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Economic capital management of top-ranked world banks

Master's Thesis

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Declaration of Authorship

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

The author also declares the master's thesis was not published prior to submission and was not used to obtain another academic degree.

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Prague, 29 July 2011 Ondřej Vejdovec

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Abstract

Economic capital management of top-ranked world banks

The thesis is focused on economic capital management of top-ranked world banks. A basic theoretical framework is summarised at the beginning. The theoretical framework is then utilised in the main - empirical part. Since economic capital is not a figure commonly reported in any available database, we have created our own database based on annual reports of top fifty world banks of the year 2008. Based on this database we provide an extensive empirical study focused on years 2007-2010. Even though one third of the banks disclose economic capital only, thanks to our approach combining both quantitative and qualitative analysis we were able to study the topic in detail. Within quantitative part the development of economic capital and its allocation is studied, the differences between regulatory and economic capital in time is measured, a relationship between quality of economic capital disclosure and rating is searched for and relationship between the value of economic capital and changes in profits during financial crisis is studied. The qualitative part consists of case studies of fourteen banks. It is focused on special and unique features of economic capital management of individual financial institutions.

Keywords: economic capital, regulatory capital, risk management, risk allocation, rating, financial crisis.

Number of characters: 155,601

Bibliografický záznam

VEJDOVEC, O. Economic capital management of top-ranked world banks. Praha: Univerzita Karlova v Praze. Fakulta sociálních věd. Institut ekonomických studií. 2011. 104 pp. Vedoucí diplomové práce PhDr. Petr Teplý Ph.D.

Abstrakt

Řízení ekonomického kapitálu v nejlépe hodnocených světových bankách

Práce se zabývá managementem ekonomického kapitálu v nejlépe hodnocených světových bankách. V úvodní části je shrnut základní teoretický rámec problematiky, ze kterého pak vycházíme v hlavní - empirické části. Jelikož ekonomický kapitál není standardně vykazovanou položkou v žádné z dostupných databází, sestavili jsme z výročních zpráv top padesáti světových bank roku 2008 vlastní databázi o ekonomickém kapitálu, na jejímž základě byla pak provedena rozsáhlá empirická studie zaměřená na roky 2007 až 2008. Z bank ekonomický kapitál reportuje pouze přibližně třetina, avšak díky přístupu zahrnujícímu jak kvantitativní tak kvalitativní analýzu bylo možné problematiku detailně rozebrat. V rámci kvantitativní analýzy je sledován vývoj ekonomického kapitálu a jeho alokace, měřen rozdíl mezi ekonomickým a regulatorním kapitálem v čase, hledán vztah mezi kvalitou vykazování ekonomického kapitálu a ratingem banky a také vztah mezi výší ekonomického kapitálu a ziskovostí v průběhu finanční krize. Kvalitativní část se zaměřuje na případové studie čtrnácti bank, ve kterých jsou detailněji rozebrána specifika managementu ekonomického kapitálu jednotlivých finančních institucí.

Klíčová slova: ekonomický kapitál, regulatorní kapitál, risk management, alokace podle rizik, rating, finanční krize.

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Master Thesis Proposal

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Proposed Topic:

Economic capital management of top-rated world banks

Topic Characteristics:

The global financial crisis has shown that the risk management of banks (even the biggest ones) is far from being perfect and most of them have to improve the methods of its assessment.
In my diploma thesis I will analyse economic capital management of 50 largest world banks before, during and after the financial crisis.
I will describe the approaches to risk measurement and economic capital modelling in banking based on literature survey in the first part.
These approaches will then be used to assess the capital management of top-rated world banks, to find the major changes that occurred after the crisis and to find differences among the banks in the sample. Data from largest banks as well as from central banks will be used for the empirical analysis.
The results from the analysis will be discussed in order to find the recommendations for the future.

Hypotheses:

- There are significant changes in the economic capital as well as in the risk management methods of top-rated world banks when comparing figures before, during and after the crisis.
- The value of economic capital as well as the approach to its measurement differs among the banks in the sample.
- Banks with transparent approach to economic capital reporting are in general less vulnerable during the crisis.
- There were risk management and economic capital modeling methods proposed in literature before the crisis which, if used, would lead to lower losses.
- The qualities of regulation and corporate governance have significant impact on the quality and transparency of the bank's risk management.

Methodology:

Present research will be examined in order to find if there were proposed some new methods of risk management and assessment which were ignored by the banks before the crisis and implemented during or after the crisis. Time series analysis and other econometric methods will be used on real data from the banks in order to find the patterns in the sample and changes which occurred during and after the crisis. Comparative analysis (both qualitative and quantitative) of risk management methods of the banks in the sample will be provided. Several case studies will be provided. The aim is to show that if more advanced methods (shown in the literature already before 2007) of risk modeling were used, the impact of the crisis might have been different.

Outline:

1. Introduction
2. Theoretical background
   - 2.1. Risks in banking
   - 2.2. Economic capital modelling
   - 2.3. Global crisis
3. Empirical analysis
   - 3.1. Quantitative and qualitative assessment of top-rated world banks' capital management
   - 3.2. Discussion & Recommendations
4. Conclusion

Core Bibliography:

Chalupka, R., Teplý, P. (2008): „*Operational Risk Management and Implications for Bank's Economic Capital"*, Prague

Chorafas, D. (2006): "Economic Capital Allocation with Basel II", Elsevier, Oxford.

Dermine, J. (2009): „Bank valuation & value-based management: deposit and loan pricing, performance evaluation, and risk management." New York: McGraw-Hill

Dutta K and Perry J (2007): „*A tale of tails: An empirical analysis of loss distribution models for estimating operational risk capital*." Federal Reserve Bank of Boston, Working Papers No. 06-13

Hubbard, Douglas W. (2009): „*The failure of risk management: why it's broken and how to fix it." Hoboken, NJ: Wiley*

Mejstřík, M., Pečená, M., Teplý, P. (2008): „*Basic Principles of Banking"*, Karolinum press, Prague

Neil, M., Häger, D., Andersen, Lasse, B. (2009): „*Modeling operational risk in financial institutions using hybrid dynamic Bayesian networks*." The Journal of Operational Risk. London: Spring 2009. Vol. 4.

van Leyveld et al. (2007): "Economic Capital Modelling: Concepts, Measurement and Implementation", Laurie Donaldson, London.

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Supervisor

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List of Abbreviations

ABS	Asset Backed Securities
AMA	Advanced Measurement Approach
ANOVA	Analysis of Variance
BBVA	Bilbao Vizcaya Argentaria, S.A
BCBS	Basel Committee on Banking Supervision
BGI	Barclays Global Investors
BIS	Bank for International Settlements
BLB	BayernLB
BoM	Bank of Montreal
CAD	Canadian Dollar
CAGR	Compound Average Growth Rate
CHF	Swiss Frank
CIB	Corporate & Investment Bank (Deutsche Bank's division)
CI	Corporate Investments (Deutsche Bank's division)
CDO	Collateralized Debt Obligation
CS	Credit Suisse
DB	Deutsche Bank
ECO	Economic Capital
ES	Expected Shortfall
EUR	Euro
FDIC	Federal Deposit Insurance Corporation
GBP	Pound Sterling
GDP	Gross Domestic Product
HGAA	Hypo Group Alpe Adria
IFRI	International Financial Risk Institute
JPM	JPMorgan Chase & Co.
JPY	Japanese Yen
LB	Lehman Brothers
LBBW	Landesbank Baden-Württemberg
PCAM	Private Clients and Asset Management (Deutsche Bank's division)
RBC	Royal Bank of Canada
ROA	Return on Assets

ROE	Return on Equity
RAROC	Risk Adjusted Return on Capital
RARORAC	Risk Adjusted Return on Risk Adjusted Capital
SOA	Society of Actuaries
SoFFin	Sonderfonds Finanzmarktstabilisierung (German Special Financial Market Stabilization Funds)
UK	United Kingdom
USA	United States of America
USD	United States dollar
Var	Value at Risk

1 Introduction

The financial crisis has shaken the banking sector and has proven once again that regulation, risk and capital management are far from being perfect. Currently adopted third version of Basel Capital Accords, commonly referred to as Basel III, has dragged the attention of many financial economists and many interesting working papers studying the regulatory capital from different points of view have been written. We, on the other hand, contribute to these capital management debates in a different way – by an extensive study of economic capital management of top-ranked world banks.

In the first part of the thesis we provide a theoretical background. We summarise the theoretical framework of economic capital concept and provide an overview of key risks in banking and their management. Recent interesting literature focused on empirical study of risk and economic capital management is summarised as well. Development of the regulatory framework from Basel I to Basel III is briefly discussed because we needed some of the key concepts and categories to be defined as they are then used in empirical part.

Main part of the thesis is devoted to empirical analysis of economic capital management of top-ranked world banks. We have chosen top fifty world banks according to The Banker TOP 1000 as of July 2008. These banks are studied over the period from 2007 to 2010. Unlike regulatory capital, economic capital is not a commonly reported figure. We have therefore created our own data set from more than 250 banks' documents (annual and risk reports) which we went through. This data set is then studied from different points of view.

We focus on economic capital allocation and its change during the monitored period, relationship between economic capital reporting and rating, relationship between economic capital reporting and profitability, the overall development of our sample, differences in economic capital management among different banks and differences between regulatory and economic capital. The chapter is structured as follows: First, we describe the data and formulate six concrete hypotheses and suggested approach to their testing based on the above mentioned topics. Second, summary statistics on economic capital allocation and development is provided. Third and most extensive part is devoted to short case studies of fourteen banks which reported most details on their economic capital management. Special attention is paid to "as reported" economic capital allocation and explanation behind its changes, comparison of economic and

regulatory capital and risk management uniqueness. Fourth, we study relationship between economic capital and banks' performance using regression and correlation methods. Our findings regarding the tested hypotheses are summarised in the last section of the empirical part.

Based on the key findings we formulate the conclusion regarding the economic capital management of top-ranked world banks in the monitored period.

2 Theoretical Background

2.1 Economic Capital

2.1.1 History

The concept of economic capital has traditionally been contrasted with that of regulatory capital in Basel I or Basel II. It is evident that Basel II incorporated many elements of the concept of economic capital first introduced during 1980s and since then was more used as the statistical methods and computer technology developed. The whole approach is based on mathematics, statistics and highly sophisticated approach. These components are introduced in Basel II as well by incorporation of the internal models of the banks for all kinds of risks and by incorporation of broader range of risks which are taken into account for the capital requirement calculation. Basel II is therefore more realistic approach to estimation of real exposition to risks and resultant capital requirements.

Since its introduction in 1980s the models of economic capital have developed and changed substantially. First company to introduce its economic capital was JP Morgan. It was based on the company's financial statements for the year 1999. Currently each large company (especially in financial sector) uses some kind of economic capital approach for the risk management and decision making.

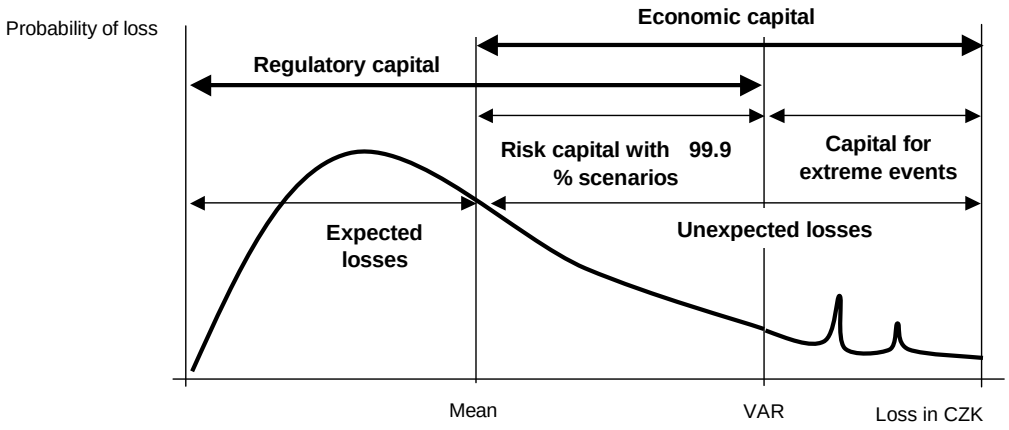
We say that regulatory capital is formula-based meaning that it is restricted by specific requirements. Economic capital, on the other hand, is very individual as many different definitions are used. Each bank or company uses individual definition according to its specific needs, quality of data or length of time series available, but it should hold that all kinds of risks which the bank is facing should be incorporated into the economic capital calculation method. Of course, the amount and intensity of risks differ among the banks. We therefore have to keep in mind that computations used in different banks are not fully comparable (Berg-Yuen & Medova, 2005).

2.1.2 Definition

Economic capital is such amount of capital which should cover all unexpected losses caused by the bank's risk exposure. The demonstration of economic capital with comparison to standard regulatory approach can be seen in Figure 1. We can see

that regulatory capital should cover both expected losses and unexpected losses excluding the extreme events. Economic capital, on the other hand, should cover all unexpected losses. Expected losses are accounted for in the pricing of the products as well as in loans provisioning.

Figure 1: Classification of bank's capital requirements according to risk



Source: (Chalupka, R.; Teplý, P., 2008)

Even though the basic intuition behind the approach might seem quite straightforward, no unique definition exists. Let us provide several definitions that appear in the literature.

Mejstřík, Pečená, Teplý (2008):

"Economic capital is a buffer against future, unexpected losses brought about by credit, market, and operational risks inherent in the business of lending money."

Alternatively, van Leyveld (2006):

"Economic capital can be defined as the amount of capital that a transaction or business unit requires in order to support the economic risk it originates, as perceived by the institution itself."

Alternatively, Chorafas (2004):

"The amount necessary to be in business – at a 99% or better level of confidence – in regard to assume risks".

Alternatively, Mueller & Siberón (2004):

„Sufficient surplus capital to cover potential losses at a given risk tolerance level, over a specified time horizon."

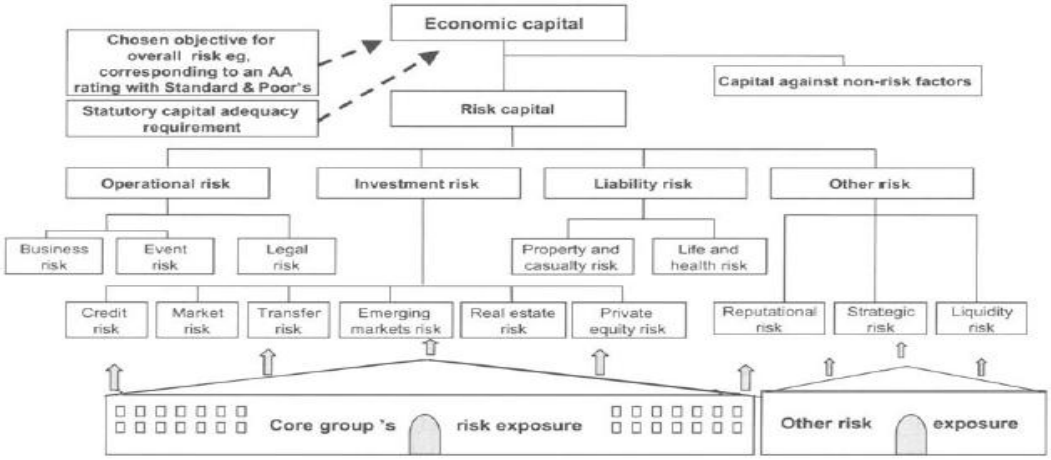
And finally, BIS definition (BCBS, 2009):

„Quantum of capital that a firm determines is prudent, desirable and achievable over the long term in the absence of regulatory requirement."

The risk tolerance mentioned above (or alternatively the loss threshold) is important in connection with the probability of default. Economic capital is in fact a calculation of the amount of additional assets needed for reduction of the probability of default to the level specified by the management, which mainly reflects the demanded rating of the company.

It is important for the top management of the bank to take part in the decision making about the level of required economic capital and about the logic of the computation. This concept is part of the broader bank's strategy and in fact influences for example pricing policy. The basic logic behind the concept of economic capital as it has been presented by Berg-Yuen & Medova (2005) can be seen in the figure below. We should mention that we use a slightly different breakdown of risks in banking. It is presented in the chapter devoted to main risks in banking. Differences in risk breakdown, though, do not change the main idea behind the economic capital framework.

Figure 2: An overview of an ECO framework



Source: (Berg-Yuen & Medova, 2005)

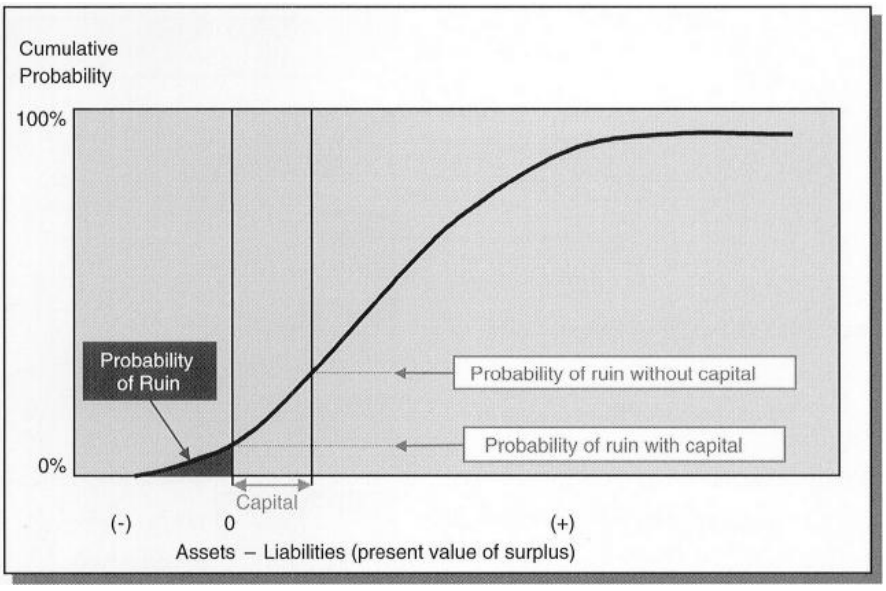
The economic capital must cover capital requirements of all risk factors - credit, market, operational and other risks (such as liquidity, reputation, strategic and others). Furthermore, it has to cover non-risk factors which were not included in the previous items. Another important building block is the bank's target rating and overall risk profile. The quality of bank's internal models of required economic capital based

on internal evaluation of the risk position play then crucial role for the calculation of so called risk capital which includes all possible risk factors. The lowest level of economic capital naturally should be the minimum regulatory capital[1]. The risk capital is calculated in the statistical model as a difference between some arbitrarily chosen (usually very low) quantile of the profit and loss distribution and its expected value, so-called unexpected loss. *More generally, risk capital is measured to a specified confidence level based on a predefine solvency standard and debt ratings over a given time horizon* (Berg-Yuen & Medova, 2005).

Main problem of the calculation cause the unexpected losses and more specifically the extreme events (see the right hand side of the distribution in Figure 1 again). These high losses are hard to model as they have a very low probability and real data cannot be easily applied. As we said, the main features of the model as well as the given confidence level should be set by the top management in cooperation with the owners and other investors and are usually different in each financial institution. Concrete assumptions, data sets and models are part of the know-how and usually are considered private and confidential.

An alternative image of economic capital in comparison with the value of probability of default with and without capital can be seen in the following figure. It is straightforward that the probability of default decreases with the increasing capital.

Figure 3: The probability of default



Source: (Mueller & Siberón, 2004)

[1] As we will see in the empirical part, this is not true in real life.

2.1.3 Practical Application of Economic Capital

As mentioned above, economic capital is widely used mainly by financial institutions. However, as we will see further, not nearly all (top) banks report economic capital in their annual reports, web pages or other publicly available official documents.

One of the purposes of the economic capital is to cover extreme unexpected losses. They occur with extremely low probability (e.g. once in thousand years). Here the banks have to take into account the market value of the capital rather than the book value. The assumption of normal distribution seems unrealistic at the same time. This can be demonstrated for example on the simple *distance-to-default* ratio which is calculated as accounting capital divided by net profit volatility (measured by standard deviation). If we take into account that the distance is usually between 29 and 30 (Gebhart, 2008), it would result in extremely low probability of default under the assumption of normal distribution. The importance of choice of a meaningful loss distribution for each risk category is further discussed in one of the chapters below.

Furthermore, three more issues have to be taken into account (Gebhart, 2008):

- It is very complicated to model loss events on a 99.9% or even 99.97% confidence level, because we do not know and cannot predict the behaviour of the variables under such circumstances. If we, for example, look back approximately 100 years, the greatest plunge took place during the Great Depression. This is situation of 99% confidence level which does not tell us anything about our possible expectations on 99.9% confidence level (assuming time horizon of 1 year). It might be therefore better to focus on losses which can be reasonably modelled, i.e. 95% confidence level (worst situation in 20 years).
- It is questionable to hold the managers responsible for losses which occur once in hundred or thousand years. They would probably argue that given situation was caused by a systemic risk that affected everyone and was impossible to predict
- It is impossible to calculate these extreme losses which take place once in thousand years. Even if that was possible, it would be extremely complicated to assign them some significant statistical probability.

Therefore, it might be more plausible to focus on shorter intervals (20 years), which can be statistically processed and verified. The managers can also bear responsibility for results in these intervals. On the other hand, such interval might not be sufficient for the risk management's effort to optimize the risk profile of the bank in a long run.

Economic capital serves as a tool of efficient allocation of capital and profitability assessment. Banks have to calculate the costs of capital which are then allocated to individual financial products and departments and they have to allocate the costs of economic capital as well. This helps to interconnect the valuation of unexpected losses (incorporated in the economic capital) with the final prices of different products. Costs of capital play crucial role for the calculation, but for the whole process of financial management and controlling, which should lead to maximization of the market value of the bank (BCBS, 2009).

Several ratios and indicators were developed in order to express the profitability in more precise way than ROA or ROE, which do not reflect the exposure to risk of different departments or products. It is necessary (especially for the banks) to incorporate the risk to calculation of returns and capital of each department or product. Each department can be then responsible for allocated part of the capital. One of the more sophisticated ratios is RAROC (risk-adjusted return on capital) which can be compared to costs of capital in order to find whether given department contributes to creation (RAROC higher than costs) or destruction (RAROC lower than costs) of the value of the company. When we consider marginal figures, market value of the bank is increased if an additional contract brings higher or equal RAROC than costs of capital.

RAROC can be defined as:

$$\mathrm{RAROC} = \frac{\mathrm{Risk-adjusted\,Re\,turn}}{\mathrm{Risk-adjusted\,Capial}} = \frac{\mathrm{After-tax\,Contribution}}{\mathrm{Total\,Economic\,Capital}}$$

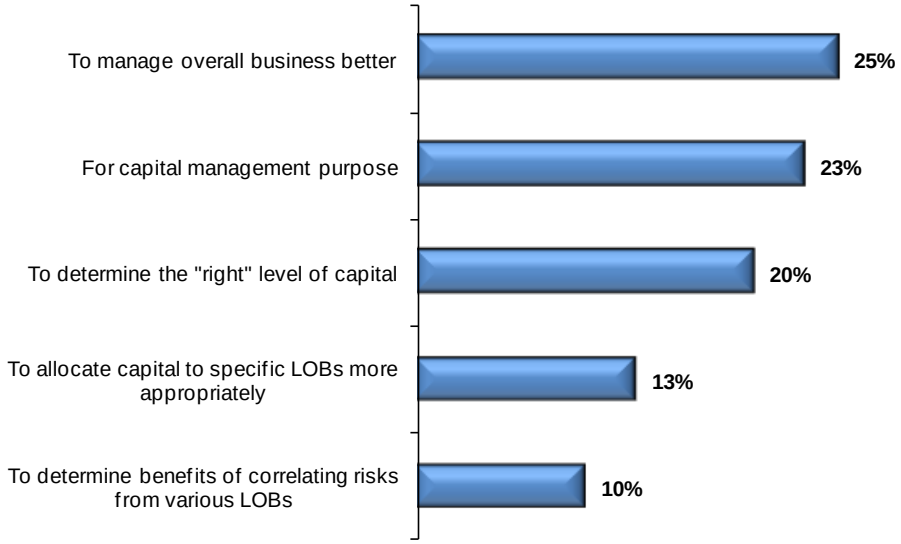
Other more sophisticated ratios are for example: RARORAC (risk-adjusted return on risk-adjusted capital), where the capital is adjusted according to guidelines as outlined by the Basel II; or RORAC (return on risk-adjusted capital), which is similar to RAROC, but the return is not adjusted for risk.

When we come back to uses of economic capital, following 5 responses were most frequent among the audience poll at SOA Survey on Economic Capital (Society of Actuaries, 2004). See Figure 4.

To conclude the chapter we would like to summarize the information on economic capital (Gebhart, 2008):

- ECO is a standard that helps us to monitor risks in the whole company
- ECO is focused on real/market/economic values, not on book values
- ECO covers all risks which the company/bank faces
- ECO is in compliance with the company goals (such as target rating)
- ECO is "tailor made" to each company/bank
- ECO is forward looking

Figure 4: Uses of economic capital - top five answers



Source: (Society of Actuaries, 2004)

2.1.4 Basic Approaches to Modelling and Management of Credit and Market Risk

In this part we will introduce some principals of credit risk modelling as well as differences from models of market risk. Modelling of credit risk has some typical specifics, which are briefly described in the following text.

The biggest development in mathematical and statistical methods used for credit risk modelling took place in last ten years. In many aspects the philosophy of the models is based on market risk models which have longer tradition than credit risk models. This can be attributed to availability of data and better quality of the data

needed for market risk modelling. On the other hand, the credit risk models have to capture a very specific data. These data are mainly defaults, credit quality upgrades or downgrades and their probabilities. All this is then used in analysis of impacts of different states of the world on the value of the portfolio.

The basic building block for the models is usually Value-at-Risk applied to data collected on credit risk. However, it is important to emphasize that no matter how sophisticated methods of assessment are, they cannot substitute a long experience and a professional evaluation and judgment. Development is stock prices is directly observable in the market (at least for publicly traded companies) and changes in the prices are directly reflected in the value of given portfolio. Credit risk models, on the other hand, cope with the problem that volatility of the credit portfolio caused by a change of the credit quality is not directly observable in the market. In the credit risk models, we are therefore not looking for a distribution that would be most suitable for the development of the market prices, but we are rather trying to construct a model which would best project the change in given risk factors into the value of our credit portfolio.

Main input data for the credit risk model are:

- Probability of default and changes in the credit rating – the so called migration analysis;
- calculation of the true risk exposure, which might be complicated for example with derivatives;
- estimate of residual value and/or recovery rates;
- correlation coefficients of variation of the credit quality of the portfolio and creation of transition matrices between rating groups.

The principal assumption is that the distribution of the data on credit risk is not normal (Gaussian). This is primarily due to fundamental characteristics of the development of the value of credit portfolio, i.e. high probability of a relatively small profit against relatively low probability of losses, which are much higher. The growth of the portfolio value is limited (by for example interest on credit), whereas the decrease of portfolio value can be up to 100% of the initial value, or its market value if this can be found out or estimated.

Another problem compared to market risk modelling is that the necessary correlation coefficients can hardly be calculated using frequent data from the liquid market, as it is possible with the data available for market risk. Data on defaults or changes in credit quality are not directly observable and at the same time these are usually illiquid markets.

Portfolio approach and selected credit risk models

A traditional approach to credit risk management is in suggestion of suitable system of limits of credit exposure to counterparty and its regular review. Furthermore it includes the classic process of credit approval including financial analysis, qualitative analysis and further quantitative analyses. These processes are still widespread and play important role in risk management. However, especially on the level of portfolio management the increasing role of modern approaches based on mathematical and statistical methods can be observed in last decade. These models usually seem like a "black box", however they, if properly used and reasonably interpreted, provide us with valuable data for example on a risk of excessive concentration or a marginal risk, i.e. analysis on how individual instrument contributed to overall diversification of the portfolio.

Two main groups of models are usually distinguished:

1) Structural approach to credit risk modelling:

An example of this type of model is CreditMetrics™ (JP Morgan, 1997) developed by JP Morgan in cooperation with other banks. It is based on assumption that a default occurs under the condition that some variable (e.g. assets at market prices) falls below a certain threshold (liabilities). CreditMetrics™ extends this idea for a credit rating and a migration analysis, i.e. the transition between different ratings depending on the cross-correlations – so called transition matrix. It is therefore focused not only on analysis of default, but on the overall development of the quality of a credit portfolio.

2) Reduced form of credit risk modelling:

In this type of models the risk is modelled as an independent stochastic variable which is not interlinked with any variable as capital structure or asset value. An example of this type of modelling is CreditRisk+ introduced by Credit Suisse, which models the average number of defaults in each homogenous sample of debtors under the

assumption of Poisson distribution. Both above mentioned models use the method Value-at-Risk in order to calculate the risk or capital requirements (BCBS, 2009).

The principle of economic capital calculation is similar: based on the significance level are the unexpected losses covered just by economic capital. However, economic capital is not only for coverage of credit risk, but all risks in bank which we mention below in next chapters. The two above mentioned models are not the only to appear in the last years. Well known is for example Moody's KMV (MKMV) model or McKinsey's CreditPortfolioView model. According to BIS data, MKMV, CreditMetrics and CreditRisk+ are used by majority of banks (BCBS, 2009).

2.1.5 Overview of Recent Literature on (Economic) Capital Management

Interesting working papers focused on empirical studies of use of economic capital as well those focused on a theory behind were published mainly before financial crisis. Among the most cited and interesting papers we should name Berg-Yuen & Medova (2005) study focused among other topics on the quality of reporting. This paper has motivated us to perform more extensive empirical study. Mueller & Siberón (2004) have canducted a study focused on use of economic capital and provided intersting theoretical background inlcuding the summary of most known models. Society of Actuaries (2004) and its Economic Capital Calculation and Allocation Subgroup, where both of the above metnioned authors participated, provided a guide on economic capital with both empirical study and theoretical background. International Financial Risk Institute and the Chief Risk Officers' Forum have conducted a study among 33 financial institutions (17 banks and 16 insurers) focused on economic capital usage and allocation in 2006 (IFRI Foundation, 2007). The main findings were that economic capital was becoming a core part of the financial steering and management of banks and insurers. Core approaches convergence in some areas and prevailing diverse approaches to diversification were identified at the same time. More complexly is the topic of economic capital summarized both from theoretical as well as practical point of view by Chorafas (2004) or Leyveld (2006).

Elizalde & Repullo (2007) analyzed the determinants of regulatory and economic capital on a theoretical basis and showed that there does not exist a direct relationship between both capital levels as they depend on different variables.

The model is based on a theoretical bank whose loan default rates are derived from the single-risk-factor model that underlies the capital charges in the internal rating based approach of Basel II. They come to conclusion that the effects on the banks' capital structure of policies aimed at increasing market discipline may be very limited. Ngo (2008) studied an interesting paradox connected to both regulatory and economic capital: Banks are almost always oppose to stricter formal requirements suggesting that holding additional capital is costly and therefore decreases profitability, but continue to maintain capital levels well above those officially required by the authorities. He argues banks' capital-risk profiles are are endogenously determined within a profit maximisation process, because otherwise why would they deviate from the regulatory minimum? At the same time, regulatory capital management diverts the banks' attention from performing the primary functions – managing economic capital. However, the economic capital is measured as equity to asset ratio in the paper which (as we present below in the empirical part) might lead to different result as economic capital is almost always different from equity in reality.

