the desired effect can be watered down as a result of a very long transition period. As Stephen Green, chairman of HSBC said at the end of consultation period in April 2010, "*changes should be gradually phased in over several years and must be internationally co-ordinated"* (Financial Times 2010a).

The following G-20 meeting in Toronto in June acknowledged delays in implementation timeline. The original plan was that the talks would be completed by the end of 2010 and the new rules would be enforceable by the end of 2012. Hopes for a swift and timely implementation were put to rest when Canadian finance minister James Flaherty announced major postponements of implementation deadlines, saying that *"there can be a compromise on that"* (Financial Times 2010c). George Osborne, the Chancellor of the Exchequer, said at the very same meeting that he is prepared to bear some delay, provided that there are no attempts at diluting the accord. With troubles heaping in the Eurozone, French and German banks were in favour of up to 10-year transition period, in connection with their reliance on hybrid capital instruments that were scrapped by Basel III and which have to be refinanced by some form of Tier 1 capital upon maturity (Financial Times 2010c).

A few days later, Nout Wellink, chairman of BCBS, said at the meeting organized by IIF that "*where there are trade-offs, these should go in the direction of giving banks the time to reach the new standards instead of watering down the standards themselves"* and *"we do realize, on the basis of quoted impact studies, that we have to compromise on certain elements...but I think we will find a very acceptable solution"* (Financial Times 2010d). Mr.

Wellink further stated that regulators will also *"take into account the impact on the economy so as not to hamper the recovery,"* but there is no doubt that *"major part of the banking sector will go through a difficult period"* (Financial Times 2010e). Praise from the sector was heard, stating that regulators *"have gone for the pragmatic outcome in which they recognize that they need a long glide path,"* (Financial Times 2010f) together with warm embrace of a wider capital definition and easements to some critical definitions concerning liquid assets. Timothy Geithner, US Treasury secretary, said at conference in New York in August 2010 that *"We know [capital ratios] need to be substantially higher than they were. But we also know that if we set them too high too fast, we could hurt economic recovery or simply end up pushing risk outside of the banking system – something that could ultimately come back to haunt us. To limit that potential, we plan to give banks a reasonable transition period"* (Risk 2010a).

But in general, there is a consensus that Basel III has achieved most of what it originally set for, at least in the initial phase of the process – "*We went out with an initial proposal that was very conservative and have naturally made some adjustments as part of the normal consultative process. But when people step back and look at the whole package in comparison with the current status quo, they will see this is a major rising of the bar in terms of capital and liquidity,"* Stefan Walter, secretary general of BCBS, said (Risk 2010a). What remains to be done is the actual implementation, where the risk of watering the final effect down is anything but negligible.

Summary of Basel III process achievements

When we take a big picture of the Basel III process so far, there are salient distinctions from that of Basel II. The biggest one is the extent and intensity of political pressure exerted on the Committee. In reaction to recent crisis, G-20 and Financial Stability Board (FSB) have been the key international players that influenced the shape of new regulation. Times when politicians were mere observers of the decision-making process at the Committee seem to be gone. The Committee had to obey a mandate set by G-20 in successive communiqués since April 2009, which made a number of people at the Committee that were accustomed to a more secretive and much slower *modus operandi* very uncomfortable.

Basel II was being completed over a few years. It seems almost unbelievable that Basel III has been completed in a year, given the scope of changes made to the framework. On the other hand, we have to acknowledge that this rush could cause a number of imperfections or measures that can manifest themselves as inappropriate or ill-fitted. As one senior Committee

member put it, *"We have been pushed very hard by politicians to rush, so very often we have not been able to complete our assessment of all the changes, and the economic and financial situation is still very difficult. That means the old way of working hasn't been appropriate, and because of the pressure to complete, the secretariat has had to be very strong, even if some countries resisted"* (Risk 2010a). This could be seen in July, when Germany refused to sign changes endorsed by the Committee to the initial proposal until the calibration and transitional arrangements had been completed.

When we evaluate Basel III process from the neo-proceduralist point of view, we have to acknowledge that it fulfils the requirements proposed by Mr. Lall to a large extent. First supply side conditions were largely fulfilled with the extension of BCBS to encompass members from 27 countries, represented by no less than 45 institutions (Risk 2010a). The Committee was pushed to open itself much more to the public. Bankers were blamed for the crisis and politicians throughout the world took advantage of this public anger to take more decisive steps in their attitude toward the banking sector. As has been stated above, it was G-20 that initiated Basel II reform and subsequently overlooked the process. Without this globalized political pressure on the Committee, we doubt Basel III to be adopted as fast and the changes to be as deep. In effect, the Committee was an extensive forum, with changes being approved by an external authority (G-20). In this setup, the effect of early arrival at the decision-making table does not constitute a comparative advantage. Even if an interest group had a privileged and early access and could influence the process to its benefit, it could not expect that decisions made at an early stage will not be revoked later.

Second, and more importantly, demand side conditions were much better than during the Basel II process. Bankers stood at the forefront when culprits of the crisis were being identified. Reform proposals concentrated on the banking sector, both due to the substantiality of the need for reform, and public pressure. To use the terms of neo-proceduralists, wide constituencies were aware and well informed about the causes and costs of the crisis. Moreover, the public was supported by supervisory bodies and other public agencies in their calls for a deep and substantial change to the way banking sector operates. This unison is unprecedented and we identify it with two facts, the degree of globalization of banking business and the ease of access to reliable sources of information.

To summarize, the conditions for a process to fall victim of regulatory capture were largely not fulfilled in the case of Basel II. Despite certain imperfections and concessions outlined herein, we argue that, in general, the process achieved the desired results to a large extent. Therefore, we reject our hypothesis that Basel III is another example of regulatory

capture due to the reasons stated above. Finding that Basel III has not been captured, however, by no means do we imply that this shall not happen in future, when public attention diverges from banking regulation and banks will again have a lot of time to lobby during the very long implementation period, when significant dilution can take place. This long implementation period is, in our opinion, the most vulnerable point in Basel III framework, as we further argue below.

What remains to be done

As successful in reaching the goals originally set as Basel III may seem to be, there still remain a number of open issues, some of which can potentially cause a salient threat to the desired outcomes. We shall now examine some of them and evaluate their potential adverse impact onto regulatory process.

First and foremost, the question of actual implementation. There are two dimensions to that; time and consistency. Considering the timeline of implementation, there are open issues with regard to liquidity ratios and the leverage ratio, the Committee has only set dates by which certain landmarks are to be achieved. There is still a lot of uncertainty about the actual shape of the process and development both within the Committee and the industry itself. These new regulatory instruments were adopted in a very short time span and hence can entail major unintended and unpredicted consequences.

