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Credit derivatives and Profitability of commercial banks

Impact of credit risk on performance of Nordea Bank

Trang Nguyen

Arman Nuri

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Laurea University of Applied Sciences

Otaniemi

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Trang Nguyen & Arman Nuri

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Abstract

Laurea Otaniemi

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Trang Nguyen

Arman Nuri

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Commercial banks are more conscious of credit risk due to diversity and complexity of modern monetary services. Additionally, due to the reform of banking industry, there is an increasing demand for investment in the capital market, which evokes the bank managers of a sound evaluation and management for credit risk. Since the credit trading and the related services embrace the main source of banks' income, it is crucial distinguish the potential customers with the risky borrowers while remaining the profitable investment. The implementation of credit score and credit rating provides the optimum valuation scale for the investment decision making process.

The ability to foresee the probable losses is very necessary to decide whether to use the derivative products. The transaction of those financial instruments offers all the involved parties the great opportunities to enlarge their investment and reduce risks.

In our study, we research the credit risk management process and profitability improvement. The experimental test of Nordea Bank is employed to highlight the iteration between credit risk and bank's performance. We establish two equations to present ROA and ROE (as the indicators for profitability) under the value of NPLR and CAR (as the indicators for credit risk). Our data is collected from Nordea bank's annual report and the outputs are computed from Microsoft Excel regression test. The time period in our research is from 2003 to 2013 for all the indicators. The result from the regression test discloses the negative relation between credit risk and profitability in general. Both of the tests return the higher significant level of NPLR on profitability in compared with the result of CAR. However, in case of ROA, our findings are not remarkable enough to conclude the dependence of ROA on NPLR and CAR.

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Abbreviations

BCBS	Basel Committee on Banking Supervision
BRA	Bankruptcy Reform Act
CAR	Capital Adequacy Ratio
CRA	Community Reinvestment Act
EAD	Exposure at Default
ECOA	Equal Credit Opportunity Act
FASB	Financial Accounting Standards Board
FCRA	Fair Credit Reporting Act
FICO	Fair Isaac Corporation
FRN	Floating-rate Note
LA	Loan & Advances
LGD	Loss Given Default
LIBOR	London Inter-Bank Lending Rate
NPLR	Non-Performing Loan Ratio
OLS	Ordinary Least Square
OTC	Over the Counter
PD	Probability of Default
ROA	Return on Asset
ROE	Return on Equity
TD	Total Deposit
TILA	Truth in Lending Act
TRS	Total Return Swap

1 Introduction

In this chapter, we present our research area in the brief introduction, starting with the studied subject. The first part contains the explanation of topic selection, supported by the theoretical starting point in the second part. In the following, we address our research problem with a view on credit risk and point out the particular research questions. Finally, we will show the practical contribution of our research within the area.

1.1 Presentation of the subject

The banking sector is consistently the most important financial institution for the economy. With the rapid growth of branches and subsidiaries around the world, the banking system becomes the lifeblood of all the economies activities. Although the function of bank is not to create wealth but its operation enables the money flow and ensure the production of other industries.

Commercial banks play an important role in maintaining the growth of business world. The Federal Reserve System has paid much effort to manage the money supply through monetary policy to ensure the viability of credit at banks (Koch & MacDonald, 2000). The credit function of banks allows to issue the loans and generate capital through deposits. However, due to the default risk related to credit events, banks are heavily exposed to the loss of outstanding loans partially or totally.

Credit risk, also called counterparty risk, can be defined as the possibility of delayed or unpaid payment. In other words, when the default happens, the debtor or financial instrument issuer get financial insolvency and the credit agreement is abolished (Greuning & Bratanovic, 2003). We can use the sovereign crisis in Eurozone in 2008 as an illustration for economy's reaction under the financial difficulties. The sovereign debt crisis that boomed in Greece at the end of 2009 is primarily due to the precarious integration of peripheral countries in the Eurozone. The crisis in 2007-2009 was the first element contributing to the emergency.

Speculative mortgage lending by US financial institutions, and trading of resultant derivative securities by the international banks created a vast bubble in 2001-2007, leading to the crisis and recession. Because of the rapid unwinding intra Eurozone lending/borrowing imbalances that built up in the 2000s, the debt in Europe was deteriorated and burdened not only the government but also the European and global economy (Baldwin and Giavazzi, 2015, 50).

As identified in three Basel Accords, default is a main source of risk. In the previous study, Chaplinska (2012), GAO (2013) indicated that the main reason of financial crises attributed to the lack of lending legislation and poor credit management. The obvious illustration can be seen in the mortgage default crisis in US, 2007. Due to the profitable investment in real

estate market, the banks in America decided to simplify the loan portfolio while the borrowers became more irresponsible and took advantage of low interest rate. Once the house buyers could not afford the payment, the crisis spread and embraced US with the fear of default.

According to Gestel and Baesems (2008), the net loss of banks happens when the price of debt bought exceeds the price of debt sold. However, the level of risk exposure can be mitigated by safe and sound risk management strategies and regulations. The three Basel Accords enable the banks to adopt the proper internal credit management practices to ensure the liquidity and capital adequacy.

Beside the control of financial guarantee, the main purpose of the commercial banks is to raise the profitability. The commercial banks ruled by national policies work as the financial tool to support and control the economy. The strength of the banking industry is an important prerequisite to ensure the stability and growth of economy (Halling & Hayden, 2006, p.48). Besides, “the safety of banking system is depending on the profitability and capital adequacy of banks. Profitability is a parameter which shows management approach and competitive position of bank in market-based banking” (Tabari, Ahmadi & Emami, 2013). Therefore, the performance of commercial banks should be measured in the systematic assessment and all the related factors should be taken into consideration. In this publication, we will use ROA and ROE as the main indicators for the performance of the banks.

1.2 Theoretical frame

The Basel Committee was founded in the end of 1974 by G10 countries due to the large foreign currency losses in 1973 and the international market turmoil. By the cooperation among the member countries on banking supervisory systems, the main purpose of BCBS was to create a level playing field in banking industry. The Committee suggests the proper regulation concerning supervisory matters to help banking risk mitigation.

Basel Accords are set of international banking agreements that help the international financial market to operate smoothly. (Basel Committee on Banking Supervision, 2015)

Basel I: Basically, it's a set a regulations and standards created by the Basel committee to manage and maintain central banks. The debt crisis in Latin America in 1980s made the members of G10 realized the risk of capital erosion (Clement and Maes, 2013). In order to sustain the equal competition and enhance the stability of international banking system, the Basel I Accord of Minimum Capital Required was introduced in 1988. The Accord called for the capital adequacy ratio (CAR) of 8% (See formula Equation 1).The main objective behind capital accord is to increase stability of international banking system. Another motto behind this accord is to create a level playing field among all the banks and setting up a fair and consistent banking sector. This principle was not compulsory but it worked as the standard to

verify banks' capacity to meet the maturity of liabilities. It's mainly focused on credit risk. In the Basel I, the committee categorized the bank assets into five risk categories.

Table 1. Risk Weighted Asset

Risk Weight	Asset Class
0%	Cash and gold held in the bank Obligation on OECD governments and US treasuries
20%	Claim on OECD banks Securities issued by US government agencies Claims on municipalities
50%	Residential mortgages
100%	All other claims such as corporate bonds, less-developed countries' debt, claim on non-OECD banks, equities, real estate, plant and equipment.

Source: Ong, 1999

CAR: Capital Adequacy Ratio is an international standard set by the Basel committee. It is a ratio of banks capital in relation to risk weighted assets. The ratio stops the bank from taking high leverage and helps to maintain stability and efficiency in the banking system. The formula for CAR is follows:-

Equation 1. Capital Adequacy Ratio

$$\text{CAR} = \frac{\text{Tier One Capital} + \text{Tier Two Capital}}{\text{Risk Weighted Assets}}$$

Source: Investopedia, 2015

Two Tiered Capital: The Basel committee also put forth two tiered capital system.

Tier 1 (core capital) - Contains stocks, declared reserves.

Tier 2 (supplementary capital) - All other capitals such as gains, return from investments, long term debts with maturity greater than five years. But short terms unsecured debts were not included.

Credit risk has been defined as the risk weighted assets (RWA) according to their level of risk.

Table 2. Example on RWA

Asset category	Risk Weight	Capital ratio	Amount	RWA	Minimum capital requirement
Treasury Bond	0%	8%	1000 \$	0 \$	0 \$
Municipal Bond	20%	8%	1000 \$	200 \$	16 \$
Residential Mortgage	50%	8%	1000 \$	500 \$	40 \$
Unsecured Loan	100%	8%	1000 \$	1000 \$	80 \$

Source: Investopedia, 2007

Example: An unsecured loan of \$1,000 to a non-bank requires a risk weight of 100%. Therefore RWA is calculated as $RWA = \$1,000 \times 100\% = \$1,000$. By using Equation 1, a minimum 8% capital requirement gives $8\% \times RWA = 8\% \times \$1,000 = \$80$. In other words, for 1000 unsecured loan, the minimum capital needed to be hold is 80.

Basel II: Basel II is an updated version of Basel I, is also a set of regulations and standards put forth by Basel committee to regulate bank finance and banking internationally. According to Basel II, all the banks need to have enough cash reserves to cover their risks from operations. Unlike Basel I which is mainly also focused on credit risk, Basel II instruct that, riskier assets should have more capital reserves on hand than other less risky assets. Basel II also requires that banks should publish the details of the risky investments and risk management practices.

The outcome of the Basel II is to secure the international evolution on revisions to supervisory regulations which conduct the capital adequacy level (Basel Committee on Banking Supervision, 2007, 13).

There are three essential part of Basel II requirement:

Capital allotment by bank managers is more risky

Credit risk and operation risk both needs to be separated and quantified.

Reduce the scope of taking advantage from price difference between two markets or market price by trying to align the economic risk with regulatory assessment.

Basel II resulted a number of changes in bank strategy for risky investments for instance subprime mortgage market. The risks can also be moved to investors through securitization process.

Basel III: Many financial institutions failed during the recession while other financial giants used government bailout program to keep them alive. The Basel Committee realized that Basel II needed a major change and this led to Basel III. Basel III is more strict and has more regulations than Basel II.

The Basel III framework forces much tighter ratios but mostly follow the direction of Basel II.

The capital requirement for Basel III became more accurate due to credit risk affordability by banks. The final version of Basel III published in 2009 and has six major parts.

- Capital definition and requirements
- Capital conservation buffer
- Countercyclical buffer
- Leverage ratio
- Liquidity ratio
- Counterparty credit risk

These measures aim to:

- Improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source
- Improve risk management and governance
- Strengthen banks' transparency and disclosures.

The reforms target:

- Bank-level, or micro prudential, regulation, which will help raise the resilience of individual banking institutions to periods of stress.
- Macro prudential, system wide risks that can build up across the banking sector as well as the procyclical amplification of these risks over time.

These two approaches to supervision are complementary as greater resilience at the individual bank level reduces the risk of system wide shocks. (Bank for International Settlement, 2015).

1.3 Research problem

The topic of relationship between banks' credit risk and profitability has raised the concern of many researchers since the Basel Accord II was announced. Most of the previous publications focus on connection of two aspects in specific region by using the quantitative examination. For example, the research of Aduda & Gitonga (2011) in Kenya, Boahene & Dasah in Ghana (2012) or Li & Zou in Europe (2009) prove the existence of the relationship between counterparty risk and banks' performance. Especially, in his study "Credit risk and performance of Nigerian banks", Kargi (2011) has introduced the model to measure the profitability ROA based on the ratio of NPL to LA, compared to the ratio of LA to TD as an index of credit risk. In order to go further on this topic, we decided not to test the theories in many banks but apply the empirical study in Nordea bank in Finland only. Our research concentrates on the credit risks, derivatives, and measurement of bank's performance, then comparing the credit risk with the performance standard of Nordea bank in Finland. The result from quantitative test of Nordea bank is employed to explain the impact of the counterparty risk on the profitability.

1.4 Reliability

Our focus areas are credit risk and profitability of the commercial banks. Because all the collected data is the real and identical numbers from Nordea bank, our quantitative outcomes are trustable and consistent.

The construct in our study relies only on regression test, therefore, the findings are unique and stable. Besides, the process of collecting data and computing information is clearly described in our thesis, which enables other writers to conduct the similar topics.

By using the real data from Nordea's annual reports, we computed and compare the correlation between credit risk and profitability. As a suggestion for further studies, the focus on loan distribution and loan performance can be an interested and constructive research.

