The Impact of Credit Risk Management on Profitability of Commercial Banks:

A Study of Europe

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ABSTRACT

Banks today are the largest financial institutions around the world, with branches and subsidiaries throughout everyone’s life. However, commercial banks are facing risks when they are operating. Credit risk is one of the most significant risks that banks face, considering that granting credit is one of the main sources of income in commercial banks. Therefore, the management of the risk related to that credit affects the profitability of the banks. The aim of the research is to provide stakeholders with accurate information regarding the credit risk management of commercial banks with its impact on profitability.

The main purpose of the research is to investigate if there is a relationship between credit risk management and profitability of commercial banks in Europe. We also aim to investigate if the relationship is stable or fluctuating. In the research model, ROE and ROA are defined as proxies of profitability while NPLR and CAR are defined as proxies of credit risk management. The research collects data from the largest 47 commercial banks in Europe from 2007 to 2012 and formulates four hypotheses which are related to the research question. A series of statistical tests are performed in order to test if the relationship exists. Other statistical tests are performed to investigate if the relationship is stable or not.

The findings reveal that credit risk management does have positive effects on profitability of commercial banks. Between the two proxies of credit risk management, NPLR has a significant effect on the both ROE and ROA while CAR has an insignificant effect on both ROE and ROA. However, from 2007 to 2012, the relationships between all the proxies are not stable but fluctuating.

Key words: Credit risk management, Profitability, Commercial banks, CAR, NPLR, ROA, ROE
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Thank you!
Umeå, May 21st

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## ABBREVIATIONS

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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>BCBS</td>
<td>Basel Committee on Banking Supervision</td>
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<td>CAR</td>
<td>Capital Adequacy Ratio</td>
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<tr>
<td>Coef.</td>
<td>Coefficient</td>
</tr>
<tr>
<td>IFRS</td>
<td>International Financial Reporting Standards</td>
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<tr>
<td>IRB</td>
<td>Internal Rating-based</td>
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<tr>
<td>LNTA</td>
<td>Natural Log of Total Assets</td>
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<td>NPL</td>
<td>Non-performing Loan</td>
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<tr>
<td>NPLR</td>
<td>Non-performing Loan Ratio</td>
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<tr>
<td>P-value</td>
<td>Probability Value</td>
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<td>ROA</td>
<td>Return on Assets</td>
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<td>ROE</td>
<td>Return on Equity</td>
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<td>ROC</td>
<td>Return on Capital</td>
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<td>RWA</td>
<td>Risk-Weighted-Assets</td>
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Chapter 1 Introduction

In this chapter, we provide the reader with an introduction to our research area. It starts with problem background, which presents how we select the research topic, the previous research and subsequently guides the reader to the research questions. In the following we will present with our research purpose, contribution & limitations and choice of and the chapter will end with the disposition of the research.

1.1 Problem Background

Banks today are the largest financial institutions around the world, with branches and subsidiaries throughout everyone’s life. There are plenty of differentiations between types of banks. And much of this differentiation rests in the products and services that banks offer (Howells & Bain, 2008, p.34). For instance, commercial banks hold deposits, bundling them together as loans, operating payments mechanism, etc.

Commercial banking in virtually all countries has been subject to a great deal of regulations (Hull, 2012, p.22). One of the regulations is the minimum capital commercial banks must keep absorbing loss if unexpected things happen. This kind of capital requirement is, in particular, conducted by Basel Committee which aims to enhance the key supervisory issue and improve the quality of banking supervision (Bis.org, 2014). In 1974, some disruptions took place in the international financial markets. West Germany’s Federal Banking Supervisory Office withdrew Bankhaus Herstatt’s banking license after finding that the bank’s foreign exchange exposures amounted to three times its capital. As a consequence, banks outside Germany took heavy losses on their unsettled trades with Herstatt. In the same year, the Franklin National Bank of New York also closed its door after racking up huge foreign exchange losses (Bis.org, 2014). All of these things contributed to the debacle of financial market which led to the Basel Committee on Banking Regulations and Supervisory Practices by central bank governors of the G10 countries.