Second, the Committee based its predictions and calculations on the assumption that Basel III is implemented at the same time and consistently throughout its jurisdictions. This assumption might be rather daring, since the actual process of implementation can result in a much less degree of consistency than the Committee would wish to achieve. National legislators and regulatory bodies must now transpose the rules into their own legal systems, which can cause a good deal of delay and cause a knock-on effect in postponing the deadlines. Regulators and the industry are well aware of this fact – *"I certainly think the hard work on this starts now. Politicians have said this is a prime opportunity to get consistency of capital and liquidity rules across all countries, but that will be very difficult to achieve. The countries may have all signed up at a broad level, but whether they implement consistently will be the real challenge"* Pamela Walkden of the London's Standard Chartered said (Risk 2010b).

There is an imminent risk that a major banking jurisdiction delays significantly with the implementation. The USA have recently adopted their own extensive financial reform, known as the Dodd-Frank Act. This piece of legislation puts an enormous deal of requirements on US banks and there are concerns whether these will have sufficient capacity to absorb Basel

III. We can be sure to expect that US banks will first strive to conform to their home regulation, before being concerned with Basel III. As one senior European regulator put it, "*If the US does not implement it, Basel III will fail. I fear more the US not implementing Basel III than Europe or the emerging markets. If US banks don't have to implement it, the European banks will lobby they are at a competitive disadvantage. If banks lobby for years and years, I'm not sure we would be able to resist"* (Risk 2010b).

Another issue is the interaction of new rules within Basel III. The whole process was so fast that there has not been time to carry out a deep and comprehensive quantitative impact study that would take into account the calibrated requirements and other features of the reform. There is a risk that individual jurisdiction can take advantage of whatever loopholes Basel III offers them and adapt some provisions to the characteristics of their banking sectors. Given the heterogeneity of banking sectors in individual countries, national regulators will be no doubt tempted to align regulatory demands with sector characteristics. Already now, serious concerns about the liquidity standards emerge, as not all countries have a sufficient supply of and market for liquid government securities that are predominant component of the stock of liquid assets. Further evolution in this area can be suggestive of the fate of the whole Basel III in our opinion.

There are also open issues that remain to be resolved in near future. The Committee has expressed the desire to add a capital surcharge for the so-called systemically important financial institutions (SIFI) to account for the additional risk they pose. The industry did not hesitate to issue a warning that this could lead to even more severe curb in lending activity and, hence, economic growth. In addition to capital surcharges, regulators are trying to figure out a failure resolution scheme in case a major global bank failed, without the enormous costs to taxpayers witnessed recently. IIF did not lose time to present own proposal in January, in a fashion akin to the practice observed during Basel II creation when it was the industry who was setting the agenda. It came in a time when there are divergent plans on how to treat SIFIs among global players. This pre-emptive action came immediately after it had become obvious that a resolution scheme of kind or the other is more or less inevitable. We could argue that they changed their minds because alternatives offered by sticking to refusing any additional requirements could be worse in the end.

Regulators, however, differ substantially in their approach to SIFI treatment. There is no international coordination on this topic whatsoever. FSB presented a paper in November 2010 at the G-20 summit in Seoul containing various measures such as capital surcharges, contingent or bail-in capital and additional liquidity requirements. Switzerland plans to

impose additional capital charges on its two largest banks, UBS and Credit Suisse, that would contain some hybrid instruments currently not treated in Basel III. National regulators are presenting their own, conflicting ways to address the topic and so far, there has not been any major breakthrough agreement. This issue is very complicate to resolve on a national level, let alone the international interaction that adds another layer of complexity. In general, there is consensus on an international level on the need to treat SIFIs in a special manner. This shall remain an open issue for some time, certainly. As difficult as this problem is to resolve, regulators should devote their effort primarily to this after dust settles on Basel III rules, in our opinion.

As far-reaching and successful in addressing problems surfaced during the latest crisis as Basel III is in our opinion, there are a number of issues that remain to be addressed and resolved in a timely fashion to avoid dilution or evasion of some proposals, preventing a regulatory failure akin to that of Basel II. We argue that the timeline of implementation and unresolved issues concerning liquidity standards and treatment of SIFIs can pose a serious risk to Basel III being successful in the end. This risk is very material and politicians should remain alert about further regulatory agenda to prevent interest groups from capturing the Committee, after financial regulation has retreated from prominence in political agenda in the months and years to come.

5.2. Simple regulation

Having evaluated the Basel III process from the regulatory capture point of view, we shall now turn our attention to the more general issue, namely how Basel III fits within the notion of optimal regulatory architecture. As we have ascertained in the previous chapter, Basel III has not fallen victim of regulatory capture, with large international banks being able to exert much less pressure on the Committee during the process. Nevertheless, it also has some serious drawbacks, as we argue below. Due to these, we argue, Basel III will fall short of successfully addressing the challenges poised to financial regulation by the recent crisis

Basel III essentially boils down to additional buffers atop the current Basel II architecture. Liquidity and leverage proposals are subject to supervisory review process and their final versions can be made much less binding and stringent than currently, given the very long transition process and uncertainty it encompasses. Contrary to wishes voiced by many regulators and academicians, Basel IIII does not address the immense perplexity of Basel II. Despite providing the banks with additional capital to accrue losses, it does not deal with the underlying source of problems – the ill-fitted quantitative risk measurement techniques and

overreliance on mathematical tools in risk assessment and the possibility for enormous capital arbitrage large banks have using the IRB approach. Here, we would like to discuss some of the most unfortunate shortfalls of Basel III and present a synthesis of different approaches that could, in our opinion, make the financial system more robust to adverse development in future.

5.2.1. A regulatory exercise

In this subsection, we would like to draw attention to one particular characteristic of Basel III and what unintended effects it might have in reality. We argue that there are some salient flaws in Basel III architecture, as Basel III introduces duplicity into the capital adequacy calculation. On one side, it forces banks to use enormously complicated quantitative techniques that have proven themselves ill-fitted for the task, failing to incorporate important sources of risk and uncertainty. On the other, it devises a new, simple leverage ratio that uses unweighted assets as an exposure measure, relative to Tier 1 capital. This duplicity and its unintended effects might well be the case of the very swift design and adoption these rules witnessed.