Additionally, there are many factors affecting the profitability, such as liquidity, economic stability, or legislation. However, since our thesis focuses on the relation between credit risk and profitability, we do not discuss other factors. Therefore, even our findings satisfy the suggested theories, they are not significant enough to generalize for all the commercial banks.

1.5 Validity

According to Carmines and Zeller (1979, 12) and Bryman & Bell (2011), validity is considered to be the most important criteria of a research. A research is significant when the intended question get solved. The validity is used to determine whether the content of the thesis measures what it is supposed to measure.

In our quantitative test, we use NPLR and CAR as the index for credit risk and ROA and ROE as the index for profitability. In the International Monetary Fund (IMF) working paper 2010, NPLR was employed as the main indicator to examine the effect of credit risk on banking system and macroeconomic environment. Besides, the application of Basel II suggested the strong relationship between credit risk and CAR. Therefore, both NPLR and CAR can be considered to reflect the influences of credit risk. ROA and ROE are also regarded as the financial soundness indicators for profitability (IMF, 2003). It is proved that our data is valid for the measurement.

Regarding the internal validity, which refers to the correlation between dependent and independent factors, the validity is achieved when the correlation is significant. In our findings, the coefficient of NPLR and CAR for ROA and ROE are not consistently reliable. However, we have made the explanation for that problem to avoid the subjective statement.

For the external validity, which refers to the generalization of the study, our test investigates only specific bank (Nordea). Because of the variation among the strategic management and financial position of the commercial banks, our finding is solely applicable for Nordea bank without the external validity.

2 Methodology

In this chapter, we explain briefly and comprehensively about our analysing process, from the employed method to the quantitative instruments. Because the thesis is directed towards the study-format and specialized for non-financial readers, all the mathematical terms are interpreted intelligibly.

2.1 Research approach

Our research is conducted by using secondary data and a quantitative analysis of a case bank. We attach to the main topic of credit risk and profitability in the commercial banks. Unlike the previous studies on the similar topic, our publication focuses not only on the quantitative analysis but also theoretical and quantitative discussion.

The research is expected to give an overview on the banking system and an intensive analysis on counterparty risk and bank's performance. We have mentioned the related theories and explained the result of the quantitative test.

2.2 Data collection

As we have explained in the Introduction, there is only one bank selected for our study case. We collected the necessary figures from Nordea Bank AB annual reports and Capital Adequacy and Risk management reports from 200 to 2013. Therefore, our regression test has 14 observations, which give us a satisfactory result to make the conclusion and recommendation.

In all the reports collected from Nordea bank's official website, we concentrate on their three financial statements and the loan loss detail to build the graph. The main data chosen is ROE, Net Income (or net profit), CAR, Impaired loan ratio, and Total Asset.

Because there are some figures were not calculated in the reports, we built another formula to define them (the formula is explained in the following chapters).

2.3 Indicators and data analyzing tool

To access the credit risk management of the banks, we have decided to use two indicators: CAR (capital adequacy ratio) and NPLR (Non-performing loan ratio). Additionally, ROE (return on equity) and ROA (return on asset) are employed to represent the performance of Nordea bank.

In the reports from Nordea, ROA and NPLR are two unavailable figures and we have calculated those numbers from the data of net, profit, assets, and impaired loans provided in the annual reports of Nordea bank.

Equation 2. Non/performing Loan Ratio

$$NPLR = \frac{\text{non - performing impaired loan} \times \text{impaired loan ratio}}{\text{Total impaired loan}}$$

Source: Investopedia, 2015.

Impaired loans consist of performing and non-performing loans. Performing impaired loans are defined as the debts which are deteriorated and their owners will highly possible pay less than the expected interest while the non-performing impaired loans are supposed to get default.

For example, in 2013, the total impaired loan was €6704 million, the non-performing loan was €2795 and the impaired loan ratio was 179 basis points.

$$NPLR = 2795 \times 179 / 6704 = 74 \text{ basis points, equivalent to } 0.74\%$$

We have employed the multivariate regression model which is presented below:

Equation 3. Multiple Regression Model

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$$

Y - The value of dependent variable

α - The constant term

β - The coefficient of the function

X - The value of independent variables

ε - The disturbance or error term.

Regression analysis is a statistical tool for the investigation of relationships between variables. To explore the correlation between one independent and one or a group of variables, the regression method is employed to calculate the quantitative impact of the variables. The regression test also estimates the level of confidence of the relationship.

In application to our research, Equation 3 can be written as two equations below:

Equation 4. ROE Regression

$$ROE = \alpha_1 + \beta_1 NPLR + \beta_2 CAR + \varepsilon_1$$

And

Equation 5. ROA Regression

$$ROA = \alpha_2 + \beta_3 NPLR + \beta_4 CAR + \varepsilon_2$$

We make NPLR and CAR independent variables to determine the value of dependent variables ROA and ROE. The coefficient β illustrates the relation between the observed variables. If the value of β is negative, the value of the independent variables will decrease when the dependent figures get increase and vice versa. α is the constant value, which represents the value of the dependent variables when the predictors are equal to zero. ε is the disturbance or error term, which sums the value of other independent factors.

To investigate the slope β , we run the ordinary least squares (OLS) method in Microsoft Excel. The Ordinary Least Squares (OLS) method can be applied to multiple linear regressions, which provides a simple procedure to estimate the data through the observations. (Investopedia, 2015)

2.4 Statistic explanation

The result from Excel Regression returns us the data of:

Multiple R: This figure shows the coefficient of multiple correlations, which determines the distance between the data and the fitted regression line. The value of R ranges from 0 to 1. Because the data illustrates the impact of the dependent and the predictor values, the smaller number is, the less linear relationship is.

R Square: R^2 represents the proportion of the variance in the dependent variable, explained by the predictors. The value of R^2 is the coefficient of multiple determinations. The value of R^2 indicates the level of prediction power of the predicted values by the observed values. In the other word, if R^2 is close to zero, there is no relationship between two variables; and when R^2 gets close to one, the correlation between credit risk and profitability is significant. In order to avoid the overestimation, we use adjusted R^2 to discover the probability of fit.

The value of R^2 can be negative if the selected predictors are irrelevant to the dependent variables. However, the result of R^2 or adjusted R^2 only reflects the solidity of the association, not measures the quantitative impact of the observed figures.

The significance F indicates the probability that the established equation does not explain the variation in the dependent variable. The correlation is only considerable when the significance F is less than 0.1 (10%)

ANOVA: the analysis of variance is used for testing the relationship among the variable values, usually between one numeric dependent variable and multiple independent variables.

P- value: Probability value represents the reliability of the obtained intercepts which is compared to 0.05 typically. If the P-value is less than the standard (0.05), it can be said that the final result is trustworthy, or else, there is no obvious relationship between the investigated factors.

3 Overview of banking industry risks

In this chapter we are going to discuss, how banking industry have changed over the years and how bank analyze their risks. We will also discuss risk analytical tools and bank derivative products.

3.1 The change of bank environment

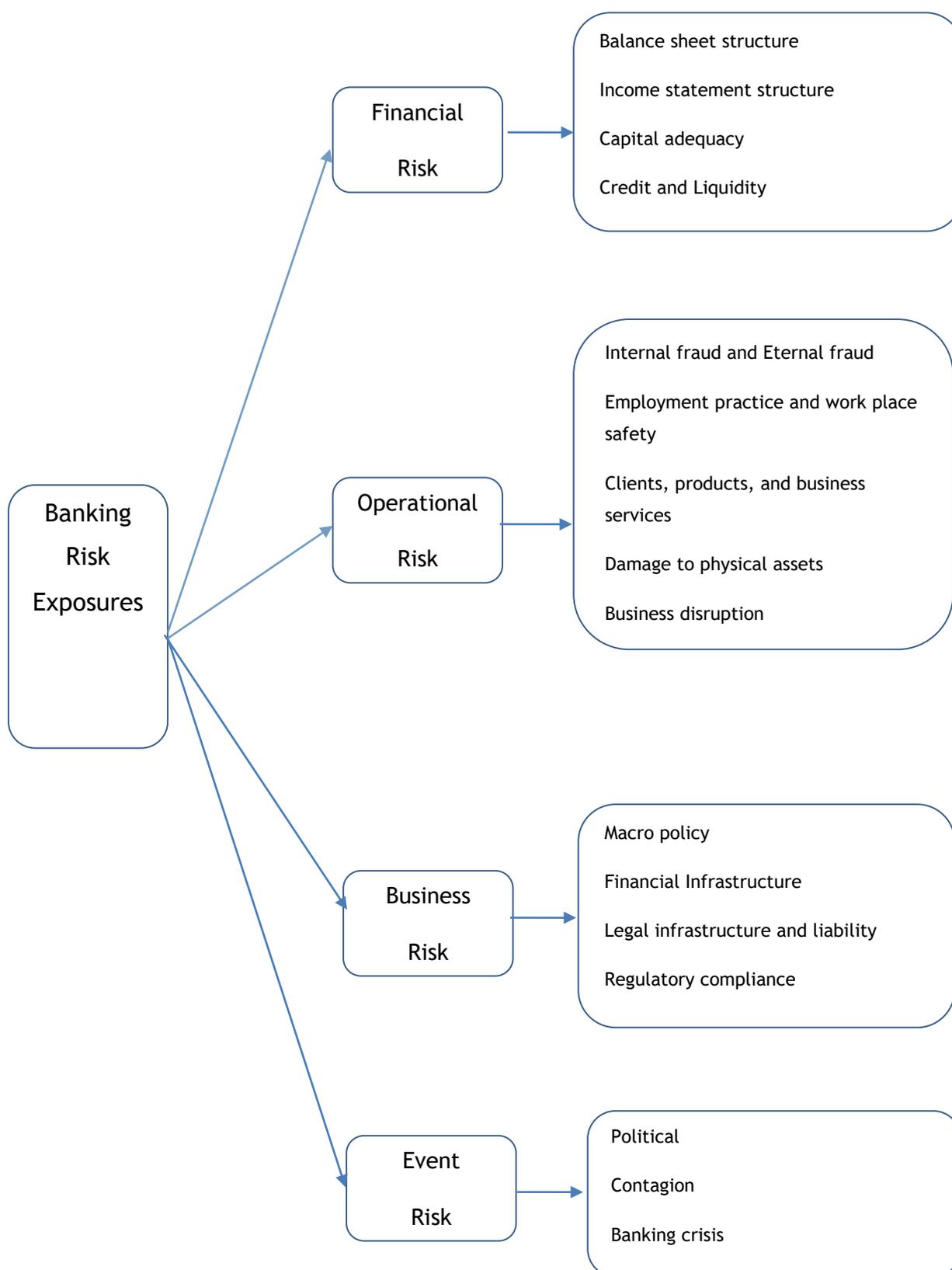
Banking system changed rapidly in past couple of decades. Technological innovations and the fast development of modern trade changed the banking system beyond recognition. Banks now have access to wider range of funds due to the expansions and variety of international financial market. The traditional banking practices such as the receipt of deposits and loan granting are only one part of a typical banking nowadays and usually make up the least profitability. The major source of the modern bank's income is trading and fees for the services.

New innovation in banking industry has led to the increased market orientation and marketability of bank assets. Prudential capital requirements have been the major inspiration behind these innovations. There is a general concern, that financial innovation particularly with respect to off record instruments could have been the result of concentrating risk and increasing volatility. (Greuning & Bratanovic 2003, 2)

3.2 Risk analysis of bank

In present times, banks are exposed to variety of risks in the course of their operations. According to Greuning & Bratanovic 2008, banking risk has four major categories: financial, operational, business and event risks.

Figure 1. Bank's risk exposures



Source: Hennie & Sonja 2008

Banking supervision usually happens through an ongoing analytical review. The methodology for analytical review of banks is off-site surveillance and on site supervision process. The process is similar that of private sectors like external auditors or bank's risk managers, therefore the analytical framework is universally accepted.

The main method for analyzing financial risk is the detailed review of a bank. Important quantitative factors and financial ratios should be added in the analysis. The quality and the style of corporate governance and management; the adequacy, completeness, and consistency of a bank's policies and procedures; the effectiveness and completeness of internal controls; and the timeliness and accuracy of management information systems and information support should also be included in the review. (Greuning & Bratanovic 2003, 9). There is a general belief that risk rises rapidly with the speed of change. In reality, it relates to the market's capacity to innovate in most situations bigger than its ability to handle. Previously, banks used to consider credit risk as their most important task, however as banking evolved and the industry became more complex, they needed to manage wider range of operational and financial risks. Normally, risk management is a several step process. Different steps and strategy used for different financial and operational risks. These steps consists of finding out risk management target and evaluate performances. The issue of acceptable risk limit and hedging process also needs to be determined.