It is interesting, that the relationship between the economic capital and a targeted rating is often mentioned in the literature (the link through chosen confidence levels). To the contrary, as we show below, the correlation between the level of economic capital and rating is insignificant.

The attention of the authors has in general diverted to regulatory issues during and after the crisis mainly due new Basel Accord (Basel III) currently being introduced. The economic capital itself is not currently in the limelight as it was five or six years ago. Even though a brief description of the regulatory framework evolution is provided below, we would like to name a few interesting papers which strive to estimate the impact of new regulatory framework on the banking sector trying to evaluate the costs and decreases in revenues for the banks. McKinsey & Company estimated the capital requirements of the European (US banks in the parenthesis) banks to increase in a following way by 2019: about €1.1 trillion ($870 billion) of additional Tier 1 capital, €1.3 ($800 billion) trillion of short-term liquidity, and about €2.3 trillion ($3.2 trillion) of long-term funding, absent any mitigating actions. The decrease in return on equity is estimated to about 4 percentage points in Europe and about 3 percentage points in the United States for the average bank (McKinsey & Company, 2010). The changes in regulatory framework will have some macroeconomic impacts as well.

Marzinotto & Rocholl (2010) estimated the range of macroeconomic costs from 0.2 percent to 1.5 percent of GDP for each percentage rise in the capital ratio.

Besides calcutlating the costs for the banking sector or total macroeconmic impacts some authors go even further and criticise the regulation system. For example Lall (2009) argues that Basel II failure was a result of regulatory capture, when small group of strong international banks were able to take control over the process. He sees the same problem in case of Basell III and argues it is likely to meet the same fate. Oliver Wyman, an international management consulting firm, present even more sceptical view on the current regulatory changes in their *State of the Financial Services Industry 2011* report (Oliver Wyman, 2011). They argue that next financial crisis will come in a few years. The reason is that banks are under pressure of stricter regulation and at the same time the shareholders do not want to decrease their profits due to increased capital requirements. Therefore, the banks will be forced to start risker projects on emerging markets and seek for other opportunities for easy profits in such way that it will create new bubbles on different markets. This process will lead to similar crisis as we experienced in 2007/2008. One might come to similar conclusion from the empirical part presented below.

As the regulatory capital is in the limelight nowadays, the motivation behind our empirical part was therefore the lack of complex empirical study of economic capital management from recent years as we felt that the financial crisis gave us a unique opportunity to study the topic from a different perspective.

2.2 Regulatory Framework Development: Basel I - Basel III

During the last decade we have witnessed a tendency towards economic and regulatory frameworks convergence. This tendency was mainly visible in Basel II. However, due to different nature of both frameworks they will probably never converge absolutely, even though some banks have already taken some steps to align their economic capital to regulatory framework (e.g. Nordea). This thesis is not focused on the regulatory issues but we compare the economic capital figures to regulatory capital ones in several chapters of the empirical part. It is therefore necessary to provide a brief overview of key categories. As we deal with years 2007-2010, both Basel I and II are concerned. Basel III and its future impact on the banks are also discussed very often in the individual annual reports. We therefore provide a short overview of the regulation development together with definition of key terms.

First Basel Accord came into effect in December 1992 after development since 1988. Its aim was to maintain enough capital to absorb losses without causing systemic problems, and second, to level the playing field internationally to avoid competitiveness conflicts (Blundell-Wignall & Atkinson, 2010). Minimum capital requirements were set to 4% for Tier 1 capital (defined roughly as equity minus goodwill) to risk-weighted assets (RWA) and 8% for total regulatory capital (Tier 1 + Tier 2 consisting of certain subordinated debts, general provisions, revaluation reserves and undisclosed reserves) to RWA. The calculation of weights for RWA was extremely simple, fixed and calculating with credit risk only.

Basel I was criticised from the beginning as it allowed the banks to control the amount of capital they required by shifting between on-balance sheet assets with different weights, and by securitising assets and shifting them off balance sheet. Banks quickly accumulated capital in excess of the regulatory minimum and capital requirements, which, in effect, had no constraining impact on bank risk taking (Blundell-Wignall & Atkinson, 2010). Revised framework (known as Basel II) was therefore released in 2004 (in force since 2008).

Basel II introduced three pillars concept. First pillar deals with the capital adequacy. Second pillar is aimed to supervisory review process and gave regulators more powers to stress test and guide the banks. Third pillar relies on disclosure and market discipline. First pillar is the most important for our purposes and we therefore provide an overview of the main changes from Basel I. First, three main risks are newly accounted for: credit, operational and market risks. For the RWA calculation, banks are allowed to use simplified standardised approach (with fixed weights, different from Basel I weights)[2], standardised approach based on external ratings or advanced internal rating based approach for sophisticated banks. Second, Tier 3 capital has been introduced as a short-term subordinated debt covering only a part of market risk. Third, the total capital requirement remained at 8% of the RWA with Tier 1 representing at least 50% of this capital. As the banks reported under Basel I until 2007 capital (adequacy) figures are not fully comparable with the subsequent years. It is therefore important to be aware of the differences.

[2] It is worth noting that the weights were surprisingly lower in Basel II compared to previous accord. For example risk weight to mortgages decreased from 50% to 35%.

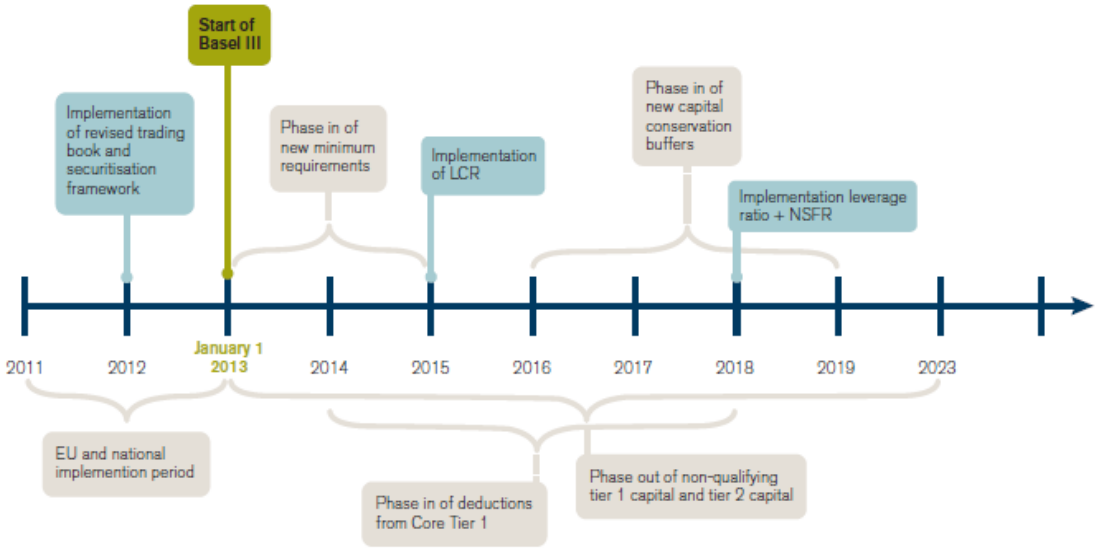
Basel II framework has revealed its weaknesses during the crisis and a significant reform has therefore been prepared again. For the main problems of Basel II you can refer to (Blundell-Wignall & Atkinson, 2010).

Towards Basel III

In the end of 2010 the leaders of G20 approved significant reforms proposed by the Basel Committee on Banking Supervision. These reforms will impose some changes to the existing capital rules and newly introduce global liquidity standards. Their aim is to strengthen the financial system by improving the quality, consistency and transparency of the capital base of the banks in order to better absorb losses and promote resilient banking sector (The Bank of Nova Scotia, 2010).

New Basel III includes three key initiatives which should improve the current regulation. They can be divided into three categories – revised capital regulation, new leverage regulation and a new liquidity regulation. Each of them is described below and the Figure 5 shows how the new rules will be phased in.

Figure 5: ***Overview of the Basel III implementation and transitional arrangements***



Source: (Nordea, 2010b)

Revised capital regulation consist of increased quality of, consistency and transparency of the capital base – the rules for eligible Tier 1 and Tier 2 capital will be stricter and Tier 3 will not be eligible. The risk coverage in RWA framework is further strengthened, capital charges are increased and several new risk categories are

introduced. Minimum capital requirements are increased and new capital buffer requirement is introduced. The Tier 1 ratio must be at least 6% and a total capital ratio 8%. Furthermore, the banks have to hold 2.5% conservation buffer on top of the minimum requirements. If the bank does not hold this buffer constraints will be imposed on the capital distribution (dividend distribution). Besides that, in periods of high credit growth, banks will be required to hold additional countercyclical buffer between 0 and 2.5% (Nordea, 2010b).

A new leverage ratio is introduced representing the endeavour of Basel Committee to involve a non-risk measure in the regulatory framework. It will be calculated as a Tier 1 capital divided by the exposure (both on and off balance sheet with some adjustments for example for derivatives). Minimum ratio of 3% will be evaluated in coming years and based on the final adjustments will become a legally binding restriction in January 2018 (Nordea, 2010b).

In order to improve the banking sector's ability to absorb shocks and reduce the risk of spill-over from the financial sector to real economy new liquidity regulations are introduced mainly being focused on internationally active banks. Liquidity coverage ratio *"aims to ensure that a bank maintains an adequate level of unencumbered, high quality assets that can be converted into cash to meet its liquidity need for a 30-day time horizon under an acute liquidity stress scenario"*. Net stable funding ratio *"establishes a minimum acceptable amount of stable funding based on the liquidity characteristics of an institution's assets and activities over a one year horizon"* (Nordea, 2010b). Basel Committee introduced a 5 year observation period until 2015 when the final version of this arrangement will be introduced and then it will come in force in 2018 (again, please refer to Figure 5 for the phase-in details).

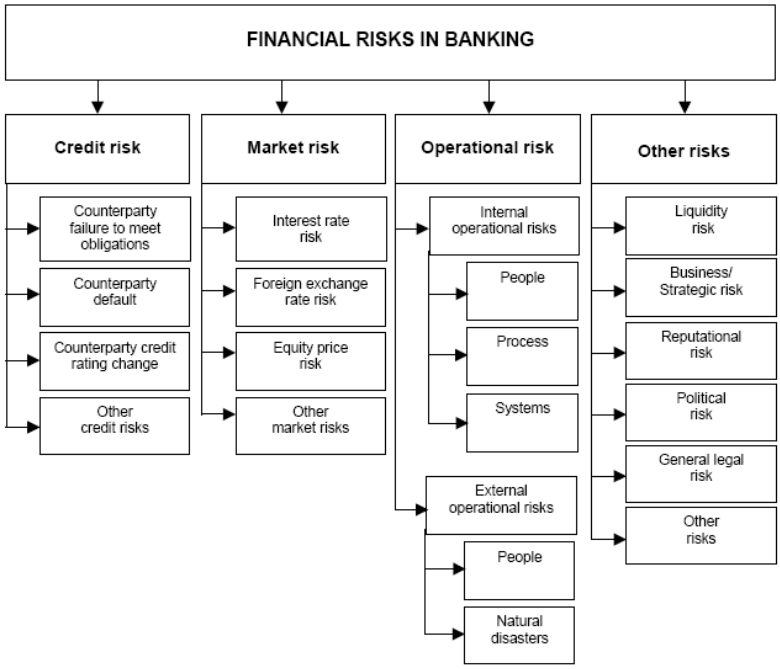
New regulations are also approaching the insurance segment under the name Solvency II which is expected to be in force in 2013. We mention this only due to the fact that many of the large banks, which we are coping in the empirical part, are partially active in the insurance segment as well.

2.3 Main Risks in Banking

In general, a risk is connected with uncertainty about future development. Usually, risk is defined as a possibility of deviation of achieved outcome from expected outcomes. Such deviation does not have to have necessarily negative impact. We take into account any difference from expected values/outcomes. The financial risks in

banking can be divided into four main groups: Credit risk, Market risk, Operational risk, Other risks. We can see and overview of financial risks in banking in Figure 6. More detailed description of each group of risks will be then provided in following text.

Figure 6: Financial risks in banking



Source: (Černohorský & Teplý, 2011)

2.3.1 Credit Risk

Credit risk is probably the most important risk which a commercial bank has to face. In general, it is a probability of loss caused by the counterparty's default to meet the contracted obligations either because unwillingness or inability to pay (insolvency). The value of bank's credit portfolio is changed as a result of counterparty's default to meet the obligations or such changes of market conditions which lead to inability of a counterparty to meet them. Therefore we are discussing a volatility of value of a given credit portfolio from expected value.

The risk of each asset can be evaluated only in connection with evaluation of other assets in a given portfolio. This means that the risk of a portfolio does not depend on separated evaluation of each asset's risk, but also on evaluation of factors "in the background" which jointly affect all the individual assets. The credit risk is diversifiable, however only partially, because part of the risk might be caused by systemic factors, which means that there is a certain level of risk under which the total credit risk cannot be decreased.

It is necessary to take into account the interconnection of market and credit risks. This should lead to creation of integrated model, which would help to estimate the changes in values of the portfolio. The relationship between credit and market risks can be illustrated for example on a change in interest rates having influence on a future development of debt service.

Similarly important is the relation between credit risk and bank's liquidity. The debt which is not serviced properly has negative impact on bank's cash flow and illiquid asset (unpaid loan) is financed by deposits, which however represent the outflow of cash due to paid interest expense.

The credit risk might have serious impact on a profit. In case of default of the debtor the bank is forced to create reserves which through cost items negatively influence the net profit as well as lower income caused by unpaid interest.

Credit risk can be divided in a following way (Gebhart, 2008):

- **Counterparty credit risk** is the most important. It represents the risk that the counterparty will not meet obligations with respect to relevant balance sheet items.
- **Risk of credit equivalents** is the probability of loss caused by the default of the counterparty to meet the obligations with respect to off-balance items, i.e. guarantees, documentary letters of credits, derivatives, etc.
- **Settlement risk** represents the risk that the transaction will fail during the settlement. It happens when some value was transferred to counterparty, but the counter-value is not available yet, or in case technical problems interrupt the settlement. It is usually connected with transactions where securities or currencies are involved.
- **Exposure risk** arises when the bank's credit portfolio is overly exposed towards some parameters, counterparties, related entities, industries or even countries.

2.3.2 Market Risk

Market risk is usually the second most important risk category in terms of capital requirementst. This risk stems from the probability of loss caused by the adverse change of market prices of financial instruments or commodities. We distinguish three principal categories of market risk (Černohorský & Teplý, 2011):

- **Interest rate risk** represents the probability of loss from price changes of instruments sensitive to interest rate movements. Risk factor of interest rate risk is the currency and maturity of given financial instrument. If value of the instrument with same risk factor is the same in assets and liabilities the bank is not exposed to interest rate risk as the positions compensate each other and we call it closed position. In case the values of such instruments with the same risk factor are different we call it open position. Interest rate risk can be further divided into specific interest rate risk and general interest rate risk. Specific interest rate risk is covered in credit risk within the bounds of capital adequacy and it is related to worsening of financial situation of concrete issuer of financial instrument. General interest rate risk, on the other hand, is connected with the whole economy and each subject is exposed to it because it is determined by macroeconomic conditions.
- **Equity price risk** is the probability of loss from adverse changes of prices of instruments sensitive to equity (share) price movements. Same as in case of interest rate risk it can be divided to specific equity price risk connected to concrete issuer and general equity price risk which is related to whole economy.
- **Foreign exchange rate risk** is related to change of values of instruments sensitive to foreign exchange rate changes.

Other market risk can be sometimes distinguished, such as correlation risk (sometimes called basis risk). It is the danger stemming from potential violation of historical correlation between specific risky assets or categories (e.g. the value of an underlying asset does not follow precisely the rate of futures).

2.3.3 Operational Risk

Operational risk is another important risk category. It is specific because efficient operational risk management requires cooperation of all bank's staff. The top management is responsible for the strategy of management of all risks, including operational risk. They also have to create the right conditions for a functional and efficient control system. The risk management department then develops and reassesses

the efficiency of used methods and instruments. However, the effective management of operational risk requires cooperation of each and every employee of the bank. Each department and employee has to have clearly defined competencies and responsibilities. A simple mistake during identification of a client at the cash desk might lead to significant loss caused by an unauthorized withdrawal.

Operational risk can be divided into internal and external operational risks. Other potential breakdown in three main categories is following (Gebhart, 2008):

- **Transaction risk** is connected with a probability of loss from transactions caused by miscellaneous mistakes, such as mistakes during clearance of the transactions, mistakes stemming from excessive complexity of the product and others.
- **Operational management risks** stem from potential mistakes of the management as a result of unclearly defined competencies and insufficient control which might lead to unauthorized transactions and system access, transactions above the limits or even embezzlements.
- **Systems risk** is connected with a probability of loss caused by mistakes in supporting systems. Here, we consider errors in data transmission, in computer programs or mathematic/statistic models, which lead to incorrect or late information for the employees and management.

Legal risk might be also seen as operational. It is very difficult to distinguish between operational and credit risk or market risk sometimes.

- Operational risk leading to decrease of the value of credit portfolio or failure of credit transaction, such as wrong revaluation o security caused by failure of internal systems or intentional breach of internal rules, would be partly or wholly ascribed to operational risk
- An example of complexity of identification of reason of loss might be following example. Failure of operational risk management leading to loss in the area of market risk might happen by intentional breach of market risk limits by broker (human factor) or by failure of bank's model monitoring risk exposure (system factor). This would be again seen as partly or wholly as operational risk.

2.3.4 Other risks

Many other risks in banking can be identified, such as: Liquidity risk, business/strategic risk, reputation risk political risk, general legal risk and others. Among these, liquidity risk and business risk usually are the most important. Liquidity risk represents the probability of loss as a consequence of momentary absence of liquid money. It usually has two forms: **Market liquidity risk** represents the inability to sell financial instruments in sufficient time because of low liquidity of the financial market. A bank is not able to sufficiently quickly close financial position at appropriate price. **Risk of financing** is a risk of momentary financial insolvency caused by imbalance in the cash flow. Bank is unable to sufficiently finance the portfolio of assets and liabilities with different maturities and interest rates (Černohorský & Teplý, 2011).

Business risk captures the risk to the bank's future earnings, dividend distributions and equity price. To put it more clearly, it is a risk that volumes (revenues) decline or margins shrink without the bank having the opportunity to offset them by cost reduction.

As we will see below in the empirical part, the differentiation of risks into categories differs substantially among the banks. Some banks isolate certain type of risk (such as life risk, holding risk or real estate risk) into special risk category as it has higher importance to them than to others.

2.4 Risk Management in Banks

In this subchapter we will provide several remarks on fundaments of risk management in banking sector. It is to provide an intuition on how the above defined main risk can be eliminated.

2.4.1 Definition

Risk management can be defined as (Danhel, 2002): *"science discipline allowing better anticipation of impacts of uncertainty of development of real economic processes during modern decision making process."*

Another precise definition was provided by Pyle (1997). He defines risk management as a process which helps managers to satisfy information requirements by identification of key risks, production of consistent, understandable and operational methods of risk measurement, which helps to select such risks which have to be reduced, optimized or increased (in relation to achieved required rate of return) and

at the same time looks for appropriate action steps. Part of the risk management is setting up of methods of monitoring of resulting risk position. Banks should not uptake unnecessary risks, which do not correspond with their activity, risk strategy and expected rate of return. Nor should they undergo risks which can be effectively transferred to other subjects. They should therefore undergo only those risks which are part of their business strategy and stem from the nature of the everyday operation.

2.4.2 Risk Categorization for the Purposes of Risk Management

In the context of risk management the risk should be categorized for example in a following way (Santomero, 1997):

Risks which can be eliminated or avoided

The goal is to avoid risks, which are not important for the purpose of the credit transaction or other activities of the bank. An example might be standardized operating procedure such as approval process of loan granting, which helps to avoid legal disputes from poorly prepared documentation, which otherwise might be avoided.

Risk which can be transferred to other entities

An example might be insurance in connection with export financing or various derivative instruments such as interest rate swaps or options.

Risk which must be actively managed within the bank

Credit risk in investment financing must be actively managed, monitored and optimized in the loan portfolio. However, its complete elimination is impossible as it would lead to the elimination of the corresponding return. The bank takes the risks because it is a fundament of its activity. Here, we can also include those cases where the elimination or transfer of the risk is possible, but would lead to undesirable situation, such as disclosure of sensitive information about clients or of valuable know-how of the bank.

2.4.3 Risk Management Tools

Some major tools for bank risk management and elimination will be mentioned in the following text. We are again using Santomero's (1997) classification as in previous text.

Setting standards and use of regular reporting

Standards for clients' assessment and their categorization into risk groups and regular screening of their risk situations are essential parts of credit analysis. Also distribution of competences among relevant departments and individual employees helps to control and monitor accepted risks. Another important part of this section is standardization of all documentation and reporting which contributes to higher transparency for internal as well as external users.

Setting rules and systems of limits of the exposure

In previous paragraph, we mentioned an important idea that it is advisable to undergo only such risk exposure to counterparties or trades which meet pre-determined criteria (such as rating requirements). Even though these criteria are met, the bank should have limits on exposure to individual counterparties or more or less homogenous groups within one industry or economically related groups. Such measure helps to get under control the so –called risk excessive portfolio concentration.

Investment strategy

Investment strategy outlines the risk profile of banks. It determines not only desirable (or maximum) risk exposure to industry or market, but also principles according to which the bank is hedged against certain types of risks. Rules, limits and standards are forms of passive management risk, while investment strategy and specific rules for e.g. acquisitions of new customers are forms of active risk management. Investment strategy directly affects a daily work of bank employees – traders as well risk managers. The well known indirect relationship between risk and return holds. Therefore, the investment strategy set by the top management and owners with support of lower levels of management must be in line with the plans for future growth or required return on capital. These facts have a direct impact on the remuneration of top management as well as individual employees of the bank.

Motivational system of incentives and benefits

Properly designed system of incentives and benefits can significantly reduce the cost of other elements of risk management because it binds the interests of individual employees with interests of owners and other stakeholders. If individual brokers/traders are paid according to fulfilment of the planned return (or its exceeding) and risk managers at the same time are paid according to quality of portfolio which went through

their assessment and approval process, then such system leads to strong relation between economic results of the bank and specific benefits of individual employees. Such system, however, requires careful analysis of individual portfolios, their precise valuation including costs allocation. Well-developed controlling system is therefore necessary.

2.4.4 Other Important Features of Risk Management in Commercial Banks

Another important feature, to be taken into account when speaking about risks in the banking segment, is the type of risk measure. Risk is a notion with clear and intuitive meaning but it is less clear how it should be quantified. Currently the main tendency in the banking sector is to try to identify certain ways to characterise the entire loss distributions and not only selected moments of the distribution such as mean and variance resulting in a wide range of potential risk measures that might be used (BCBS, 2009). In practice Value at Risk (VaR) is the most widely used measures. Other potential measures are simple expected shortfall (ES), standard deviation, spectral and distorted risk measures and others. More details as well as comparison of the methods can be found for example in Hull (2007). Each risk measure has strengths and weaknesses and no single measure can capture all the complexity of risk measurement. A meaningful risk measure should be intuitive, stable, easy to compute and understand, coherent and interpretable in economic terms (capital allocation).

The calculation of risk measures is based on choice of reasonable confidence interval, time horizon and aggregation approach. The confidence interval is usually linked to the targeted rating. Through this link, there should be therefore a relationship between rating and the level of economic capital. As we show in our empirical part, this relationship has not been found. Time horizon, on the other hand, is usually chosen according to risk type (e.g. credit risk usually has one-year time horizon, whereas market risk several days) and other factors. When it comes to risk aggregation, BIS lists five main approaches to risk aggregation in the economic capital framework: simple summation (ignoring potential diversification benefits), fixed diversification percentage (similar to simple summation, but fixed level of diversification benefits is assumed), variance-covariance matrix approach, copulas approach (combining marginal probability distributions into joint distribution) and full modelling of common risk drivers across all portfolios (BCBS, 2009).

One of the most important things in risk management is a continuous validation of the models. The validation should be made both on qualitative and quantitative basis. Qualitative validation consists of use test (testing which model properties are used and which are not), complex qualitative review, and risk measurement systems implementation, management oversight of the processes, data quality checks and examination of assumptions. Quantitative process includes testing of inputs and parameters, replication of the model, benchmarking with other banks, back testing (testing the model forecasts), profit and loss attribution and stress testing (BCBS, 2009).

3 Empirical Analysis

3.1 Data Sample and Our Approach

Based on the list of top world banks published in The Banker (2008) Top 1000 World Banks 2008 we have created a dataset of top 50 world banks as ranked in mid 2008, therefore before the financial crisis culminated. The reason behind this is that we not only want to see the development of economic capital of individual banks, but also the overall development of the sample of the banks. We wanted to look at the top rated banks as seen before crisis and monitor their development over four years with the special focus on their economic capital management. The sample would look different in the final year of our analysis as some of the banks seized to exist during financial crisis or were acquired by stronger competitors. However, from our point of view, we would not record the most interesting stories in the banking world if we started with the most recent list of top rated banks. The reason is that some banks would not be in the list any more either due to fact that they went bankrupt or were so seriously affected by the crisis that they cannot be considered as top rated any more.

We have focused on years 2007-2010 in our analysis. With this approach we are able to cover the period before, during and after the crisis. This is in line with the above indicated scope of interest – we took a sample of top before-crisis banks and monitored their development during and after the crisis with special focus on economic capital.

As we have found out, the economic capital and its composition are not commonly reported figures and are therefore impossible to be easily found in any widespread database such as Bankscope. For this reason we have chosen a different approach. We have collected the annual reports of all the banks in the sample for all 4 studied years (therefore 200 annual reports in total) and created our own database. Some of the banks have their risk reports separated from annual reports, in which case we tried to search for required data there. Furthermore, some of the banks report the data on economic capital on their web page only. Therefore, we had and extensive dataset with approximately **250 documents** to be gone through. Even though we used this extensive approach, we came to conclusion that only 18 banks from our sample report at least some details on their economic capital in at least one of the monitored years. Furthermore, out of these 18 banks Fortis seized to exist and had been acquired by the Belgian government and later sold partially to BNP Paribas and partially

integrated into ABN AMRO Group. Besides that, some of the banks in the sample started reporting their economic capital only during the covered period. This is case of LBBW and Dexia. The situation is further complicated by different fiscal year in case of Japanese banks (Resona and MIZUHO). MIZUHO furthermore has reported the details on economic capital in year 2008 only. If we take into account all the limitations mentioned above, we have full details on economic capital for all the period in case of 14 banks and partial data on 5 other banks. Rest of the sample does not report details on economic capital at all.

Even though our sample is extremely small, we are convinced that we were able to find some interesting patterns which have occurred during the covered period. The approach is following: In the first part of this chapter we will provide a summary statistics of our findings on economic capital allocation and economic capital development. In the second part, short profile / case study focused on economic capital management is provided for all the banks at which the required data were available (14). The final part of our empirical analysis is devoted to a deeper study of relationship between economic capital and performance measured by rating and profit change during the crisis.

Based on the above mentioned approach we then make conclusions about the economic capital management of the sample of top rated world banks. The aim is to provide a detail overview of economic capital management of 2008 top-ranked word banks before, during and after the crisis and search for the changes during the period. Since we are using two approaches (an overall overview as well as detailed profiles of selected banks), we are both focused on quantitative and qualitative changes.

3.1.1 Hypotheses and Suggested Testing

In the first step we would like to study the number of banks which report details on their economic capital. Our hypothesis is that only minority of the banks provide data on the amount of economic capital, its allocation to risk categories or other details. This question has been addressed above in the description of data gathering and dataset creation process. We made a very extensive and intensive research through more than 250 documents published by the banks (annual reports and risk reports) in order to put together small pieces of information reported. The hypothesis is also addressed in the analytical part where we study the relationship between quality of economic capital reporting and banks' performance.

Our second hypothesis deals with the issue of economic capital allocation into risk categories as well as its overall development over the monitored period. We expect some significant changes to occur during the crisis. This hypothesis is tested in the summary statistics part and the analysis is based mainly on a "soft" descriptive statistics. We monitor average allocation, growth of the economic capital ratios in comparison with growth of regulatory capital (some convergence is expected) and convergence of economic capital ratios of the banks in our sample.

Our third hypothesis states that there are significant differences in economic capital management among the banks and there have been significant changes in the economic capital management of individual banks during the monitored period. This hypothesis is addressed by 14 case studies of selected most openly reporting banks. In each case study we focus on specifics of each bank's economic capital reporting, explanation of changes in different categories in each year and comparison with regulatory capital. Again, mainly soft has been approach applied.

Fourth hypothesis states that there is a relationship between economic capital reporting and credit rating of the bank. More openly reporting banks should have in general higher rating. We have developed our own system of scoring of the bank's quality of reporting, went through their latest available annual reports and scored the quality ourselves based this system. The hypothesis is then tested by a simple regression model in the section 3.4.1. The model itself is simple; however, the input data gathering was the hardest part of the section. The analysis is further extended for tests of correlation between banks' economic capital ratio and rating. Negative correlation is expected (see the respective chapter for explanation). Furthermore, the relationship between regulatory capital (measured by Tier 1 ratio) and rating is tested as well. This is to verify whether there is some change from year 2004 when Berg-Yuen & Medova (2005) tested this relationship and came to the conclusion that there was a positive correlation identified.

Fifth hypothesis states that there is a relationship between the level of economic capital and a change of profit in subsequent year. The hypothesis is tested in section 3.4.2. We have used a sample of 15 banks and their economic capital ratios in 2007-2009 and tested their correlation with change in profit in respective subsequent year. Again, negative correlation is expected.

Last hypothesis is an extension of the previous one. We are testing whether the banks which we have denoted as "Losers" (those who had to be bailed out by the state

or those profit of which dropped very significantly and were on the edge of receiving state aid) have in general significantly higher economic capital then the others named "Winners" in our analysis. We compare the average economic-to-regulatory capital ratio of these two subgroups in time and by single factor ANOVA test whether the difference is significant.

Besides the above mentioned hypothesis testing, the aim of the empirical part also is to provide an overview of the recent development in economic capital management both on the individual and general levels.

3.2 Summary Statistics

3.2.1 Economic Capital Allocation

As indicated above, this sub-chapter is devoted to summary statistics of development of economic capital composition. Since we are covering 4 years long period, we have to use different approaches to capture all potential changes within the years. First set of figures (Figure 7) represents economic capital allocation of each bank in comparison to other banks in year 2007 and 2010. Please refer to appendix (A5) for full the full set of graphs for all covered years.

First thirteen banks in each graph are those which have reported details on economic capital in all covered years[3]. The remaining banks in each graph are marked with lighter colour. These banks reported details on economic capital for less than four covered years. Whereas most of the banks have increased the share of credit risk on total economic capital in years 2008 and 2009, this is not the case of Deutsche Bank (DB). DB's credit risk capital has decreased both in relative and absolute values. At the same time, the total economic capital was increased substantially.