This approach tries to achieve two conflicting goals at the same time – banks can either optimize their portfolio with respect to complicated quantitative risk assessment rules, or forget portfolio riskiness altogether, at the extreme, and follow a simple, leverage rule not to take on more leverage via expanding asset base. The problem is that these two rules do not connect seamlessly to each other as the bank's balance sheet grows. Rather, there is likely to be a discontinuity in rules' effectuality. At some instances, there might be a situation when these rules conflict, pushing the bank into a "regulatory corner" as we argue herein.

Imagine a bank that has a constant regulatory capital, whatever its definition, and a constant absolute (unweighted) asset base. This implies a constant leverage ratio by Basel III rules. Now the bank can be in such a situation that it is very close to the leverage ratio minimum and a minor change in the composition of its asset base causes the bank to fall below the capital adequacy threshold, despite still meeting the leverage criterion. In this case, the bank must react to the new situation and further change its asset base, or increase regulatory capital.

Suppose that the bank's balance sheet is composed in such a way that it can only meet the adequacy criteria by selling riskier assets and acquiring less risky ones, typically sovereign or high-grade corporate bonds. In our hypothetical situation, this could cause the bank to *decrease* its risk-weighted asset base, but *inflate* its absolute asset base, due to different

weights assigned to various asset classes in the Basel II/III framework. The bank would, by avoiding one pitfall, fall into another. In effect, these rules will force the banks to behave in an erratic way to satisfy the conflicting regulatory criteria.

Moreover, we argue that these rules will create another perverse incentive to avoid regulation. Banks will doubtlessly seek ways to avoid one rule or the other, most likely via new OBS instruments and entities constructed in such a way that they fall without the reach of current regulation, or using new instruments that do not fall within any regulatory category. Already now, there are growing markets for CDS index options, a new exotic instrument that is OTC and so complicated, no one except for its traders understands it (Financial Times 2011). But even traders of these new exotic products can often be mistaken, as was proven recently in the case of CDS and other mortgage-related products. Overall, we are sure banks will show an immense degree of ingenuity in inventing and constructing new instruments aimed at avoiding regulation. At the end of the day, they are the largest banks that employ the brightest minds in the business, so the competitive edge is on their side, in our opinion.

5.2.2. Synthesis proposal

In our analysis of Basel III, we have argued that Basel III is, in general, a step in the right direction, but it will be very difficult to accomplish its objectives, for several reasons outlined above, such as lobbying pressure from the industry or difficulties to find accord among politicians. Basel III declares clearly declares what we perceive to be right objectives, but the final outcome will most likely be far off the intended path, as in the case of its predecessors. By no means, however, do we intend to satisfy ourselves with this assertion. Rather, to complete the picture, we shall now draw up a proposal that should, in our opinion, make the banking system more robust to adverse shocks, banking regulation more immune to regulatory capture and lobbying pressure and taxpayer better protected from footing the bill in case of failure of a systemically important financial institution.

We advocate the approach described as “simple regulation”, although there is no precise definition thereof. One peculiar characteristic common to these proposals is that they try to make the system more robust in an increasingly complicated and interconnected reality. To give an overview of the notion, there are four elements of regulatory architecture common to effective regulatory structure. Good regulatory architecture should:

1) encourage innovation and efficiency,
2) ensure transparency,
3) provide safety and soundness; and

4) promote competitiveness in global markets (Acharya et al. 2011, p. 35).

We further argue that optimal regulatory structure must be kept simple, in order to be robust.

The flipside to this is that there are certain trade-offs associated with pursuing these objectives, as is often the case in economic policy. Competitive pressures can destabilize the system by forcing the banks to run on thinner margins, while increasing leverage to boost returns on equity. Greater efficiency may not go hand in hand with increasing transparency, when banks invent new instruments to gain competitive edge. There is a number of other instances but the presence of these trade-offs is by no means an excuse to refrain from seeking the best possible solutions to make the financial system more resilient to adverse shocks and more supportive of long-term growth of the economy.

Unfortunately, benchmarks that can be used to measure the degree of regulatory architecture efficiency and appropriateness are difficult to agree upon and even more difficult to measure. We know that overregulation involves costs, but how large are they? By the same coin, underregulation or misregulation can unleash catastrophes, but these can be observed only *ex post.* So *"optimum regulation is the art of balancing the immeasurable against the unknowable"* (Acharya et al. 2011, p. 35)[32]. We now present a few notions that should at least partially contribute to finding the balance.

Quantitative risk assessment

First and foremost, obligatory quantitative risk assessment with detailed prescription of form and processes must be cancelled. Banks can be left to use these methods at their own discretion, but they cannot be forced to do so by the regulator. We believe that misunderstood, ill-fitted and inappropriate risk models used by banks were at the very heart of recent crisis. Blind reliance on these methods caused the banks to stop considering the business from the perspective of common sense coupled with extensive experience, precisely the way it worked before the advent of sophisticated mathematical techniques and powerful computational technology. And it does not matter whether bank managers were aware of this or just let them be carried by the current.

Both the scope of risk included in regulatory framework and the way it was treated can be deemed wrong with the luxury of hindsight. The models have relied on the stationarity assumption, i.e. the assumption that future resembles the past. If this holds, it is theoretically

[32] There is a more philosophical point to it, to which we return later on.

possible to calibrate a model that produces accurate predictions.[33]But if the behaviour of certain crucial variables, such as delinquency rates or incidence of macroeconomic shocks, is not stationary, we might simply not be able to estimate the parameters whatsoever. So if we employ such a misestimated model on real data and use it as a basis for banking regulation, the conclusions can be dire, as we could experience recently.

At the heart of this fact is the problem of induction. It has a long history in human thinking, starting with David Hume and peaking in Karl Popper's philosophy. The basic principle is that we are not able to deduct true principles from however large number of observations, i.e. our capability to know the world based on empirical observations is limited. When we apply this to economics, there are a number of variables, behaviour of which cannot be asserted with certainty purely from observations. So for example, observing a long series of, say, stock prices or loan default rates does not warrant enough information to infer, what the distribution governing their behaviour might be[34]. The fact that we have not observed extreme realizations of random variables in the past does not give us any evidence that these extremes are impossible to occur - absence of evidence is far too often mistaken with evidence of absence. Models used for risk modelling in the Basel framework fall precisely in this category of mistake. They assume certain variables to be realizations of random variables governed by well-behaved distributions[35] and use this assumption to infer predictions about their behaviour. Applying these models can lead to severe underestimation of risk, as we could vividly experience recently.