If needed, a bank should be inspected as a single entity as well as a consolidated basis. For consolidated basis holistic assessment approach should be used, especially in regards to multiple jurisdictions and foreign markets. The analysis also needs to be similar with similar institutions or groups, especially for the big issues like profitability, structure of the balance sheet, and capital adequacy.

3.3 Analytical Tools

There are some analytical tools explained in the book by Greuning & Bratanovic (2003). Each tool is unique and can be used against different needs.

Table 3. Analytical tools

Source and tools	Analytical Phase	Output
Questionnaire Financial data tables	Data collection	Completed input data, questionnaire, and financial data tables
Completed input data, Questionnaire, and financial	Manipulation of data	Data manipulated by the model

data tables		
Manipulated data	Analysis and interpretation of both manipulated and original input data	Analytical results(output summary report, tables, and graphs)
Analytical results	Off-site analysis of a banks' financial condition	Report on a bank's financial condition and risk management and terms of reference for on-site examination
Off-site examination report and terms of reference for on-site examination	Focused follow up through an on-site examination, audit, or review engagement	On-site examination report
On-site examination report	Institutional strengthening	Well funding financial intermediary

Source: Greuning & Bratanovic, 2003, 11.

3.4 Derivative products

3.4.1 Forward contract

Fundamentally, forward contract provides the private trade of risk and opportunity between two owners. In the forward contract, two involved parties exchange an asset at a predetermined price (also called spot price) at a specified time in the future. In the other word, the buyer pays intermediately and the purchased item will be received later in the future. There are three elements of a forward contract, including the number of exchanged unit, the forward price (can be cash or asset), and the delivery date (Gestel & Baesens, 2009, 69). The forward contracts happen in decentralized market, without a physical and official location; therefore they are regarded as OTC instruments. The typical features of OTC are flexible and easily customized but also less transparent and loose (Marketsmedia, 2015). Therefore, the expected profit from the contract goes along with the higher risk.

In a forward contract, the seller holds the long forward contract when the buyer is in the short position. The initial value of the contract is zero and there is no money exchanged hands in the time of agreement. Due to the original and follow-up survey in 1985 of 500 systematically selected companies, the forward contract was ranked as the most popular hedging instruments (Stonehill & Moffet, 1993, 105)

Supposed the spot price of the exchanged asset at present time t is A_T and the matured price of the asset at time T is A_T . If the forward price is F , we have the equations to calculate the pay-off (P) for both positions:

Equation 6. Price for long-position

$$P_{long-position} = A_T - F$$

Equation 7. Price for short-position

$$P_{short-position} = F - A_T$$

(Gestel & Baesens, 2009)

3.4.2 Future contract

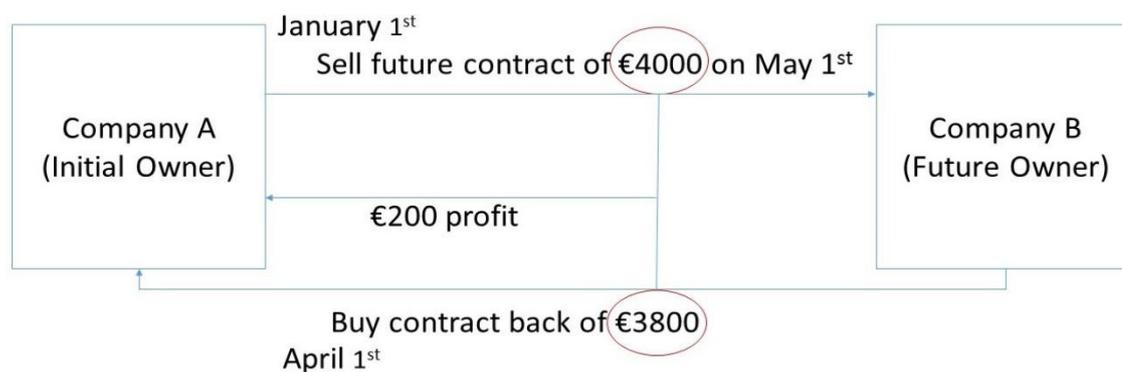
The future contract was first introduced by the Chicago Board of Trade in 1865 as the standardized agreement for risk hedging. A contractual agreement, generally made on the trading floor of a futures exchange, to buy or sell a particular commodity or financial instrument at a pre-determined price in the future (Investopedia). The detail of the quantity, quality and time must be included in the contract. The distinguish features of future contract from the forward contract are the involvement of broker and the specific delivery. Firstly, in the future contract, the buyer and seller make a deal through the clearinghouse, which helps reduce the credit risk inherent if one of the parties cannot fulfill the obligations. Secondly, the settlement only happens when the standard quality and predetermined time are met. Besides, it is easier for the investors to monitor the profit or loss since the market changes are settled daily. Future contract often used for trading commodities, stocks, and bonds. (National Taiwan University, 2015)

Let us take stock market future contract as an example. It usually has two positions; one is called long position, another one is called short position.

Going long: In January Company 'A' made a futures contract to purchase 100 shares of Apple stock at €40 per share on May 1 for a total price €4,000. Hence if the market value of the stock rises before May 1, Company 'A' can sell the contract early for a profit. Assuming the price of Apple stock rises to €42 a share on April 1. If company 'A' sell the contract for 100 shares with a price of €4,200, and make a €200 profit.

In terms of Going short: Company 'A' enter into a futures contract on January 1st to sell 100 shares of Apple at €40 per share on May 1 for a total price of €4,000 to company B. But then the value of Apple stock drops to at €38 per share on April 1. The strategy with going short is to buy the contract back before having to deliver the stock. We can look at the figure below for more details.

Figure 2. Buy-back option for short position



3.4.3 Option contract

Option contract allows a buyer and seller to be in a contract, where the purchaser of the contract holds the right to buy or sell the assets or commodities at a later date an agreed upon price. The agreed upon price also known a strike price. In the simple terms, option contracts give power to one party to buy or sell at a later point in time and price is specified in the contract.

Example: A trader expects the price of a share will rise from 60 to 100 in the future. Instead of buying the shares itself he makes an option contract with the owner of the share, stating he can make a strike price call between 60-100. And if the price does rise to 100 and he makes the strike price at 80, he gets the gain of 20 per share.

However, option contract has its cost. The buyer of the shares needs to pay the cost for the option. Option contract is a very handy tool to hedge stock positions. It can also be used as a risk mitigating option for a business.

4 Credit risk analysis

The likelihood of credit default does not indicate the performance of banks or the financial institutions, but predicts the potential loss of the investments. Through the analysis process, the commercial organizations can avoid or reduce the risks to the lowest level of damage. However, no matter how hard they try, risk is an inherent characteristic of the every trading activity. The measurement of potential exposure is subjective due to the nature of investment, the amount of transaction and the trustworthiness of the borrowers or the counterparties. In this chapter, we highlight the basic system to evaluate the quality of loan applicants and focus on the common credit derivative instruments.

4.1 Credit scoring and rating

In practice, credit score and credit rating can be alternatives for each other and they are investigated and calculated by the third party rather than the creditors or the borrowers.

However, credit rating- which reveals the credit quality, is widely used to measure a business or movement, credit score is employed to estimate individual credit worthiness. The basic difference of two systems is their written form. While credit rating is recorded as a letter grade, credit score is presented in form of the three-digit number.

4.1.1 Role of credit score and scoring system

Over the last two decades, due to the great demand of private investment and the growth of capital market, consumer lending aroused more and more default risk concern of the lenders. The market becomes increasingly complicated and exposure to the higher risk, which requires a new credit judgement method instead of relationship-based underwriting. Data-driven model appears as a replacement for the conventional system to assess and price credit risk.

Credit score, presented in numeric form, is a resume of individual or corporate credit report at a specific point of time. The main purpose of the score is to provide the lenders (banks or financial institutions) the financial situation and trustworthiness of the borrowers.

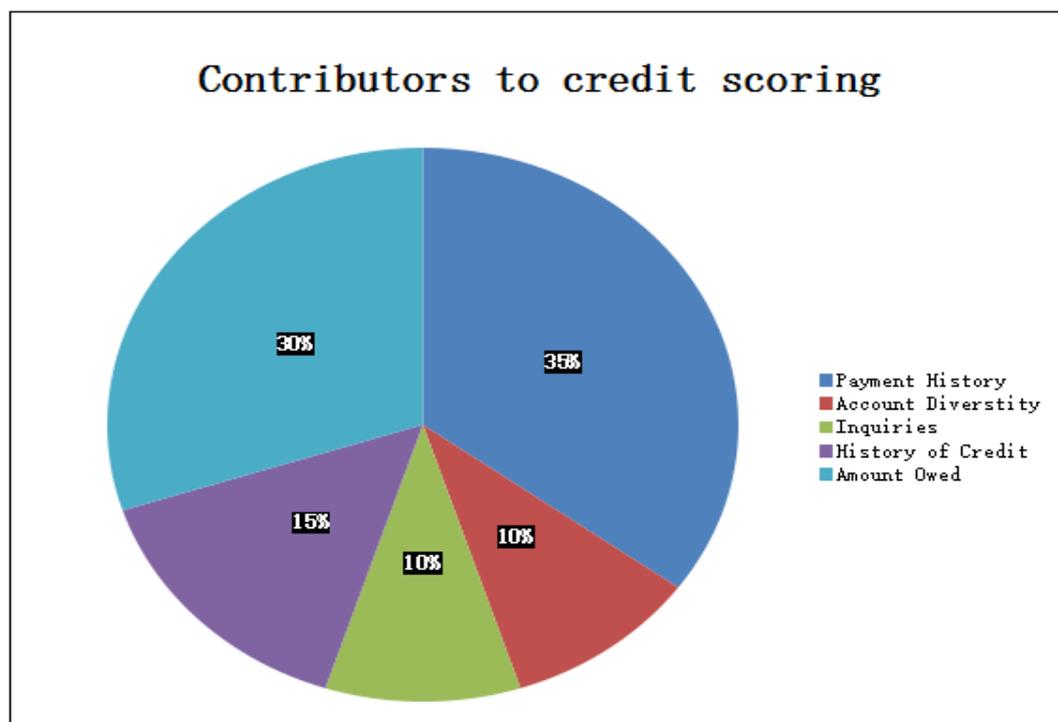
Despite the innovation of credit scoring and its impact on credit assessment, there is no specific quantitative research to qualify its effect on availability and affordability of credit. In practice, the quantitative proof reveals that the creation of credit-scoring system enables the credit portfolio diversification. The application of this scientific method helps the capital holders get more customers, reduce the investment for marketing and ensuring the new credit, and increase the speed of decision making. The public information of credit score also creates a fair play market place for all the creditors.

The analysis of credit quality costs much effort and financial investment. However, the result of the assessment can be widely used by many capital lenders, which drive the operational cost to be marginal. The application of score contributes to lower interest rate and greater access of credit. The capital market also benefits from the accuracy of credit score as the lenders have been noticed about their potential customers and saved costs of lending activities. Additionally, credit scoring contributes to the proficiency of credit markets by enabling the lenders select the proper prices related to risk exposures and increasing demand of loan. According to Federal Reserve Board (2015), risk-based pricing can limit the excessive borrowings from the risky customers by reducing the cross-subsidization and improving the transparency of lending policy. The higher interest rate charged for risky customers and lower interest rate provided to less-risky customers motivate the good investors to take more credits. Finally, the credits can evaluate the loan performance in a more accurate system, thus can expand their investments to more customers.

Figure 3 indicates five general categories affected the scale of credit quality. It is clear that the previous background has the greatest impact on the present assessment with 35% in the paid loan and 30% in the remained debt. The credit score will be higher if the amount of

payback exceeds the debt and conversely. Besides, the pie chart from FICO represents the key elements in the decision making process of the lenders. From the lenders' viewpoint, consider account diversities and inquiries have less influence in the trustworthiness of the borrowers.

Figure 3. Contributors to credit scoring



Source: myFICO, 2015

The credit agencies maintain the information on millions of individuals in their data systems. The reports of customers are reported to the reporting agency by the lenders who have extended the credit details. The credit reports mainly contain important information, including the credit types, maturity time and payback situation. FICO score is the best known and most widely used to judge the credit. The scoring software from FICO is implemented in US and Canada banking system. By analyzing and comparing the received credit reports, FICO score gives the capital holders the complete credit profile of their expected customers as well as the associated future credit risks.