Latin American debt crisis burst in early 1980’s. Mexico's bank indebtedness expanded almost 230% over the six-year period from 1976 to 1982, Brazil's 160%, Venezuela's obligations spurted 330%, Argentina's by a monstrous 550% and Chile's 850% (Wessel, 1984, p.5). This has attracted the attention of Basel Committee, and the capital adequacy soon became the main focus of its activities. In December 1987, the capital measurement system called Basel Accord was approved by the G10 governors and came into effort in 1988 (Bis.org, 2014). The Basel Accord (Basel I) mainly focused on credit risk and called for a minimum capital ratio of capital to risk-weighted assets of 8% to be implemented by the end of 1992 (Bis.org, 2014). In January 1996, an amendment of Basel 1 was issued with incorporation of a capital
requirement for the market risks. Later in time, Basel committee was still endeavoring
to make the Basel Accord more completed and up-to-date (Bis.org, 2014). So they
released a new capital adequacy framework called Basel II in June 2004. This
framework contained three pillars which we would like to discuss in later chapters.
However, the 2007 financial crisis made the Basel committee realized that Basel II
seems not enough in the complicated financial markets. A major overhaul of Basel II
was necessary. The banking sector had entered the crisis with too much leverage and
inadequate liquidity buffers (Bis.org, 2014). These defects were accompanied by poor
governance and risk management, as well as inappropriate incentive structures. The
combination of these factors was manifest in the mispricing of credit and liquidity risk,
and excess credit growth (Bis.org, 2014). Therefore, a new standard Basel III was
published in December 2010 and will be fully effective by the end of 2019. It
strengthened the Basel II framework and made some innovations, including tightened
definition of capital, requirements for leverage ratio and a countercyclical buffer, the
capital for liquidity risk and counterparty credit risk as the derivatives had gained
their population in 20th century.

Credit risk is one of significant risks of banks by the nature of their activities.
Through effective management of credit risk exposure banks not only support the
viability and profitability of their own business but also contribute to systemic
stability and to an efficient allocation of capital in the economy (Psillaki, Tsolas, and
Margaritis, 2010, p.873). “The default of a small number of customers may result in a
very large loss for the bank” (Gestel & Baesems, 2008, p. 24). It has been identified
by Basel Committee as a main source of risk in the early stage of Basel Accord.
Credit risk is a risk of borrower default, which happens when the counterpart fails to
pay on time. There can be many reasons for default. One of the most common ones is
the obligor is in a financially stressed situation (Gestel & Baesems, 2008, p. 23-24).
Besides, if a borrower with high credit quality has deteriorated profile, it can also
cause credit risk loss to the banks (Gestel & Baesems, 2008, p. 23-24). Banks invest
in debt of those customers (Gestel & Baesems, 2008, p. 23-24). The price of debt sold
might be lower than the price as the bank bought debt (Gestel & Baesems, 2008, p.
23-24). This makes a net loss of banks. However, the loss from the default of the bank
does not have to be great (Gestel & Baesems, 2008, p. 23-24). It depends on the
percent of recover from obligor and total exposure of banks (Gestel & Baesems, 2008,
p. 23-24). And a good risk management tries to avoid high exposure on risk (Gestel &
Baesems, 2008, p. 23-24). Although the regulations have been evolutionarily
developed, the three Basel Accords all have placed explicitly the onus on banks to
adopt sound internal credit risk management practices to assess their capital adequacy
requirement.

The strength of the banking industry is an important prerequisite to ensure the
stability and growth of economy (Halling & Hayden, 2006, p.48). As a consequence,
the assessment of banks’ financial condition is a fundamental goal for regulators
(Halling & Hayden, 2006, p.48). Besides, Tabari, Ahmadi and Emami (2013) have
mentioned “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. This parameter helps the banks to tolerate some level of risk and support them against short-term problems.”

The profitability of banks is influenced by different factors including management, size, location and time according to a study conducted by Haslem (1968). And it is of great interest to see how the profitability is affected by the risks faced by commercial banks. There have been lots of researchers devoted into this topic. For example, Bourke (1989) found there exists a positive relationship between liquidity and profitability of banks in 12 European, Northern American and Australian countries while Molyneux & Thornton (1992) in their study found the two variables are negatively related. Berger in 1995 in his empirical study surprisingly reported that for U.S. banks in the 1980s, there was a strong positive relationship between capital-assets ratio and profitability under the condition he considered the relationship should be negative. Several latest researchers have also dug into these topics, Ara, Bakaeva and Sun (2009) have found the positive relationship between credit risk management and profitability of commercial banks in Sweden. Kolapo, Ayeni and Oke (2012) showed that credit risk management is positively related to profitability of banks in Nigeria. Kithinji (2010) assessed the effect of credit risk management on the profitability of commercial banks in Kenya and found that banks’ profitability is not affected by credit risk management. When it comes to both credit risk and liquidity risk, Ruziqa (2013) has tested the impact of credit risk and liquidity risk on the financial performance of conventional banks in Indonesia. The results illustrated that credit risk was negatively related to profitability while liquidity risk demonstrated a positive effect. These kinds of researches show that no exact final conclusion could be drawn until now and thus make this area worth studying.