Finally, even more uncertainty and unreliability arises from the fact that for some variables there might not exist a distribution whatsoever, or that we are not able to unveil it given our limited timeframe and cognitive ability. When we take this into account, a number of seemingly complicated and important problems in financial economics lose their relevance at all[36]. We have to be aware not of what we *know*, but of what we *do not know*, and even more importantly, of what we *will never be able to know*. In other words, we have to

[33] Theoretically only; conditional on having enough data used for parameters estimation. Even then, there is still a probability that we simply misestimate the model or that the model fails to account for some source of variability. Consider for example quantum mechanics. They predict the behaviour of micro-particles spectacularly well but fail in the macro-world. So even having a right model in some instances does not ensure that the model works under all circumstances and across the whole extent of its domain.

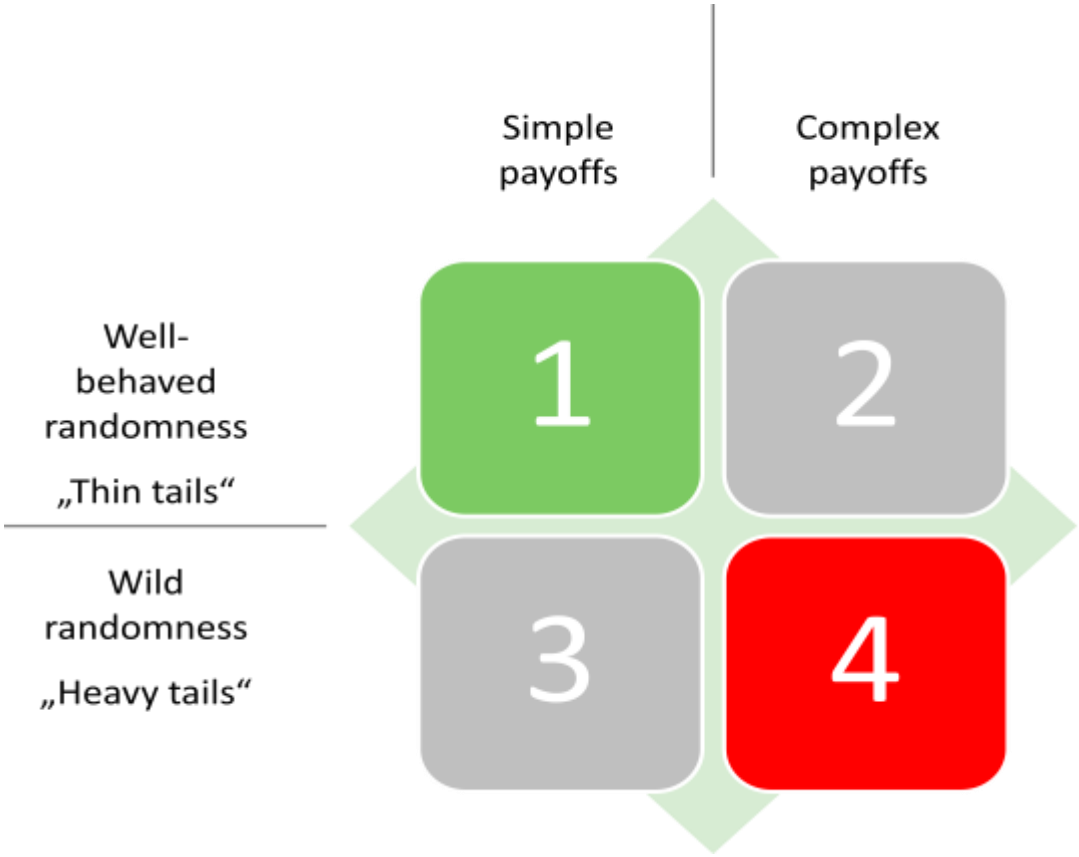
[34] An anecdotal evidence from history is that of the Australian black swan. Everyone in the United Kingdom believed that all swans are white until the Brits inhabitated Australia and discovered the black variety of swan. Not even centuries of observations are sufficient to discover the truth in some instances.

[35] Typically by distributions from the stable family of distributions that are mathematically well-tractable.

[36] I cordially recommend to curious reader the work of the late Benoit Mandelbrot, who devoted his lifetime to uncovering the riddles and miracles of randomness and chaos. It was him who made us aware of the various forms of randomness and what this implies for the way we behave.

distinguish between the *known unknown*, i.e. well-behaved and nicely tractable randomness such as gambling, and the *unknown unknown*, meaning those phenomena about which we will never be able to tell much in advance, only ex post. It is precisely this *unknown unknown* that is central to our notion of financial regulation robustness, which is understood as robustness to this *unknown unknown*. We cannot be surprised by unexpected events, as it happened recently. Instead, we have to be aware of the possibility of such events and have in place such measures and checks, that their occurrence does not cause as much damage as it did.

Figure 12: The Four Quadrants



Source: adapted from (Taleb 2010)

This complexity can be best illustrated using a simple division into quadrants. In the upper left quadrant, simple, or well-behaved and well-tractable randomness meets with simple payoffs. This is the case of e.g. gambling or other instances when odds and payoffs are known with certainty. The two greyed areas denote instances where a well-behaved distribution produces complex payoffs, or simple payoffs come from an unknown or heavy-tailed distribution. Both these cases are quite well manageable and ignorance of the properties of random events in these quadrants can have serious, but not devastating consequences.

The problem comes when we move to the fourth quadrant, where events with complex payoffs, such as incidence of natural disasters, armed conflicts, industrial catastrophes or financial shocks, come from an unknown distribution. These are precisely the events that have the largest and longest-lived impact on our society. When we apply our standard statistical methods in this domain, the outcome can be devastating, as in the case of recent financial crisis. What Taleb shows in his work is that we cannot hope to discover true properties of the distribution in this quadrant, or how he calls it, in "Extremistan" (Taleb 2010), either because no distribution exists or the problem of induction prevents us from doing so. Instead, we should strive for a society that would take these limitations into account and be robust to these Black swans, to the greatest possible extent.

Simple regulation should shield us from making mistakes of this type. In our approach to regulation, we should acknowledge the limits of our knowledge and incorporate these limits into regulatory architecture[37]. By acknowledging these limits, we can make the regulation robust to unexpected events, at least in the sense that our actions do not *amplify* the impact of such events. The world we live in is becoming increasingly more complicated and adverse events have proportionally more serious impact. Sticking to the methods we have been using so far can lead to a much more serious meltdown than the last crisis.