Table 4. Credit score and interests

Score	Categories	Lending
300-500	Poor credit	Hard money
500-619	Sub prime	High interest

620-679	Alt A	Average interest
680-750	Prime	Low interest
751-850	Excellent	Best interest

Source: Total Debt Network, 2015

The categories of credit scores are illustrated in the table 4. The FICO score uses 3-digital scale to estimate the safety of the credits. However, the score range from 300-850 only inform the lenders about risk level of loan, not the quality of customers. In fact, there are three different FICO scores, developed by three separate reporting agencies mentioned in table 5.

Table 5. Credit report agencies

Credit report agency	FICO score name
Equifax	BEACON
Experian	Experian\FICO Risk Model
TransUnion	FICO Risk Score, Classic Model

Source: SkyBlue, 2015

4.1.2 Implementation and use of rating system

In the last decades, the creditworthiness was measured in the ratings of the external issuers, for example, through the bond market or lending companies. The analysis and results carried out the rating agencies such as Moody's, Standard and Poor's (S&P), and Fitch. However, the measurement scales of those agencies vary from others, which lead to the different assessments of credit quality. The role of the rating agencies is the connection between the bond investors and bond issuers and they are financed by the commission fees.

The rating index indicates the security of debts. In the other words, the primary purpose of the figures is to illustrate the potential losses of the loans. Recently, due to the high demand of capital and investment, credit ratings also contribute to the research in creditors' default risk and borrowers' recovery risk.

Table 6. Global long term rating scales

Moody's	S & P	Fitch	
---------	-------	-------	--

			Investment grade
Aaa	AAA	AAA	
Aa1	AA+	AA+	
Aa2	AA	AA	
Aa1	AA-	AA-	
A1	A+	A+	
A2	A	A	
A3	A-	A-	
Baa1	BBB+	BBB+	
Ba1	BB+	BB+	
Ba2	BB	BB	
Ba3	BB-	BB-	
B1	B+	B+	
B2	B	B	
B3	B-	B-	
Caa1	CCC+	CCC+	
Caa2	CCC	CCC	
Caa3	CCC-	CCC-	
Ca	CC	CC	
C	C+,C,C-	C+,C,C-	
	D	D	

Source: QuadCapital Advisors LLC, 2015.

Table 6 presents the different long term scale measurement from three rating agencies S&O, Moody's, and Fitch for two investment types- investment grade and non-investment grade. The credits considered as the investment grade must have the relatively low expected default risk and vice versa for the non-investment grade. Although the credit research and risk assessment products from the rating agencies have great impact on the capital market, the

Basel II Capital Accord has motivated financial institutions to develop internal rating systems for regulatory capital calculations.

The process of rating relies mainly on the quantitative analysis, which accumulates the information and data from debt structure, financial statement, and balance-sheet. The research can be conducted in the private or public sector from all the relevant sources. The factors affected the results include management quality, competitive position, growth prospects, etc. The credit issuers, at the first stage, send the requests to the rating committees. In the second step, the orders are assigned to the specific agencies, which will fulfil the task and transfer the result to the clients. However, the initial rates are continuously observed and re-evaluated till the requests are cancelled.

4.2 Credit derivative contracts

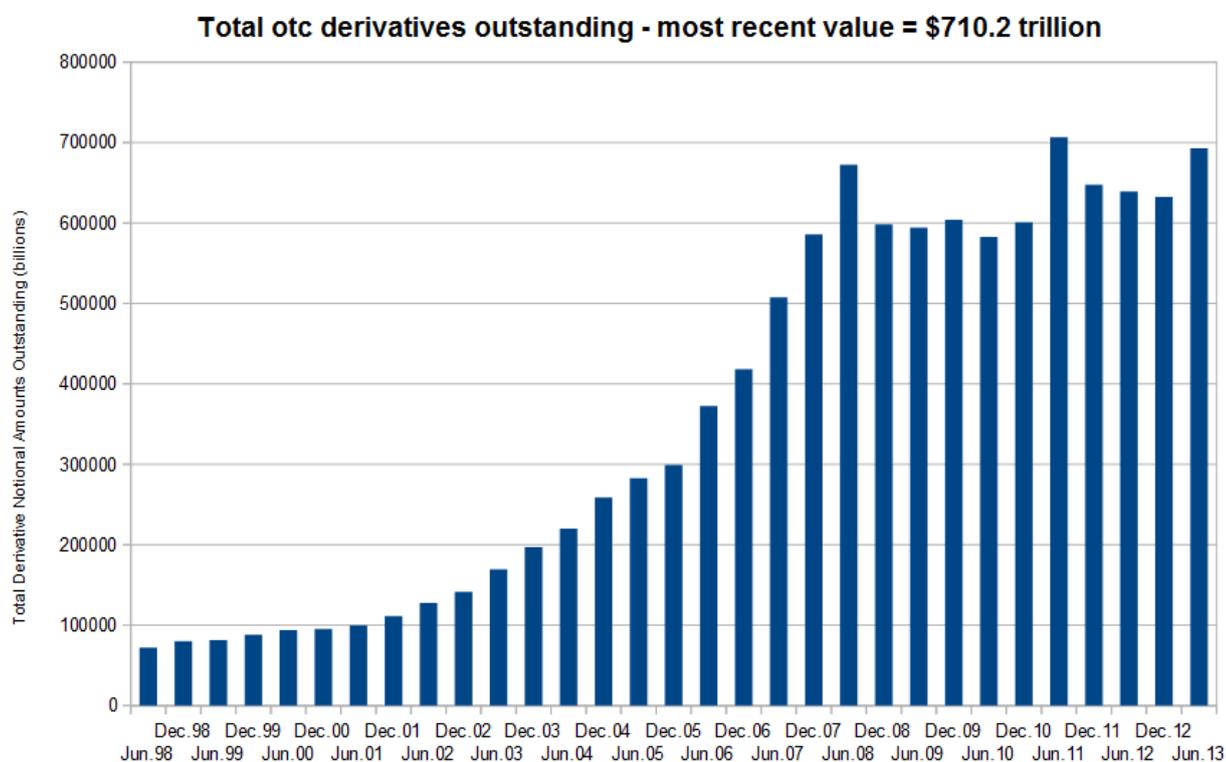
In 1992, the International Swaps and Derivatives Association introduced the concept of credit derivatives as a tool to transfer risks between two parties. Banks, Glantz and Siegel (2006) have mentioned the working operation of derivatives contracts for risk mitigation managers and international investors in their research. The two involved factors in the contracts are credit guarantors and the beneficiary. Credit derivatives are off-balance sheet arrangements that allow one party (the "beneficiary") to transfer the credit risk of a "reference asset," which it often actually owns, to another party (the "guarantor") (Board Of Governors Of The Federal Reserve System, 1996). For equity, the credit guarantors are in long positions, which own the securities. On the contrary, the buyers in short position pay for securitization to absolve themselves of assets' devaluation. The credit guarantors play the role of protection sellers, who will exchange the insurance with the buyers and undertake the risks associated with the debt obligations. Normally, the debt obligations are financial institutions, commercial or industrial firms.

Based on the agreement in the pay-off contract, the beneficiary will be compensated when the predefined events occur with the debt obligation. However, the condition of compensation does not solely depend on the damage but also on the credibility and financial situation of the debt obligor. For instance, the downgrade in creditworthiness of the financial organization will lead to the deterioration in the value of the swaps. Regardless the solvency of the obligor, the derivative holder will still receive the lost money due to the difference between value at trade date and maturity date (Banks, Glantz and Siegel, 2007). In terms of banks, once the decrease in credit valuation happens due to the weakness of credit obligor, the profitability will be certainly damaged. Conversely, if the standard of credit increases, banks will get benefits from holding long positions.

Since 1990, the application of credit transfer instruments has developed rapidly and the credit derivative has become the most attractive and dynamic market in the global commerce (Banks, Glantz and Siegel, 2007).

The tremendous growth in value of credit derivative products can be seen in this figure below.

Figure 4. Amount of credit derivatives



Source: Tenebrarum, P. Acting Man, 2015.

From December 1998 to June 2013, the sales of risk transfer contracts experienced a dramatic increase of nearly \$620,000 billion. The amount reached the peak in 2011 with more than \$700,000 billion. The wide spread of credit derivative market has assigned to the awareness of risk mitigation, the diversification of participants and product improvement (Credit Derivatives Handbook, 2006). In this chapter, we will discuss the three types of credit derivatives and focus on the most and common used contract - CDS.

Table 7. Derivative contracts

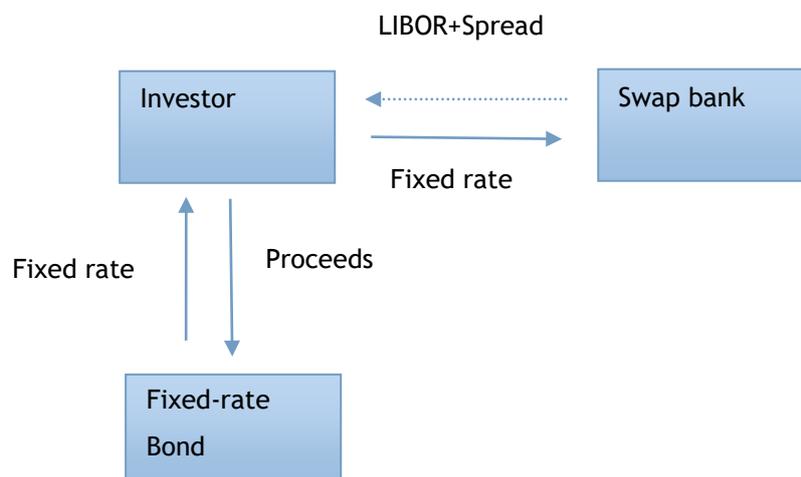
Contract	Type	Protection	
		Default	Deterioration
Asset Swaps	Bilateral	✓	✓

Credit default swaps	Unilateral	✓	
Credit spread forwards	Bilateral	✓	✓
Total return swaps	Bilateral	✓	✓
Basket swaps	Unilateral	✓	
Credit spread options	Unilateral	✓	✓

Source: Banks, Glantz & Siegel, 2007

Asset Swaps combine the risky liabilities and interest rate or currency swap (Banks, Glantz and Siegel, 2007, 29). In the other words, the investors exchange their fixed investment with a floating asset to hedge risk. Asset swaps package allow the investors to hold either long or short positions due to their arbitrage opportunities.

Figure 5. Asset swap options



Source: Banks, Glantz and Siegel, 2007

According to Oxford dictionary, floating rate note (FRN) is type of Eurobond with the flexible interest rate. The value of FRN Floating rate notes is usually based on the London Inter-Bank Offered Rate.

Bond issuers can use the asset swap contracts to convert the security packages from fixed to variable liabilities and conversely. For example, if the favourable required features are not available, the issuers can attach a swap to convert the available bonds to the favourable package. The process of synthetic FRN package, the process is applied for the floating bonds.

The investors can buy the liabilities and then transform it into an associated swap with the banks. After paying LIBOR plus a spread, investors will receive the fixed return without concerning any risk. The same method is also applied for the fixed rate bonds. The typical

notional amount of a swap contract varies from \$5 million to several hundred million with the maturity period between one and ten years.

Credit spread forward (CPF) allows the buyers to make the purchase the credit spread at a forward price. By extension, the buyers receive the differential between the credit spread at maturity, and a fixed spread.

Based on the purpose, credit spread contracts can be negotiated to be absolute or relative. In the absolute contract, both parties play in one benchmark and the profit or loss is calculated by the differential between the fixed credit spread and market spread. Basically, the investors purchased the floating spread and the sellers receive the fixed spread. In the maturity date, if the value of purchased spread exceeds the price of credit at transaction date, the investor gets a gain. On the contrary, the investor will receive a loss as the credit quality decreases.

Unlike the absolute version, the relative forward consists of two separate risk-free scales between two risky bonds. A combination of spread forward and credit spread forward allows one counterparty to pay periodically the relative credit spread to another (Bluhm, Overbeck, and Wagner, 2003, 276).