We also have to take into account that each bank assesses the economic capital in slightly different way and under different criteria. Some banks for example do not consider business risk (Resona, Dexia). Some banks, on the other hand, report more categories of risk capital and we had to rearrange them in order to make the categories comparable among individual banks.

The case of Dexia is interesting from another point of view. The bank was hit by the financial crisis and hat to be bailed out by the governments of Belgium, France

[3] These 13 banks are: JPMorgan Chase & Co., Banco Santander, Barclays PLC, Rabobank, Deutsche Bank, Credit Suisse, Banco Bilbao Vizcaya Argentaria, S.A. (BBVA), Commerzbank, Nordea Bank, Bank of Montreal, BayernLB (BLB), Royal Bank of Canada (RBC), ING Group.

and Luxembourg in last quarter of 2008. Since 2009 the bank has started reporting details on economic capital. Before that the date the bank reported only the value of economic capital. Since the bail out from the state usually requires some reorganisations within the banks administration as well as operation, the situation might have led the bank to examine its risk management procedures and reporting. Since each investor should prefer more detailed information, Dexia might have decided to start reporting in more details in order to regain part of the lost trust of the financial markets. The crisis in this case revealed weakness and probably forced the bank to make some improvements (if not in risk management, then at least in reporting). On the other hand, the case of Fortis bank proves that there is a difference between necessity and sufficiency. It had reported quite openly its economic capital allocation and was anyway acquired by the state and later sold to its rival BNP Paribas after it had been seriously hit by the financial crisis.

More details on individual banks' stories regarding economic capital management are provided below in the section with individual bank profiles. This first summary statistics was provided mainly in order to show how different banks respond differently to same impulse.

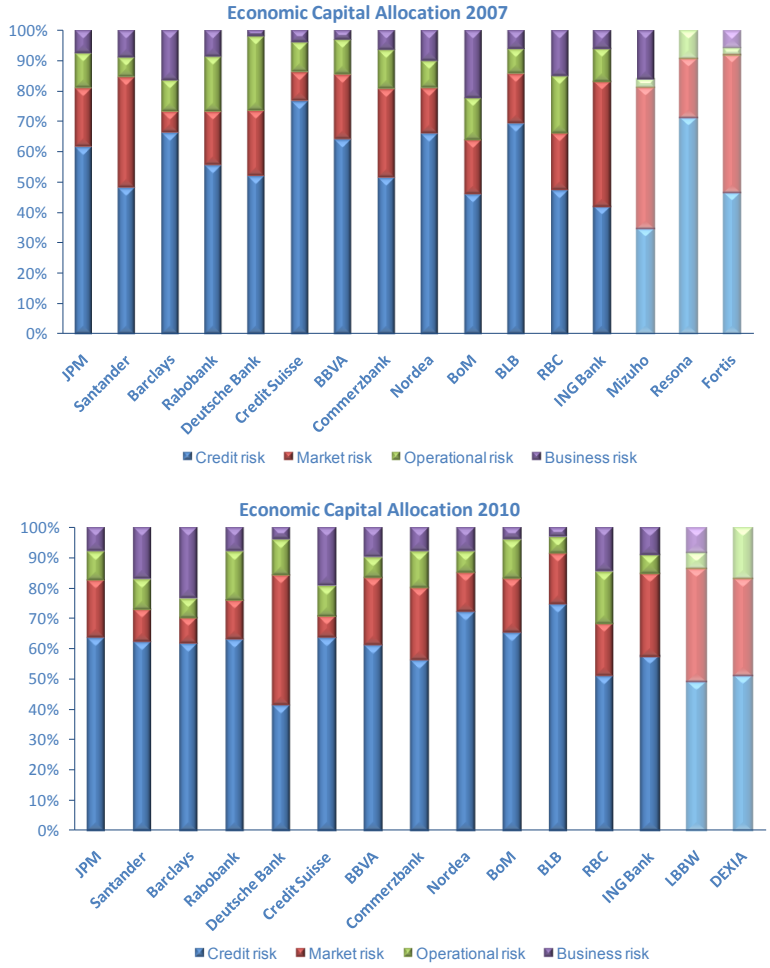
The pie charts in Figure 8 are devoted to analysis of changes in average economic capital allocation of our overall sample of 13 banks between years 2007 and 2010. Even though the sample is far from being representative, we strive to find some general patterns of economic capital development. In order to provide complete overview, we have also calculated the average allocation for all the reporting banks in each year[4] (2007-2010) which can be found in the appendix (A1-A4). As mentioned in the introductory chapter, we expected to find substantial changes to occur during the covered period as the banks faced atypical situation.

We expected substantial increase in share of credit risk capital on total economic capital during the financial crisis. The analysis of average economic capital allocation of thirteen banks shown in the figure 8 (and in appendix A1-A4) partially verifies this hypothesis. The share of credit risk rose in years 2008 and 2009 as the crisis peaked in the financial sector, and decreased slightly in 2010. The average figures are partially distorted by Deutsche Bank, the only bank which has substantially decreased its relative value of credit risk capital in favour of market risk capital. If we eliminate DB from the

[4] 16, 15, 16 and 15 banks in 2007, 2008, 2009 and 2010 respectively

sample, the above mentioned effect is stronger. Whereas share of operational and business risk capital remained approximately same, the share of credit risk capital rose from 58% in 2007 to 63% in 2009 if we consider the sample of 12 banks without DB. This was followed by a modest decrease in 2010. The effect of increased share of credit risk capital was then offset by a decrease of market risk share.

Figure 7: Economic capital allocation of individual banks (2007 vs. 2010)



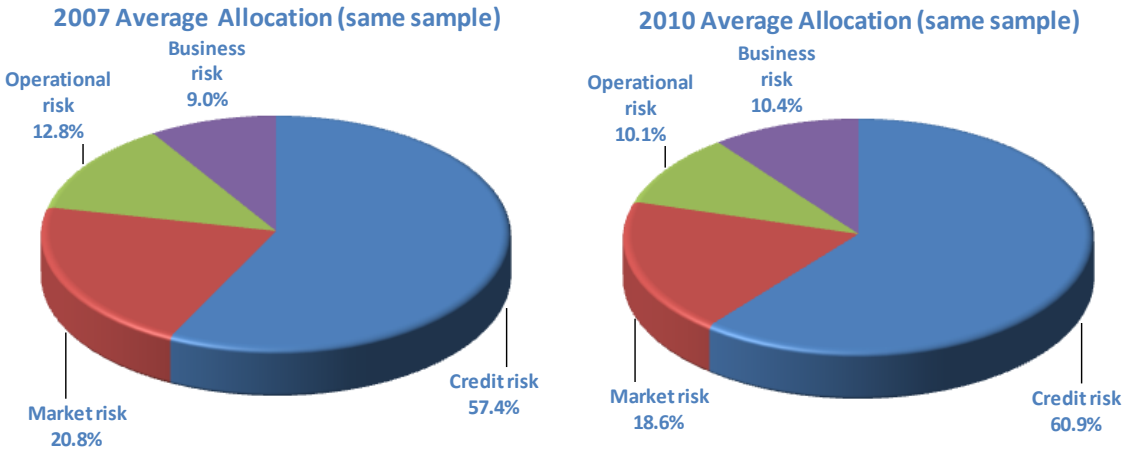
Source: Own analysis based on banks' annual reports

Even though the effect of increased preference of credit risk capital to other types of risks is evident in years 2008 and 2009, it is not as strong as we expected. We should mention at this stage, that we were describing relative values only. The economic capital has risen substantially in absolute terms at almost all banks in all covered years. This is with the exception of for example BayernLB, which decreased total economic capital substantially in 2009 compared to previous year, or LBBW[5], which decreased economic capital both in 2009 and 2010. The changes of economic

[5] LBBW is not included in our sample of 12 banks, because it did not report ECO allocation in 2007.

capital values are therefore more significant than the changes of the overall capital allocation. The details on the development in case of individual banks are, however, provided in the separate chapter as well as the overall assessment of the changes.

Figure 8: Economic capital allocation of 12 banks in the sample (2007 vs. 2010)



Source: Own analysis based on banks' annual reports

Based on the collected data described above, we have also prepared a distribution of banks according to allocation of risks. In each covered year we have created small histograms for each type of risk. We have therefore created a matrix of 16 histograms (4 types of risk and 4 covered years). This was performed for all the banks which reported economic capital allocation in the given year[6].

3.2.2 Economic Capital Development

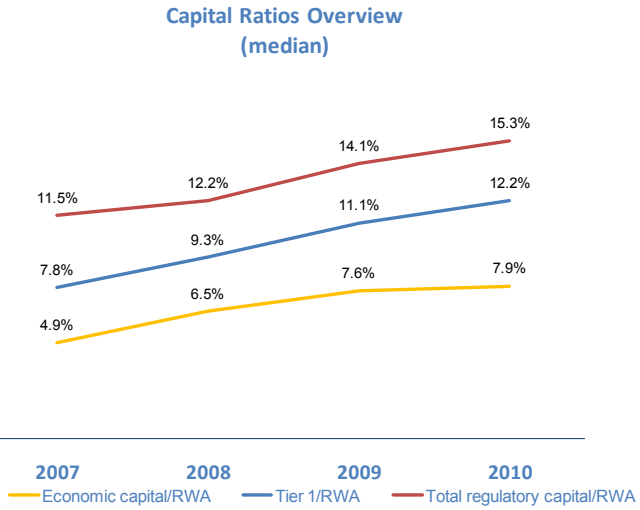
In order to obtain a closer overview we have collected data from 13 banks which reported the value of economic capital in all monitored years. These banks are: JPM, Barclays, Rabobank, Deutsche Bank, Credit Suisse, BBVA, Commerzbank, Nordea, BayernLB, RBC, ING Bank, LBBW and Dexia. Other banks, which are included in the statistics above or in the capital profiles below, did not provide the total value of economic capital in all years (Santander, Resona, Fortis, Mizuho and Bank of Montreal). Even though the sample is not representative, it has one advantage. It includes "winners" (e.g. JPM, Barclays, Rabobank, Nordea, and RBC) and "losers" (e.g. BayernLB, LBBW, Commerzbank and Dexia) of the financial crisis as well as those in the middle. Therefore, it captures development in all parts of the spectrum

[6] Please find the graphs in appendix A5-A8.

and again we can see the advantage of using the list of banks from 2008 as some of the "losers" would hardly appear among top-ranked banks in following years.

The Figure 9 shows a development of key capital ratios in our sample of thirteen banks. We have used a comparison of Tier 1, total regulatory and economic capital ratios. The first two are ordinary ratios defined as Tier 1 capital (or total regulatory capital) divided by risk-weighted assets. We have divided the reported economic capital by risk-weighted assets as well and created a possible measure of "economic capital ratio". Based on ratios of individual banks we have calculated median of each of the three ratios[7] and put them together in one chart so that we could see the development in monitored years.

Figure 9: Key capital ratios development (13 selected banks)



Source: Own calculation based on annual Report of sample banks 2007-2010

It is evident that the capital ratios have risen dramatically. The economic capital has risen by 60% with compound average growth rate (CAGR) 17%, Tier 1 ratio has risen by 58% with CAGR 17% and total regulatory capital has risen by 33% with CAGR 10%. Whereas regulatory ratios have grown rather steadily, economic capital ratio grew mainly in 2008 and 2009 and only modestly in 2010. The gap between regulatory and economic capital has therefore widened in absolute terms, whereas in relative terms (measured by economic capital divided by Tier 1 or by total regulatory capital) it contracted a bit. The growth rates for each period, total growths as well as CAGR can be found in Table 1 below.

[7] We should mention that differences between medians and averages are very small (almost interchangeable) and potential use of averages would not change the overall picture of the development.

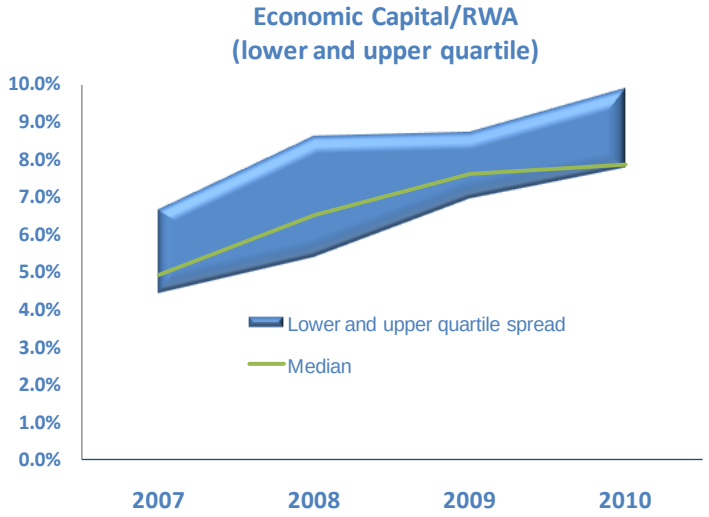
Table 1: Growth rates of capital ratios

Growth rates	2007-2008	2008-2009	2009-2010	2007-2010	CAGR
Economic capital/RWA	32.6%	16.4%	3.3%	**59.5%**	**16.8%**
Tier 1/RWA	20.3%	19.0%	10.4%	**58.0%**	**16.5%**
Total regulatory capital/RWA	6.6%	15.6%	8.2%	**33.2%**	**10.0%**

Source: Own calculation based on annual Report of sample banks 2007-2010

In order to answer another interesting question, that is whether economic capital ratios in our sample converge or diverge in time, we have done lower versus upper quartile spread analysis presented in Figure 10. This analysis has revealed that the economic capital ratios of 13 banks in our sample tended to converge in 2009 and then slightly diverged in 2010. The spread was 2.2 percentage points (pp) in 2007, increased to 3.2 pp in 2008 and then decreased to 1.8 and slightly increased to 2.1 pp in 2009 and 2010 respectively. We can conclude that the banks have become only very little more coherent in terms of economic capital ratio. This convergence is more evident in case of regulatory capital. The lower to upper quartile spreads decreased substantially for both Tier 1 (from 2.2 to 1.7 pp) and total regulatory capital (from 1.7 to 1.1 pp) over the period.

Figure 10: Economic capital ratios (13 banks, lower and upper quartile)



Source: Own calculation based on annual Report of sample banks 2007-2010

3.3 Capital Profiles of Selected Banks

This chapter is devoted to deeper analysis of 14 selected banks which reported details on their economic capital. The development of the individual banks is studied mainly from the point of view of the capital as well as other key financial indicators.

We mainly focus on comparison of regulatory, accounting and economic capital. The aim is to provide a deeper view on the development of the bank in the context of the global financial crisis.

There are differences among the banks in understanding of the economic capital concept. We also try to collect interesting details from banks' annual reports in order to provide more complex view on each bank's economic capital assessment and to explain significant changes. As mentioned above, banks in general do not use same standardized categories of economic capital. In the chapter devoted to summary statistics we have tried to standardize the categories in order to make the reporting comparable. However, in this chapter we keep the categories as reported by the banks and (if available / applicable) provide comments on the unusual ones.

The selection of the banks was made according to quality of reporting of details on economic capital.

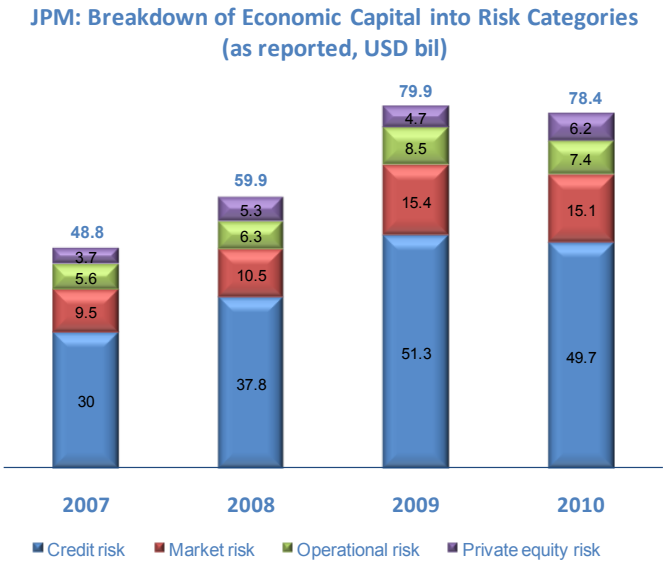
3.3.1 JPMorgan Chase & Co.

JPMorgan Chase & Co. (JPM) is a financial holding company incorporated under Delaware law in 1968. JPM is one of the largest banking institutions in the United States of America, with $2.1 trillion in assets, $176.1 billion in stockholders' equity and operations in more than 60 countries. JPM activities are organized, for management reporting purposes, into six business segments. The Firm's wholesale businesses comprise the Investment Bank, Commercial Banking, Treasury & Securities Services and Asset Management segments. The Firm's consumer businesses comprise the Retail Financial Services and Card Services segments (JPMorgan Chase & Co., 2010).

In March 2008 JPM acquired the deposits, assets and certain liabilities of Bear Stearns & Co. Inc. bank. In September 2008, the same JPM absorbed Washington Mutual Inc[8].

[8] Main reasons why we mention these two acquisitions are following: First, Washington Mutual was one of the top 50 rated banks in 2007 and therefore appeared in our sample. However, due to its practical bankruptcy and acquisition by JPM, the latest available data for this bank are 2007. Second, acquisition of two problematic banks during crisis obviously has serious impact to the reported figures as well as to total level of economic capital.

Figure 11: JPM breakdown of economic capital ratio into risk categories



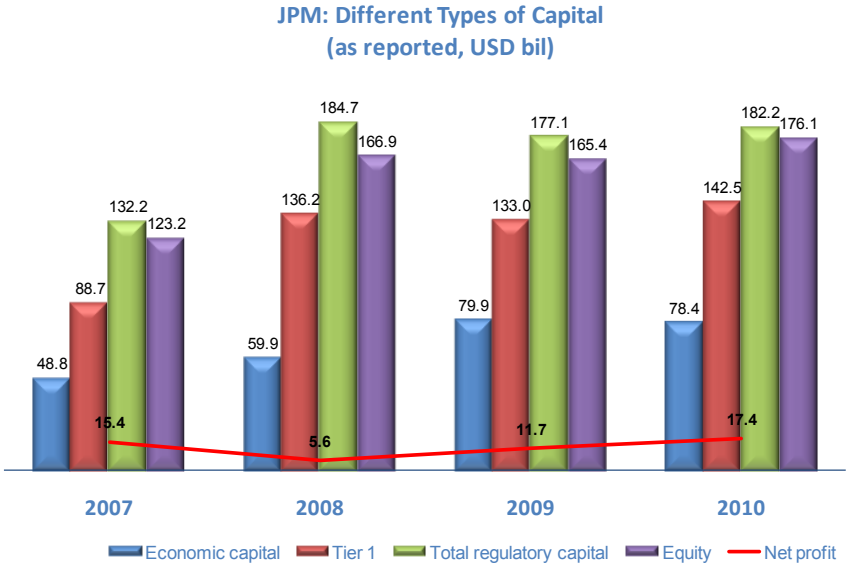
Source: JPM Annual Reports 2007-2010

The Figure 11 shows economic capital of JPM in categories as reported in annual reports. The Firm measures economic capital primarily based on four risk factors: credit, market, operational and private equity risk. The total economic capital has grown substantially mainly between years 2008/2009. The growth was primarily driven by higher credit risk capital within the consumer businesses, due to the full year effect of the Washington Mutual transaction and revised performance data in light of the recent weak economic environment. The proportion of each category has remained almost the same over the years with a minor change in the proportion of capital attributed to credit risk in 2010 (from 63% to 61%) and modest change in proportion of private equity capital 2008/2009, which however went down to relative level of 2007 in the last year.

The private equity risk capital is a category which is not commonly used by all the banks and we therefore provide definition as stated by the bank: *"Capital is allocated to privately- and publicly-held securities, third-party fund investments, and commitments in the private equity portfolio to cover the potential loss associated with a decline in equity markets and related asset devaluations. In addition to negative market fluctuations, potential losses in private equity investment portfolios can be magnified by liquidity risk. Capital allocation for the private equity portfolio is based on measurement of the loss experience suffered by the Firm and other market participants*

over a prolonged period of adverse equity market conditions (JPMorgan Chase & Co., 2010).”

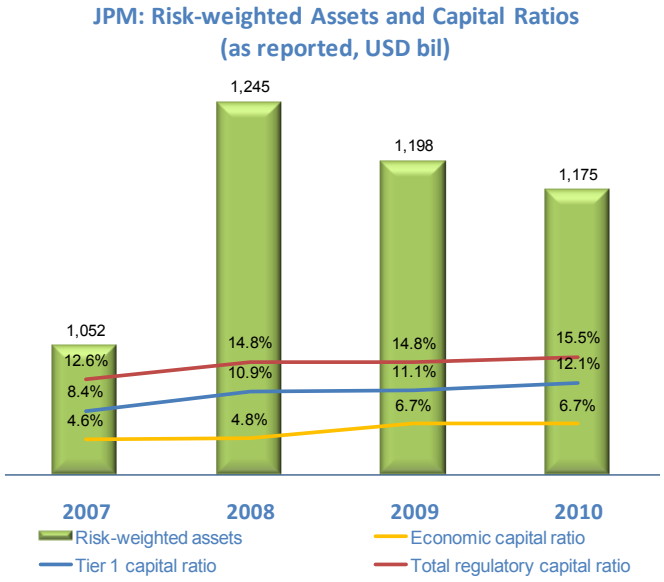
Figure 12: Different types of JPM capital, net profit



Source: JPM Annual Reports 2007-2010

The development of capital ratios as well as other indicators was stable and all capital indicators were increasing with the exception of modest decrease of economic capital in 2010. This was, however, offset by decrease in risk-weighted assets. The increase in risk-weighted assets in 2008 was mainly caused by the acquisitions of troubled banks. The net profits in 2008 and 2009 were positively influenced by recognition of extraordinary profit resulting from negative goodwill (of total USD 2 billion) after acquisition of Washington Mutual. Despite the positive effect of extraordinary income the net profit decreased substantially in 2008 due to culminating financial crisis.

Figure 13: JPM risk-weighted assets and capital ratios



Source: JPM Annual Reports 2007-2010

3.3.2 Banco Santander

Santander group, headquartered in Spain, is one of the largest banking groups in the world. According to its web page, it is the fourth largest bank in the world by profits and eighth by stock market capitalisation. It is mainly focused on retail commercial banking. Its presence is concentrated in 9 major markets: Spain, Portugal, Germany, the UK, Brazil, Mexico, Chile, Argentina and the US, and in most of these markets it has attained high market shares in retail banking (Banco Santander, 2011a).

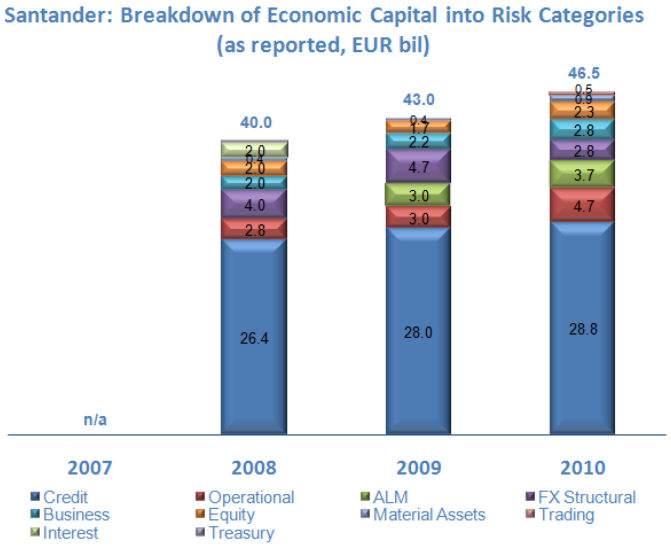
The group was very active in acquisitions and major recent acquisitions include: 2007 acquisition of Banco Real in Brazil from ABN AMRO, 2008 incorporation of Alliance & Leicester and Bradford & Bingley (United Kingdom), 2009 acquisition of Sovereign (US), which enabled Santander to enter the US retail banking market (Banco Santander, 2011b).

The overall economic capital has not changed substantially. However, it is interesting that there was some change in the categories in each year. The major change occurred (if we abstract away from change in categories) in operational risk capital, which increased by 57% between years 2010 and 2009 and a 40% decrease in FX structural risk capital in the same period. The bank had six business units as of December 31, 2010[9]. The economic capital was allocated to them in a following way:

[9] This figure has been changed over the monitored years. In 2007 the bank had 4 units only. The number of business units has been increased in connection to executed acquisitions – separate Brazil and Sovereign units were added.

Continental Europe (38%), Brazil (20%), Rest of Latin America (12%), Financial Management and Equity Stakes (13%), United Kingdom (11%) and Sovreign – an American bank acquired in 2009 (6%).

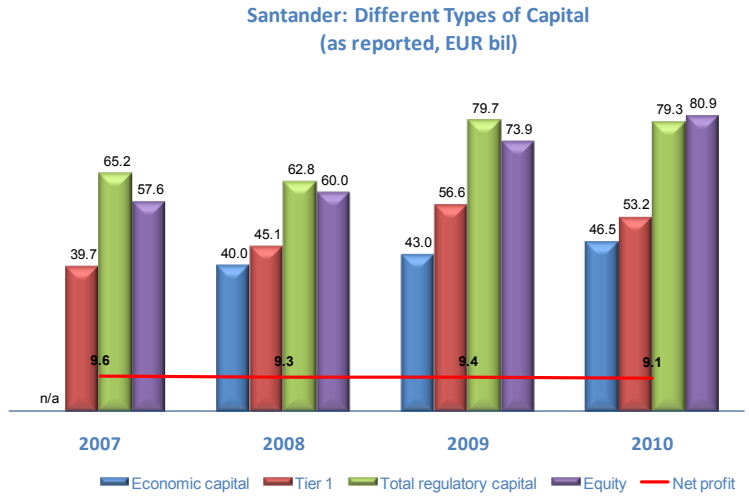
Figure 14: Santander breakdown of economic capital into risk categories



Source: Banco Santander annual reports 2007-2010

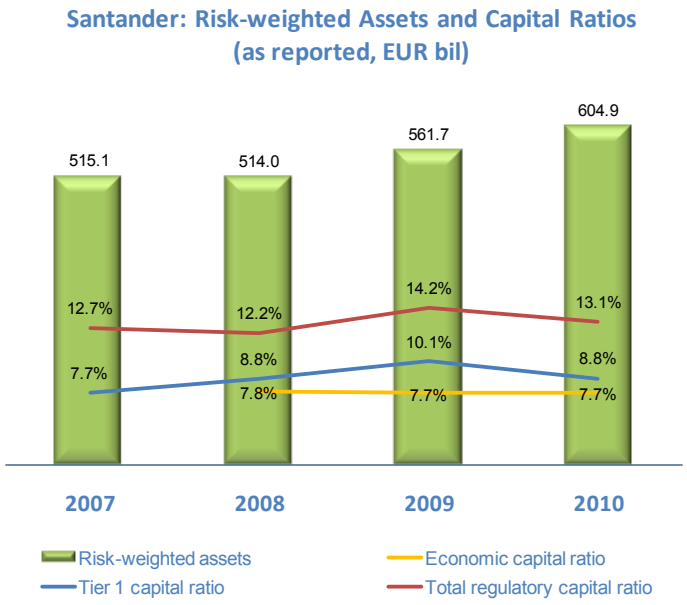
Unfortunately, the bank did not report the total amount of economic capital for 2007 and we can therefore only study three years. It is interesting that the bank was able to keep its profitability (in absolute terms) during the crisis and the value of net income is virtually same in all studied years. Compared to JPM, the economic capital is relatively (measured against risk-weighted assets) higher and the regulatory capital lower. This might be caused by a different focus of each bank.

Figure 15: Different types of Santander capital, net profit



Source: Banco Santander annual reports 2007-2010

Figure 16: Santander risk-weighted assets and capital ratios



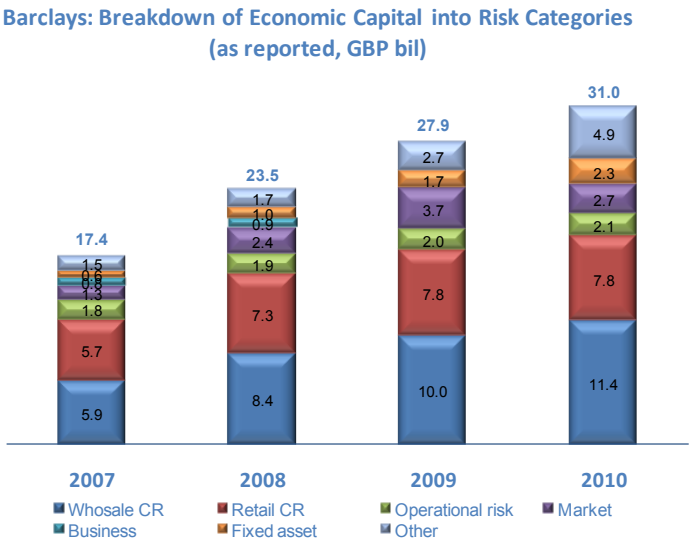
Source: Banco Santander annual reports 2007-2010

3.3.3 Barclays PLC

Barclays, a British banking house, is a major global financial services provider engaged in retail banking, credit cards, corporate and investment banking, and wealth management with an extensive international presence in Europe, United States, Africa and Asia (Barclays PLC, 2010).

Barclays acquired core assets of the bankrupt Lehman Brothers (LB) bank in at the peak of the credit crisis 2008 and was later sued by LB claiming the bank was given special treatment. In February 2011 the court, however, ruled that the acquisition was flawed but fair (BBC News, 2011). In 2009 the bank sold its Barclays Global Investors (BGI), a fund management unit, to BlackRock for a total consideration of GBP 8.2 billion. The recognised profit before tax on this disposal was GBP 6.3 billion and Barclays gained 19.9% interest in the enlarged BlackRock group (Barclays PLC, 2009). The transaction, on the other hand, makes the comparison of profits for 2009 and 2010 slightly complicated.

Figure 17: Barclays breakdown of economic capital into risk categories

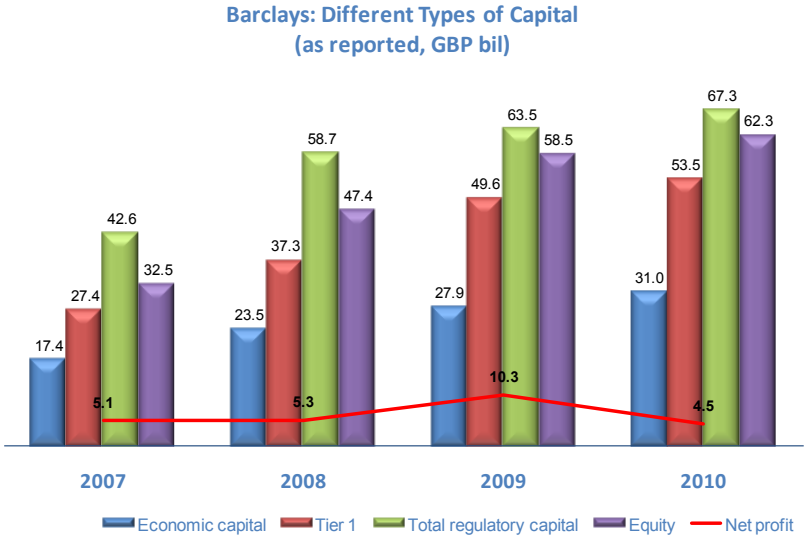


Source: Barclays PLC annual reports 2007-2010

When it comes to economic capital of the group, it has grown substantially over the monitored years (almost by 80%) and the structure has changed as well. The allocation to market risk decreased between 2009 and 2010 by 27% and the category "Other" increased by 81% during the same period. This category includes investments in associates, private equity risk, insurance risk, residual value and business risk. Also includes BGI related exposures post-disposal, mainly the Group's investment in BlackRock, Inc. (Barclays PLC, 2009).