SIFI treatment and failure resolution mechanism

SIFIs have come under regulatory scrutiny in past months. There are a growing number of approaches considered to be implemented in order to safeguard the financial system from the systemic risk their failure poses. In our opinion, this issue must be resolved one way or another, because s*tatus quo* renders us virtually hostages in their hands. In order to diminish the fragility of financial sector, their influence on global financial system must be made substantially smaller. We shall now identify and discuss some of the most interesting possibilities how this could be achieved.

An almost obvious thing to do would be to tax these institutions and set up a failure resolution fund - mispriced government subsidies, implicit or explicit, contributed to the crisis (Acharya et al. 2011, p. 39). Despite its first-glance appeal, there are several drawbacks to this. First, how high should the tax be? Setting it too high could curb financial intermediation, too low would not guarantee enough funds. Second, this would give the banks another perverse incentive to gamble for increased profitability, knowing that their failure would be

[37] And to our behaviour in general. This is the "Black swan-proof" society Nassim Taleb describes in his work (Taleb 2010).

paid for from the fund. Increasing moral hazard is certainly not a good thing to do. Third, there is a concern about their international presence. How would the funds be divided between states affected by the failure? Or would there be an international pool shared by the countries?

Another avenue is to break the SIFIs into smaller, capitally independent units. This breakdown can be done in a variety of ways. First, we could reintroduce the Glass-Steagall-Act-type of regulation in some form. Traditional banks that finance real economy would be isolated from more risky operations involving securities underwriting, derivatives trading, hedge funds, proprietary trading and other similar activities. These Chinese walls worked surprisingly well during the most of the 20th century and withstood serious crises in the 70s and 80s. Second, carve-out these risky activities according to function and run them in ring-fenced entities that would isolate the core business of a bank from the impact of these operations. Third, limit the size of financial institutions to prevent any of them from becoming systemically important. As some authors argue, this would be the most elegant and market-oriented solution that would enhance stability, competitiveness and transparency at the same time (Acharya et al. 2011).

A separate issue that is outside the scope of this thesis is the international alignment of regulatory rules and failure resolution mechanism. Despite often reassurances about how important it is to make global players act in accord, there is a wide disparity between actions taken by them. As we presented above, some countries shall levy taxes on their SIFIs, some still do not have any measures prepared. Like protectionism in international trade, costs of regulatory fragmentation could be enormous if current model of home-host supervision of SIFIs prevails.

A new approach to banking regulation

In our opinion, a few simple rules[38] coupled with commitment on the part of the most important global political players could deliver spectacular results. The idea is to get out of the box of current approach. What we suggest, in line with some recent proposals, is to:

1) remove the too-big-to-fail institutions,
2) devise a truly global and enforceable regulatory framework,
3) force banks to have much more genuine equity on their balance sheets; and
4) change our perception of risk and its assessment.

In the following section, we discuss these in turn and present a possible remedy to problems that emerged over last decades. These include resolution of the too-big-to-fail problem, more

[38] Simple in their nature, certainly not simple to implement whatsoever.

equity as loss absorbent, revocation of prescriptive obligatory quantitative risk assessment, true global coordination and a major reconsideration of banks' role and position within a society.

Clearly, too-big-to-fail institutions turned out to be the curse of the financial system in this crisis. Their interconnectedness, size, ingenuity and global presence caused them to be immune to regulatory demands, bringing us on the verge of total financial collapse. Limiting their systemic importance in one way or another, as described above, is a necessary condition for making the financial system more robust to adverse events. If we do not achieve this, we dare to argue that nothing will save us from an even worse crisis than recently experienced.

Banks and other financial intermediaries much funded by much more equity and much less short-term debt[39]. More equity funding shall bring several advantages. First, it would provide the banks with a larger buffer to absorb losses. Second, more equity would force the investors to monitor the bank better and insist on prudential management. Third, by abolishing the variety of instruments eligible as equity under Basel III and limiting it to shareholders' equity, plus a form of contingent convertible instruments that would be converted into equity in predefined events, would disincentivize banks from seeking evasion from the rules by setting up various vehicles and conduits to shift the exposure off-balance sheet. The argument that more equity will cause its price to rocket is flawed – if banks become much safer and more stable in the medium-term, returns required by investors should decrease in proportion to that.

On top of the increased equity pile, a simple leverage ratio in force would give a very clear, even if somehow simplified, picture of the amount of leverage in individual institutions and the system as a whole. We see no real point in trying to measure and weight asset riskiness using artificial methods. As we could witness recently, when panic hits the market, assets considered to be safe and liquid quickly lose their perceived properties and become heavily correlated, contributing to a downward spiral of declining prices and fire sales triggered by the fall.

A crucial feature of simple regulation must be the commitment not to bail out failed institutions. This creates the most perverse incentives and most severe externalities in the system. This could be coupled on an international level with a commitment to SIFI failure resolution mechanism, if we do not succeed in treating them as described above. If this is not

[39] Mervyn King, Governor of the Bank of England, made the following point in 2010: *"The broad answer to the problem is likely to be remarkably simple. Banks should be financed much more heavily by equity rather than short-term debt. Much, much more equity; much, much less short-term debt"*

reached, there is still a possibility to force internationally operating banks to establish their cross-border units as direct subsidiaries that would fall under the host country supervision, and not branches that are outside the reach of the host authority, which can only ask the home country supervisor for information.

Third, cancel the obligatory quantitative risk assessment with prescribed form and processes. Basel treatment, as argued above, is profoundly flawed and has been proven inadequate for its task and easy to manipulate to the banks' favour. What we would like to see instead is a system where banks know that if they mismanage their risks, they will be punished for it. This will, however, only be attainable when the governments credibly commit not to bail the banks out in case of failure. Ideally, we would let banks devise their own risk assessment tools and calibrate them in-home. In our opinion, a functional and robust system can be arrived at using traditional risk management techniques, without the recourse to abstract tools that rely on untenable assumptions. Prior to the advent of quantitative risk management techniques, banks were able to manage their risks spectacularly well, despite the fact that the scope of globalization was much smaller than today. Nevertheless, we believe that returning to these rather simple principles shall make the financial system more robust. At the end of the day, a simple leverage ratio could perform very well, as we argued above.

Next, regulation must be made truly global in scope and, even more importantly, enforceable. It is absolutely clear that this will entail enormous costs and difficulties and will be very a hard goal to reach, but we are left with no other alternative, in fact. Without a substantially greater degree of international alignment we will be condemned for another crisis that can have much worse consequences rather soon, if we fail to address the SIFI issue in a way that would make global financial system more resilient to negative shocks.