The payoff to the buyer in CPF can be computed by the equation below:

Equation 8. CPF Pay-off

$$P = (\text{Spread at maturity} - \text{contract spread}) \times \text{Notional Principal} \times \text{Risk Factor}$$

Source: Marciniak, 2015

For example:

Table 8. Example of CDF

Fixed spread	4%
Market spread	7.5%
Notional of the transaction	\$100000
Risk factor	20

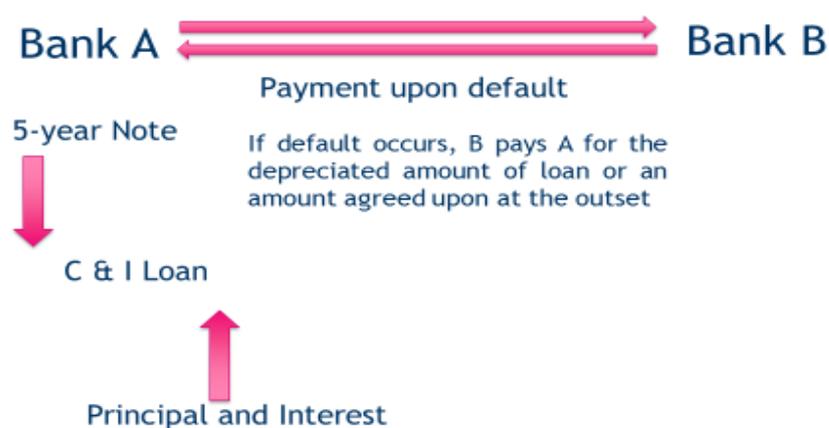
Using equation 8, we can calculate the payoff

$$P = (7.5 - 4) \times \$100000 \times 20 = \$70000$$

Credit default swap (CDS) offers another distribution channel for risk management. The purpose of CDS contract is to create a mechanism for the financial investors (banks or

financial institutions) to transfer the default risks of the securities or loans from one to another. This unilateral contract gives the buyers risk-free confidence after they pay an up-front or periodic fee to the guarantors. However, the compass of CDS contracts limit on the credit default and there is no compensation made for credit deterioration. During the life of contract, if the reference assets remain in solvency, the agreement will be terminated without any payment from protection sellers. The fundamental structure of CDS contract is illustrated in Figure 6.

Figure 6.Credit Default Swap Process



Source: Board of Governors of the Federal Reserve System, 1996

Banks A and B can be the investors, insurance companies, or financial institutions. Both involved parties are obliged by the term of contract. The par value of reference credit is paid to protection buyers under physical settlement or in cash when the default happens.

CDS has emerged as the most popular credit derivative product in the financial market. The key advantage the contract offers to its beneficiaries is the default-free investment against bankruptcy and other credit events.

In case the recompense is made under form of cash, the price discovery method must be predetermined and regulated in the agreement. The level of monetary compensation depends on the formulation of multiple merchants. Unlike a normal insurance contract, CDS is an OTC contract and it can be established via a third party, which is not involved in the risk exposure of underlying asset.

CDSs have become more popular since the last, especially; the medium and small size businesses enjoy the advantage of the unilateral contract. For the small financial institutions

and low capital investors to build the short positions in credit market, the derivative contracts appear to be more attractive than the conventional physical finance.

The premium or insurance fee can be paid forward or periodic during the life time of CDSs. Practically, the basic form of payment is LIBOR spread. There are many factors affecting the value of requital or indemnification. The main contributors are listed with their impacts in the table 9.

Table 9. Considerations for CDS price

Factor	Pricing impact
Maturity period	The potential of default is proportional to the duration of matured time, dragging the higher compensation
Probability of default on reference credit	The higher probability of default, the higher premium
Credit quality	The decrease in credit rating of guarantor leads to the drop in premium
The relation between guarantor and reference credit	The higher the correlation between the seller and reference asset, the lower premium
Expected recovery date	The recovery rate and compensation rate are disproportional

Source: Banks, Glantz and Siegel, 2007

The common matured period of a CDS ranges from six months to five years with the notional amount between \$10 and \$50 million. There is no specific requirement for the sector of assets and the contract can be customized based on investors' purpose. We can analyze a contract between a bank and housing company in the following example.

Suppose that the housing company X is the loyal and biggest customer of the bank. In the new project, company X applies for a loan of \$30 million. Because the real estate market always contains an underlying risk of mortgage crisis, bank wants to reduce the default exposure of the liability. Considering the importance of customer relationship, the bank is eager to hedge risk of the loan but reluctant to transfer the ownership of the loan portfolio. Consequently, it participates in a CDS transaction with a credit derivative dealer for \$30 million to transfer the probability of default. However, because this CDS transaction is private negotiation, company X cannot notice the existence of bank's suspect in the loan portfolio and bank still remains the good image to its customer.

Due to the term of contract, bank will get the requital from guarantor if company X gets default on its bond. For instance, the credit price of X deteriorates from the face value of 100 to the market value of 70, the lost value of 30 will be recovered by the dealer, which is equivalent to. Compare to the post potential loss of \$9m, now the bank just drives a small amount of \$100000 to protect its profit.

In practice, the premium is impacted by the correlation between credit derivative provider and reference bond. If the credit has negative influence on the profitability of financial institution, the price of compensation will be lower and vice versa.

Total return swap (TRS) is a bilateral financial transaction of the total returns between two parties. In order to hedge the credit-sensitive assets, two financial institutions (usually banks) conduct an agreement to transfer the credit exposure from one to another. The typical feature of a TRS is that the exchanged risks in the agreement only contain the value of assets, not the ownerships. This synthetic instrument provides a more flexible and highly leveraged hedge fund.

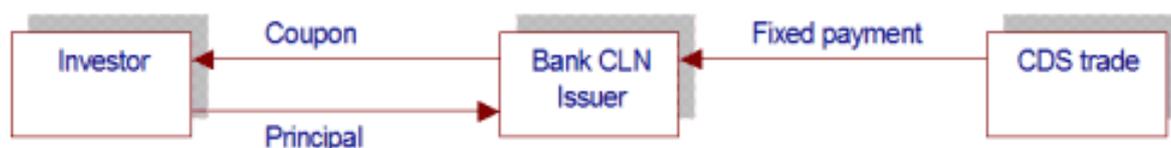
The TRS contracts cover a wide range of financial aspects, from income and profit to deterioration and loss. In a standard transaction, the protection buyers make payments for reference assets to the protection sellers, in exchange; the protection sellers settle a fixed or floating return to the TRS receivers. For example, a bank possesses a loan portfolio of \$5 million with an annual interest of 8%. If the bank wants to hedge risk of default or asset deterioration, it can buy the insurance from another bank and receives the constant cash flow (for example, LIBOR based-flow and spreads). The insurance issuer, on the other hand, is entitled to economic value of the hedged loan portfolio plus any deterioration associated with that debt. Investors or financial institutions use TRS as a tool to diversify their investment portfolio and increase yields by receiving banks' credit exposure. In return, banks also obtain the confident loan security without transferring the loan portfolio to other financial institutions. Banks still keep their customer relationships while devastating credit risks.

TRS are off-balance sheet transactions. The contracts enable low cost borrowers with large global balance sheets to take advantages of credit exposure. At the same time, the large capital holders, such as the insurance issuers or TRS receivers, prefer the financing and leverage of the total return transaction. Usually, the payments to TRS payers are settled in floating rate and the reference assets can be any type of economic values such as indices, bonds (emerging market, sovereign, bank debt, mortgage-backed securities, corporate), loans (term or revolver), equities, real estate receivables, lease receivables, or commodities. Because the transaction only swaps the value of reference asset, not the ownership, the total rate of return payer is the legal owner and holds the reference asset on its balance sheet. In the financial market, TRS contracts happen for the short period.

Credit-linked notes (CLNs) provide a combined mechanism of regular high-quality note or bond and credit derivatives. The reference assets can be credit- risky or risk- free, which are issued by highly ranked credit issuers or special-purpose companies.

The working process of CLN is described in the figure 7 below

Figure 7. Issuance



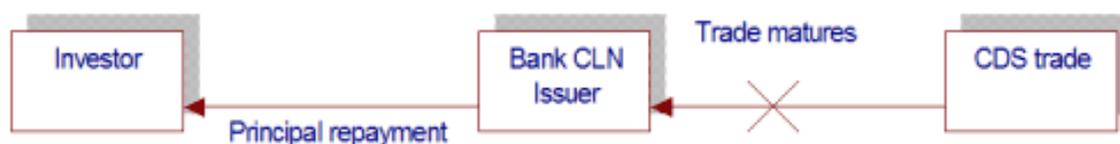
Source: Barbican consulting, 2015.

Suppose that a bank possesses a risky entity and wants to swap risk by involving in a credit default swap (CDS) contract with an investor. The investor has to pay a principal notional amount of the reference asset to the bank in return for the interest from the coupons. In order to avoid potential risks related to default or improvement from investor, bank continues to sell the credit protection (which it has purchased from the investor) to another dealer (which can be a bank or financial institution). The bank now issues the CLN. The CLN would be for the same principal amount and maturity as the CDS. The final terms of the CLN would mirror the terms in the CDS transaction (Barbican Consulting, 2015)

At this stage, the transaction of notes benefits both the bank CLN issuer and the initial investor. Investor can widen the investment portfolio without the concern of legislation limits. Concurrently, bank, while transferring the protection to another party, can save its capital and limit the impact of credit performance from other two parties. For example, in case either the initial investor or CDS trader gets bankruptcy, the bank is still in control of the cash.

Figure 8 elucidates the scenario of maturity date without credit event. The payment will be return to investor, which presents the differential between face value and market value of reference entity. The deal with the third party is terminates.

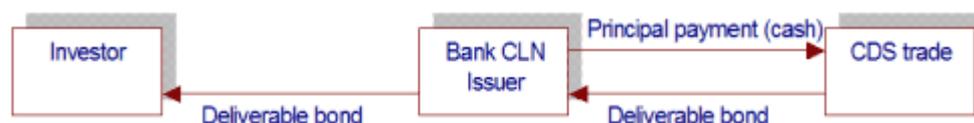
Figure 8. Maturity and no credit event



Source: Barbican consulting, 2015.

If the credit event happens, as illustrated in figure 9, bank CLN issuer has to pay a deliverable bond to the investor and also receives another from its counterparty. In return, CDS seller get a par value and investor experienced a credit loss.

Figure 9. Credit event



Source: Barbican consulting, 2015.

4.3 Credit risk management

With the severe attack of financial crisis, the shortage of credit has raised the concern of credit risk management in terms of structure and regulator. In order to control the risk efficiently, the management process is required to be more transparent and the customer credit portfolio should be monitored thoroughly. The proper credit management strategy not only mitigates the default risk but also improves the general performance and secures the competitive advantages of the commercial banks.

4.3.1 Measurement of credit risk

Since the last two decades, there has been an increasing demand for the credit risk measurement. In response to the temporal factors including:

- The increase in bankruptcies
- The reduction in the credit quality and the amount of largest borrowers
- The deterioration of reference asset value in the market
- The escalation of off-balance sheet instruments associated with the intrinsic default risk exposure (Mohd, Sok-Ge, Sallahudin)

There is a need to assess the level of damage credit risk may return to the creditors in case of default or deterioration. In the other words, the credit issuers or financial agencies use the special measurement tools to calculate the credit quality of their customers and the loan decision is made based on the quality statement. However, due to the lack of customers default history, it is difficult for the bank managers to forecast the possibility of risk. In order to improve the confidence of risk management, most of the banks nowadays implement the credit risk models provided by the credit rating agencies such as Moody's KMV. The advantage of those instruments is the anticipation function for the default frequencies.

Besides, many banks remain their internal calculation system for the frequent customers, using PD (probability of default), EAD (exposure at default) and LGD (loss given default). Based on the analysis, the credit qualification is rated in three level: "good", "fair", and "need improvement". The advantage from a good credit assessment is the best deal of

interest rates. In the other hand, the credits ranked fair do not allow the loan applicants the best interest rates available. Finally, if the credit worthiness is rated as “need improvement”, the customers are limited to apply for many loans (bankrate, 2015). The formula to calculate EL (expected loss) is written as:

Equation 9. Expected Loss

$$EL = PD \times LGD \times EAD$$

Source: riskarticles, 2015

PD is the estimation of possibility that a loan will fall into default. The number is specific for each client and needs to be adjusted periodically. Based on the loan portfolio and credit history of the borrowers, bank managers can anticipate the default percentage. In addition, the nature of investment should be considered since the level of risk in the business differs from each other. The result of PD varies from 0% to 100% and the smaller it is, the better it is (Jorion, P, 2011, 434).

LGD is defined as the rate of loss that the creditors suffer from the credit default when the borrowers face the insolvency. Usually, in case the counterparties are not able to make the repayment, there is always a recovery of total loss for the lenders. The amount of compensation is obtained by the sales of obligors' assets and the percentage of compensation is called recovery rate (RR). The portion of LGD is calculated by subtracting RR from 100%.

EAD is the outstanding debt at the time of default, which the creditors are supposed to lose. Although the value of loans remained stable in the balance sheet, several products with the increasing values should be calculated at the default time rather than the reference date of contracts. The underlying exposure is determined by the internal rating boards (IRB) of banking internal system.