The economic capital is allocated into 10 business units (2010 percentage included in the parentheses): UK Reatail Banking (12.6%), Barclaycard – an international payment business (10.3%), Western Europe Retail Banking (5.8%), Barclays Africa (2.6%), Barclays Capital – an investment banking division (35.3%), Barclays Corporate – banking solutions to large corporations (15.6%), Barclays Wealth - a wealth management division (1.8%), Investment Management – manages group's 19.9% economic interest in BlackRock, Inc. and the residual elements relating to Barclays Global Investors, (11.6%), Absa – a banking service and insurance company in South Africa (3.9%), Head Office Function and Other Operations (0.5%) (Barclays PLC, 2009).

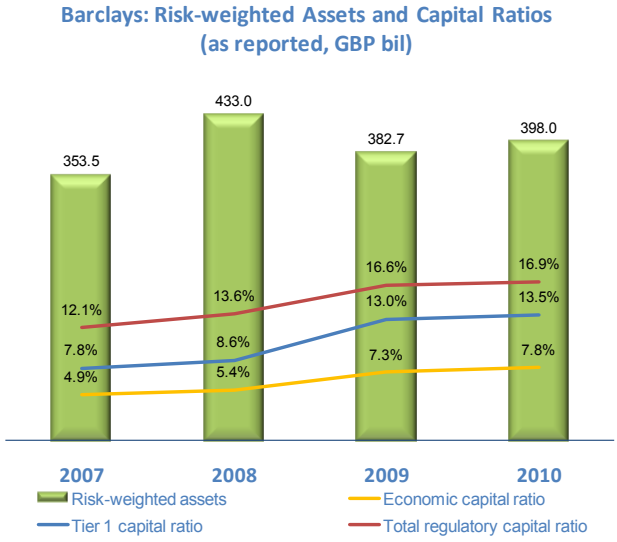
Figure 18: Different types of Barclays capital, net profit



Source: Barclays PLC annual reports 2007-2010

The portion of Tier 1 capital on total regulatory capital rose substantially between years 2008 and 2009 (from 63% to 78%) as a consequence of tightened regulation set by the Financial Service Authority in United Kingdom (see Figure 19). The substantial growth of capital ratios was caused both by above mentioned effect as well as by decrease of risk-weighted assets. As mentioned above, the net profit of 2009 was influenced by the one-off item, the profit from disposal of BGI. The net profit without the proceeds from the sale would be around GBP 4 billion, which is a decrease compared to 2008.

Figure 19: Barclays risk-weighted assets and capital ratios



Source: Barclays PLC annual reports 2007-2010

At the end of this sub-chapter, we would like to mention the resources of Barclays PLC's economic capital. According to its 2010 annual report, the capital resources to support economic capital comprise adjusted shareholders' equity including preference shares but excluding other non-controlling interests. "*Shareholders' equity is adjusted for:*

- *Net retirement benefits liability – representing a non-cash reduction in shareholders equity;*
- *Cash flow hedging reserve – representing amounts that will be offset against the gains or losses on the hedged item when it is recognised in the income statement;*
- *Available for sale reserve – representing unrealised gains and losses on available for sale securities;*
- *Cumulative gains on own credit – representing cumulative gains arising on the fair value of changes in own credit; and*
- *Preference shares – are included in funds to support economic capital as preference shares have been issued to optimise the long term capital base of the group* (Barclays PLC, 2010)*."*

3.3.4 Rabobank Group

Rabobank Group is an internationally active banking group operating on the cooperative basis. Its main services include banking, wholesale banking, asset management, leasing and real estate services. It is market leader in banking sector in Netherlands and it builds a leading position as a food and agriculture bank internationally[10]. It is comprised of independent local Rabobanks, Rabobank Nederland[11], which is an umbrella organisation for all the Rabobanks, and number of associates across the world (Rabobank Group, 2010a). It is worth noting that Rabobank is one of few banks in the world to have the triple A rating with a stable outlook. Rabobank keeps the highest rating for many years already and it is considered one of the safest banks in the world.

Recent acquisition activity include: 2007 takeover of Mid-State Bank & Trust (USA) for a total consideration of USD 857 million (Rabobank Group, 2007b) and 2010

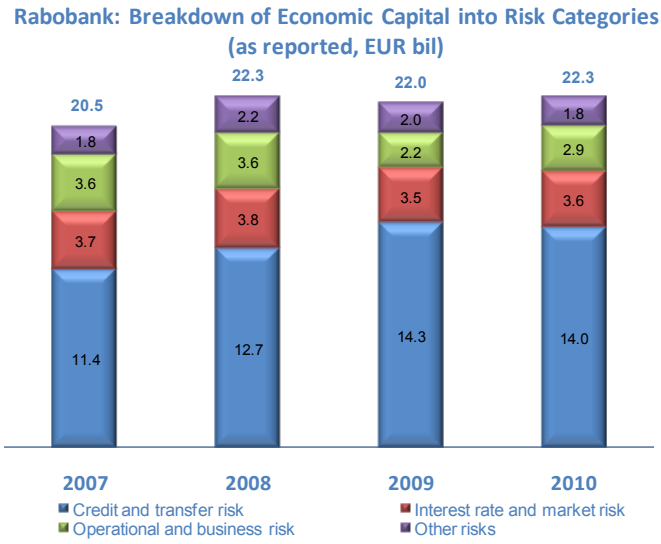
[10] Rabobank Group is already one of the leaders in food and agriculture financing providers in the world.
[11] Full name is Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A.

acquisition of two failed banks from FDIC - Butte Community Bank and Pacific State Bank (Rabobank Group, 2010b).

The bank keeps a high level of economic capital. In order to fit its triple A status, the bank uses high level of confidence for capital requirement calculation purposes (99.99%). We should note that the internal capital requirements are much lower than the available qualifying capital which provides the bank with sizeable buffer. In 2008, the economic capital grew mainly due to growth in lending. In 2009 it slightly declined mainly due to decrease of economic capital for interest rate risk caused by the development in the absolute interest rate risk position and lower interest rates. In 2010 the figures went back close to the levels of 2008.

Rabobank's economic capital is broken down into 6 group entities/business divisions in a following way (2010 percentage): Domestic retail banking (37%), Wholesale banking and international retail banking (33%), Real estate (7%), Leasing (5%), Asset management (4%), Other (14%).

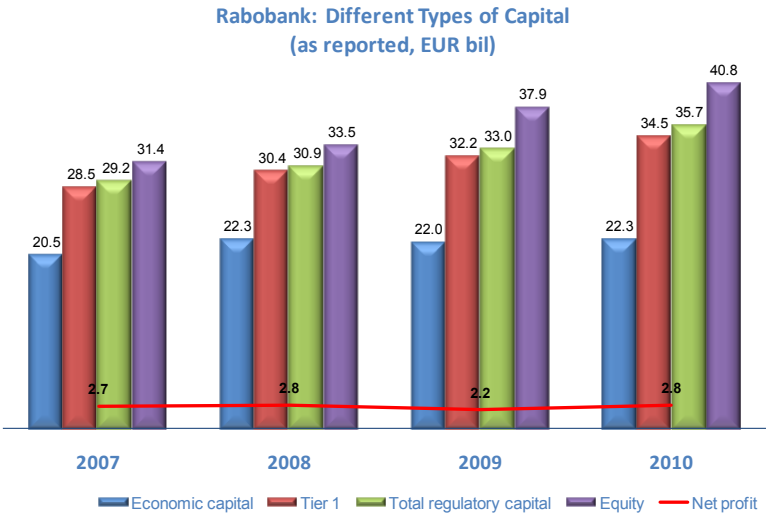
Figure 20: Rabobank Group breakdown of economic capital into risk categories



Source: Rabobank annual reports 2007-2010

Compared to other banks Rabobank keeps a very high level of capital (measured by all monitored types) and it was able to keep its profitability. The net profit decreased in 2009 only due to increased bad debt costs during poor economic situation. The situation improved in 2010 with the modest upturn in the economy and net profit went back to 2008 level.

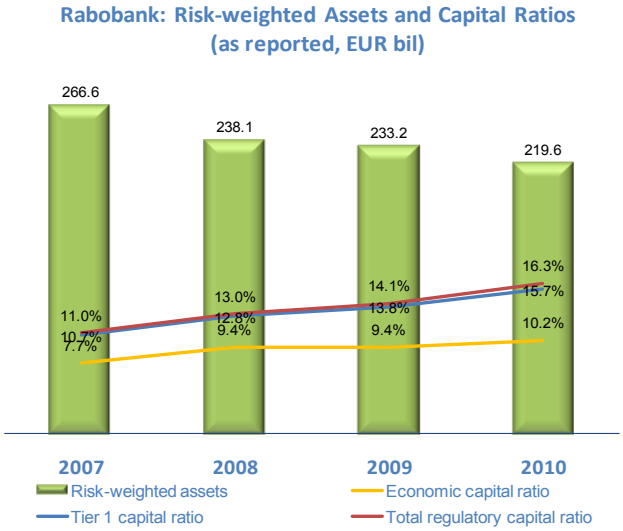
Figure 21: Different types of Rabobank Group capital, net profit



Source: Rabobank annual reports 2007-2010

Compared to other banks in the sample, Rabobank's regulatory capital is by majority represented by Tier 1 capital (approximately 97% of the overall regulatory capital). Another interesting point is the level of equity being higher than the total regulatory capital. This was not the case in the above mentioned banks. All the capital ratios are high both due to increase of capital as well as decrease in risk-weighted assets as a result of further roll-out of Basel II, portfolio developments and stricter control of solvency requirements.

Figure 22: Rabobank Group risk-weighted assets and capital ratios



Source: Rabobank annual reports 2007-2010

3.3.5 Deutsche Bank

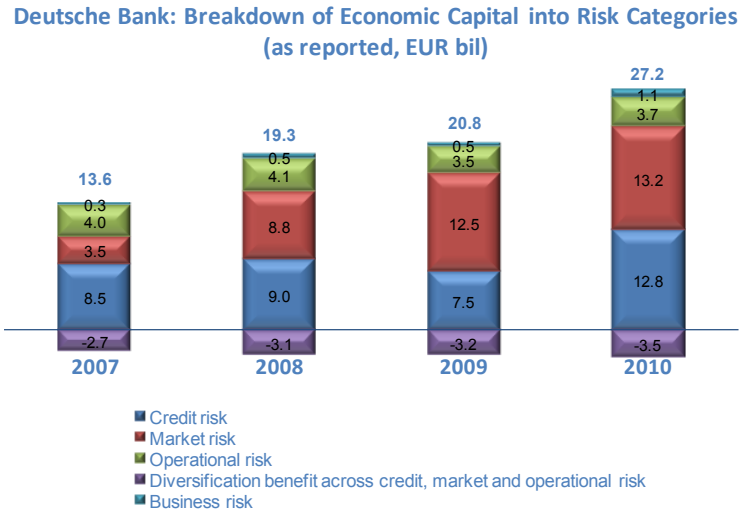
Deutsche Bank (DB) is a one of the leading investment banks in the world with a global presence and headquarters in Frankfurt, Germany. The group's business is made up of three divisions: Corporate & Investment Bank (CIB), Private Clients and Asset Management (PCAM) and Corporate Investments (CI) (Deutsche Bank, 2010).

DB was to large extent involved in the housing mortgage bubble in the United States trading in 2007 and was one of the major traders with collateralized debt obligations (CDO). As the U.S. Senate panel found DB kept selling poor quality CDOs to its clients in 2007 when the executives already foresaw a market slump (Ivry, Shenn, & Moore, 2011). At the same time DB was betting against some of the mortgage bonds in the CDOs which helped the bank to weather the crisis. Despite this ethically problematic behaviour the bank suffered significant loss in 2008.

The bank executed several important acquisitions in past four years. In 2007 DB acquired among others Berliner Bank, MortgageIT Holdings, Inc. (a residential mortgage real estate investment trust (REIT) in the U.S.), Abbey Life Assurance Company Limited (an insurance company in the UK). In 2008 DB acquired HedgeWorks, LLC (a hedge fund administrator in Calfironia, US). In 2009 the group acquired minority stake in Deutsche Postbank and completed the acquisition of Dresdner Bank's Global Agency Securities Lending business from Commerzbank. In 2010 DB has acquired Sal. Oppenheim bank (Germany), majority in Deutsche Postbank, leading German retail bank, parts of ABN AMRO's commercial banking activities in the Netherlands (Deutsche Bank, 2011).

The economic capital is reported in slightly different way compared to previous banks as DB reports clearly the diversification effect across credit, market and operational risks. In general, DB is very open about the details on economic capital management compared to other banks and provides not only break-down of the total figures, but also high quality notes to substantial changes. We are able to look closely on the economic capital management in each year. As we already mentioned above, DB was outlier in our sample as it has very low portion of capital attributed to credit risk compared to other banks. The economic capital has grown substantially mainly in 2008 (42%) and in 2010 (31%).

Figure 23: Deutsche Bank breakdown of economic capital into risk categories



Source: Deutsche Bank annual reports 2007-2010

Note: Market risk category is further broken down into trading market risk and non-trading market risk.

In 2008, which was the hardest year of the monitored period, the substantial increase in economic capital principally reflected the effects of various refinements made to our economic capital calculations during the year, as well as the effects of higher market volatility. In particular, the main changes were:

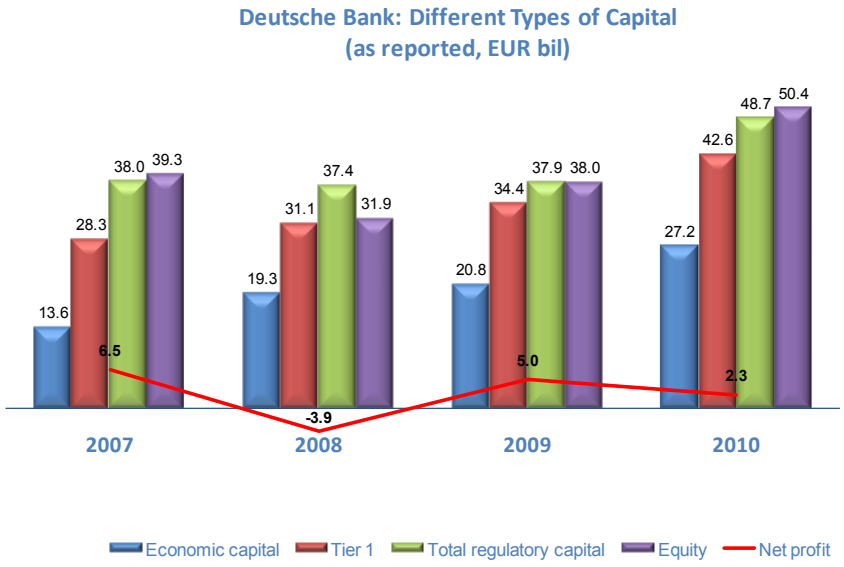
- *"the completion of a Group-wide roll-out of our "multi-state" model for credit risk, which increased economic capital by € 1.4 billion,*
- *the introduction of trading market risk economic capital calculations for banking book assets subject to fair value accounting, which added € 958 million economic capital,*
- *the recalibration of stress test shocks used for calculating trading market risk economic capital, which increased economic capital by € 1.1 billion, and*
- *higher market volatility resulting in increased internal exposure measures for derivatives, which contributed € 1.0 billion to the increase* (Deutsche Bank, 2008)*."*

The above mentioned changes were then key drivers of the changes in individual risk categories. Due to change in methodology, the economic capital as reported in 2007 annual report is not fully comparable to 2008.

The growth of economic capital in 2009 was 8% only; however substantial changes were done within the individual categories. Credit risk capital decreased mainly due to lower derivative exposure. Market risk capital, on the other hand, rose substantially (42%) which was mainly driven by non-trading market risk growth reflecting the acquisition of minority stake in Deutsche Postbank. The modest decrease in operational risk capital is a result of improved insurance coverage, new monitoring and control mechanisms and an increased sensitivity of AMA model to better reflect recent developments of the control framework (Deutsche Bank, 2009).

The 2010 increase of economic capital was driven by executed large acquisitions which we mentioned already above. Newly consolidated acquired banks caused mainly substantial increase in credit risk capital. DB also provides economic capital allocation to individual business segments (2010 percentage): CIB (59%), PCAM (35%), CI (3%) and Consolidation & Adjustments (3%) (Deutsche Bank, 2010).

Figure 24: Different types of Deutsche Bank capital, net profit



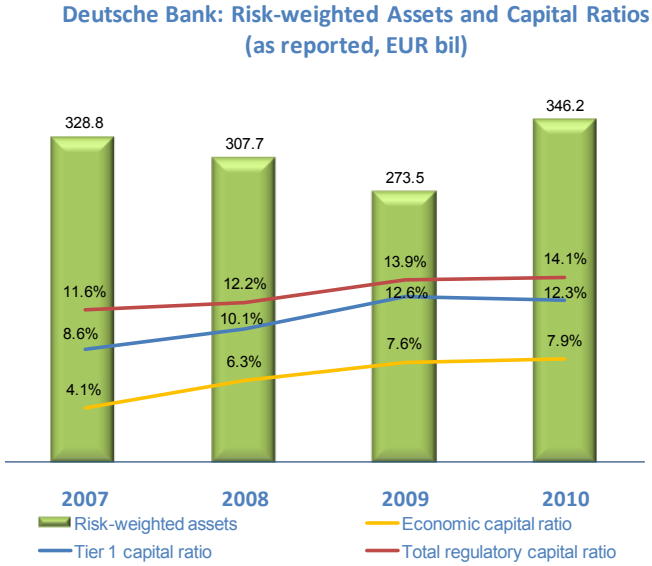
Source: Deutsche Bank Annual Reports 2007-2010

The development of all capital categories was rather stable in years 2007-2009 with the exception of negative net result in 2008 caused by the financial crisis and bank's involvement in subprime mortgage bubble. The year 2010 on the other hand brought significant changes as large acquisition required additional capital. DB successfully completed capital increase in October 2010 with net proceeds of approximately EUR 10.1 billion raised in the new shares issuance, which were mainly

used to cover the capital consumption from the consolidation of Postbank, and, in addition, to support the existing capital base.

Risk-weighted assets were up by EUR 73 billion to EUR 346 billion at the end of 2010 as a result of the above mentioned acquisitions. However, with the additional capital the bank was able to keep capital ratios above the targeted levels (10% and above in case of Tier 1 capital ratio).

Figure 25: Deutsche Bank risk-weighted assets and capital ratios



Source: Deutsche Bank Annual Reports 2007-2010

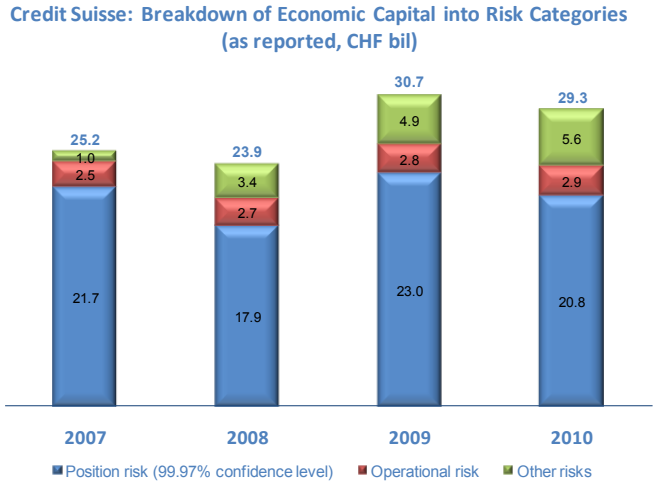
3.3.6 Credit Suisse

Credit Suisse Group (CS), one of the world's leading banking houses, is the second largest Swiss bank (after UBS) with presence in more than 50 countries in all continents. It offers integrated bank services in three global divisions – Private Banking, Investment Banking and Assets Management, which are supported by Shared Services functions.

Recent acquisition activity: In 2007 CS acquired majority interest in Hedging-Griffo, a leading independent asset management and private banking firm in Brazil. In 2008 it acquired the corporate advisory business of Hindal (Australia), majority interest in Asset Management Finance Corporation (a US based company providing asset management firms with capital) and sold part of its Global Investors business (asset management). In 2010 CS announced the purchase of Prime Fund Solutions business (a global leader in hedge fund administration services) from Fortis

Bank and acquisition of minority interest in York Capital Management,a hedge fund manager based in New York (Credit Suisse, 2011).

Figure 26: Credit Suisse breakdown of economic capital into risk categories

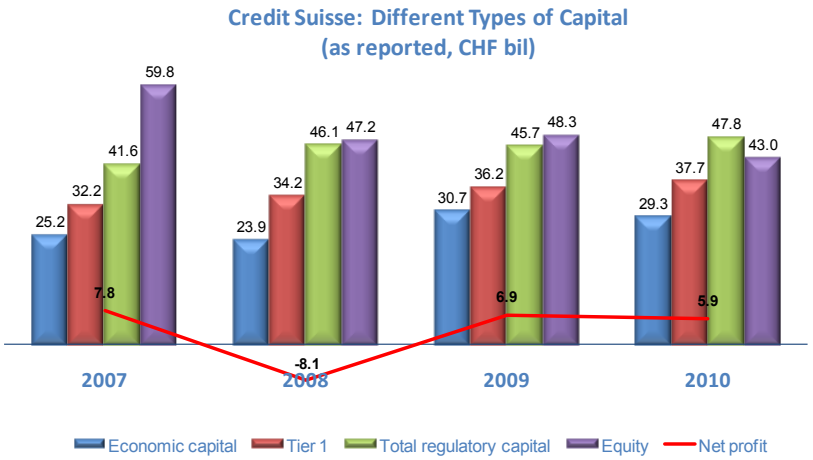


Source: Credit Suisse Annual Reports 2007-2010

The economic capital management and reporting is different from other banks again. Economic capital is calculated separately for position risk, operational risk and other risks. For the purposes of the summary statistics above, we were therefore forced to estimate the split of position risk into credit risk and market risk based on the split of risk-weighted assets into risk-weighted positions and market risk equivalents[12]. However, in this chapter we focus on the "as reported" figures. CS defines the position risk as "*the level of unexpected loss in economic value on our portfolio of positions over a one-year horizon which is exceeded with a given small probability (1% for risk management purposes; 0.03% for capital management purposes)"* (Credit Suisse, 2010). Operational risk is defined in a standard way as a loss from inadequate or failed internal processes or people's failure. The category other risks includes: expense risk, pension risk, foreign exchange risk between economic capital resources and utilized economic capital and risk on real estate held for own use. Expense risk is defined as the difference between expenses and revenues in a severe market event, exclusive of the elements captured by position risk and operational risk. Pension risk is defined as the potential under-funding of pension obligations in an extreme event (Credit Suisse, 2010).

[12] With this approach the credit risk represented approximately 89% of the position risk and therefore 63% of the total economic capital in 2010.

Figure 27: Different types of Credit Suisse capital, net profit

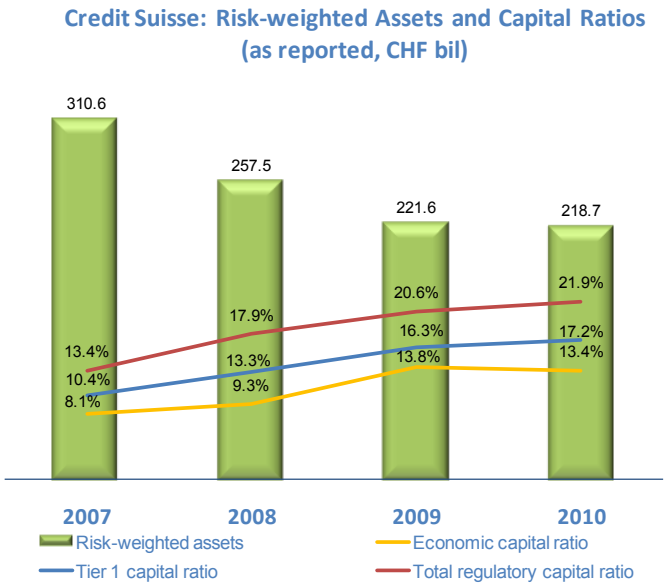


Source: Credit Suisse Annual Reports 2007-2010

The economic capital decreased in 2008 partially due to depreciation of US dollar against Swiss franc and partially due to reductions in position risk. At the same time, the methodology and model were refined and therefore enhanced, which led to changes in the allocation. Another substantial of methodology occurred in 2009. Under new methodology the total economic capital for 2008 would be CHF 31.9 billion (higher than 2009 figure), whereas under the old methodology it was CHF 23.9 billion. The methodology changed again in 2010 mainly in the other risks category. Economic capital decreased due to US dollar translation impact and due to reduction in position risk. We can conclude that even though it seems there are substantial changes in the level of economic capital, these were mainly caused by important changes in the methodology as well by refinement of the calculation model.

Besides above mentioned CS reports allocation of economic capital by segment (2010 percentage): Private Banking (22%), Investment Banking (63%), Asset Management (11%) and Corporate Centre (4%).

Figure 28: Credit Suisse risk-weighted assets and capital ratios



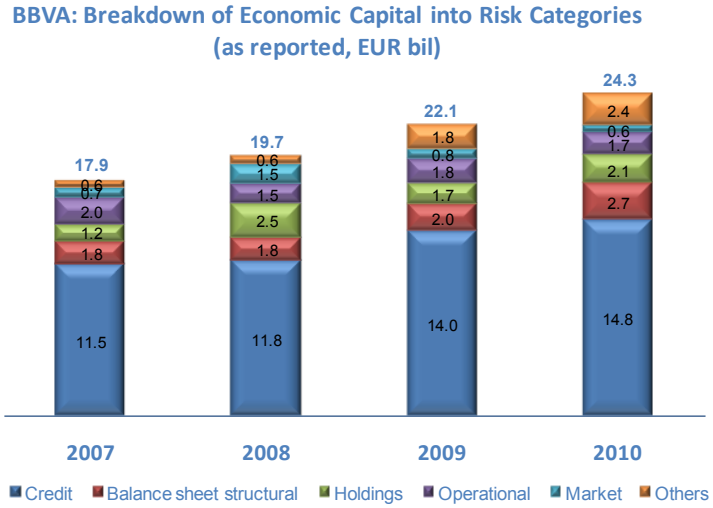
Source: Credit Suisse Annual Reports 2007-2010

3.3.7 Banco Bilbao Vizcaya Argentaria

Banco Bilbao Vizcaya Argentaria (BBVA) is a multinational banking house headquartered in Spain and with strong position in Mexico and other Latin-American countries and with operations in more than 40 countries in total (Europe, Americas and Asia). It is the second largest Spanish bank after Santander. The operations of the bank are divided into five business units: Business in Spain and Portugal (retail and corporate banking services), Wholesale Banking & Asset management, Mexico (banking, insurance and pension business), South America (covers all the banking activities of the group in the region) and USA (retail banking) (BBVA, 2011).

Similar to other banks in the sample, BBVA was active in terms of acquisitions executed in past 4 years. In 2007 the group acquired Compass Bancshares Inc. (retail bank in the United States), in 2009 it acquired Guaranty Bank from FDIC (failed U.S. bank), and in 2010 it acquired Crédit Uruguay from Crédit Agricole and 24.9% in Turkish Garanti bank.

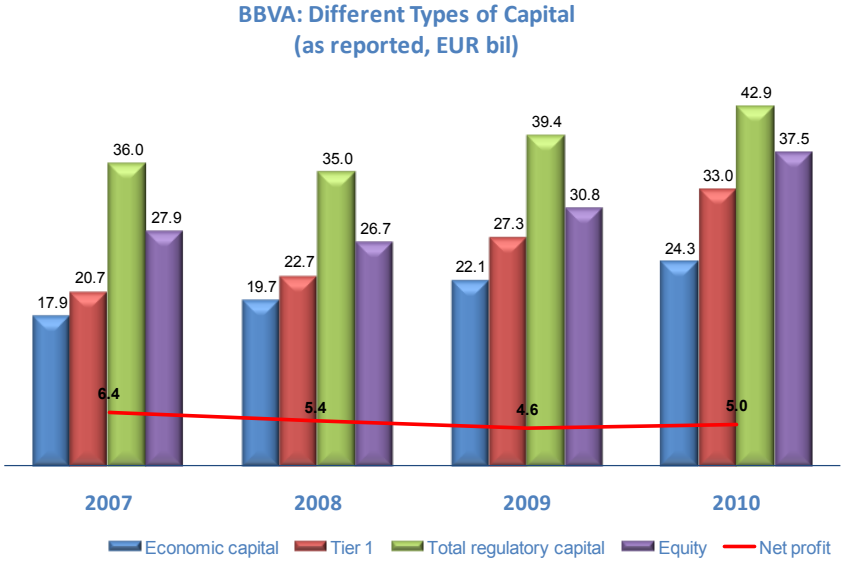
Figure 29: BBVA breakdown of economic capital into risk categories



Source: BBVA Financial Reports 2007-2010

The distribution of ECO by business area in 2010 was following: Spain and Portugal (32.7%), Wholesale Banking & Asset management (16.2%), Mexico (13.7%), United States (10.7%), South America (9.4%) and Corporate Activities (17.3%).

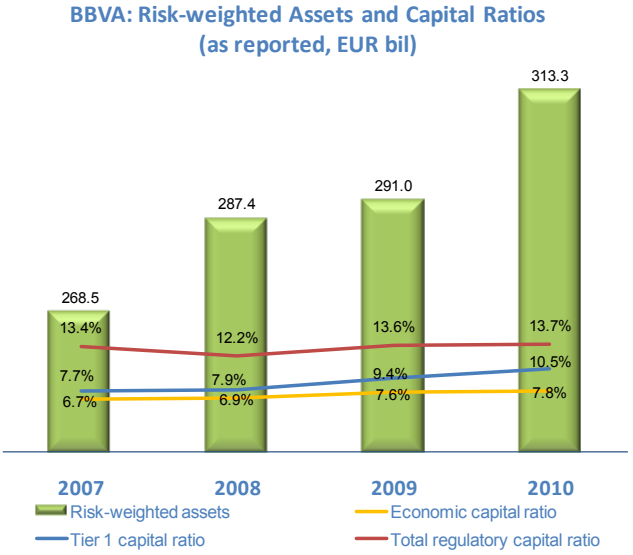
Figure 30: Different types of BBVA capital, net profit



Source: BBVA Financial Reports 2007-2010

When it comes to regulatory capital, the group was able to keep high level of capitalisation despite increase in risk-weighted assets in each year, which grew mainly in connection with the above mentioned acquisitions. BBVA was also able to remain profitable during the hardest year 2008 when many of its peers suffered significant losses.