In general, what we propose here is to stop and ask ourselves what a bank actually is. We have to remind ourselves of its basic functions, position within the economy and the privileged role banks play in it. Banking business and its regulation has gone a long way from the original "follow the cash", or "originate and hold" model, where banks aim for stable loan and deposit portfolios, to the business model witnessed during the last two decades. We should rather change our perception of the banking sector and perceive it more like utilities – business sector with lower but steady returns (Acharya et al. 2011). What is the most desired is to go back to the good old basics of banking business, when bankers were among the most conservative members of the society. This model worked very well for centuries and we think that an argument that this model has been overcome is not tenable anymore, after our recent experience. What we propose is not new to the traditional form of banking business at all, in

fact. Despite that, it requires a profound change of our perception, objectives and values, which is a very tough thing to accomplish. If we do not change our perception, we are most certainly condemned for a repetition of recent, or God forbid, even a more serious crisis.

6. Conclusion

This thesis was devoted to an assessment of new capital adequacy rules commonly known as Basel III. These react to recent global financial crisis and ensuing recession that uncovered serious flaws in regulatory approach that failed to account for most serious sources of risk. Banking sector was the originator of some of the most salient problems and Basel III aims to prevent this from happening again.

Our approach was twofold. Firstly, we tried to estimate the quantitative impact of new rules on four major Czech banks. To this end, we devised models for household and corporate default rate published by the Czech National Bank in its annual Financial Stability Report. Applying logistic transformation on the data, we estimated models of default rates using various macroeconomic data as explanatory variables. Both models exhibit a satisfying degree of fit. Model for household default rates shows an interesting characteristic. In this model, household spending index growth has a positive impact on default rates, i.e. these grow with growing consumer spending. Although this might be counterintuitive at first glance, we think this could be caused by the fact that households increase their pre-debt service consumption with growing income, not post-debt service. More research is needed in this area, since if this hypothesis were true, it would have important policy consequences, both for the banking sector and central bank.

Having estimated a model for household and corporate default rates, we applied these in Basel II/III regulatory capital formula to estimate risk weights of particular asset classes and used these as inputs in capital adequacy calculation, using 2010 data on banks' balance sheets. We had to make a few simplifying assumptions about banks' loan portfolios, namely we assume their homogeneity in terms of PD, LGD and maturity. We come up with three scenarios of economic development for the rest of 2011, namely the baseline, debt crisis and double-dip recession. Assuming constant capital structure of the banks, we find that only a quite sudden and severe recession return would force banks under the 10.5% total capital adequacy requirement foreseen by Basel III. Four major Czech banks would in this case fall to 9.5%, still meeting the 6.0% Tier 1 requirement. We conclude the chapter with an assertion that Basel III capital rules will not be of significant impact for major Czech banks, given their strong capital position and prudential lending policy.

We turn our attention to the institutional dimension of Basel III in turn. We are convinced that understanding institutional aspects of any regulation is absolutely crucial to our ability to draw up efficient and viable regulatory framework. In the first part of the chapter, we adopt

the neo-proceduralist approach to regulation assessment put forth by Ranjit Lall who uses a method of "process-tracing" to analyze regulatory process from the regulatory capture point of view. Based on that, we find that Basel III has successfully evaded the fate of its predecessor and is not a victim of regulatory capture.

On the other hand, as we argue further, Basel III will once again fail to meet its objectives, due to several reasons. First, it retains all the shortcoming and flaws of Basel II in terms of quantitative risk assessment. In our opinion, it is inherently impossible to use a prescribed, obligatory quantitative risk assessment approach in the increasingly complex and interconnected world we live in. We point to the long-know, but somehow forgotten, problem of induction that shows us our cognitive limits and the limitations we face in inferring true properties of certain variables solely from observations.

Next, Basel III combines inherently incompatible approaches to capital regulation. On the one hand, it retains the very complex internal ratings-based approach, whereby banks can devise their own models and risk assessment techniques, subject to supervisory approval. On the other, it proposes a very simple leverage ratio that utilizes unweighted assets as exposure measure. On a simple example we show what potential conflicts this dichotomy could produce and argue that it is not desirable to construct regulatory frameworks with such conflicting notions of capital adequacy. After that, we focus on challenges that remain to be faced by the regulators. In particular, we point to the problem of systemically important financial institutions. We argue that failure to resolve this issue can jeopardize regulatory reforms and stability and soundness of global financial markets.

In the end, we propose a synthetic approach to financial regulation. It is a combination of approaches that have one thing in common – financial sector's robustness to adverse shocks. We argue that our world has become so interconnected and complicated it is virtually impossible to predict its behaviour with results that are robust to the unforeseeable. We back our approach by an allusion to the Black Swan notion – we could see and learn the hard way recently, how rare, unforeseeable events with far-reaching consequences influence our lives. We believe that it should be our primary aim not to try to predict these events, as they are unforeseeable by their very nature, but rather try to build a society that will be robust to such events, at least in the sense that their occurrence does not cause a meltdown similar to that during the last crisis. In general, we have to abandon our current mindset and adapt it to the development of recent decade that proved our current approach wrong in several dimensions. If we fail to react to these challenges, we believe to be destined for a repetition of a similar, if not a worse crisis.

References

Acharya, V., Thomas F. Cooley, Matthew P. Richardson, and Ingo Walter. 2011. The Architecture of Financial Regulation. In *Regulating Wall St.* New York: John Wiley & Sons.

Akerlof, George. 1970. "The Market for Lemons: Quality Uncertainty and the Market Mechanism." *The Quarterly Journal of Economics* 84 (3) (August): 488-500.

BCBS. 1993. The Supervisory Treatment of Market Risk. Bank for International Settlements.

———. 1995. An Internal Model-Based Approach to Market Risk Capital Requirements. Bank for International Settlements, April.

———. 1999. A New Capital Adequacy Framework. Consultative Paper Issued by the Basel Committee on Banking Supervision. Bank for International Settlements.

———. 2001. Overview of the New Basel Capital Accord. Consultative Document. Bank for International Settlements, June.

———. 2004. Changes to Securitization Framework. Bank for International Settlements.

———. 2006. Basel II: International Convergence of of Capital Measurement and Capital Standards. A Revised Framework, Comprehensive Version. Bank for International Settlements, June.

———. 2009. Strengthening the Resilience of the Banking Sector. Bank for International Settlements, December.

———. 2010a. The Group of Governors and Heads of Supervision Reach Broad Agreement on Basel Committee Capital and Liquidity Reform Package. Bank for International Settlements, July.