4.3.2 Management process

For the commercial banks, the threat of credit exposure is the greatest concern for bank managers. From the experiences in the past, the bank supervisors are able to build the useful monitoring system to control and limit the effect of default risk. In practice, the banking system has its own credit policy to manage this problem. Credit policy is defined as a course of terms and conditions for approval criteria, credit services, and solution for the bad debts. The official form of a credit policy is written guideline, which is comprehensive enough to avoid confusion and misunderstanding.

Based on the credit policy, the proper credit managing system is created to maintain the safety of the business and minimise the exposure to the customers' delinquency. The common process includes four basic steps: identifying, measuring, monitoring and controlling. The

Basel Committee also mentioned those principles as the standard approach for credit management.

In the “Principles for the Management of Credit Risk” (2000), the Basel Committee indicated: “Banks should identify and manage credit risk inherent in all products and activities”. This can prove that risk identification and analysis is the basis for a successful credit strategy. The management of credit risks require the cautious review of the both present and future risks as well as the deep understanding of products’ characteristic. For the traditional credit-granting activities, the credit risk management requires less complex procedures rather than the new-raising services (such as credit derivatives, asset securitization). Based on the typical features of credit contracts (for example credit quality, nature of investment, sources of payment), the level of risk can be assessed.

Besides the identification of credit risks, banks should always ascertain the current financial situation of their debtors to track the solvency. The update customers’ profile is critical not only for review but also for the recording of credit history. That information is sufficient in the future if the customers want to extend or apply for more loans.

5 Profitability and Indicators for commercial banks

Retained earnings is the key consideration for a bank’s competitive advantages and internal efficiency. In the past, a majority of the commercial banks’ profitability comes from the surplus of interests. However, due to the intense rivalry in the capital market, the structure of banks’ profitability has modified to adapt the non-traditional business activities such as derivatives or trading services. The new orientation signals the higher probability of risk exposure as well as the volatility of revenue and profit.

Changes in regulation of capital requirement and monetary policy also influence the investment portfolio of the commercial banks. In order to remain the liquidity, the commercial banks have adjusted their business from the highly involved capital activities to the lower capital commerce.

5.1 Analyzing commercial bank performance

The primary function of the commercial banks is finance and they lubricate and transfer the money flow in the society from the excess of income or the idle balance to the deficit spending. According to Timothy and Scott (2000, p.95), there are three peculiar features of the commercial banks, including:

- Low operational leverage: The focus area of the commercial banks is the monetary acceleration, most of their assets are floating and highly affected by the legislation.
- Unstable interest rate: because of the flexibility in the maturity of deposit, depositors have power to change or negotiate the new interest contract with the

banks. Coincidentally, the interest expenses of commercial banks are fluctuated in the long-term, which challenge the asset allocation and pricing.

- Low equity capital: Because the commercial banks utilize the available capital in the market to support the other business activities, the vast amount of their equity is borrowed capital, which leads to the high financial leverage and increases the volatility of income.

The financial information of banks is normally written under the balance sheet and income statement. The balance sheet is a comparison between the owned asset with the liabilities and it explains the source of capital supporting the business. The advantage of balance sheet is the ability to acknowledge bank manager the capacity and limitation of the bank. From the balance sheet, we can have more information about liquidity and the investment portfolio. The basic structure of a balance sheet is consist of three elements: assets, equity (owned and borrowed), and liabilities (long-term and short-term). Despite the functional advantages of the balance sheet, the limit of moment reporting prevents the bank manager from seeing the whole picture of the operation.

While the balance sheet is important to reveal the financial position of bank, the bank income statement gives an explanation to the profitability of the bank at a specific point of time. The revenue and expenses are two main elements of an income statement. For the commercial banks, the majority of revenue comes from interests and fees of loans. The expenses of the commercial banks are the sum of interest paid on the arrears, deposits, short term and long term debts. Additionally, the non-interest costs such as the salary, rental fees and other operating costs also contribute to the total expenses.

5.2 Indicators for commercial bank's performance

Profit is the ultimate indicator for a bank. The more profit a bank makes it means its policies and activities are working very well. Profitability usually measured by some financial ratios. The most used profitability indicators for financial institutions are Return on Equity (ROE) and Return on Assets (ROA).

ROE- The ratio indicates profitability by comparing the net income to average shareholder equity. The ROE ratio indicates how much the shareholders earned against their invested capital. The higher the ratio the better it is for the shareholder as they have earned more. In addition, ROE uses the retained earnings from the previous years and indicate the shareholders how efficiently the capital is reinvested. From the investor's view ROE is a profitability ratio to find the amount of money is being made by the investor's investment. It is also used as an indicator of how effectively management using the fund of the institution.

Generally, ROE is calculated for common shareholders. In that case, preferred dividends excluded from the calculation due to unavailability of profits to common stakeholders. Later on, preferred dividends were taken out from net income.

To find out the average beginning and ending equity, average common stockholder's equity is used.

Equation 10. Return on Equity

$$ROE = \frac{\text{Net Income}}{\text{Equity}}$$

ROA- The ratio shows, how profitable the bank and efficiency of bank management by dividing the net income produced by total assets to average total assets. In other words, ROA measures the efficiency of an institution to manage its assets within certain specific time.

Since, the objective for assets is to make revenues and profits, ROA helps both the investors and management to see how efficiently the institutions were converting their investments in assets into profits.

Equation 11. Return on Asset

$$ROA = \frac{\text{Net Income}}{\text{Total Asset}}$$

Source: Fuhrmann, 2014

ROA indicates generated earnings from invested capital. The higher the ROA percentage, the better. It means the bank is earning more money on less invested capital. Some investors may add interest expense back into net income while trying to find the ration, because they'd like to use operating returns before cost of borrowing.

5.3 Managing the profitable investment

A bank invests money or assets to earn profit. Nowadays of complex financial system it is very important for all banks to maintain their respective profitable investments. Usually bank needs to have some reserves before it starts to invest. Many people don't recognize, but there is a difference between loan and an investment of bank. A loan happens usually for shorter period of time on condition of repayment and it is being asked by the customer. By granting a loan, the bank creates credits and again it used as a temporary source for the bank. On the other hand, an investment is the outlay of funds for longer period without creating credits. A bank may invest in securities of governments or buy large stocks of big a company.

All the banks have their own investment policy. Both the small and big investments has their own risk parameters. However the objective is to earn high returns from investments by having proper safety and liquidity of its resources.

Bank investment activities consist of two distinct functions. Large banking organizations manage trading accounts in which they offer investment to other market participants. The aim is to take advantage of perceived changes in interest rates. All banks, regardless of size, also own marketable securities for their own portfolios and generate substantial interest income that supplements earnings from their loan portfolios. By Financial Accounting Standard-115 regulation (FASB, 1993) forces bank to classify investment securities either as a trading securities, held to maturity, or available for sale with each category subject to different accounting treatment. Held to maturity securities are valued at amortized cost, while all others must be reported at market values.

From 1965 through 1990 banks slowly reduced their security holdings as a fraction of assets. During the early 1990s with the recession and recent problem loan experience, banks added substantially to their security holdings at the expense of loans. Historically, commercial banks were the dominant investors in municipal securities. They also owned large amounts of U.S. treasury and agency securities. With the Tax Reform act of 1986 banks shifted the composition of investments more toward mortgage-backed and straight corporate securities. By year end 1998, federal agency securities including mortgage backed securities were the dominant instruments owned, followed by U.S. Treasuries. (Koch & Macdonald 2000, 765).

CAR and profitability: Many people doesn't realize the relation between CAR and profitability. The experts, regulators and the bankers have difference of opinion regarding the level of adequacy ratio. On one side, the regulators prefers more safety by having higher level of adequacy ratio, on the other hand bankers usually prefers to operate with lower adequacy level. CAR has significant impact on banks income. Smaller adequacy means banks will have much funds to invest, greater financial leverage and equity multiplier resulting in normal return from assets and higher returns on equity. Higher adequacy means banks will have less funds on their hand to invest resulting less income for the bank. Higher adequacy also works as a positive impact on investors for the banks. However there are many issues to consider before deciding the CAR. The bank must ensure that their CAR is adequate enough to absorb all unexpected losses and also there should be enough money for running their daily operations and future growth. There are several factors which influence the capital adequacy ratio of the banking system such as size liquidity, profitability, assets and management efficiency etc.

Size is also an important factor to consider. As profitability and loan capability increases with the size but capital adequacy decreases with size. That means, larger banks can afford to have smaller adequacy ratio and smaller bank needs bigger adequacy level in comparison.

Al-sbbagh (2004) researched on determinants of CAR in Jordanian commercial banks, his study reports, CAR was positively affected by assets, dividends, loan to asset ratio and risky asset ratio at the same time negatively affected by size of bank and loan provision ratio (Aspal, Nazneen, 2014)

6 Study case of Nordea

To elucidate the interaction between credit risk and profitability of the commercial banks, we employ the example of Nordea bank in the period of 14 years from 2000 to 2013.

6.1 Introduction to Nordea Bank

Nordea Nordic banks was founded from 1820s onwards and officially became one unit in 2001 after four major branches Sweden (Nordbanken), Finland (Merita Bank), Denmark (Unibank) and Norway (Christiania Bank or Kreditkasse) successfully merged (Nordea Bank). Nowadays, Nordea Group consists of more than 1400 offices over 19 countries in the world, specifically in the Nordic region. The group works as a financial institution, which provides a variety of services from household banking products (mortgage and consumer loans, credit and debit cards, to many types of insurance, risks hedging and additional banking services for both private and corporate customers. The Nordea Bank AB stock is noted in Stockholm, Helsinki and Copenhagen (Nordea Group, 2011). The parent company of Nordea Group, named Nordea Bank AB, is located in the capital city of Sweden. In the end of 2012, Nordea comprised of the greatest market share in Nordic market, with the customer number of around 11 million, and the total assets of € 677 (\$894) billion and Tier 1 capital of € 23.9 (\$38.7) billion. The good reputation and long term relationship with the customers made Nordea the largest asset manager of € 218 (\$288) billion.

Nordea is a joint stock company with the owners from the public sectors. Among those, Sampo Plc. and Swedish state are the biggest shareholders, comprising of 20.1% and 19.9%, respectively. Nordea bank is rated AA and the business profile is evaluated conservative (Nordea Group, 2011).

The key advantage of Nordea bank is the highly segmented customers, which allow the bank to deliver the different value and resource allocation based on the demands. The Nordea's target customers are divided into two groups: household customers and corporate customers. Nordea Group maintains the strategic direction towards the long term customer relationship, which defines its bank as the lifetime financial partner with the insight in customer's needs.

The market research and business analysis of Nordea always focus on customer's satisfaction and the specific products to approach customers' daily lives in a closer distance.

Nordea Group believes that attracting and retaining customer is the best strategy to remain the high income. In 2010, the total revenue was contributed by approximately 40% from household segment and 55% from corporate customers (Nordea Annual report, 2010).

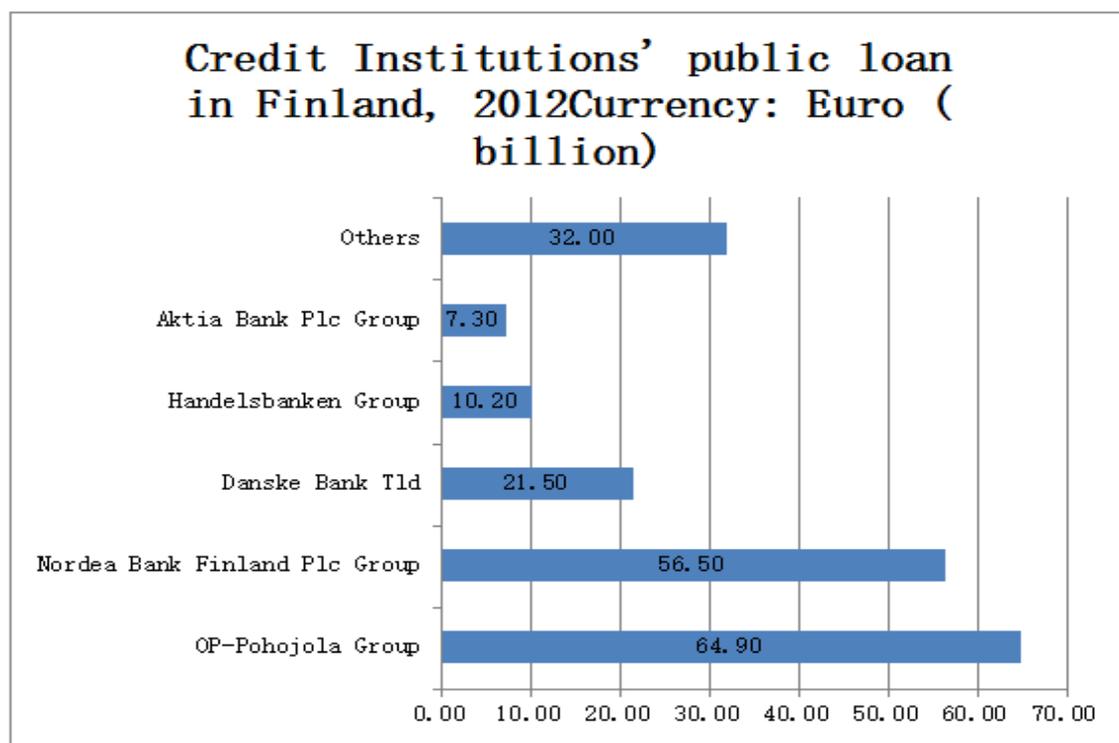
In order to increase the performance in household customer service, Nordea Group separates the business line into three sectors: Retail Banking, Wholesale Banking and Wealth

Management. In addition, Nordea banks provide the services in business unit Group Operations and Other Lines to specific-purpose customers.