Many forces of change have influenced the competitive environment in European banking industry. Especially when the adoption of Second Banking Co-ordination Directive of 1992 as part of the single European market project which removed institutional obstacles for banks to operate in foreign countries in EU, the establishment of Economic and Monetary Union and the introduction of the single currency also had affected the banking industry (Bikker, 1999, p.2). Large and transparent euro capital markets are emerging. Domestic banks take the advantage for bonds and equity from the crumble trade activities for the loss of national currencies with euro (Bikker, 1999, p.2). And fund management has no longer been reserved mainly for the local financial institutions (Bikker, 1999, p.2). This international integration and national deregulation have boosted competition in the Europe. The adoption of the euro began in the early 1990s with the signing of the Maastricht Treaty (Startfor, 2010). Once the European countries such as Spain, Portugal, Italy and Greece joined the Eurozone, their cost of borrowing has been reduced due to the implied guarantee that their debt would be as solid as Germany’s government debt (Startfor, 2010). It indicates that those countries can access to credit with lower rate than the rate based on their own economies (Startfor, 2010). However, this creates
some housing bubbles in the Europe, especially in Spain and Ireland, which lead to the relatively high level of private-sector indebtedness (Startfor, 2010). And this exposure to credit bubbles cause Europe vulnerable to the financial crisis, Swedish, Italian, Austrian and Greek banking systems have expanded into the new markets in Central and Eastern Europe, and the financial centers of France, Germany, Switzerland, Netherlands and United Kingdom dabbled in the derivatives markets (Startfor, 2010). One particular case of German is the low profit margin generated by highly fragmented banking system of more than 2000 banks (Startfor, 2010). In this research, we mainly focus on commercial banks in Europe.

1.2 Research question

Among other risks faced by banks, credit risk plays an important role on banks’ financial performance since a large chunk of banks’ revenue accrues from loans from which interest margin is derived (Kolapo, Ayeni & Oke, 2012, p.31). Based on the information we have studied in the previous part, we have realized that it is of great interest to study the relationship between credit risk management and profitability of commercial banks. And there is no research that could clearly explain the relationship of credit risk management and profitability of commercial banks. Another factor leads us to the topic is that research in the Europe, as a complicated and stable financial market, has not been developed until now.

In order to acquire the knowledge of impact of credit risk management and profitability of commercial banks, we made the following research question:

What is the relationship between the credit risk management and profitability of commercial banks in Europe from 2007 to 2012?

1.3 Research Purpose

The main purpose of the research is to analyze how the credit risk management will influence the profitability of commercial banks in Europe. To analyze the effect, we need to find whether the relationship of those two variables exists or not firstly. The major issue is the indicators of credit risk management and profitability. We will use capital adequacy ratio (CAR) and non-performing loan ratio (NPLR) as variables to represent credit risk management and ROE and ROA as variables to measure the profitability of commercial banks. When we have found if the relationship truly exists, the next step will be to investigate whether the relationship is positive or negative. Finally, we will test the stability over time of such relationship to find whether the relationship is fluctuating or stable. This kind of test will be conducted on sub-periods in the chosen time horizon. This will help us to go deep into the research area and could lead to further research topics in the future.
1.4 Research Gap and Contribution

As we have described before, banks’ strength plays an important role in the stability and growth of economy. And the stability of banks depends on the profitability and capital adequacy (Tabari et al., 2013, p.1624). A thorough study of previous research relating the profitability of banks has made us aware of the lacking conclusion of relationship between credit risk management and profitability of commercial banks. Most of researchers have focused on one or several countries and showed different results. However, no researcher has put the research in Europe. Therefore, we have found the existence of research gap and devote our effort to conduct a research on it.

For a theoretical contribution, our study will fill the research gap on the influence of credit risk management to the profitability in commercial banks. And under the condition that derivative market now is getting increasing popularity. Banks are using diversified derivatives (futures, options, and swaps) to hedge counterparty default risks (Jones & Pérignon, 2013, p. 373). Consequently, we can provide more comprehensive knowledge to the readers. Another contribution will be that this research will supply the foundation for other researchers who wish to dig into further study of such area, for example, is the geographic variable an influential factor related to the stability of the relationship?

From a practical perspective, the information provided in this research will offer a guideline for bank managers, investors and bank supervisors, depending on the outcome of our research. Bank managers could pay more attention to improve banks’ performance by managing the credit risk banks face. Banks thus can better arrange and allocate their resource regarding the position of credit risks. Besides, private investors can have a more comprehensive outlook of how the profitability will be affected. By evaluating the risk management from the risk report that banks provide, they may have more resources on decision making according to the empirical result of our research. Last but not least, bank supervisors will be provided more evidence for the impact of credit risk management and to investigate if it is necessary to deregulate or impose further regulation. If the result indicates that no relationship exists, the contribution could be that there is no need for other researchers to make effort into this area or more influential factors should be considered to produce more significant relationship.