———. 2010b. Basel III: A Global Regulatory Framework For More Resilient Banks and Banking Systems. Bank for International Settlements, December.

———. 2010c. Basel III: International Framework for Liquidity Risk Measurement, Standards and Monitoring. Bank for International Settlements, December.

Blundell-Wignall, Adrian, and Paul Atkinson. 2010. "Thinking Beyond Basel III: Necessary Solutions for Capital and Liquidity." *OECD Journal: Financial Market Trends* 2010 (1).

Bryant, John. 1980. "A model of reserves, bank runs and deposit insurance." *Journal of Banking & Finance* 4 (4) (December): 335-344.

CNB. 2008. Decree No. 123/2007 Coll., as amended by Decree No. 282/2008 Coll. CNB.

———. 2010. Financial Stability Report 2009/2010. Czech national Bank.

———. 2011. Inflation Report I/2011. Czech national Bank, April.

Danielsson, Jun, Paul Embrechts, Charles Goodhart, Con Keating, Felix Muennich, Olivier Renault, and Hyun Song Shin. 2001. "An Academic Response to Basel II." *LSE and ESRC Special Paper No. 130*, May.

Dewatripont, Mathias, and Jean Tirole. 1993. *The Prudential Regulation of Banks*. Cambridge, Massachusets: The MIT Press.

Dewatripont, Mathias, Jean Tirole, and Jean-Charles Rochet. 2010. *Balancing the Banks: Global lessons from the financial crisis*. New Jersey: Princeton University Press.

Diamond, Douglas W. 1984. "Financial Intermediation and Delegated Monitoring." *The Review of Economic Studies* 51 (3) (July): 393-414.

Diamond, Douglas W., and Philip H. Dybvig. 1983. "Bank Runs, Deposit Insurance and Liquidity." *Federal reserve Bank of Minneapolis Quarterly Review* 24 (1): 14-23.

Fama, Eugene. 1985. "What's different about banks?" *Journal of Monetary Economics* 15 (1) (January): 29-39.

Financial Times. 2010a. "Financials seek to soften Basel stance." *Financial Times*, April 11.

———. 2010b. "Intesa chief calls for clear rules." *Financial Times*, May 24.

———. 2010c. "G20 delay on Basel III bank curbs." *Financial Times*, June 4.

———. 2010d. "Banks are to get more time to implement new capitalrule." *Financial Times*, June 11.

———. 2010e. "Basel chief points to reform benefits." *Financial Times*, June 12.

———. 2010f. "Bank regulators reach deal on liquidity." *Financial Times*, July 26.

———. 2010g. "Is Basel III just like tightening monetary policy?" *Financial Times*, September 13.

———. 2011. "CDS options market multiplies alongside questions." *Financial Times*, March 28.

Freixas, Xavier, and Jean-Charles Rochet. 1994. *Microeconomics of Banking*. Cambridge, Massachusets: MIT Press.

Chiappori, Pierr-Andre, David Perez-Castrillo, and Thierry Verdier. 1995. "Spatial Competition in the Banking System: Localization, Cross-Subsidies and and the Regulation of Interest Rates." *European Economic Review* 39 (5) (May): 889-918.

IIF. 1993. Report of the Working Group on Capital Adequacy. Institute for International FInance.

———. 1997. Report of the Working Group on Capital Adequacy: Recommendations for

Revising the Regulatory Capital Rules for Credit Risk. Institute for International FInance.

———. 2010. Interim Report on the Cumulative Impact of Proposed Changes in the Banking Regulatory Framework. Institute for International FInance.

Jacklin, Charles. 1987. Demand Deposits, Trading Restrictions and Risk Sharing. In *Contractual Arrangements for Intertemporal Trade, Edward C. Prescott and Neil Wallace (eds.)*.

Jackson, Patricia. 1999. "Capital Requirements and Bank Behaviour: The Impact of the Basel Accords." *BIS Working Paper series* (1) (April).

Jackson, Patricia, Pamela Nickell, and William Perraudin. 1999. "Credit Risk Modelling." *Financial Stability Review* (6): 94-121.

Jakubík, Petr, and Christian Schmieder. 2008 "Stress Testing Credit Risk: Is Czech Republic Different from Germany?" *CNB Working Paper Series* (9/2008).

Jensen, Michael, and William Meckling. 1976. "Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure." *Journal of Financial Economics* 3 (4) (October): 305-360.

Kashyap, Anil K., and Jeremy C. Stein. 2003. "Cyclical Implications of the Basel-II Capital Standards." *Economic Perspectives* 28 (1) (November): 18-31.

Kingsbury, Benedict, Nico Krisch, and Richard Stewart. 2005. "The Emergence of Global Administrative Law" Law and Contemporary Problems (68): 15.

Krasa, Stefan, and Anne Villamil. 1992. "Monitoring the Monitor: An Incentive Structure for a Financial Intermediary." *Journal of Economic Theory* 57 (1) (June): 197-221.

Lall, Ranjit. 2009. "Why Basel II Faile and Why Any Basel III is Doomed." *GEG Working Paper* (2009/52) (October).

———. 2010. Reforming Global Banking Rules: Back to the Future? Paper prepared for seminar at the Danish Institute for International Studies.

Leland, Hayne E., and David H. Pyle. 1977. "Informational Asymmetries, Financial Structure and Financial Intermediation." *The Journal of Finance* 32 (2) (May): 371-387.

MAG. 2010a. Interim Report Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements. Bank for International Settlements, August.

———. 2010b. Final Report Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements. Bank for International Settlements, December.

Mandelbrot, Benoit. 1997. *Fractals and Scaling in Finance: Discontinuity, Concentration, Risk*. New York: Springer Verlag.

Mattli, Walter, and Ngaire Woods. 2009. *The Politics of Global Regulation*. Princeton:

Princeton University Press.

Miller, Merton, and Franco Modigliani. 1958. "The Cost of Capital, Corporation Finance and the Theory of Investment." *The American Economic Review* 48 (3) (June).

Pierson, Paul. 2004. *Politics in Time*. Princeton: Princeton University Press.

Risk. 2010a. "A crucial month for Basel III calibration." *Risk,* September.

———. 2010b. "The end of the beginning for Basel III." *Risk,* December.

Rose, Andrew. 1996. "Explaining Exchange Rate Volatility: An Empirical Analysis of the 'Holy Trinity' of Monetary Independence, Fixed Exchange Rates and Capital Mobility." *Journal of International Money and Finance* (15): 925-945.