In Finland particularly, Nordea Group is the second biggest credit institution after OP-Pohjola Group. In figure 10, Nordea bank in Finland made up 56, 5 billion, equivalent to 29, 4% of market share. Besides, Nordea Group hold approximately 30, 1% in the public deposit in Finnish market in 2012 (Federation of Finnish Financial Services). It can be concluded that Nordea has a huge impact on the Finnish financial system and positive reputation of trustworthiness for the Finnish customers.

In June 2007, the Nordic Financial Supervisor Authorities gave Nordea bank the permission to apply the Foundation Internal Rating Based approach (FIRB) on the corporate and institutional portfolios. FIRB is the calculating instrument for the risk parameter under the guideline of Basel Committee (Nordea annual report, 2007).

Figure 10. Finnish market share of public loan in 2012



Source: Federation of Finnish Financial Services

In the annual report 2013, Nordea bank defined its credit risk as the financial loss as the customers are unable to afford the agreed obligations and the reference securities could not cover the required compensation. The credit risks include the various factors, where lending

activities are the most common and guarantees or documentary credits also contribute to the potential loss.

6.2 Rating and scoring in Nordea bank

Generally, credit rating is used for corporate exposure and credit scoring is used for retail exposure. Nordea bank employ the ratings to measure the repayment capacity of the customers based on their one year probability of default. Nordea banks uses 18 grades rating scale from 6+ to 1- for non-defaulted customers and 3 grades from 0+ to 0- for defaulted customers.

Nordea uses different rating models to calculate the risk involved for customers with different repayment capacity. To develop different rating models, different methods have been used, for example, statistical methods, expert based methods, etc. Those methods are established from both quantitative and qualitative data.

Unlike the rating system, scoring models are purely based on statistical factors to predict probability of customer default in the retail sector. The retail scores comprise of 18 grades for non-defaulted customers ranging from A+ to F-, and three grades from 0+ to 0- for defaulted customers.

6.3 Quantitative test

In order to solve the research problem, we collect the data of net interest (NI), total asset, return on equity (ROE), and capital adequacy ratio (CAR) from Nordea bank annual reports in the period of 14 years. The data of return on asset (ROA) and non-performing loan ratio (NPLR) are calculated from other data (explained in the methodology).

The collected data is recorded in the table 10.

Table 10. Nordea bank from 2000 to 2013

Year	NI	Total Asset	ROA	ROE	NPLR	CAR
	EURm	EURb				
2000	1733.0	224.0	0.77%	16.10	0.55	9.4
2001	1568.0	242.0	0.65%	13.80	0.54	9.1
2002	887.0	250.0	0.35%	7.50	0.65	9.9
2003	1490.0	262.0	0.57%	12.30	0.64	9.3
2004	2078.0	280.1	0.74%	16.90	0.60	9.5
2005	2269.0	325.5	0.70%	18.00	0.33	9.2
2006	1036.0	346.9	0.30%	22.90	0.28	9.8

2007	1187.0	389.1	0.31%	19.70	0.19	10.9
2008	2672.0	474.1	0.56%	15.30	0.29	12.1
2009	2318.0	507.5	0.46%	11.30	0.62	13.4
2010	2663.0	580.8	0.46%	11.50	0.61	13.4
2011	2634.0	716.2	0.37%	10.60	0.55	13.4
2012	3069.0	668.2	0.46%	11.6	0.78	16.2
2013	3107.0	630.4	0.49%	11	0.74	18.2

Based on the guideline of BIS II, Nordea uses its own estimation approach, which is also called Internal Ratings-Based (IRB) Approach to capital requirements for credit risk. The bank ranked the credit risk the greatest exposure since 75% of the RWAs was accounted for credit risk (annual report, 2013).

The diluted and impaired exposure involves the constant monitor and quarterly update on the basis of current performance, business outlook, future debt service capacity and the possible need for provisions. Any contributive factor to the loss events is taken into account. If the full repayment is unlikely to be made within 90 days, the loan is considered to be non-performing impaired. The lost value is the difference between the book value of the outstanding exposure and the downgraded value of the future cash flow.

6.3.1 Correlation among NPLR, CAR, and ROE

Figure 11. Correlation between ROE&NPLR

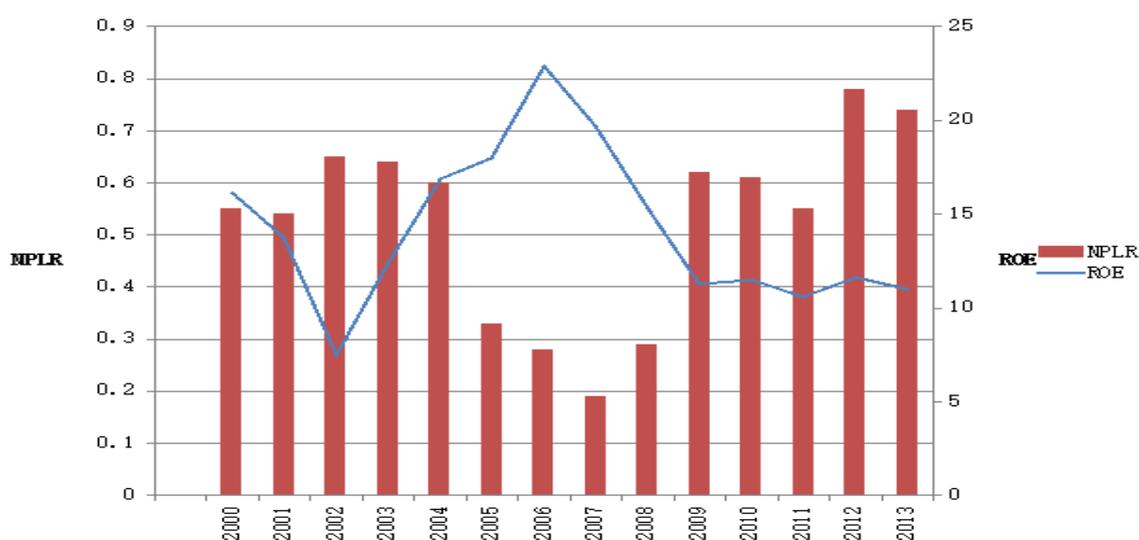
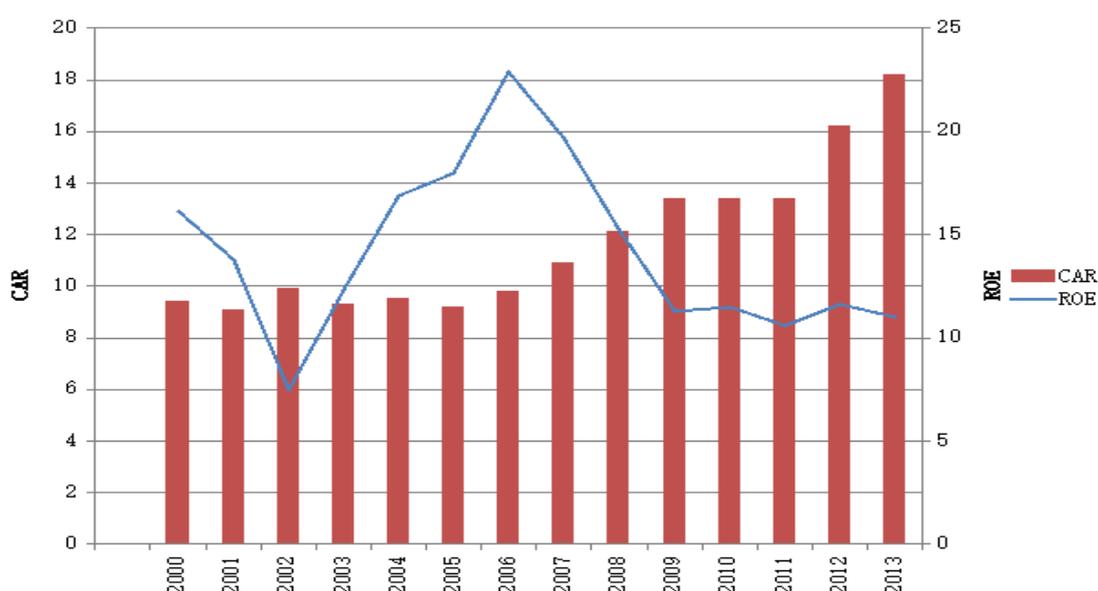


Figure 11 shows that Nordea bank had substantial decrease in NPLR by 65% from 2000 to 2007. However, from 2008, the ratio has the upward trend. Compared to the NPLR in 2008, the number in 2013 had a fourfold increase. Nordea attributed this dramatic raise to the negative effect of the migration in the portfolio. In 2013, the ratio of NPLR got improve slightly due to the positive condition in the shipping segment (Nordea annual report 2013).

Due to the economic downturn and the uncertainties on the equity market, the ROE ratio experienced a sharp decrease from 2006 to 2013 by more than 50%. Qualitatively, the drop in the value of ROE is contrast to the rapid increase of NPLR in the same period. Nordea's financial target is to obtain the ROE of 15% in a normalized interest rate environment and with a core tier 1 capital ratio of above 13% (Nordea annual report, 2012).

Figure 12. Correlation between ROE&CAR



Regarding the correlation between ROE and CAR of Nordea from 2000 to 2013, figure 12 presents a gradual increase in CAR and a noticeable reduction in ROE from 2006 to 2013. It can be asserted that qualitatively, for Nordea bank, CAR does not have significant effect on ROE despite the contrast tendencies. In general, the values of ROE of Nordea bank in the 14-year period remained higher than the minimum requirement of capital adequacy mentioned in the Basel Record.

To observe the correlation among NPLR, CAR, and ROE, we established the OLS regression test, for the equation $ROE = \alpha_1 + \beta_1 NPLR + \beta_2 CAR + \varepsilon_1$, using the data from 2000 to 2013.

Table 11. Coefficient and model summary for ROE

	<i>Coef.</i>	<i>P-value</i>
Intercept	24.786	0.000
NPLR	-16.921	0.005
CAR	-0.145	0.645

The coefficient of NPLR and CAR are both negative, showing that the two independent variables have negative impacts on the value of ROE. When CAR remains stable, one unit increase in NPLR reduces ROE by -16.921 units. Similarly, with the same value of NPLR, ROE will decrease by -0.145 unit if CAR increases by one unit.

Table 12. Regression test for ROE

<i>Regression Statistics</i>	
Multiple R	0.789
R Square	0.622
Adjusted R Square	0.553
Standard Error	2.791
Observations	14

R^2 of the regression shows the level of confidence of both NPLR and CAR in predicting the value of ROE. In table 12, the value of R^2 is 0.622, indicating the opportunity of 62.2% to forecast ROE from the independent variables. This result proves the significant relationship between credit risk and profitability of Nordea bank. However, adjusted R^2 provides a more reliable index for the model analysis. Besides, the value of significance F (0.05) is less than the standard value (0.1), assuring the stability of the correlation.