Figure 31: BBVA risk-weighted assets and capital ratios



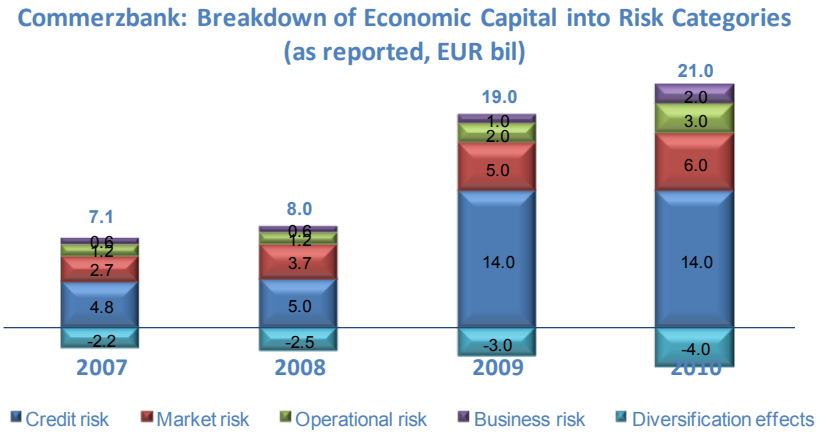
Source: BBVA Financial Reports 2007-2010

3.3.8 Commerzbank

Commerzbank is a leading bank for private and corporate customers in Germany. It is the second largest German bank after Deutsche Bank. It operates within six business segments: Private Customers, Mittelstandsbank (corporate clients), Corporates & Markets, Central & Eastern Europe and Asset Based Finance. It has above 60 sites in 50 countries and serves more than 14 million private clients as well as one million business and corporate clients worldwide (Commerzbank, 2010).

In 2007 the bank acquired majority share in the Ukrainian bank Forum, in 2008 Commerzbank announced it would acquire large Dresdner Bank from Allianz SE. The acquisition took place in 2009 during prevailing crisis on the financial markets. The costs related to acquisition and prevailing crisis caused significant loss to Commerzbank in the financial year 2009 and forced it to ask the German Special Financial Market Stabilization Funds (SoFFin) to increase the bank's capital base in exchange for 25% silent participation on the equity. In 2010 the company achieved positive net result again and will start repaying the government's bailout in 2011 (Commerzbank, 2009).

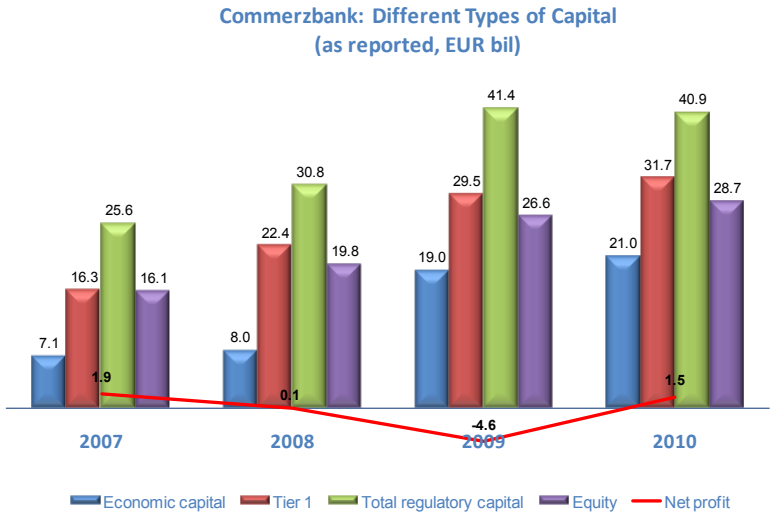
Figure 32: Commerzbank breakdown of economic capital into risk categories



Source: Commerzbank Annual Reports 2007-2010

The economic capital is measured at a confidence level of 99.95%. The above mentioned development was a cause of substantial changes in the economic capital in 2009. First of all, the bank introduced new credit portfolio model, which created much higher credit VaR and hence economic risk-weighted assets in the Group. Another reason was the integration of Dresdner Bank itself. Furthermore, additional capital from SoFFin led to increase in all levels of capital.

Figure 33: Different types of Commerzbank capital, net profit

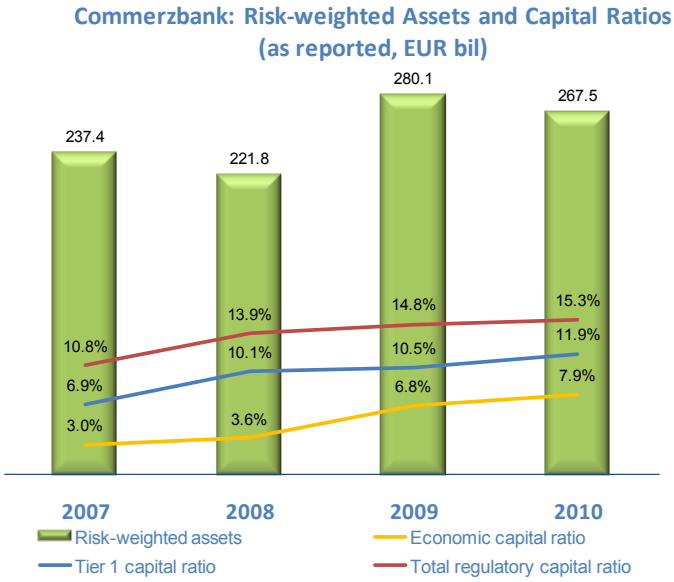


Source: Commerzbank Annual Reports 2007-2010

The development of capital (ratios) follows the pattern indicated above. The crisis for Commerzbank peaked in 2009 and was one year delayed compared to most of the peers (e.g. Deutsche Bank). We can conclude that the bank probably has not chosen

the best time for acquisition during the crisis and was therefore forced to ask German government for partial bailout.

Figure 34: Commerzbank risk-weighted assets and capital ratios



Source: Commerzbank Annual Reports 2007-2010

3.3.9 Nordea Bank

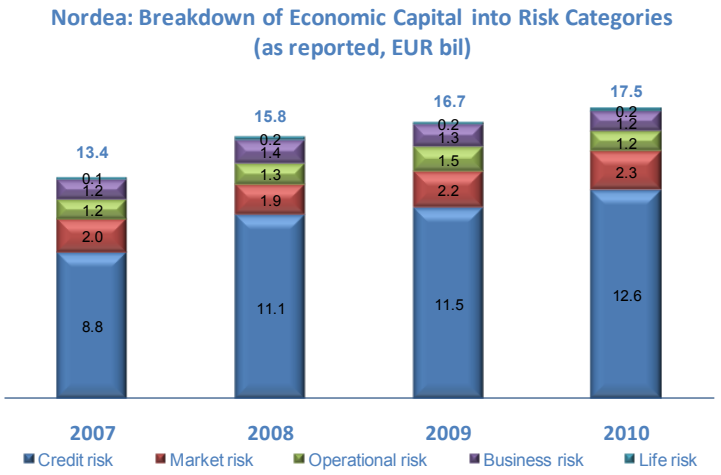
Nordea is the largest financial service company in the Northern Europe. It was established in 2010 by merger of large banks in Denmark, Finland, Norway and Sweden. It provides corporate merchant banking as well as retail banking, private banking and asset management. It is also the leading provider of life and pensions products in the Nordic countries. Nordea serves approximately 11 million clients mainly in 9 home markets (Denmark, Finland, Norway, Sweden, Estonia, Latvia, Lithuania, Poland and Russia), but also has branches in the most important financial centres around the globe in order to serve the international corporate clients (Nordea, 2011a).

Nordea completed acquisition of a 75% stake in Russian JSB Orgresbank in 2007 and acquired the remaining stake in 2008 (Nordea, 2011b). In the same year the bank sold the institutional global custody business to JPMorgan. In 2009 Nordea acquired the healthy part of troubled Danish Fiona Bank (Nordea, 2011c).

The economic capital management of the bank is based on 5 risk categories – credit, market, operational, business and life risk. Life risk is connected to insurance products of the group and represents the impact from changes in mortality rates, longevity rates and disability rates. The confidence level for all risk types is 99.97%.

In 2009, as a consequence of the financial turmoil in previous years, Nordea decided to make substantial changes in the economic capital framework, which has been aligned to the regulatory capital framework since 2010. The pillar I risk measurements methods are used in the economic capital framework for credit, market and operational risk, however, both pillar I and pillar II risks are included in the framework (Nordea, 2010a). Before 2010, there were substantial differences between internal models and models for regulatory capital calculation. These have been eliminated and credit, market and operational risks calculation are aligned with regulatory framework calculation. Numbers for 2007-2009 presented in Figure 35 are restated according to new methodology used in 2010.[13] The growth of economic capital was mainly driven by increasing capital for credit risk which can be to high degree explained by growth in volumes (revenues).

Figure 35: Nordea breakdown of economic capital into risk categories

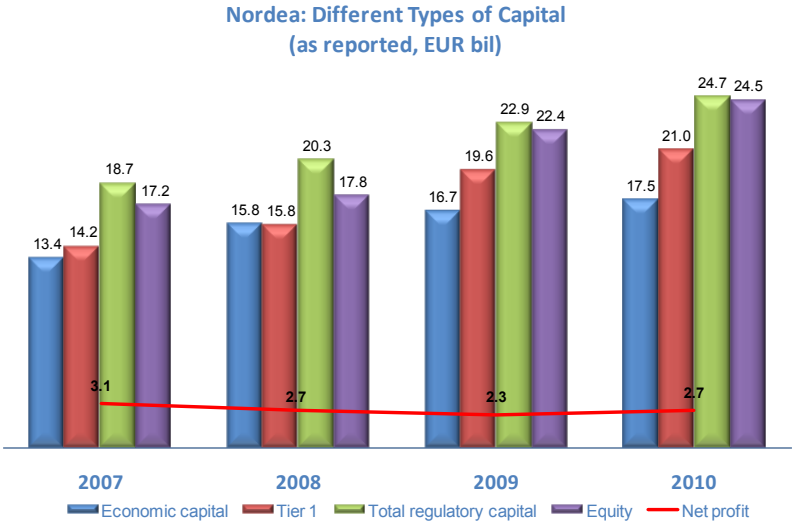


Source: Nordea Annual Reports 2007-2010

Besides allocation by risk category, Nordea also reports allocation by customer area (2010 percentage): Nordic banking (67%), Corporate Merchant Banking & Capital Markets (6%), Shipping Private Banking & Savings Products (13%), New European Markets, Banking Products & Group Operations (9%), Group Corporate Centre (4%) and Other (1%).

[13] Note: Total economic capital at the end of 2007, 2008 and 2009 would be EUR 10.9, 12.8 and 14.1 billion respectively under old methodology.

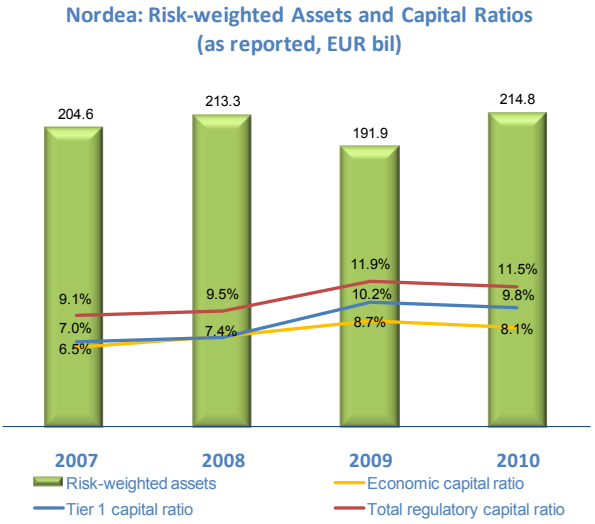
Figure 36: Different types of Nordea capital, net profit



Source: Nordea Annual Reports 2007-2010

Capital base has grown substantially over the years due to both positive net results in each year being transformed to retained earnings (lower dividends in 2009) and due to increase of share capital by rights issue in 2009. This was mainly motivated by Nordea's effort to improve capital ratios. At the same time Nordea tightened the control over the growth of risk weighted assets by reduction of investments in markets and business lines with high risk and by reinforcement of credit processes.[14]

Figure 37: Nordea risk-weighted assets and capital ratios



Source: Nordea Annual Reports 2007-2010

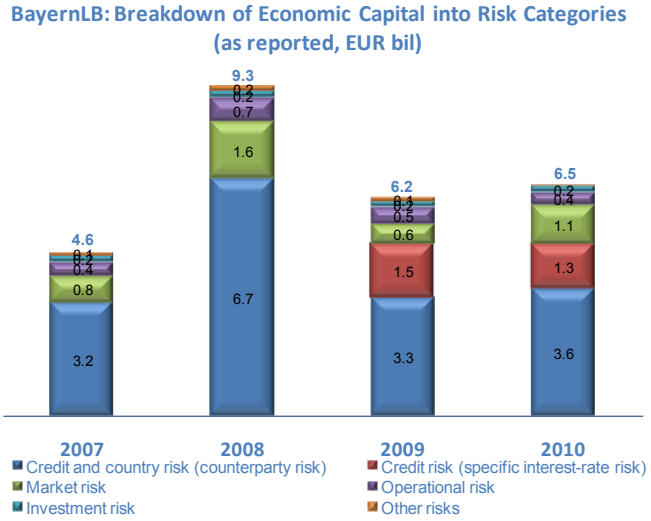
[14] See figures 36 and 37 with the development of capital and respective ratios.

3.3.10 Bayerische Landesbank (BayernLB)

BayernLB is a leading commercial bank in Bavaria serving large and middle-market corporate customers in Germany and Europe as well as retail customers. It is publically owned by the Free State of Bavaria holding 94%. Rest of the shares are held by the Association of Bavarian Savings Banks (BayernLB, 2011). Current shareholders' structure is a result of bank's weak performance during financial crisis. BayernLB invested in problematic American asset backed securities (ABS) and was forced to write down EUR 3.6 billion on the ABS investment portfolios and secondary market portfolios. Together with increased risk provisions of group's subsidiaries caused by investment on the Icelandic market the total negative impact of the financial crisis on consolidated income was around EUR 5.4 billion. As the bank would not be able fulfil basic capital requirements the Free State of Bavaria provided additional capital of EUR 10 billion increasing its share on the bank's equity to current 94% and provided additional EUR 4.8 billion guarantees on the ABS portfolio. In addition, the German SoFFin has provided guarantees of up to EUR 15 billion for bonds issued by BayernLB (BayernLB, 2008). These capital injections allowed BayernLb to survive.

Furthermore, the bank's management had decided to acquire majority in Hypo Group Alpe Adria (HGAA), Austrian mortgage provider with strong position in Slovenia, Croatia, Serbia and Bosnia. The motivation behind the acquisition was an expansion of BayernLB to the Balkans. This was, however, disastrous decision as HGAA went almost bankrupt in 2009 and has been taken over by Austrian state for symbolic 1 EURO leaving BayernLB (and Bavarian tax-payers) with huge loss. As it later came to light all of the BayernLB's former members of the Board of Management were liable for a bad decision as they ignored the findings of due diligence which caused that BayernLB overpaid for the acquisition. Legal actions were launched against the former management and some of the members were already arrested (BayernLB, 2010).

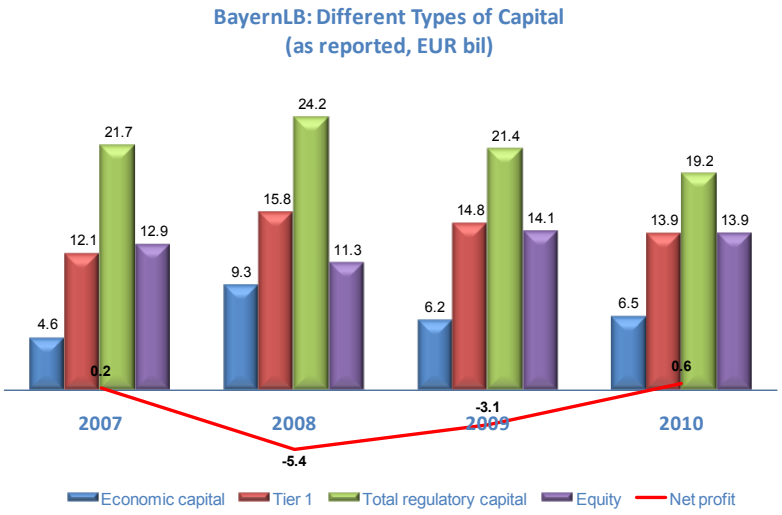
Figure 38: BayernLB breakdown of economic capital into risk categories



Source: BayernLB Annual Reports 2007-2010

Both above facts (ABS losses and HGAA acquisition) clearly had significant impact to development of all capital indicators. The credit risk capital had to be increased substantially in 2008 with the help from the government (ABS crisis). Since 2009, economic risk has been calculated on the basis of a confidence level of 99.95% (which corresponds to an A2 rating on Moody's ratings scale) whereas before 2009 the confidence level was 99.96%, corresponding to the previous strategic target rating of A1. Since 2009, new risk category has been introduced as well – credit risk (specific interest rate risk) which had been reported under market risk before. A modest economic capital increase in 2010 is explicable by changes in calculation methodology.

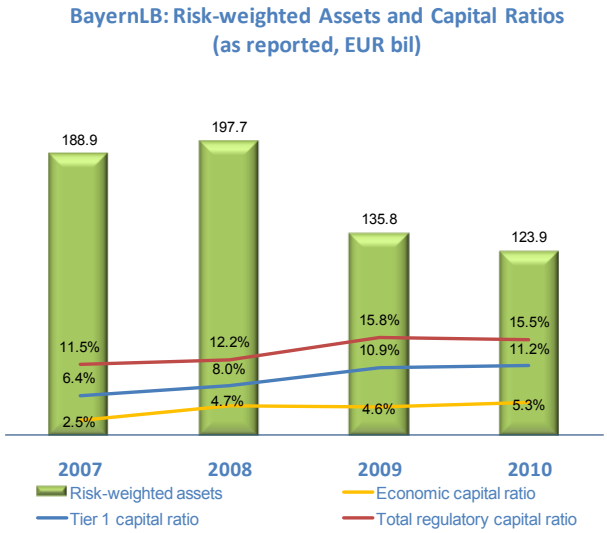
Figure 39: Different types of BayernLB capital, net profit



Source: BayernLB Annual Reports 2007-2010

The development of other capital indicators and ratios is in line with the above described situation. We can conclude that the economic capital ratio is very small compared to other banks in the peer group whereas the regulatory capital ratios improved significantly after the capital injection and due to decrease in risk-weighted assets caused by disposal of HGAA in 2009. Further decrease in 2010 can be explained mainly by another disposal – the group has sold its majority stake in Landesbank Saar. Further disposals of non-core assets are planned for the coming years.

Figure 40: BayernLB risk-weighted assets and capital ratios



Source: BayernLB Annual Reports 2007-2010

3.3.11 Royal Bank of Canada

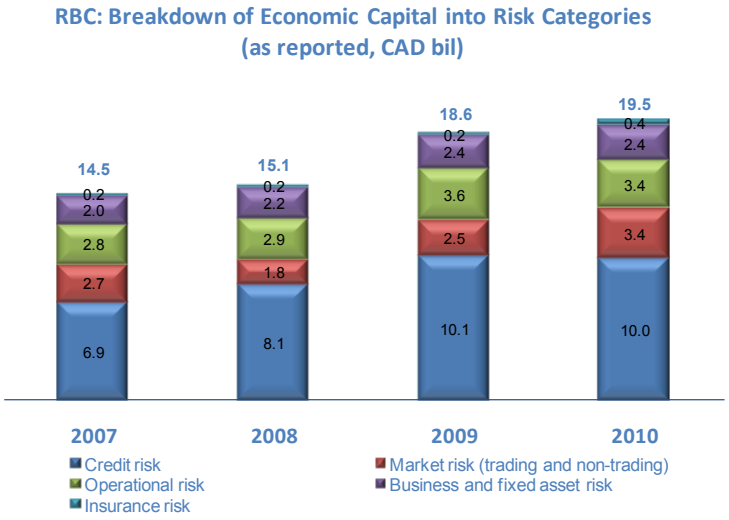
Royal Bank of Canada (RBC) is the largest Canadian financial institution as measured by assets and market capitalisation, and among the largest banks in the world, based on market capitalisation. It provides diversified financial services and provides personal and commercial banking, wealth management services, insurance, corporate and investment banking and transaction processing services on a global basis (RBC, 2010). On June 20, 2011 RBC announced the sale of its U.S. retail banking operations to PNC Financial Services Group, Inc for a total consideration of USD 3.6 billion. The company will focus on the strategy of being the market leader in Canada (RBC, 2011).

RBC has executed several acquisitions in past four years. Among others: In 2007 the acquisition of RBTT, a leading commercial banking provider in Trinidad and Tobago and other Caribbean countries, was announced as well as three other smaller acquisitions. In 2008, 6 acquisitions were announced (among others ABN AMRO's Canadian commercial leasing division). In 2009, 2 acquisitions were announced -

J.P. Morgan's Third Party Registered Investment Advisor Servicing Business and advisory firm Rundle Energy Partners. In 2010, wealth management business of Fortis in Hong Kong was acquired and BlueBay, a U.K. asset management company, were acquired.

The group has a slightly different approach to economic capital reporting/terminology compared to its peers. The numbers presented in Figure 41 represent composition of "Risk capital" which after adding a "Goodwill and intangibles"[15] item are together called economic capital. However, the "Risk capital" is the item which is called economic capital in other banks. We therefore considered this one in our calculations.

Figure 41: RBC Breakdown of economic capital into risk categories



Source: RBC Annual Reports 2007-2010

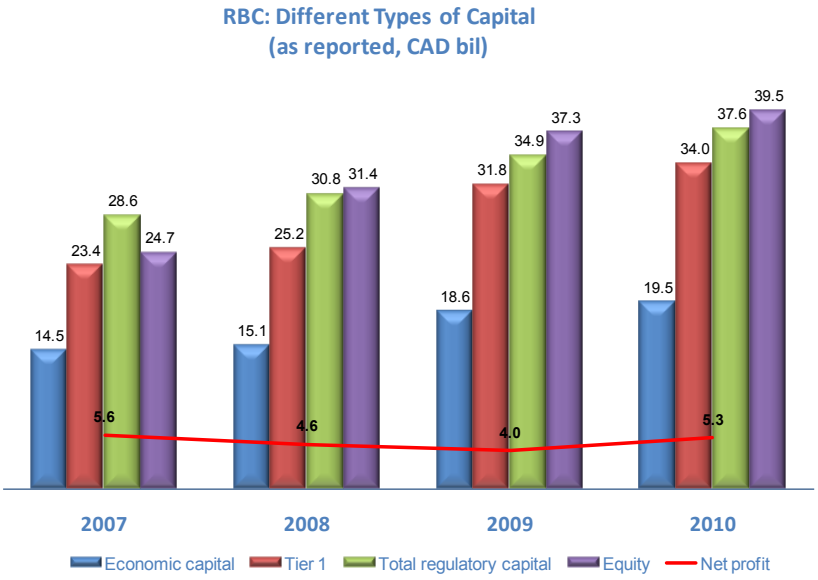
The risk capital is allocated into five categories: credit, market, operational, business and fixed asset and insurance risks. Fixed asset risk is defined as a risk that the value of fixed assets will be less than their book value at a future date. Insurance risk stems from the insurance activities of the group. It reflects the risk that the payments of the group will be higher than anticipated. Other risk categories are defined in a standard way.

Substantial growth of economic/risk capital took place in 2009 mainly as a result of increased credit risk (25% growth), market risk (39% growth) and operational risk (24% growth). According to 2009 annual report, "*credit risk increased mainly due to lower credit quality and business growth. Market risk increased largely reflecting*

[15] Being CAD 5.6, 7.7, 11.3 and 10.1 billion in 2007, 2008, 2009 and 2010 respectively.

portfolio growth and market volatility, while the increase in operational risk was attributable to higher revenue (RBC, 2009)." Modest increases in 2008 and 2010 are mostly explicable by methodology changes.

Figure 42: Different types of RBC capital, net profit



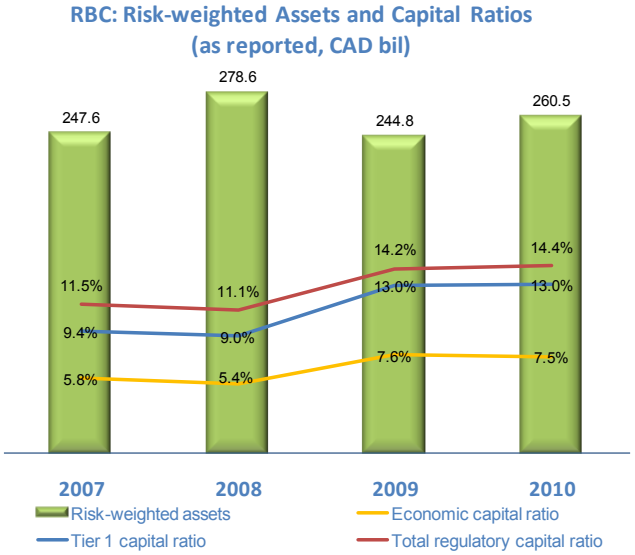
Source: RBC Annual Reports 2007-2010

The financial crisis had negative impact on the RBC revenues (as it influenced revenues of all the banks in our sample). According to company calculations presented in 2009 annual report, the market environment net income impact (loss) was CAD -0.1, -1.0 and -1.1 billion in 2007, 2008 and 2009 respectively. Despite this strong negative impact of the economic environment RBC remained profitable in all monitored periods. At the same time, it was able to substantially improve its capital base by issued new shares (in 2008 and 2009) and by increasing retained earnings. Both of these factors combined with modest decrease in risk-weighted assets led to substantial improvement of capital ratios in 2009 and 2010. Risk-weighted assets increased in 2008 by CAD 31 billion due to business growth (acquisitions), change in methodology (Basel II) and weaker currency. In 2009 on the other hand, RWA decreased substantially, primarily due to a decrease in wholesale credit exposures, refinements in asset risk classifications and favourable impact of stronger CAD. The 2010 increase is explicable by credit migration and risk parameter revisions primarily in wholesale and retail portfolios (RBC, 2010).

We should also mention that 2007 capital figures are under Basel I, whereas rest of the years are under Basel II, meaning that the numbers are not fully comparable.

Despite this limitation, we can to conclude that RBC was one of the winners during the financial crisis.

Figure 43: RBC risk-weighted assets and capital ratios



Source: RBC Annual Reports 2007-2010

3.3.12 ING Bank

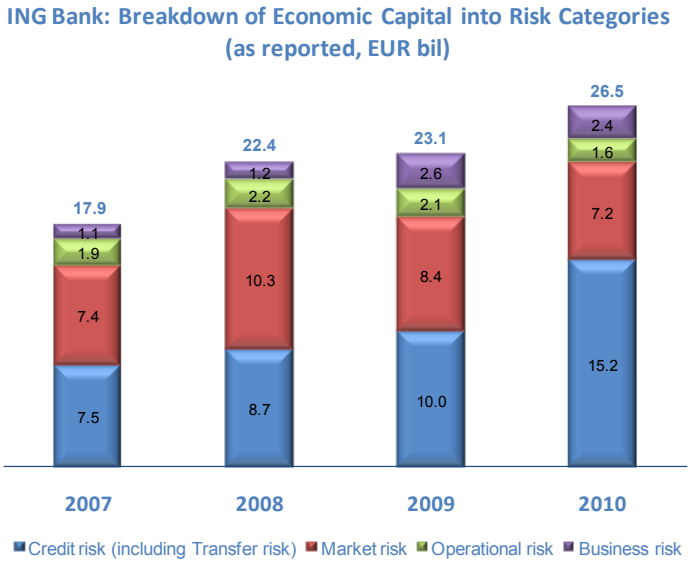
ING Group is a globally active Dutch financial group offering banking, investments, life insurance and retirement services. It is active in more in 40 countries in all continents except for Africa. ING was very active in acquisitions as well as disposals during monitored years, except for 2010 when no major acquisition was executed and only disposals took part. The main acquisition activity took place in 2007 and 2008. To name a few, ING acquired Latin American pension business from Santander in 2007, acquired Germany's largest independent residential mortgage distributor Interhyp in 2008, sold part of its Mexican business to AXA in 2008, sold 70% stake in ING Canada for EUR 1,316 million in 2009, sold Taiwanese life insurance business in 2009 and many other transactions (ING Group, 2010).

In October 2008 ING announced that it had reached an agreement with the Dutch government to strengthen the group's capital by issuing non-voting core Tier 1 securities for a total consideration of EUR 10 billion to the Dutch state. ING repaid half of these securities in December 2009 and further EUR 2 billion in May 2011 and plans to repurchase the rest of the securities by May 2012. The payments come from the retained earnings and rights issue and are connected with significant premiums

(EUR 605 million and EUR 1 billion in case of the first and second repurchase respectively (ING Group, 2011)).

ING Group reports all economic capital figures separately for banking and insurance division. As there are differences in the assumptions (such as confidence levels – 99.95% for Bank and 99.5% for Insurance) and there would be positive effects of diversification, we cannot easily sum up the figures. Unfortunately, the group do not provide consolidated economic capital figures in required details. Our quantitative analysis is therefore focused on the banking division only.

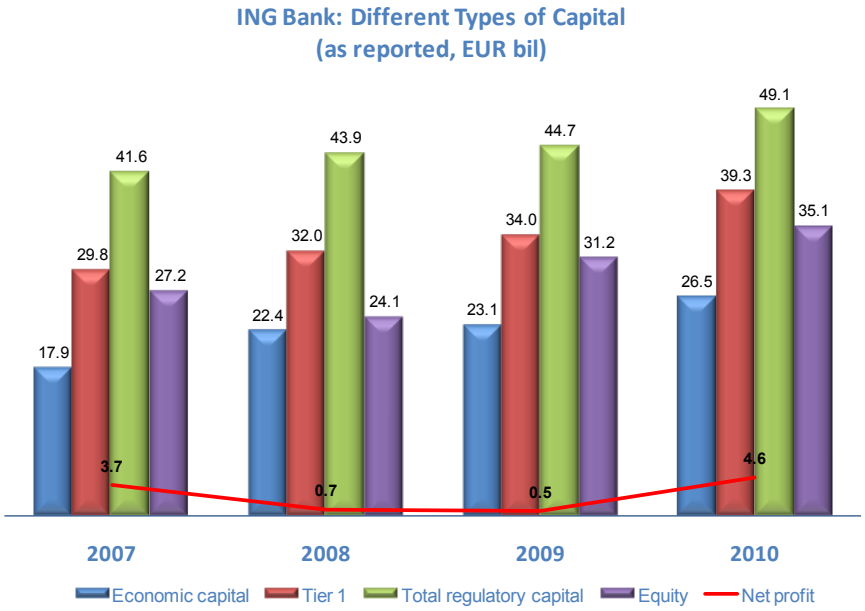
Figure 44: ING Bank breakdown of economic capital into risk categories



Source: ING Group Annual Reports 2007-2010

The economic capital in banking is calculated with AA confidence interval of 99.95% and for a one-year time horizon. It is broken up into four risk categories as presented in Figure 44. The increase in 2008 can be explained partially by modest change in methodology (*inclusion of the core equity investments in market risk Economic Capital Bank, whereas previously it was taken as an add-on at Group level* (ING Group, 2008)) and by credit migrations, increased market volatility and model enhancements. In 2009 the credit deterioration increased the credit risk capital. There has been made a change in methodology at the same time. Client behaviour risk has been moved under business risk instead of market risk which explains the increase of business risk capital and partially decreases of the market risk capital. The decrease of market risk capital can be further explained by de-risking efforts in commercial banking division.