Schoenmaker, Dirk, and Sander Oosterloo. 2007. Cross-border Issues in European Financial Supervision. In *The Structure of Financial Regulation, David G. Mayes and Geoffrey E. Wood (eds.)*. London: Routledge.

Skinner, Douglas J. 2008. "The Rise of Deferred Tax Assets in Japan: The Role of Deferred Tax Accounting in the Japanese Banking Crisis." *Journal of Accounting and Economics* 46 (2-3) (December): 218-239.

Taleb, Nassim Nicholas. 2010. *The Black Swan: The Impact of the Highly Improbable*. Random House.

Teply, Petr. 2010. Regulation of Financial Markets. Presentation at the University of Economics, Prague.

List of Appendices

Appendices

Appendix 1: Corporate Default Rate Model

Model: Logistic, observed values 2002:4-2010:4 (T = 29)
Dependent variable: dfrate_corp
yhat = 1 / (1 + exp(-X*b))

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-5.64395	0.760262	-7,4237	<0,00001	***
loans_GDP_4	23.7945	2.08848	11.3932	<0.00001	***
PPI	-2.10932	0.886071	-2.3805	0.02558	**
CZK_EUR_1	-0.0513604	0.016624	-3.0895	0.00501	***
Real_IR_1Y	-8.13634	2.37913	-3.4199	0.00225	***

Statistic based on transformed data:

RSS	0.287097	Regression std. error	0.109373
Coefficient of determination	0.975147	Adjusted coefficient of determination	0.971005
F(4, 24)	235.4210	P-value(F)	7.05e-19
Likelihood logarithm	25.77162	Akaike criterion	-41.54324
Schwarz criterion	-34.70676	Hannan-Quinn criterion	-39.40214
Rho (autocorrelation coefficient)	0.199687	Durbin-Watson statistic	1.502208

ARCH test of order 4 -
Null hypothesis: no ARCH effect
Test statistic: LM = 3.21651
with p-value = P(Chi-square(4) > 3.21651) = 0.522268

Residual normality test-
Null hypothesis: residuals are normally distributed
Test statistic: Chi-square(2) = 1.28147
with p-value = 0. 526904

Variance Increasing factors (VIF)
Minimum possible value= 1.0
Values > 10.0 might indicate a multicollinearity problem

loans_GDP_4	4.341
PPI	1.984
CZK_EUR_1	4.203
Real_IR_1Y	1.923

VIF(j) = 1/(1 - R(j)^2), where R(j) is a multiple correlation coefficient between variable *j* and other explanatory variables

Appendix 2: Household Default Rate Model

Model: Logistic, observed values 2007:3-2010:4 (T = 14)
Dependent variable: dfrate_hh_total
yhat = 1 / (1 + exp(-X*b))

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-10.1528	1.50159	-6.7613	0.00005	***
loans_GDP	3.59351	0.517422	6.9450	0.00004	***
GDP_growth	-1.51806	0.376222	-4.0350	0.00238	***
cons_spending_i	4.67282	1.1734	3.9823	0.00259	***

Statistic based on transformed data:

RSS	0.020324	Regression std. error	0.045082
Coefficient of determination	0.956454	Adjusted coefficient of determination	0.943390
F(3. 10)	73.21405	P-value(F)	4.16e-07
Likelihood logarithm	25.87997	Akaike criterion	-43.75995
Schwarz criterion	-41.20372	Hannan-Quinn criterion	-43.99657
rho (autocorrelation coefficient)	0.296732	Durbin-Watson statistic	1.386148

ARCH test of order 4 -
Null hypothesis: no ARCH effect
Test statistic: LM = 6.78566
with p-value = P(Chi-square(4) > 6.78566) = 0.147658

Residual normality test-
Null hypothesis: residuals are normally distributed
Test statistic: Chi-square(2) = 1.1587
with p-value = 0.560262

Variance Increasing factors (VIF)
Minimum possible value= 1.0
Values > 10.0 might indicate a multicollinearity problem
loans_GDP 1.560
GDP_growth 1.251
cons_spending_i 1.587

VIF(j) = 1/(1 - R(j)^2), where R(j) is a multiple correlation coefficient between variable *j* and other explanatory variables

Appendix 3: Model for Producer Price Index

Model: Cochrane-Orcutt, using observed values 2003:1-2010:4 (T = 32)
Dependent variable: PPI

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.00348151	0.0143568	0.2425	0.81004	
GDP	0.605528	0.196371	3.0836	0.00436	***

Statistic based on rho-differenced data:

Dependent variable mean	0.021125	Dep. var. std. error	0.032426
RSS	0.008423	Regression std. error	0.016756
Coefficient of determination	0.741766	Adjusted coefficient of determination	0.733158
F(1. 30)	9.508590	P-value(F)	0.004363
rho (autocorrelation coefficient)	0.235345	Durbin-Watson statistic	1.505135

Residual normality test -
Null hypothesis: residuals are normally distributed
Test statistic: Chi-square(2) = 0.269249
With p-value = 0.874044

ARCH test of order 4 -
Null hypothesis: no ARCH effect
Test statistic: LM = 3.8482
With p-value = P(Chi-square(4) > 3.8482) = 0.426939

Appendix 4: Model for the Household Loan-to-GDP Ratio

Model: OLS, using observed values 2007:3-2010:4 (T = 14)
Dependent variable: loans_GDP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.185207	0.00167445	110.6078	<0.00001	***
time	0.00718297	0.000196654	36.5260	<0.00001	***

Dependent variable mean	0.239079	Dep. var. std. error	0.030183
RSS	0.000106	Regression std. error	0.002966
Coefficient of determination	0.991086	Adjusted coefficient of determination	0.990343
F(1. 12)	1334.148	P-value(F)	1.14e-13
Likelihood logarithm	62.70079	Akaike criterion	-121.4016
Schwarz criterion	-120.1235	Hannan-Quinn criterion	-121.5199
rho (autocorrelation coefficient)	0.413430	Durbin-Watson statistic	0.813440

Breusch-Pagan heteroskedasticity test -
Null hypothesis: no heteroskedasticity
Test statistic: LM = 0.253791
with p-value = P(Chi-square (1) > 0.253791) = 0.614418

Residual normality test -
Null hypothesis: residuals are normally distributed
Test statistic: Chi-square (2) = 4.81927
With p-value = 0.0898483

ARCH test of order 4 -
Null hypothesis: no ARCH effect
Test statistic: LMF = 0.726583
With p-value = P(F(4.8) > 0.726583) = 0.59808