Table 13. ANOVA for ROE

ANOVA	df	F	Significance F
Regression	2	1.700189	0.227302
Residual	11		

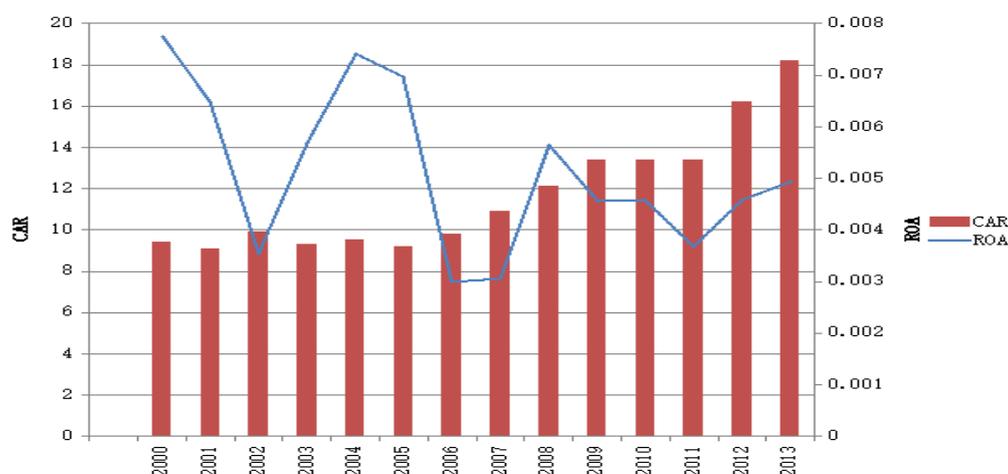
Total	13		
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The result of the regression provides p-value for CAR and NPLR of 0.645 and 0.005 respectively. Under the condition that the level of significance is 5%, the p-value of CAR is not strong enough to prove the stable correlation between CAR and ROE. Based on the significance of 0.645, CAR only can predict ROE with 35.5% probability. At the same period, the significance value of NPLR implies that it can predict ROE with 99.5% probability. Individually, NPLR has greater influence on ROE than CAR does. Although CAR has impact on ROE, the correlation is not stable during the researched period.

6.3.2 Correlation between NPPLR, CAR, and ROA

The economic in the Nordic countries is increasingly resilient with the increase in demand for the financial services. While the upward trend of the economy accelerates the consumption and investment, the regulatory framework has become more solid. The influences the restrict regulations drives the banks to the pressure on return on asset (ROA).

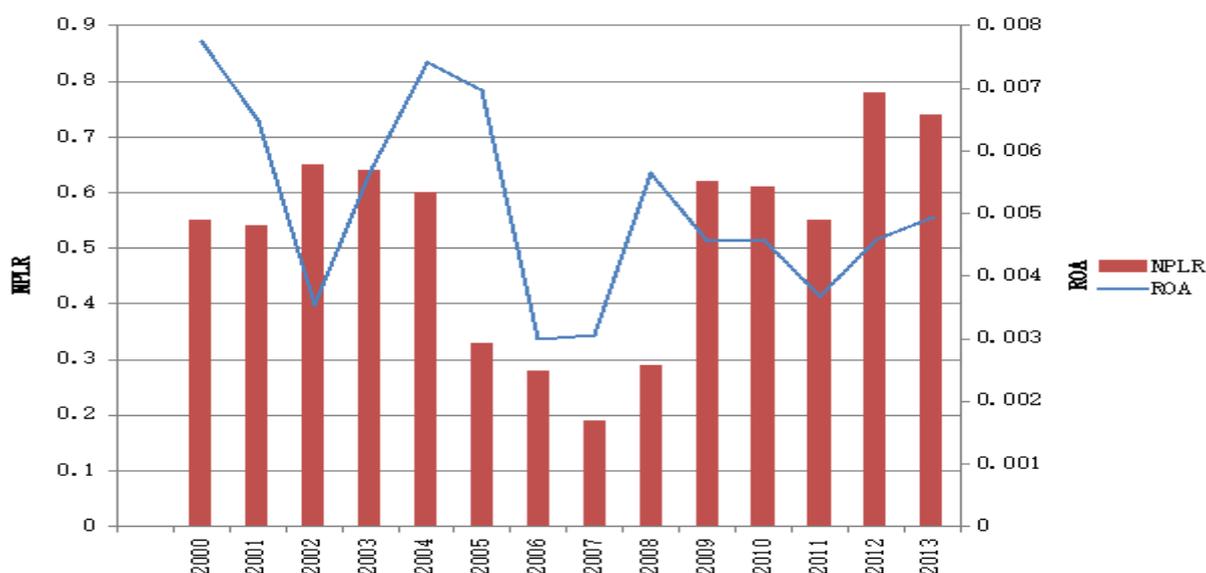
Figure 13. Correlation between ROA&CAR



During the period of 14 years, Nordea reached the highest records of ROA in 2000 and 2004 with 0.77% and 0.44%, respectively. Although Nordea bank experienced the fluctuated trend, in general, the ROA has a significant drop between 2000 and 2013 by 42.9%.

In figure 13, the value of CAR in 14 years was also fluctuated, but the general trend was gradual increase. Compare to the CAR in 2000, the CAR in 2013 inclined by 93.6%. Therefore, we can estimate that CAR has the negative effect on ROE of Nordea bank in the period of 14 years.

Figure 14. Correlation between ROA&NPLR



The examination of NPLR and ROA (figure 14) shows the notable interdependence of two analyzed factors. The trends of NPLR and ROA from 2000 to 2014 were unstable. For example, between 2002 and 2004, while the value of NPLR decreased slightly, ROA experienced the rapid growth. By contrast, from 2005 to 2006 when ROA dropped by approximately 57.14%, CAR also declined by 42.42%. We can estimate that the correlation between CAR and ROA are not significant.

In order to investigate the estimation from two graphs, we run the regression test on the equation $ROA = \alpha_2 + \beta_3 NPLR + \beta_4 CAR + \epsilon_2$, using the data from table 10.

Table 14. Coefficients and model summary for ROA

	<i>Coefficients</i>	<i>P-value</i>
Intercept	0.0067	0.0033
NPLR	0.0035	0.2089
CAR	-0.0003	0.1068

The examination of interdependence of credit risk and ROA returns the value of NPLR and CAR at 0.0035 and -0.0003, respectively. While the coefficient of CAR is marginal and negative, NPLR has positive scope of 0.0035. This finding is contrary to the previous study of Li and Zou (2009) that both CAR and NPLR have significant negative impact on ROE. Besides, our regression test with ROA as the dependent variable is not accordance with the results of other researchers. For example, the research of Ara, Bakaeva and Sun (2009) in SEB bank,

Sweden found the positive relationship between ROE and CAR (4.261); Million, Matewos, and Sujata (2013) showed the coefficient of CAR on ROA at 0,044624. However, the relationship between CAR and ROA is not stable in all the cases. In the research conducted by Kithinji (2010), based on the data of 43 commercial banks in Kenya from 2004 to 2008, the interconnection between CAR and ROA was not significant.

Table 15. Regression test for ROE

<i>Regression Statistics</i>	
Multiple R	0.486
R Square	0.236
Adjusted R Square	0.097
Standard Error	0.001
Observations	14

The value of R^2 is too marginal, showing that only 23.6% of ROA can be predicted from NPLR and CAR (table 15). Besides, the p-values of NPLR and CAR are higher than the level of significant (5%), which means the effect of those independent factors on ROA in Nordea bank from 2000 to 2014 were not significant enough (table 16). This correlation is even weak since significance F gets distant from the standard of 0.1

Table 16. ANOVA for ROA

<i>ANOVA</i>	<i>df</i>	<i>F</i>	<i>Significance F</i>
Regression	2	1.700189	0.227302
Residual	11		
Total	13		

In general, we found the insignificant relationship between the credit risk and ROA in case of Nordea bank. It cannot exclude that our selected independent variables are not sufficient enough to present the observed factors, which leads to the insignificant result.

7 Discussion and Conclusion

In general, credit risk has the negative effect on the bank's profitability. Since the main source of commercial banks' income is generated from lending activities, they are very

sensitive to risk exposure. The implementation of the credit assessment tools becomes the core factor in the decision making process for the loan applicants. By using the report of credit score and credit rating, bank managers can evaluate the risk level associated with the lending. In addition, the availability of the modern credit derivative contracts allows the both involved parties, even the third parties, to exchange and reduce the default risk while diversifying their investment portfolio.

The functions of credit derivatives are limited to credit insurance since the diversification of credit portfolio. Nowadays, banks can utilize credit derivative products for securitization, hedging risk, or making profit from derivative contracts. As a result, banks may play different roles in the contracts, due to their specific purposes. Firstly, as the owners of assets, they can act as the originators of the underlying exposures. Secondly, banks can create and control the securitizations from the assets of other organizations. Finally, they can invest in their own credit risks in their trading activities. (Nordea Group, 2011)

The new requirement in minimum capital adequacy was introduced in Basel II and implemented in Nordea bank from 2007 (Nordea annual report, 2007). In comparison with Basel I, the three pillars of Basel II proposed a supplementary instrument to risk-weighted requirements. The research from Senior Supervisors Group, March 2008 has proven the influences of risk-weighted capital ratios and leverage ratios on the liquidity of banks. Therefore, the combination of two capital ratios improve the strategic management of banks and improve the financial security. However, the implementation of Basel II also raised the concern of excessively large amount of capital resources (Philipp, 2008).

Table 17. Influence of Basel II on coefficient

Coefficient	2000- 2006		2007-2013	
	ROA	ROE	ROA	ROE
NPLR	0.0025	-27.0984	-0.0003	-17.9202
CAR	-0.0048	-0.9620	0.0001	0.4758
R-square	0.6146	0.6961	0.1390	0.8120
Significance F	0.1485	0.0924	0.7413	0.0924

In case of Nordea bank, table 17 have confirmed the different impacts of NPLR and CAR on the performance. We can see that before the enforcement of Basel II, for every unit increase in NPLR, there is a 27.0984 unit decrease in the predicted ROE, keeping the other variable CAR constant. On the other hand, after the introduction of Basel II, for one unit increase in

NPLR, there is a 17.9202 unit decrease in the predicted ROE. Table 18 implies that the variable NPLR is statistically significant as P-values for this coefficient (0.039 and 0, 05 before and after, respectively).

The notable change is the difference between CAR coefficients before and after the implementation of Basel II. While CAR has negative influences on both ROA and ROE from 2000 to 2006, in the next period, this trend turns into positive. However, the P-value of CAR in all the cases are not really significant (all is greater than 0.05, table 18), indicating the unreliability of the result.

Regarding the value of R^2 , while the new regulation strengthens the effect of NPLR and CAR on ROE (from 0.6961 to 0.8120), it decreases the predictable proportion of ROA (from 0.6164 to 0.1390).

Table 18. Influence of Basel II on P-value

P-value	2000- 2006		2007-2013	
	NPLR	CAR	NPLR	CAR
ROA	0.557	0.071	0.942	0.661
ROE	0.039	0.840	0.050	0.456

In table 18, the outputs show P-values of NPLR and CAR for ROA escalate after the Basel II, the value of CAR for ROE drop remarkably. Thus, the new application weakened the dependence of ROA on credit risk while ROE get more sensitive to the risk exposure.

Compare to other previous findings, our test was the only one which returned the positive NPLR coefficient on ROA. It is interesting that none of previous researchers in the similar topic gain the same result as we do, and all of their publication confirmed the negative effect of NPLR on ROA and ROE. For example, Fan and Yijun (2014); Million, Matewos and Sujata (2013); Indiael and Dickson (2013) examined the quantitative correlation between credit risk and profitability of commercial banks in various countries and concluded the negative relation between NPLR and ROA.

To explain, in the research on the non-performing loan, Yixin and David suggested the threshold regression technique developed by Dagenals (1969). Threshold regression techniques are used to address the question whether regression functions are identical across all observations in a sample or fall into discrete classes (Yixin & David, 2007). The research focused on the countries in three regions Asia, Western Europe, and Eastern Europe. Yixin revealed that when banks had the NPLR less than the determined threshold, the coefficient of

NPLR on the performance could be positive and banks were encouraged to increase their lending. Applying the result of his test on our study, the positive NPLR explains the values of NPLR are less than the affordable NPLR and Nordea bank should expand the loan portfolio.

In our study, we mainly focus on the credit risk analysis and profitability management. To illustrate the correlation between those factors, we calculate the impact of NPLR and CAR on ROA and ROE. From the quantitative analysis, we find that in Nordea bank during the chosen period, while NPLR and CAR can predict ROE with the confidence of 62, 2%, this data for ROA comprise only 23.6%. Additionally, it has witnessed that the influences of two credit risk indicators on the profitability are unstable, and not significant in case of ROA of Nordea bank. We assume that our chosen independent factors are not sufficient enough to present the dependent ones. That means Nordea bank should have more reliable predictors for their performance rather than NPLR and CAR.

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