Figure 45: Different types of ING Bank capital, net profit



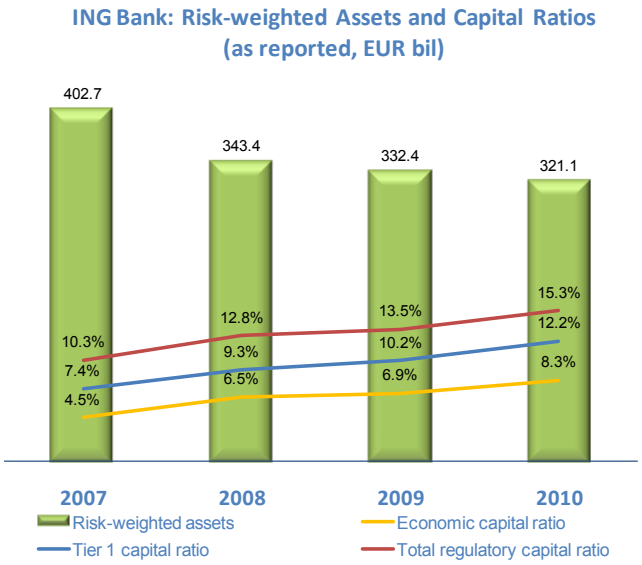
Source: ING Group Annual Reports 2007-2010

Similarly to Nordea, ING Bank has recalibrated the assumptions for credit, transfer and operational risks in order to align more closely the regulatory capital and economic capital approaches. As a result of these changes, the credit risk economic capital grew significantly in 2010. Besides allocation to risk categories, ING further allocates the economic capital to business lines (2010 percentage): Commercial Banking (40%), Retail Banking Benelux (17%), Retail Banking Direct & International (34%) and Corporate Line Bank (9%) (ING Group, 2010).

In order to provide comparable numbers, the figures presented in Figures 45 and 46 are collected and calculated for ING Bank division only as well. We should mention that the results of the banking division were in general better compared to the insurance division. Despite the significant decrease in volumes, the banking division remained profitable during the monitored period, whereas the group reported losses in 2008 and 2009 mainly due to negative results in insurance.[16] We can conclude that the banking division has improved all the capital indicators as well as ratios over the monitored period.

[16] We should mention at this stage that Asset management is reported under Insurance division

Figure 46: ING Bank risk-weighted assets and capital ratios



Source: ING Group Annual Reports 2007-2010

3.3.13 Landesbank Baden-Württemberg

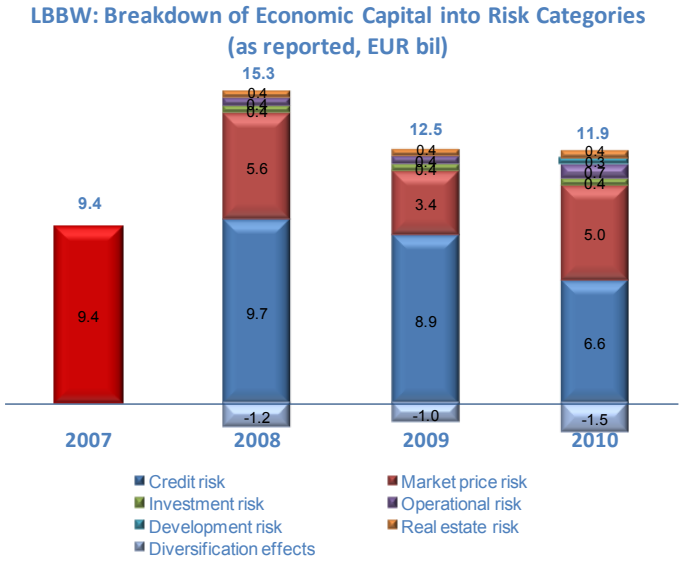
Landesbank Baden-Württemberg (LBBW) is one of the largest banks in Germany. It is controlled by the state of State of Baden-Wuerttemberg and by the Savings bank Association of Baden-Wuerttemberg (40.5% each). It offers all types of transactions of a universal and commercial banking at over 200 branches and offices throughout Germany. With branches in major financial centres in the world it delivers services to internationally active customers. It also works as a central bank for the savings banks. LBBW acquired Sachsen LB bank in 2007 and BAWAG Bank CZ (Czech operations of Austrian BAWAG P.S.K.) in 2008 (LBBW, 2010).

Similarly to BayernLb, LBBW suffered substantial losses during the crisis which caused that the bank was forced to ask the owners (mainly the state of Baden-Württemberg) for financial aid in order to improve its capital base. The financial aid was approved by European Commission in 2009 under the condition that LBBW restructures its business substantially, reduces assets by 40 percent and closes or divests part of its subsidiaries by 2013. In total, EUR 5 billion was injected in the company's capital and guarantees for losses up to EUR 12.7 billion were issued (LBBW, 2010).

LBBW's economic capital is expressed by value-at-risk (VaR) at a high confidence level (99.95 %) or by a comparable risk measure. It has been allocated into five risk categories since 2010: credit risk, market price risk, investment risk, operational risk, development risk and real estate risk. The diversification is effect

quantified separately in the reports. The investment risk comprises losses in value of Group companies and equity investments which are not covered in other categories. The real estate risk represents losses in value of the bank's real estate holdings. The development risk is a new risk category introduced since 2010 and represents risks that arise when implementing commercial and residential project developments and in residential real estate trading. Other risk categories are defined in a standard way. Unfortunately, the bank only provided the total value of economic capital but did not report the breakdown of economic capital into risk categories in 2007 as we can see in Figure 47.

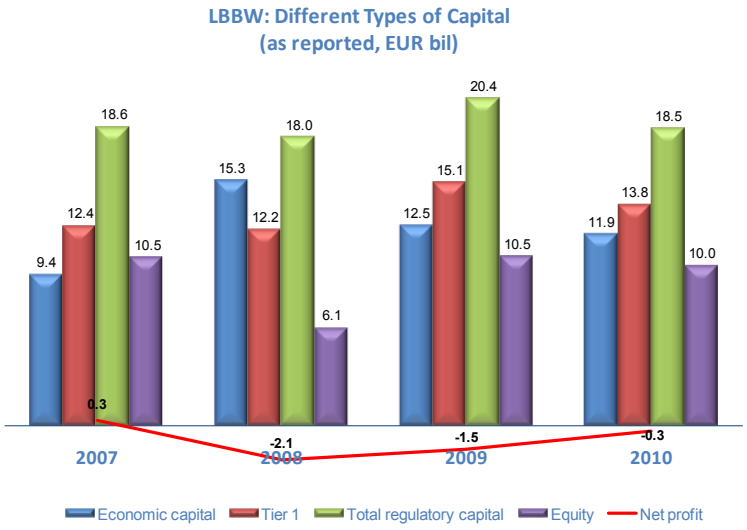
Figure 47: LBBW breakdown of economic capital into risk categories



Source: LBBW Annual Reports 2007-2010

The total economic capital increased substantially (63%) in 2008. The rise can be explained by the integration of Sachsen LB (a troubled bank acquired in 2007), the deterioration of borrower ratings and changes in market data (e.g. spreads, correlations, volatility) during culminating financial crisis (LBBW, 2010). In the same year (2008), LBBW introduced a plan to reduce the economic capital gradually to the level before the financial crisis partly through the reduction of risk positions in the credit substitute business. This activity was effective only partially as the world financial crisis was followed by the debt crisis in Europe. LLBW was therefore not able to fulfil the plan of reduction of economic capital reduction yet.

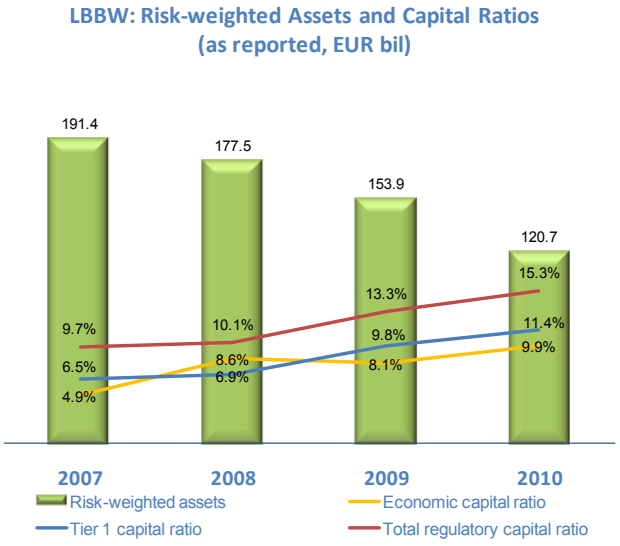
Figure 48: Different types of LBBW capital, net profit



Source: LBBW Annual Reports 2007-2010

When it comes to economic and regulatory capital comparison, unusual situation occurred in 2008 when LLBW reported higher economic capital than Tier 1 capital (see Figures 48 and 49). It is the only bank in our sample to which such a situation happened. After the above mentioned capital injection and economic capital reduction steps, the situation has improved significantly since 2009. Gradually decreasing risk-weighted assets (by 37% during four years) are in line with the restructuring plans and the plan of economic capital reduction. Substantially lower risk-weighted assets positively influenced all the capital ratios mainly in 2010.

Figure 49: LBBW risk-weighted assets and capital ratios



Source: LBBW Annual Reports 2007-2010

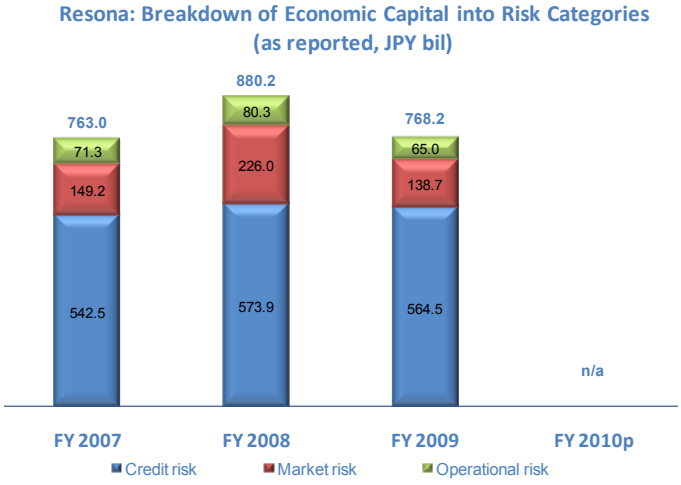
To conclude it, LLBW is one of the losers of the financial turmoil as it was forced to ask for a state aid connected with significant business restructuring and reduction without which it would hardly meet capital requirements.

3.3.14 Resona Holdings

Resona Group is the fourth largest Japanese financial service group (after Mitsubishi UFJ Financial Group, Sumitomo Mitsui Financial Group and Mizuho Financial Group). It consists of three commercial banks – Saitama Resona Bank, Resona Bank and Kinki Osaka Bank. The group had serious capital problems in 2003 and was nationalised then by the Japanese state investing JPY 3.1 trillion in the company. The company has made significant repayments of the state funds in recent years, but it still owes JPY 871.6 billion. The share repurchases are made from retained earnings as well as from global share offering (Resona Holdings, 2011). Since the bank has used most of its available funds for the public funding repayment, no material acquisitions have been executed in recent years.

It is common that fiscal year ends on March 31 in Japan. We are therefore limited in comparison with other banks as well as with the data available on financial year 2010 (ending March 31, 2011). Only preliminary financial results were available by the time we prepared this thesis and we unfortunately do not have any data on economic capital for FY 2010. At the same time, Resona does not report many details on its economic capital management.

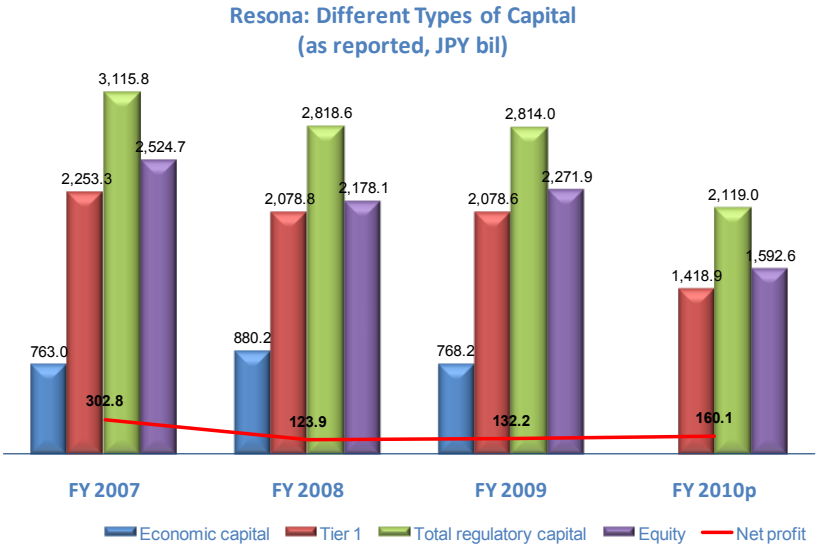
Figure 50: Resona breakdown of economic capital into risk categories



Source: Resona Holdings Annual Reports 2007-2009

The economic capital is allocated to three risk categories – credit risk, market risk and operational risk. The confidence interval used for VaR calculation is 99% and the holding periods assumed for credit, market and operational risks are 1 year, 10 days to 1 year (depending on the nature of assets) and 1 year (Resona Holdings, FY2009).

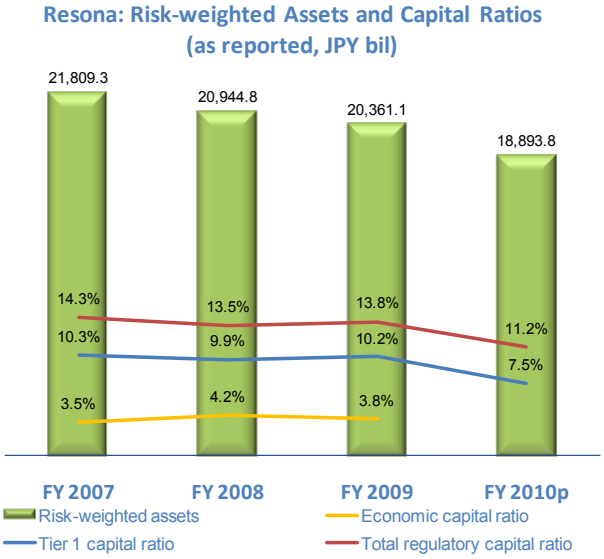
Figure 51: Different types of Resona capital, net profit



Source: Resona Holdings Annual Reports 2007-2009

Unlike to its peers, the capital indicators and ratios worsened in Resona substantially during monitored years. Even though, the risk-weighted assets have decreased substantially (unfortunately, the explanation of the 2010 significant decrease is not yet available), the capital decreased more rapidly causing the ratios went down significantly mainly in FY 2010. The reason behind the substantial decrease of the capital in 2010 might be the massive repayment of the state shares. Not only the capital ratios are decreasing, but they are also very low compared to the peers.

Figure 52: Resona Risk-weighted Assets and Capital Ratios



Source: Resona Holdings Annual Reports 2007-2009

3.4 Economic Capital versus Performance

In this chapter we would like to answer a question whether quality of economic capital reporting as well as its relative value have some influence on the bank's performance?

3.4.1 Economic Capital and Rating

The performance can be measured defined in several ways. One possible approach is to use bank's rating. We have developed a simple model which strives to answer a question whether more detailed economic capital reporting has positive impact on the bank's rating. Our hypothesis is that better reporting positively influences the rating.

We have collected data from latest available annual reports of 44 banks[17] from our large sample of 50 banks. Latest available are in general 2010 annual reports with the exception of Japanese banks where the latest annual reports are available for March 31, 2010 (March 31, 2011 reports were not available by the time we were finishing this paper). We went through the annual reports (or risk reports, in case they are reported separately) and looked whether given bank reports total value of economic capital, breakdown of economic capital into risk categories, breakdown of economic

[17] Note: Following six banks are not included because they do not exist as independent entities any more: HBOS (acquired by Llloyds Banking Group), Wachovia Corporation (acquired by Wells Fargo), Fortis (acquired by BNP Paribas and partially by ABN AMRO), Groupe Caisse d'Epargne (merged to BPCE), Groupe Banques Populaires (merged to BPCE) and Washington Mutual (acquired by JPM).

capital into business lines or provides some explanation to risk management methods (e.g. confidence interval used, bank's individual definitions of risks involved etc.). If the information is provided the bank receives 1 point. If not, then receives 0. The points are then summed up and it is obvious that each bank can receive from 0 to maximum 4 points as a total score for economic capital openness.

The independent variable is the current bank's rating (as of May 2011) according to Standard & Poor's (S&P) Long Term Issuer Credit Rating. Three banks are not rated by S&P (Sberbank, LBBW and BayernLB) in which case we have used Fitch Ratings instead. The ratings were then transformed to numbers – BBB was the lowest rating in our sample and was therefore scored with number 1. AAA was the highest (Rabobank) and was scored number 9. Please refer to Appendix B1 for a full table of banks with individual economic capital reporting scores and ratings in both original and transformed form.

We will use a simple OLS estimator and the regression equation has a following form:

$$Rating = \beta_0 + \beta_1 \cdot Total\ Score + \varepsilon$$

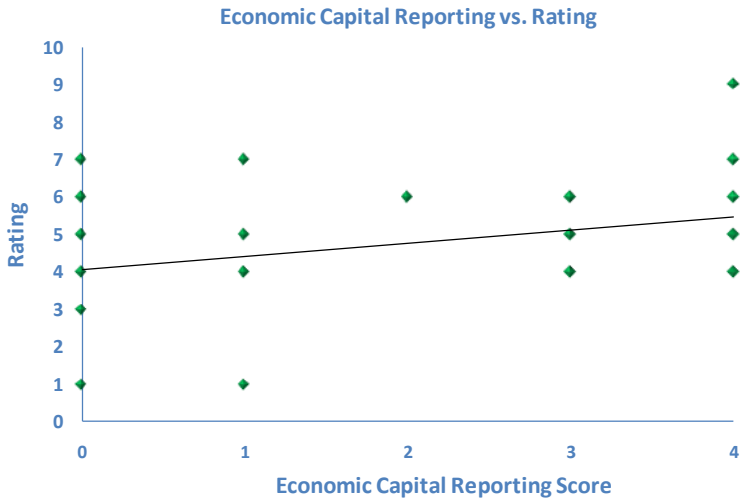
We have used Gretl software (an open source program) to perform the estimate. In statistical testing, we will use 95% confidence level if not stated otherwise. The output from the program can be found in Appendix B2. Our variable is significant, the test against heteroskedasticity revealed that we cannot reject the null hypothesis of no heteroskedasticity and according to statistical test of normality we cannot reject the null hypothesis that the errors are normally distributed. The assumptions of OLS model are therefore fulfilled. On the other hand, the value of adjusted R-squared around 12% shows extremely small explanatory power of the model. The aim of this exercise, however, was not to find the explanation for the bank's rating. The purpose was to verify that more open economic capital reporting positively influences the overall rating of the bank. This small model has confirmed our hypothesis.

The final equation of our estimate now is:

$$\widehat{Rating} = 4.1 + 0.36 \cdot Total\ Score$$

The respective scatter plot with fitted trend line can be found in Figure 53. It is very interesting that such a small number of banks report openly detail on their economic capital even though it might have positive impact on their overall rating.

Figure 53: Economic capital reporting vs. rating



Source: Own analysis based on banks' annual reports, S&P

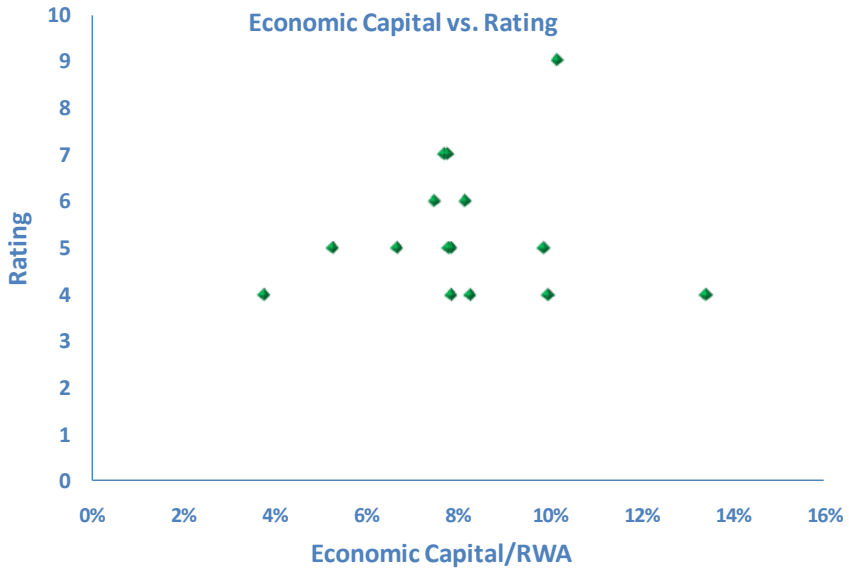
Since we have discovered some relationship between economic capital reporting and bank's rating we would like to answer a question whether there is also a relationship between the level of economic capital in the bank and rating. Berg-Yuen & Medova (2005) found a significant positive correlation between Tier 1 capital ratio and bank's rating in 2004. In case of economic capital, the relationship might be different. As economic capital is a bank's own estimate of capital requirements based on bank's own assessment of all risks, higher economic capital should (ceteris paribus) imply that the bank faces higher risks than comparable bank with lower economic capital. On the other hand, higher economic capital might mean that the bank has better and more complex risk management model. The relationship is further complicated by the fact that confidence level used in VaR models is usually chosen with respect to targeted rating (e.g. Rabobank targets AAA rating with 99.99% confidence level). The relationship is therefore not simple and we would like to use exact methods to see whether there is any.

We can use the sub-sample of 15 banks[18] and their latest available economic capital ratios. Figure 54 shows a scatter plot with economic capital ratio on a horizontal axis and rating (same approach as above) on the vertical axis. We cannot see any clear relationship between two variables and we have therefore used Pearson correlation coefficient computed in Gretl software. The correlation coefficient is 0.07 only (with

[18] JPM, Santander, Barclays, Resona, Rabobank, Deutsche Bank, Credit Suisse, BBVA, Commerzbank, Nordea, BayernLB, RBC, ING, LBBW, Dexia

two-tailed p-value 0.79). We therefore cannot reject the null hypothesis of zero correlation between economic capital and rating (95% confidence level).

Figure 54: Economic capital ratio vs. rating



Source: Own analysis based on banks' annual reports

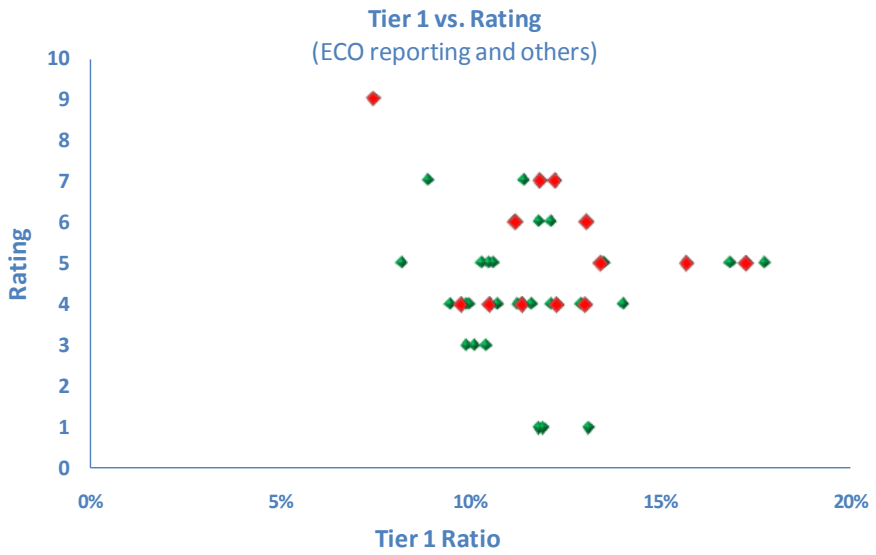
The reason behind this result probably has two explanations. First of all, our sample is extremely small and it is therefore hard to proof correlation with such small degrees of freedom. The other reason might be that the two above mentioned opposite factors offset each other perfectly. We are therefore unable to conclude whether bank with higher economic capital ratio should have higher rating because it has better (more prudent) risk management or lower rating because it faces high risks.

A scatter plot (economic capital vs. rating) divided into "Winners" and "Losers" can be found in appendix A10. The definition of distinction between "Winners" and "Losers" is provided in the subchapter below. The correlation coefficient between "Winners'" economic capital ratio and rating (8 observations) is 0.85 with two-tailed p-value 0.01 and is therefore significant. The correlation in case of "Losers" subgroup (7 observations), on the other hand is -0.47 with two-tailed p-value 0.29 and therefore is not significant. In these cases we clearly suffer from extremely low degrees of freedom and significantly larger number of observations (if they were available) might prove different relationships in each subgroup.

Since we were not able to prove any relationship between economic capital ratio and rating, we would like to verify whether correlation between Tier 1 capital ratio and rating is still positive as proved by Berg-Yuen & Medova (2005). Figure 55 is a scatter

plot with Tier 1 ratio on horizontal axis and rating on vertical axis. 15 banks used in our economic capital analysis (ECO reporting) are marked red, the rest is marked green. As we can see, we come to opposite conclusion than the above mentioned authors, i.e. there is no relationship between tier 1 capital ratio and rating. The correlation coefficient is 0.05 only with two-tailed p-value of 0.75 and we cannot reject the null hypothesis of no correlation.

Figure 55: Tier 1 capital ratio vs. rating



Source: Own analysis based on banks' annual reports, Banscope, and S&P

3.4.2 Economic Capital and Profitability

The question now is whether the level of economic capital has some relationship with the bank's performance measured by net profit change. We will use the economic capital ratio (as mentioned above – economic capital divided by risk-weighted assets) as a measure of bank's level of economic capital. The aim is to find the relationship between this level and change in net profit in the subsequent year. Net profit change is not easy to measure especially in times when the profit moves from negative to positive values. In case the profit is negative in one period and changes to positive value in the subsequent period, the standard percentage change does not give us reasonable measure of the change.[19] We have therefore used a different approach. Net profits were divided by risk-weighted assets (this enables us to abstract from the currencies and banks' size) and multiplied by one hundred. The change is then computed as a difference between

[19] Imagine a company has a net result -1 in the first year and +1 in the subsequent year. The percentage change is -100%, but such a number does not reasonably represent the growth.

values in given years. The resulting values for all the banks can be found in appendix (B3).

We expect that there is a negative relation between the economic capital ratio and change in profit in the subsequent year. The banks with higher economic capital hold riskier assets and, therefore, should have higher economic (risk) capital. The riskier the bank is the more significant losses it should suffer during the crisis.

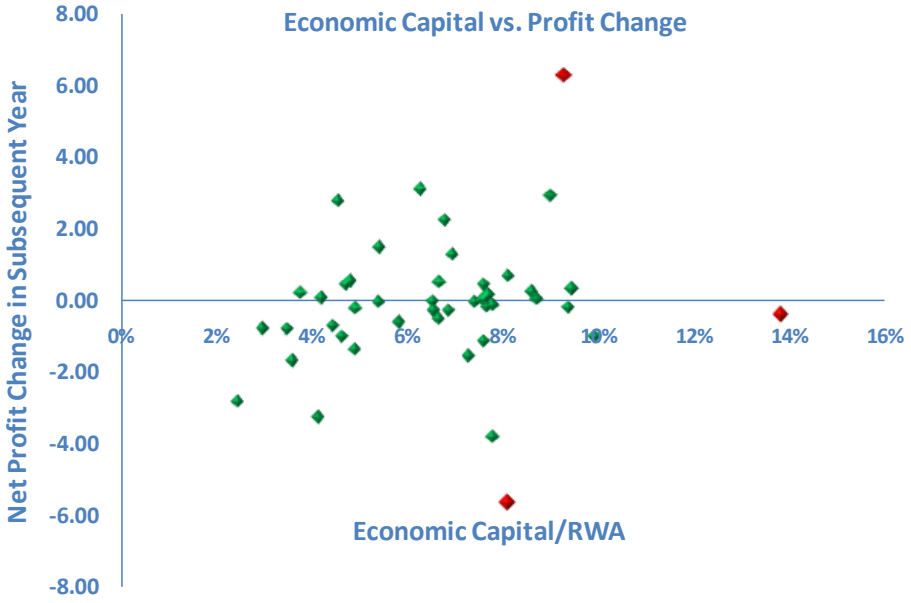
In the first step, we have assigned to each year's economic capital ratio a respective change in net profit of the subsequent year. As we have in total 15 banks and three years of changes observed (2007/2008, 2008/2009 and 2009/2010) in our sample the total number of observations is 44 (we do not have the economic capital of Santander bank for 2007). Figure 56 shows a scatter plot with the economic capital ratio on the horizontal axis and respective change in the net profit in a subsequent year on the vertical axis.

The relationship is not clear from the picture alone and we are able to identify 3 outlying observations (market red). It is interesting that all these 3 observations belong to Credit Suisse bank. The bank has been increasing the economic capital ratio substantially (it was by far the highest in our sample in 2009 and 2010) and at the same time it suffered significant loss in 2008 followed by high profit in 2009 and 2010.

We have calculated the correlation in Gretl software again and the Pearson's coefficient is 0.19 only with two-tailed p-value 0.22. Again, we cannot reject the null hypothesis of no correlation between economic capital and profit change in subsequent year. Leaving out the outlier (Credit Suisse) does not improve the result.

In order to explore whether the relationship is significant in at least one of the periods, we have split our sample into three small samples. Respective scatter plots for three periods can be found in appendix (A11, Credit Suisse marked red). Unfortunately in none of the periods we were able identify significant correlation. The only exception is the period 2007/2008 if we leave out Credit Suisse and Dexia as outliers. In this case (12 observations only) we have identified correlation coefficient 0.62 with two-tailed p-value 0.03 which allows us to reject the null hypothesis of no correlation on 95% confidence level. In all other periods the correlation was not identified (both with and without Credit Suisse or Dexia). These results are opposite to our expectation that negative correlation between economic capital and profit change in next period would be identified.

Figure 56: Economic capital vs. change in subsequent year's net profit



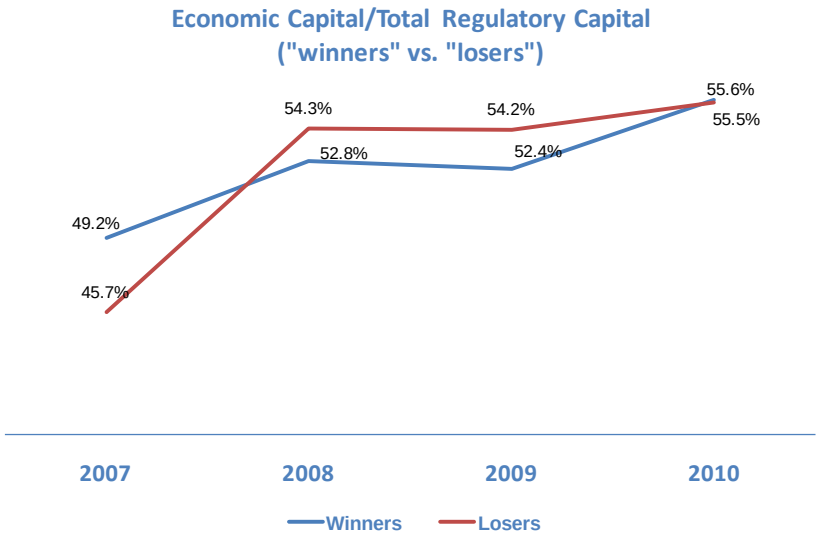
Source: Own analysis based on banks' annual reports

In the last part of this small chapter we will look at the relationship between economic capital and profitability from the opposite point of view. We have divided our small sample into two categories "winners" and "losers" according to their performance during financial crisis. Losers are those who received state aid or their profit decreased very significantly (Deutsche Bank, Credit Suisse, Commerzbank, BayernLB, ING, LBBW and Dexia) and winners are all others (JPM, Santander, Barclays, Resona, Rabobank, BBVA, Nordea and RBC). The average economic-to-total regulatory capital ratio was then calculated in each year. The results are presented in Figure 57.

We expected the ratio to be higher in case of losers as they hold riskier assets and they should therefore have higher economic capital to cover them. The ratio, however, fluctuated and the lines in the graph intersect twice. It seems the "losers" increased the ratio substantially during the culminating financial crisis in 2008 and then left it more or less same in the subsequent years. The "winners", on the other hand, have increased the ratio both in 2008 and 2010 substantially.

In order to find out whether the difference is significant, we have run a simple single factor ANOVA analysis for each year (full output from statistical program can be found in appendix B4). In each year we cannot reject the null hypothesis that the samples are equal. This might be also caused by very low number of degrees of freedom.

Figure 57: Economic capital/total regulatory capital (winners vs. losers)



Source: Own analysis based on bank's annual reports

Even though the difference between "winners" and "losers" is not statistically significant, it is interesting that the average ratio of "losers" was higher during the financial crisis and lower before and after. This indicates that "losers" have underestimated their risks and increased their economic capital after the crisis had started and they realised their mistake. This overall picture is supported by a figure in appendix A12 which shows the average economic capital ratio in both subgroups. Average economic capital of the "losers" grew faster in 2008.

3.5 Key Findings

Hypothesis 1 – based on our research among top-ranked world banks, we can conclude that still the vast majority of the banks do disclose neither the value of economic capital nor the allocation. Out of 44 banks which survived as separate entities until 2010 only 15 (34%) reported the value of economic capital, only 16 (36%) reported allocation into risk categories, only 12 (27%) reported breakdown into business lines and only 28 (64%) provided at least a couple of sentences regarding economic capital management in their latest available annual report (or publically available risk report if this is separated from the annual report).

Hypothesis 2 – The average allocation of economic capital has been changing over the monitored period, however the effect was not as strong as we expected. We expected mainly substantial increase in credit risk share in 2008 and 2009 followed by a modest decrease in 2010. This actually happened, but the changes were almost

negligible. On the other hand we came to conclusion that the median of economic capital ratio has risen significantly (mainly in 2008). The regulatory capital has risen as well causing the gap between economic capital and regulatory capital has not contracted. At the same time, the effect of economic capital ratios convergence was only visible in 2009 and we can reject the hypothesis that the ratios converged during monitored period.

Hypothesis 3 – In our small case studies focused on economic capital management we came to conclusion that there are huge differences among individual banks. First of all, each bank uses different risk categories and in case the categories are same their meaning is usually different. Second, the confidence levels vary according to targeted rating of the given bank. Highest confidence level 99.99% is used by Raboabank with AAA rating. Third, there were changes in risk categories within individual banks. Santander is probably a record holder with 10 risk categories used and different combination of these categories used in each year. Fourth, most banks refined and enhanced their models mainly in 2008 and 2009. As a result, the risk categories and total values are not fully comparable to other years. Fifth, many acquisitions have been executed during the monitored period (mainly failed banks being acquired by strong competitors). This had significant impact on risk-weighted assets, capital categories and other financial figures (e.g. profits). Sixth, many banks have received state aid and others issued shares or rights in order to improve their capital ratios. All above mentioned facts had impact on the economic capital management causing further differences among individual banks.

Hypothesis 4 – We have rejected the hypothesis that more open economic capital reporting has no impact on the bank's credit rating. Despite the low R-squared of the regression there probably is some positive relationship between open reporting and higher rating. Our reporting score is a significant variable able to explain 12% of the total variance in rating. On the other hand, we have not indentified significant correlation between the economic capital ratio and rating nor between Tier 1 regulatory capital and rating.

Hypothesis 5 – We have not identified significant correlation between economic capital ratio and profit change in the subsequent year. We expected to find negative relationship between these two variables as riskier banks (with higher economic capital) should in general have worse performance during crisis.

Hypothesis 6 – We have split our sample into “Winners” and “Losers” according to criteria explained in the section 3.4.2. Differences in economic capital ratios in these two subgroups were, however, not statistically significant.

4 Conclusion

The aim of this paper was to provide a comprehensive study of economic capital of top-ranked world banks in the period from 2007 to 2010. Based on the theory, the economic capital should be the level of capital the bank would chose in the absence of regulation taking into account all risks being faced. Therefore it inherently should be an important piece of information for the shareholders. In the contrast with this seemingly intuitive and logical conclusion we have proven in our research that only one third (or less) of the 2008 top-ranked banks provide the information on the value of economic capital and its risk or business allocation in the annual or risk report. The fact that most of the worlds' largest institutions do not publically disclose any details on this topic is worrying.

In our case studies focused on economic capital management of individual banks we found out several interesting facts: there are substantial differences among individual banks in terms of risk categories and risk allocation, confidence levels used, allocation to business lines and model disclosure. All fourteen banks have recalibrated and enhanced their models during the crisis. These enhancements often led to introduction of new risk categories. The changes in economic capital were often related to boosted acquisition activity.

Based on the limited data from those banks which disclose the details on their economic capital we have come to some interesting findings. The average risk allocation has been changing over the monitored period only very modestly. Significant changes in case of individual banks were usually offset by opposite change of other bank's allocation. On the other hand, the median value of economic capital ratio measured by economic capital to RWA has increased substantially. Given that the regulatory capital has risen substantially the gap between economic and regulatory capital has not contracted significantly. Economic capital represents only 56% of the total regulatory capital in average.

We have found a significant relationship between the quality of economic capital information disclosure and rating. On the other hand, we have not found any significant relationship between the relative value of economic capital and rating. Therefore, the fact that a bank reports openly on its economic capital positively influences its rating, but the banks with lower economic capital, which should be according to theory be less risky, do not have in general higher rating. This is a slightly paradoxical situation when

the fact that the bank discloses details on economic capital is significantly related to rating but the value of economic capital is not. We have also measured a correlation between the Tier 1 ratio and the rating. Unlike Berg-Yuen & Medova (2005) we have not found any significant relationship.

Similarly, we have not found any significant relationship between the relative value of economic capital and a change in profitability in a subsequent year. We have also divided the sample into two sub-groups: "Losers" (banks which received state aid or their suffered huge loss during the crisis) and "Winners" (others) and measured differences in their economic capital in all years 2007-2010. The difference was not statistically significant.

To summarise our findings, the economic capital is substantially lower than the regulatory capital. There is no significant relationship between the bank's economic capital and performance. Only minority of the banks report it. We therefore argue that the economic capital, as officially disclosed by banks, is an illusion only. The figures disclosed in annual reports should only serve as one of the arguments of the banks in their dispute with regulators regarding the capital requirements. Banks try to prove that they need much lower capital than it is required by the regulations. This conclusion could be further examined by even more extensive study focused on all top 1000 banks (current or former). Such a research would, though, require several months of data mining from hundreds of annual reports.

References

[1] BANCO SANTANDER. (2011a). *About the Group*. Retrieved 7. 7., 2011, from http://www.santander.com/csgs/Satellite?accesibilidad=3&canal=CAccionistas&cid=1148925257148&empr=SANCorporativo&leng=en_GB&pagename=SANCorporativo/Page/SC_ContenedorGeneral

[2] BANCO SANTANDER. (2007). Annual Report. Madrid.

[3] BANCO SANTANDER. (2008). Annual Report. Madrid.

[4] BANCO SANTANDER. (2009). Annual Report. Madrid.

[5] BANCO SANTANDER. (2010). Annual Report. Madrid.

[6] BANCO SANTANDER. (2011b). *Grupo Santander - History*. Retrieved 7. 7., 2011, from http://www.santander.com/csgs/Satellite?accesibilidad=3&canal=CAccionistas&cid=1146205899430&empr=SANCorporativo&leng=en_GB&pagename=SANCorporativo/Page/SC_ContenedorGeneral

[7] BARCLAYS PLC. (2007). Annual Report. London.

[8] BARCLAYS PLC. (2008). Annual Report. London.

[9] BARCLAYS PLC. (2009). Annual Report. London.

[10] BARCLAYS PLC. (2010). Annual Report. London.

[11] BAYERNLB. (2007). Annual Report. Munich.

[12] BAYERNLB. (2008). Annual Report. Munich.

[13] BayernLB. (2009). Annual Report. Munich.

[14] BayernLB. (2010). Annual Report. Munich.

[15] BAYERNLB. (2011). *Company profile - BayernLB - Company profile*. Retrieved 7. 6., 2011, from Web BayernLB: http://www.bayernlb.de/internet/en/meta/Ueber_uns/Facts_figures/Company_Profile/Company_Profile.html

[16] BBC NEWS. (2011, February 23). *BBC News - Lehman Brothers $11bn case against Barclays fails*. Retrieved 7. 8., 2011, from http://www.bbc.co.uk/news/business-12549242

[17] BBVA. (2007). Financial Report. Madrid.

[18] BBVA. (2008). Financial Report. Madrid.

[19] BBVA. (2009). Financial Report. Madrid.

[20] BBVA. (2010). Financial Report. Madrid.

[21] BBVA. (2011). *Investment in Europe – BBVA*. Retrieved 7. 7., 2011, from http://inversores.bbva.com/TLBB/tlbb/jsp/rii/El_Grupo_BBVA/areas_de_negocio/index.jsp

[22] BCBS. (2009). *Range of practices and issues in economic capital frameworks.* March. Basel Comittee on Banking Supervision. Bank for International Settlements.

[23] BERG-YUEN, P., & MEDOVA, E. (2005, August). Economic Capital Gauged. *Journal of Banking Regulation* , pp. 353-378.

[24] BLUNDELL-WIGNALL, A., & ATKINSON, P. (2010). Thinking Beyond Basel III: Necessary Solutions for Capital and Liquidity. *OECD Journal: Financial Market Trends. Issue 1* , p. 23.

[25] BUREAU VAN DIJK. (2011, March). Bankscope database (DVD).

[26] ČERNOHORSKÝ, J., & TEPLÝ, P. (2011). *Základy financí.* Prague: Grada.

[27] CHALUPKA, R.; TEPLÝ, P. (2008). Operational Risk Management and Implications for Bank's Economic Capital - A Case Study. *IES Working Paper 17/2008* . Charles University.

[28] CHORAFAS, D. N. (2004). *Economic Capital Allocation with Basel II: Cost, Benefit and Implementation Procedures* . Oxford: Elsevier Butterworth-Heinemann.

[29] COMMERZBANK. (2007). Annual Report. Frankfurt am Main.

[30] COMMERZBANK. (2008). Annual Report. Frankfurt am Main.

[31] COMMERZBANK. (2009). Annual Report. Frankfurt am Main.

[32] COMMERZBANK. (2010). Annual Report. Frankfurt am Main.

[33] CREDIT SUISSE. (2007). Annual Report. Zurich.

[34] CREDIT SUISSE. (2008). Annual Report. Zurich.

[35] CREDIT SUISSE. (2009). Annual Report. Zurich.

[36] CREDIT SUISSE. (2010). Annual Report. Zurich.

[37] CREDIT SUISSE. (2011). *Credit Suisse - Acquisitions / Divestitures*. Retrieved 7. 7., 2011, from https://www.credit-suisse.com/investors/en/acquisitions.jsp

[38] DANHEL, J. (2002). *Kapitoly z pojistné teorie.* Prague: Oeconomica.

[39] DEUTSCHE BANK. (2007). Annual Report. Frankfurt am Main.

[40] DEUTSCHE BANK. (2008). Annual Report. Frankfurt am Main.

[41] DEUTSCHE BANK. (2009). Annual Report. Frankfurt am Main.

[42] DEUTSCHE BANK. (2010). Annual Report. Frankfurt am Main.

[43] DEUTSCHE BANK. (2011). *Deutsche Bank - FAQs*. Retrieved 7. 7., 2011, from Deutsche Bank Investor Relations: http://www.db.com/ir/en/content/faqs.htm

[44] ELIZALDE, A., & REPULLO, R. (2007, September). Economic and Regulatory Capital in Banking: What Is the Difference? *International Journal of Central Banking* , pp. 87-117.

[45] GEBHART, J. (2008). *Kapitál bank, jeho regulace a úloha v moderním bankovnictví.* Prague: University of Economics. Faculty of Finance and Accounting. Department of Banking and Insurance. 128 pp. Supervisor: Ing. Stanislava Půlpánová, Ph.D.

[46] HULL, J. C. (2007). *Risk management and financial institutions.* Boston: Pearson Education.

[47] IFRI FOUNDATION. (2007). Insights from the joint IFRI/CRO Forum survey on Economic Capital practice and applications. Geneva, Switzerland.

[48] ING GROUP. (2007). Annual Report. Amsterdam.

[49] ING GROUP. (2008). Annual Report. Amsterdam.

[50] ING GROUP. (2009). Annual Report. Amsterdam.

[51] ING GROUP. (2010). Annual Report. Amsterdam.

[52] ING GROUP. (2011, April 13). *Transactions with Dutch State | ING*. Retrieved 7. 12., 2011, from Web ING: http://www.ing.com/Our-Company/Investor-relations/Transactions-with-Dutch-State.htm

[53] IVRY, B., SHENN, J., & MOORE, M. J. (2011, April 13). *Deutsche Bank Sold CDO 'Pigs' as Market Buckled, Lawmakers Say*. Retrieved 7. 7., 2011, from Bloomberg Businessweek: http://www.businessweek.com/news/2011-04-13/deutsche-bank-sold-cdo-pigs-as-market-buckled-lawmakers-say.html

[54] JP MORGAN. (1997). *CreditMetrics - Technical Document.* New York.

[55] JPMORGAN CHASE & CO. (2007). Annual Report. New York.

[56] JPMORGAN CHASE & CO. (2008). Annual Report. New York.

[57] JPMORGAN CHASE & CO. (2009). Annual Report. New York.

[58] JPMORGAN CHASE & CO. (2010). Annual Report. New York.

[59] LALL, R. (2009, October). Why Basel II Failed and Why Any Basel III is Doomed. *Global Economic Governance Programme Working paper 2009/52* . University College, Oxford.

[60] LBBW. (2007). Annual Report. Stuttgart.

[61] LBBW. (2008). Annual Report. Stuttgart.

[62] LBBW. (2009). Annual Report. Stuttgart.

[63] LBBW. (2010). Annual Report. Stuttgart.

[64] MARZINOTTO, B., & ROCHOLL, J. (2010, October). THE UNEQUAL EFFECT OF NEW BANKING RULES IN EUROPE. *BRUEGEL POLICY CONTRIBUTION* , pp. 1-13.

[65] MCKINSEY & COMPANY. (2010, November). *Basel III and European banking: Its impact, how banks might respond, and the challenges of implementation.* Retrieved July 1, 2011, from Web McKinsey & Company: http://www.mckinsey.com/clientservice/Financial_Services/Knowledge_Highlights/~/media/Reports/Financial_Services/Basel%20III%20and%20European%20banking%20FINAL.ashx

[66] MEJSTŘÍK, M., PEČENÁ, M., & TEPLÝ, P. (2008). *Basic Principles of Banking.* Prague: Karolinum press.

[67] MUELLER, H., & SIBERÓN, J. (2004, August). Economic Capital in the Limelight. *Journal of Financial Regulation and Compliance* , pp. 351-358.

[68] NGO, P. T. (2008). *Capital-Risk Decisions and Profitability in Banking: Regulatory versus Economic Capital.* Canberra: Australian National University.

[69] NORDEA. (2007). Annual Report. Stockholm.

[70] NORDEA. (2008). Annual Report. Stockholm.

[71] NORDEA. (2009). Annual Report. Stockholm.

[72] NORDEA. (2010a). Annual Report. Stockholm.

[73] NORDEA. (2010b). Capital and risk management (pillar III). Stockholm.

[74] NORDEA. (2011b). *Divestments & Acquisitions 2007 | Nordea.com*. Retrieved 7. 6., 2011, from http://www.nordea.com/About+Nordea/Nordea+overview/History/Divestments+Acquisitions+2007/1069232.html

[75] NORDEA. (2011c). *Divestments & Acquisitions 2009 | Nordea.com*. Retrieved 7. 6., 2011, from http://www.nordea.com/About+Nordea/Nordea+overview/History/Divestments+Acquisitions+2009/1480102.html

[76] NORDEA. (2011a). *Facts and figures | Nordea.com*. Retrieved 7. 6., 2011, from http://www.nordea.com/About+Nordea/Nordea+overview/Facts+and+figures/1081354.html

[77] OLIVER WYMAN. (2011). The Financial Crisis of 2015: An Avoidable History. *State of the Financial Services Industry 2011* .

[78] PYLE, D. (1997). *Bank Risk Management: Theory.* Berkeley: University of California.

[79] RABOBANK GROUP. (2007a). Annual Summary. Utrecht.

[80] RABOBANK GROUP. (2008). Annual Summary. Utrecht.

[81] RABOBANK GROUP. (2009). Annual Summary. Utrecht.

[82] RABOBANK GROUP. (2010a). Annual Summary. Utrecht.

[83] RABOBANK GROUP. (2010b, August 20). *Rabobank - Rabobank acquires deposits certain assets and liabilities of Butte Community Bank and Pacific State Bank:*. Retrieved 7. 7., 2011, from http://www.rabobank.com/content/news/news_archive/013-RabobankacquiresdepositscertainassetsandliabilitiesofButteCommunityBankandPacificStateBank.jsp

[84] RABOBANK GROUP. (2007b, May 1). *Rabobank - Rabobank Completes Acquisition of Mid-State Bank & Trust*. Retrieved 7. 7., 2011, from http://www.rabobank.com/content/news/news_archive/rabobank_aquisition_mid_state_bank.jsp

[85] RBC. (2007). Annual Report. Toronto.

[86] RBC. (2008). Annual Report. Toronto.

[87] RBC. (2009). Annual Report. Toronto.

[88] RBC. (2010). Annual Report. Toronto.

[89] RBC. (2011, June 20). *RBC Sells U.S. Retail Banking Operations to PNC Financial Services Group, Inc.* Retrieved 7. 6., 2011, from Web RBC: http://www.rbc.com/investisseurs/pdf/0620rbcbankfr.pdf

[90] RESONA HOLDINGS. (FY2007). Annual Report. Tokyo.

[91] RESONA HOLDINGS. (FY2008). Annual Report. Tokyo.

[92] RESONA HOLDINGS. (FY2009). Annual Report. Tokyo.

[93] RESONA HOLDINGS. (2011, March 8). *Resona Holdings Announces Repurchase and Cancellation of Shares of the Preferred Stocks Issued with Public Funds.* Retrieved 7. 17., 2011, from Web Resona Holdings: http://www.resona-gr.co.jp/holdings/english/newsrelease/pdf/20110308_a.pdf

[94] RESONA HOLDINGS. (FY2010). Summary of Consolidated Financial Results. Tokyo.

[95] SANTOMERO, J. (1997). *Commercial Bank Risk Management: An Analysis of Process.* Pennsylvania: The University of Pennsylvania.

[96] SOCIETY OF ACTUARIES. (2004, March). Specialty Guide on Economic Capital. Economic Capital Calculation and Allocation Subgroup.

[97] STANDARD & POOR'S. (2011). *S&P | Ratings | Europe*. Retrieved 7. 10., 2011, from Web Standard & Poor's: http://www.standardandpoors.com/ratings/en/eu/

[98] THE BANK OF NOVA SCOTIA. (2010). Annual Report. Toronto.

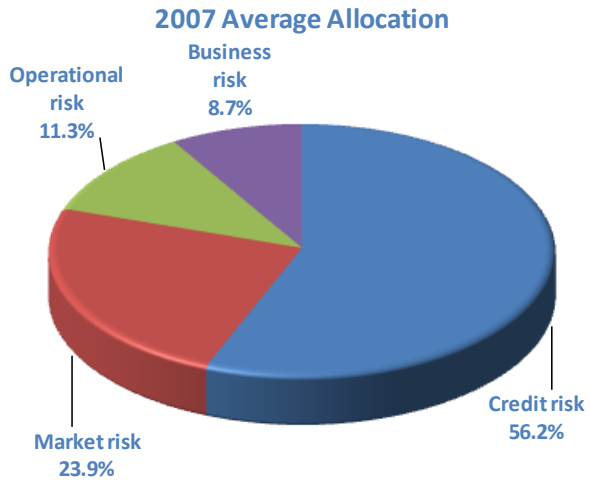
[99] THE BANKER. (2008). *Top 1000 World Banks 2008.* London: The Financial Times Ltd.

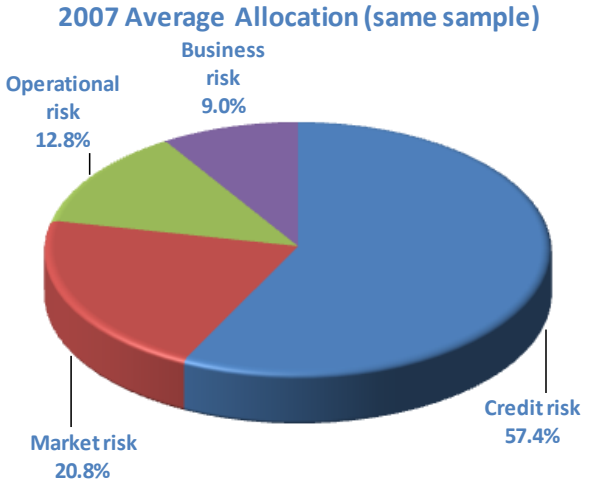
[100] VAN LEYVELD, P. (2006). *Economic Capital Modelling: Concepts, Measurement and Implementation.* London: Laurie Donaldson.

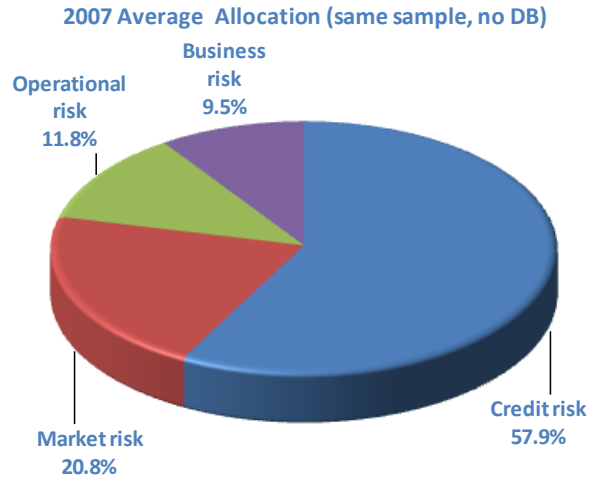
Appendix A: Graphics

A1: Average Allocation of Economic Capital 2007

(Comparison of sample of 15 banks, standard sample of 12 banks and standard sample with Deutsche Bank omitted)



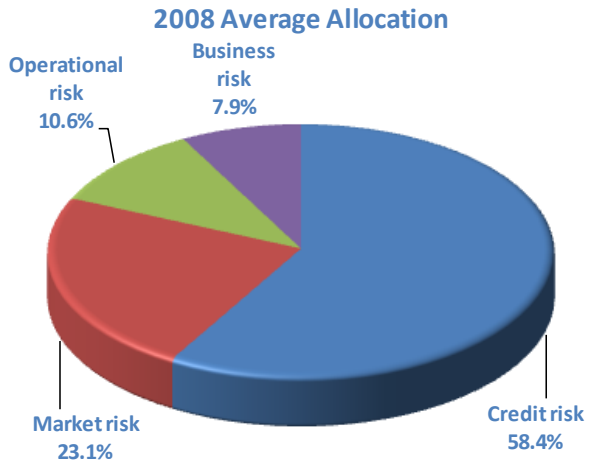


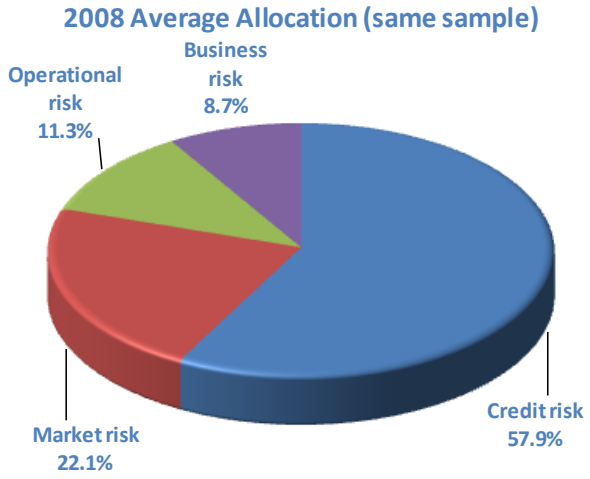


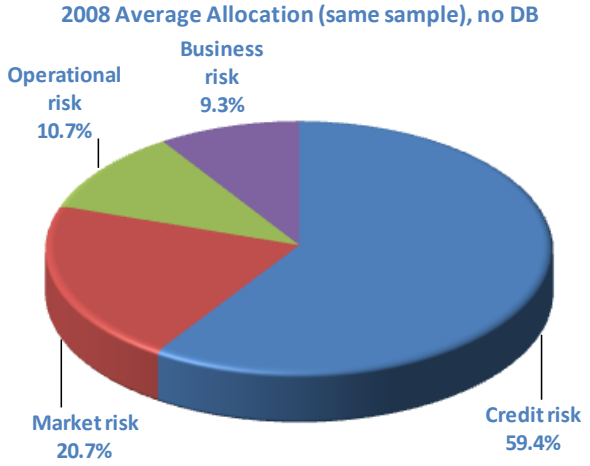
Source: Own analysis based on banks' annual reports

A2: Average Allocation of Economic Capital 2008

(Comparison of sample of 14 banks, standard sample of 12 banks and standard sample with Deutsche Bank omitted)



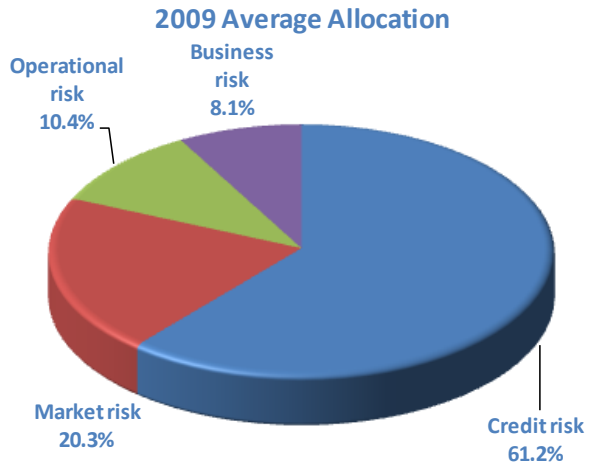


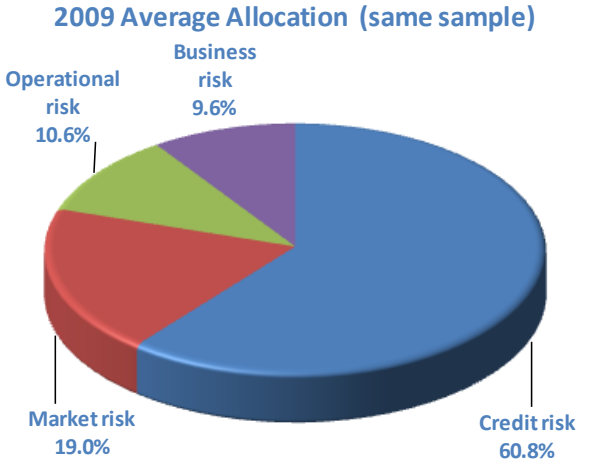


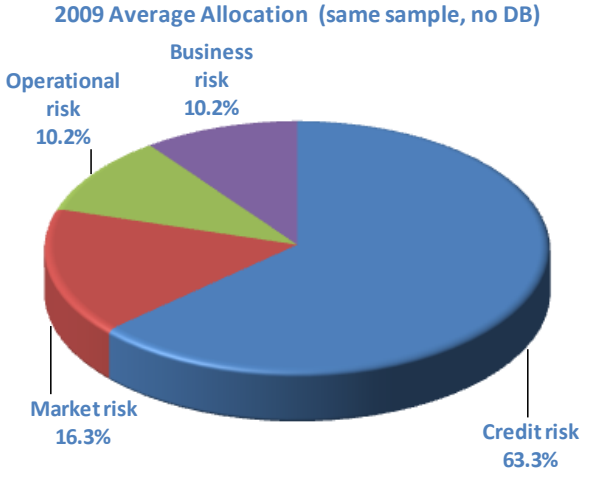
Source: Own analysis based on banks' annual reports

A3: Average Allocation of Economic Capital 2009

(Comparison of sample of 15 banks, standard sample of 12 banks and standard sample with Deutsche Bank omitted)



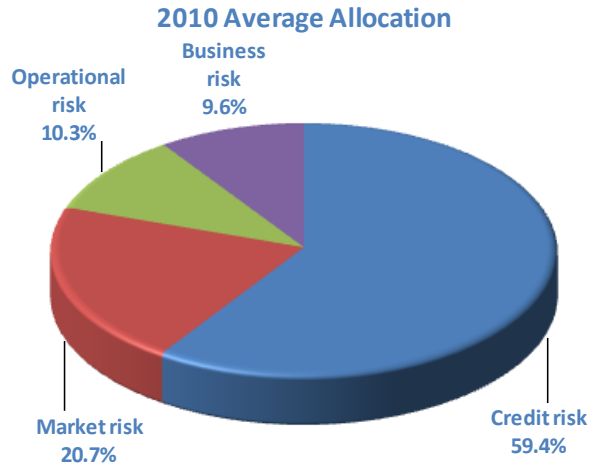


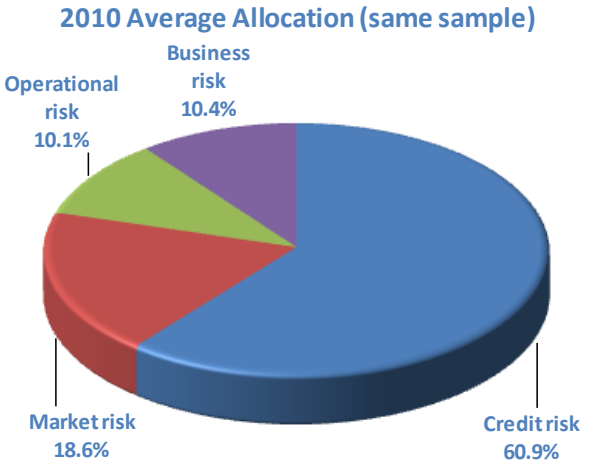


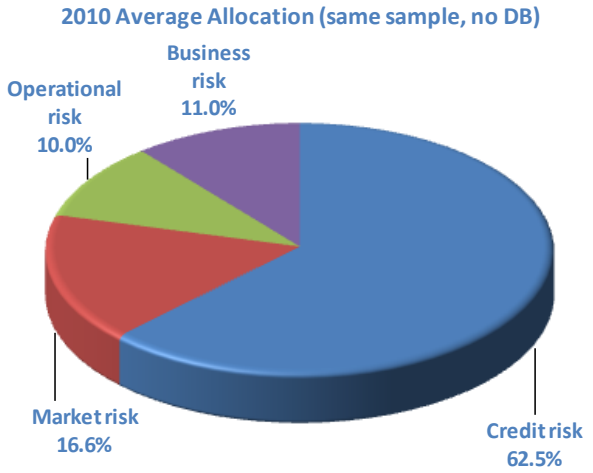
Source: Own analysis based on banks' annual reports

A4: Average Allocation of Economic Capital 2010

(Comparison of sample of 14 banks, standard sample of 12 banks and standard sample with Deutsche Bank omitted)

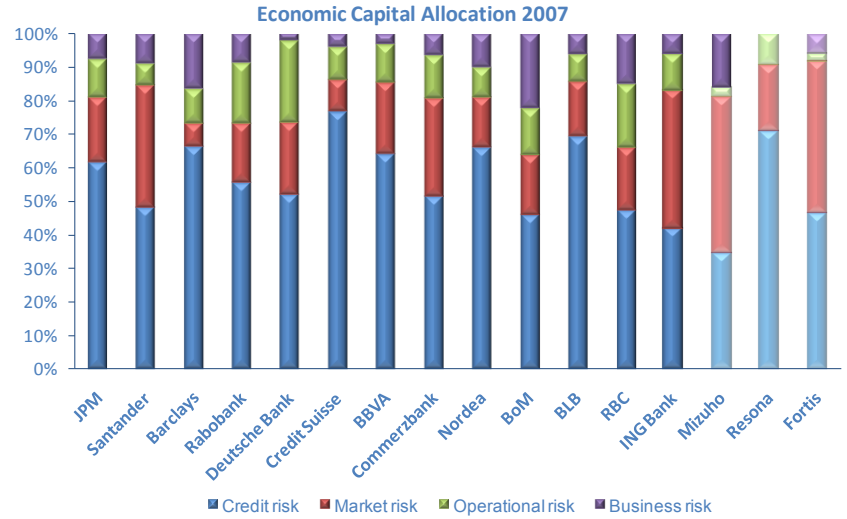


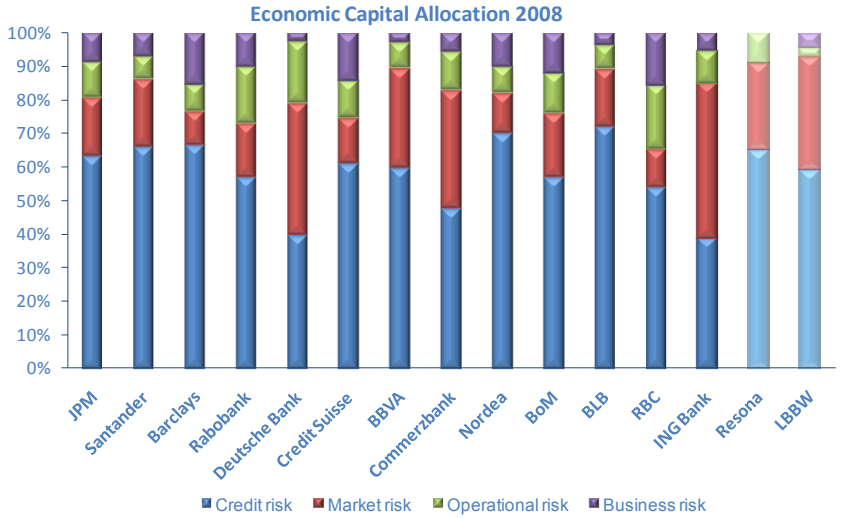


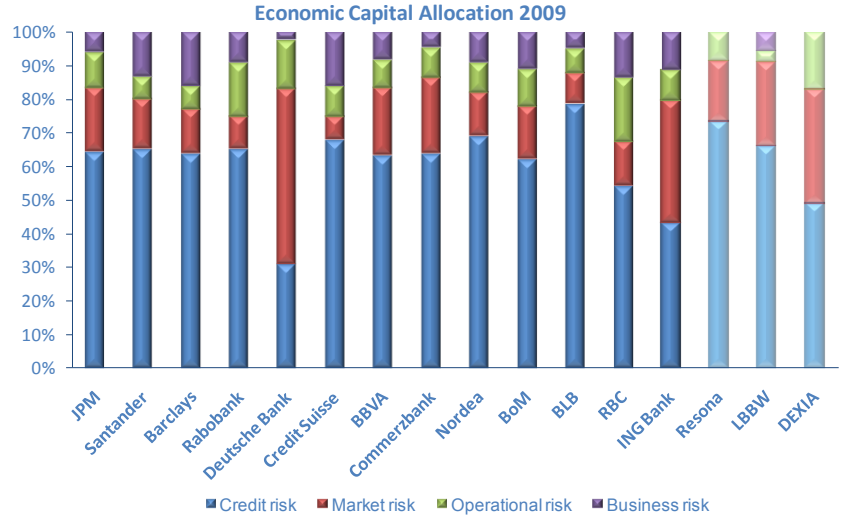


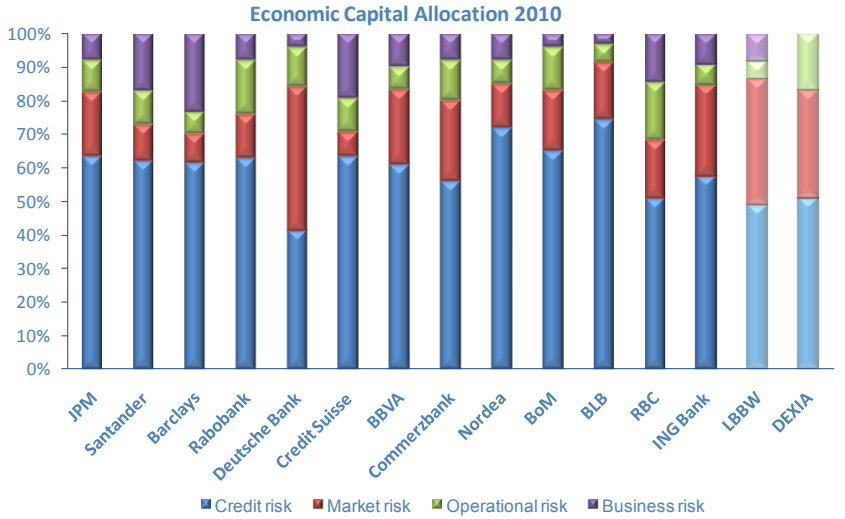
Source: Own analysis based on banks' annual reports

A5: Economic Capital Allocation of Individual Banks





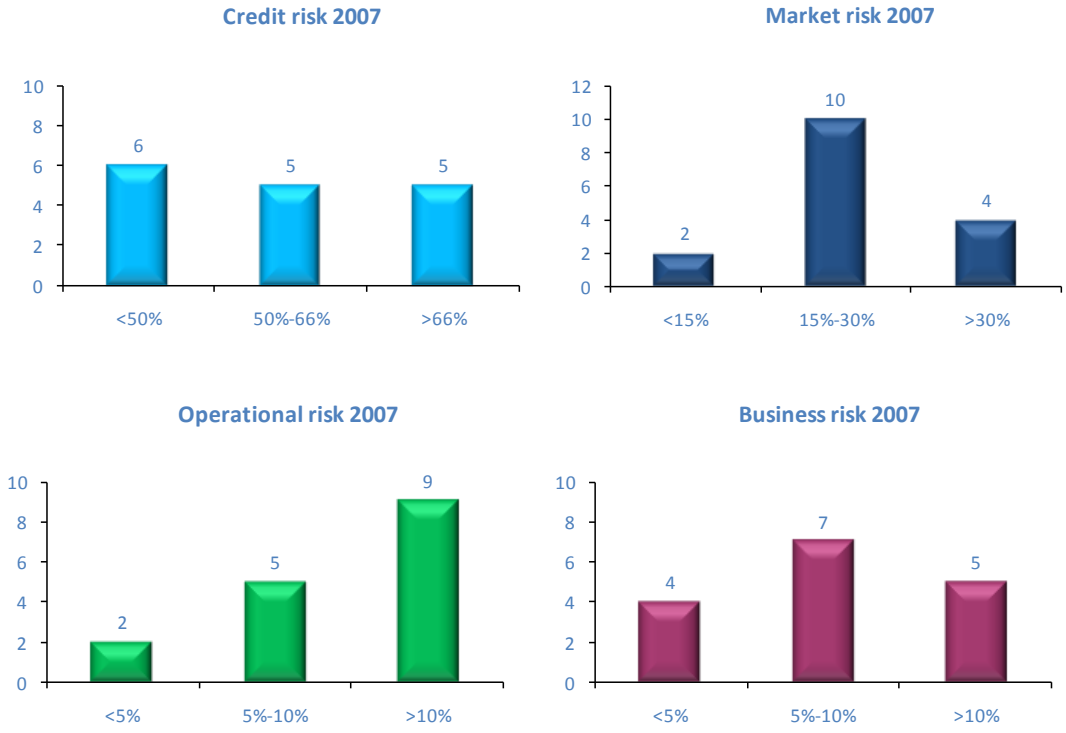




Source: Own analysis based on banks' annual reports

A6: Histograms 2007

(Complete sample of 16 banks)



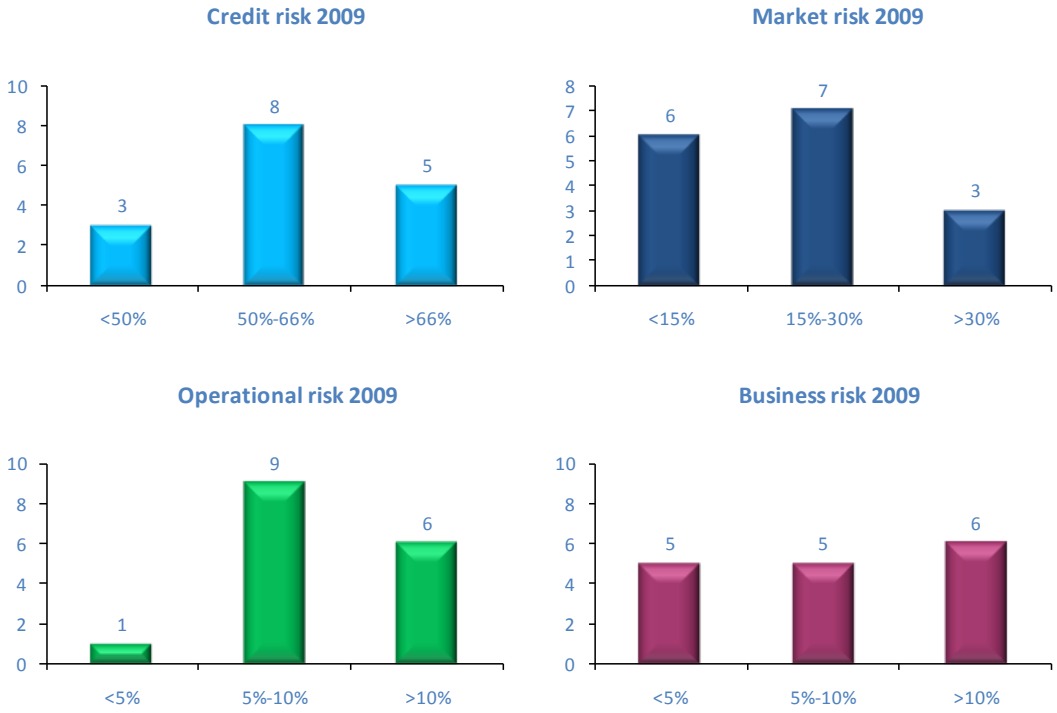
A7: Histograms 2008

(Complete sample of 15 banks)

Source: Own analysis based on banks' annual reports

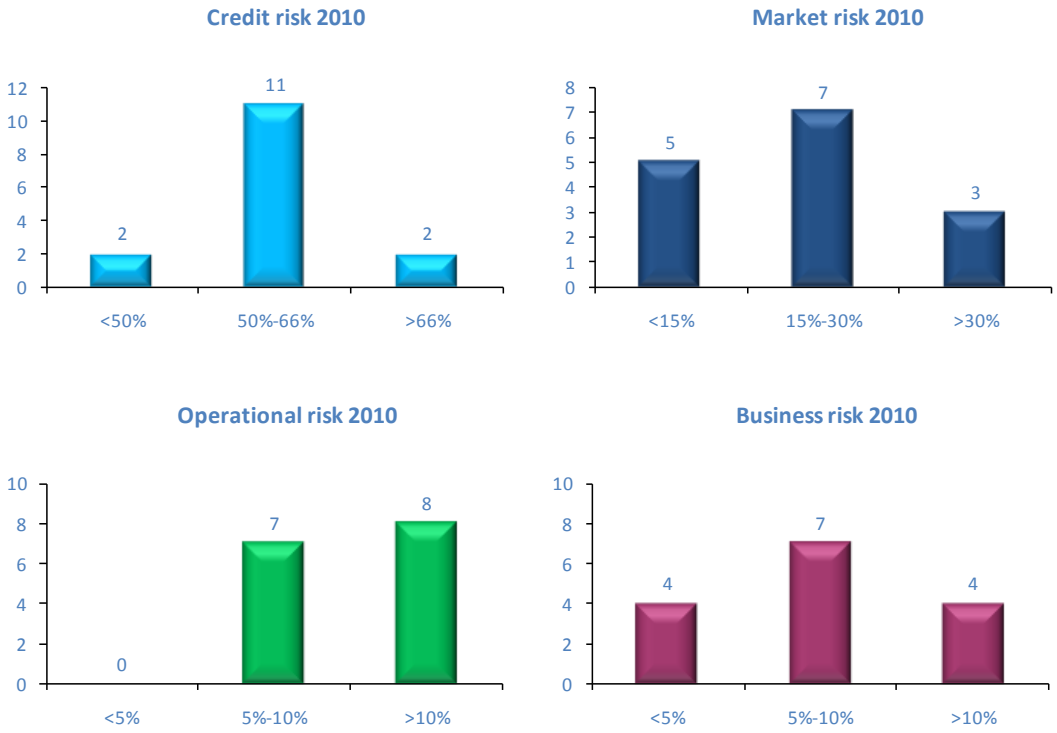
A8: Histograms 2009

(Complete sample of 16 banks)



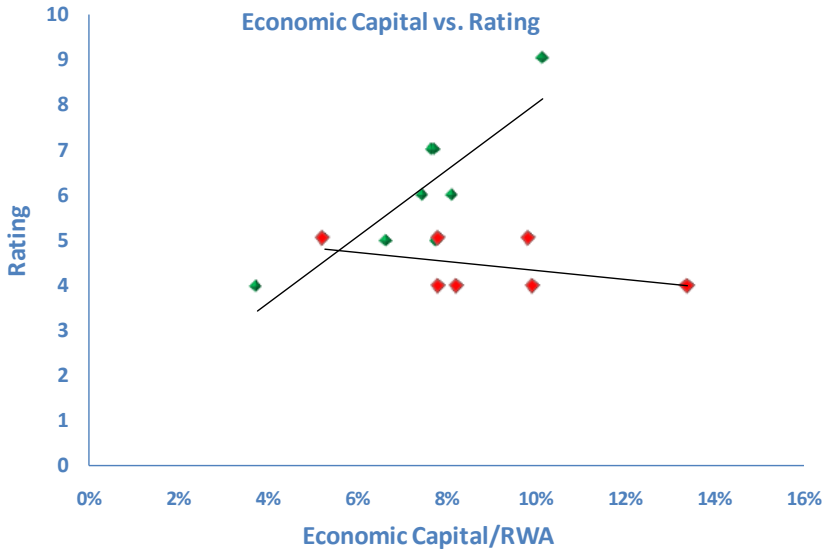
A9: Histograms 2010

(Complete sample of 15 banks)



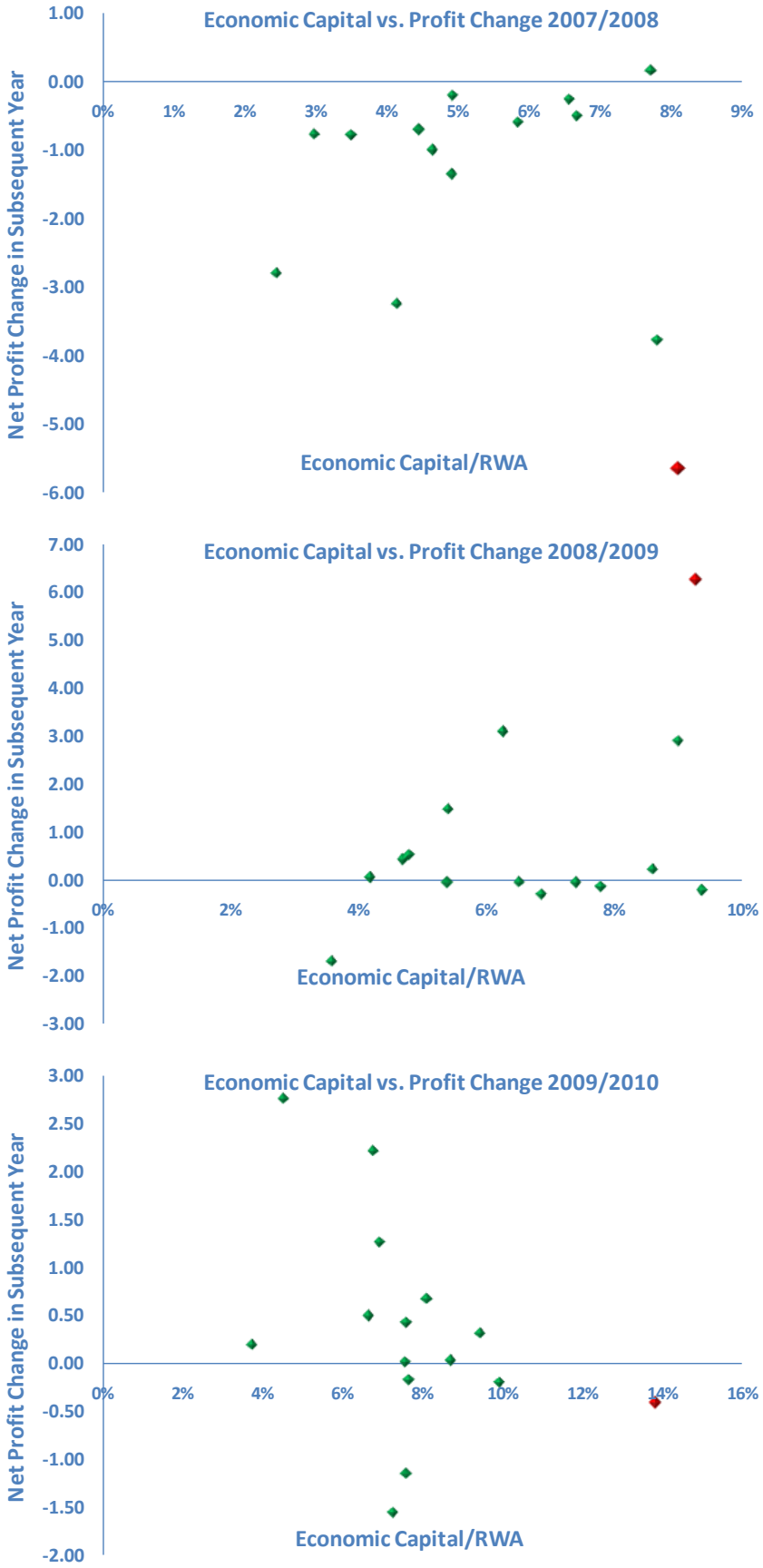
Source: Own analysis based on banks' annual reports

A10: Economic Capital Ratio vs. Rating (Winners and Losers)



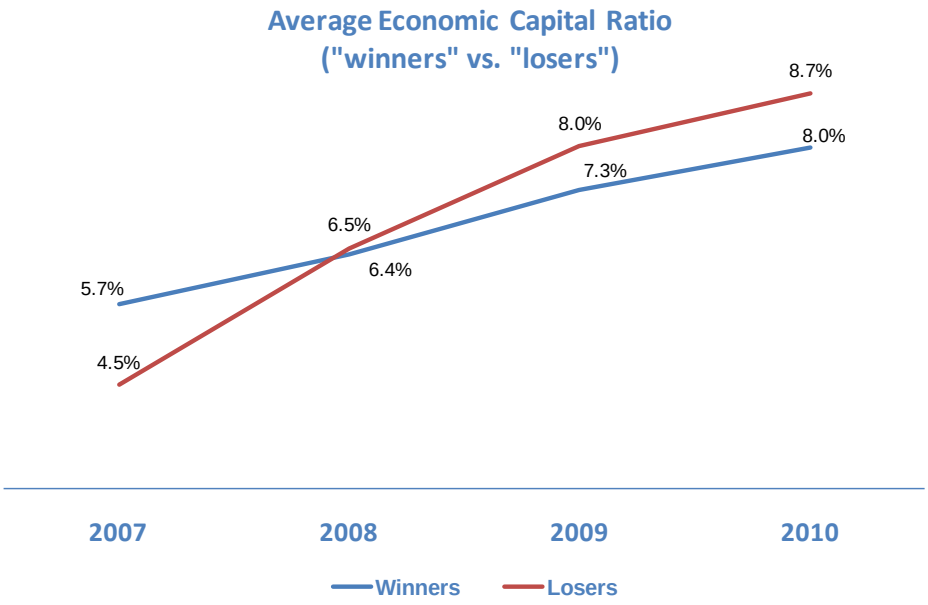
Source: Own analysis based on banks' annual reports

A11: Economic Capital vs. Profit Change Scatter Plots



Source: Own analysis based on banks' annual reports

A12: Economic Capital Ratio (Winners versus Losers)



Source: Own analysis based on banks' annual reports

Appendix B: Tables

B1: Banks: Rating and Economic Capital Reporting Score

Nr.	Bank	ECOvalue	ECOriskcat	ECObreakbus	ECOexpl	Total Score	Rating (numbers)	S&P (Issuer LT credit rating)
1	HSBC	0	0	0	0	0	6	AA-
2	Citigroup	0	0	0	1	1	4	A
3	Royal Bank of Scotland	0	0	0	0	0	4	A
4	JP Morgan Chase & Co.	1	1	1	1	4	5	A+
5	Bank of America	0	0	0	1	1	4	A
6	Mitsubishi UFJ Financial Group	0	0	0	1	1	4	A
7	Credit Agricole Group	0	0	0	1	1	5	A+
8	ICBC	0	0	0	0	0	4	A
9	Banco Santander	1	1	1	1	4	7	AA
10	Bank of China	0	0	0	0	0	3	A-
11	BNP Paribas	0	0	0	0	0	7	AA
12	Barclays Bank	1	1	1	1	4	5	A+
13	China Construction Bank	0	0	0	0	0	3	A-
15	Mizuho Financial Group	0	0	0	1	1	4	A
16	Unicredit Group	0	0	0	1	1	4	A
17	ING Group	1	1	1	1	4	4	A
18	Sumitomo Mitsui Financial Group	0	0	0	1	1	4	A
20	Rabobank	1	1	1	1	4	9	AAA
21	Deutsche Bank	1	1	1	1	4	5	A+
23	Wells Fargo	0	0	0	0	0	6	AA-
24	Credit Mutuel	0	0	0	0	0	5	A+
25	Intesa San Paolo	0	0	0	0	0	5	A+
27	Société Générale	0	0	0	0	0	5	A+
28	Resona Holdings	1	1	0	1	3	4	A
29	Credit Suisse	1	1	1	1	4	4	A
30	Banco Bilbao Vizcaya Argentaria	1	1	1	1	4	7	AA
31	UBS	0	0	0	1	1	5	A+
32	Lloyds Banking Group	0	0	0	0	0	4	A
33	Sberbank	0	0	0	0	0	1	BBB
34	Royal Bank of Canada	1	1	0	1	3	6	AA-
35	Caja de Ahorros	0	0	0	0	0	3	A-
36	Commerzbank	1	1	0	1	3	4	A
38	Norinchukin Bank	0	0	0	1	1	5	A+
40	Dexia	1	1	1	1	4	4	A
41	Scotiabank	0	0	1	1	2	6	AA-
42	Nordea Group	1	1	1	1	4	6	AA-
43	National Australia Bank	0	0	0	1	1	7	AA
44	LBBW	1	1	0	1	3	5	A+
45	Bank of Montreal	0	1	1	1	3	5	A+
46	Bayerische Landesbank	1	1	0	1	3	5	A+
47	U.S.Bancorp	0	0	0	0	0	5	A+
48	Banco Bradesco	0	0	0	0	0	1	BBB
49	Standard Charter	0	0	0	0	0	4	A
50	Itau Unibanco Holdings	0	0	0	1	1	1	BBB

Source: Banks' annual reports, S&P

B2: Output from Gretl Program (1)

Model 1: OLS, using observations 1-44
Dependent variable: Rating

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	4.06077	0.314987	12.8919	<0.00001	***
Total_Score	0.356703	0.138071	2.5835	0.01335	**

Mean dependent var	4.636364	S.D. dependent var	1.571415
Sum squared resid	91.62185	S.E. of regression	1.476981
R-squared	0.137123	Adjusted R-squared	0.116578
F(1, 42)	6.674377	P-value(F)	0.013352
Log-likelihood	-78.56986	Akaike criterion	161.1397
Schwarz criterion	164.7081	Hannan-Quinn	162.4630

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 1.48269
with p-value = P(Chi-square(2) > 1.48269) = 0.476473

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 2.20589
with p-value = 0.331892

B3: Banks – Economic Capital and Profitability

Bank	ECO (%)				ECO/Total regulatory capital (%)				w/l
	2007	2008	2009	2010	2007	2008	2009	2010	
JPM	4.6%	4.8%	6.7%	6.7%	36.9%	32.4%	45.1%	43.0%	1
Santander	n.a.	7.8%	7.7%	7.7%	n.a.	63.7%	54.0%	58.7%	1
Barclays	4.9%	5.4%	7.3%	7.8%	40.8%	39.9%	43.9%	46.1%	1
Resona	3.5%	4.2%	3.8%	n.a.	24.5%	31.2%	27.3%	n.a.	1
Rabobank	7.7%	9.4%	9.4%	10.2%	70.2%	72.1%	66.7%	62.4%	1
Deutsche Bank	4.1%	6.3%	7.6%	7.9%	35.8%	51.6%	54.8%	55.8%	0
Credit Suisse	8.1%	9.3%	13.8%	13.4%	60.5%	51.9%	67.1%	61.3%	0
BBVA	6.7%	6.9%	7.6%	7.8%	49.6%	56.3%	55.9%	56.7%	1
Commerzbank	3.0%	3.6%	6.8%	7.9%	27.8%	26.0%	45.9%	51.4%	0
Nordea	6.5%	7.4%	8.7%	8.1%	71.8%	77.7%	72.8%	70.8%	1
BayernLB	2.5%	4.7%	4.6%	5.3%	21.4%	38.5%	28.9%	34.0%	0
RBC	5.8%	5.4%	7.6%	7.5%	50.6%	48.8%	53.3%	51.8%	1
ING	4.5%	6.5%	6.9%	8.3%	43.1%	51.1%	51.6%	54.0%	0
LBBW	4.9%	8.6%	8.1%	9.9%	50.5%	84.9%	61.2%	64.3%	0
Dexia	7.8%	9.0%	9.9%	10.0%	80.8%	76.0%	70.1%	67.9%	0
Bank	**100*Net profit/RWA**				**Net profit/RWA change (absolute)**				**w/l**
	2007	2008	2009	2010	2007	2008	2009	2010	
JPM	1.46	0.45	0.98	1.48	n.a.	-1.01	0.53	0.50	1
Santander	1.87	1.82	1.68	1.50	n.a.	-0.06	-0.14	-0.17	1
Barclays	1.44	1.22	2.69	1.14	n.a.	-0.22	1.47	-1.55	1
Resona	1.39	0.59	0.65	0.85	n.a.	-0.80	0.06	0.20	1
Rabobank	1.01	1.16	0.95	1.26	n.a.	0.15	-0.21	0.32	1
Deutsche Bank	1.98	-1.27	1.81	0.67	n.a.	-3.25	3.08	-1.14	0
Credit Suisse	2.52	-3.15	3.12	2.71	n.a.	-5.66	6.27	-0.41	0
BBVA	2.39	1.87	1.58	1.59	n.a.	-0.52	-0.30	0.02	1
Commerzbank	0.81	0.03	-1.65	0.56	n.a.	-0.78	-1.68	2.21	0
Nordea	1.53	1.25	1.21	1.24	n.a.	-0.28	-0.04	0.03	1
BayernLB	0.09	-2.71	-2.28	0.48	n.a.	-2.80	0.43	2.75	0
RBC	2.27	1.66	1.62	2.04	n.a.	-0.61	-0.05	0.43	1
ING	0.92	0.20	0.16	1.42	n.a.	-0.71	-0.04	1.26	0
LBBW	0.17	-1.19	-0.96	-0.29	n.a.	-1.36	0.23	0.68	0
Dexia	1.65	-2.13	0.76	0.57	n.a.	-3.78	2.89	-0.19	0

Source: Own analysis based on banks' annual reports

B4: ANOVA Test ("Winners" vs. "Losers")

Anova: Single Factor 2007

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Winners	7	3.443909634	0.491987091	0.029799137
Losers	7	3.198418941	0.456916992	0.041537516

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.004304691	1	0.004304691	0.120686668	0.734307928	4.747225336
Within Groups	0.428019916	12	0.035668326			
Total	0.432324608	13				

Anova: Single Factor 2008

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Winners	8	4.223236312	0.527904539	0.031273758
Losers	7	3.800363838	0.54290912	0.041467737

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.000840513	1	0.000840513	0.023361428	0.880867814	4.667192714
Within Groups	0.467722729	13	0.035978671			
Total	0.468563242	14				

Anova: Single Factor 2009

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Winners	8	4.191480528	0.523935066	0.019921737
Losers	7	3.796364088	0.542337727	0.019721666

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.001264323	1	0.001264323	0.06376003	0.80459734	4.667192714
Within Groups	0.257782155	13	0.019829397			
Total	0.259046478	14				

Anova: Single Factor 2010

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Winners	7	3.894151782	0.556307397	0.009168172
Losers	7	3.8872078	0.5553154	0.0124649

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3.44421E-06	1	3.44421E-06	0.00031842	0.986056298	4.747225336
Within Groups	0.129798434	12	0.010816536			
Total	0.129801878	13				