1.5 Limitations

Our study intends to focus the 50 largest commercial banks in Europe. Thus, the small and medium size commercial banks will not be included in our study. Besides, large banks could have mixed activities from commercial banking and investment banking, e.g. the main risks faced by commercial banks and investment banks are not usually identical. For instance, from our academic experience, credit risk is the largest risk for
commercial banks while market risk and credit risk are important to investment banks. The difference between concentrations of risks might make our study biased.

Secondly, in order to collect enough data to make generalization, we have chosen the time horizon from 2007 to 2012, which covers the 2007 financial crisis. In this case, we do not take into account the impact of financial crisis could have on the result of our studies, which might cause bias to the estimates.

1.6 Choice of subject

Deciding to research the finance area is unproblematic for us, since both of us have strong interest and knowledge foundation in this area. But finding a suitable topic in this comprehensive area is not that much easy. However, when we have finished the D-level financial management courses in Umeå University, the two courses “financial statement analysis and security valuation” and “risk management” have attracted us so much. So we decided to choose a topic that could combine the knowledge from the two courses.

The second motivation for us to decide on this topic is that although our major is finance, we have also taken several courses in accounting. “Financial statement analysis and security valuation” is one of them. And choosing a research topic from the overlapping area of finance and accounting is of great attractiveness. From the topic, we will strengthen our knowledge of finance and deepen knowledge of accounting.

Considering both of us have working experience in commercial banks and want to start our careers in financial institutions in Europe, we prefer to have an in-depth understanding of banks in Europe. That is another reason we focus our research on commercial banks in Europe. In addition, lacking a precise conclusion of this area contributes to the final decision on the topic.

1.7 Disposition

Chapter 1: introduction
In the section, we have provided a brief introduction to our research topic. It includes the problem background which introduces general knowledge according to our research topic and previous research for a better understanding to the readers. We also present our research question and purpose with the analysis of the contribution and limitation. In the last is the reason for the choice of subject and chapter layout.

Chapter 2: Theoretical methodology
This chapter we will describe and motivate our research process and method of collecting and analyzing data. We aim to provide a description for readers to have
critical review and understand the methodological choice. In the end of this chapter, we provide a brief summary of theoretical methodology and a discussion the societal and ethical considerations for this study.

Chapter 3: Theoretical framework
This section involves the previous research studies and relevant theories which provide readers deeper understanding to this thesis. We mainly review theories from three areas: regulation, profitability and credit risk management of banking industries. Key indicators (ROE, ROA, CAR and NPLR) and theories in our research will be defined hence it will be feasible for readers to eliminate the obstacle of reading.

Chapter 4: Practical methodology
In this chapter, we present our practical research methodology in a statistical manner. We discuss more information of the data, including the sample, population as well as time horizon. Then we introduce detailed methods of data collection and explain the hypothesis according to the research questions. Finally, we introduce the main concepts of statistical tests such as variables, multivariate regression analysis, R square, multicollinearity and heteroskedasticity.

Chapter 5: Empirical findings
This chapter shows the result from the last chapter from two perspectives. We firstly present all descriptive statistics of variables and illustrate the distribution of sample banks according to total assets and countries. Then we present the regression result of all statistical tests and find the feature of these results.

Chapter 6: Analysis & Quality criteria
In this part, we explain our findings based on the results from previous chapter. We analyze the results from both significant and insignificant meaning of indicator’s relationships. Then we also discuss the stability of these relationships. This analysis will link to the theoretical framework, previous research and quality criteria.

Chapter 7: Conclusion & Further research
This chapter is the conclusion for the entire research. The first part of this chapter is the general review and main results for the whole research. We discuss the quality of the research from reliability and validity perspectives. Then we present both the theoretical and practical contribution of this study and suggestions for further research.
Chapter 2 Methodology of the Research

The second chapter describes the methodological considerations, which is the guideline of our research. In the beginning of the chapter preconceptions and perspective are presented to give readers a deepened view of our research. Next, the writers’ belief of the construction of knowledge and an explanation of the structure of the research are presented. After that we will describe our data source and ethical and legal considerations will be the end of this chapter.

2.1 Preconceptions

The preconception will greatly affect the method applied during the procedure of finding the results. Based on our personal interests and previous experience, we are keener on working with numbers, and think that it is the way to produce results with reduced bias. All the data referred to the study are factual numbers recorded on the authoritative database or official annual report. They are collected without any artificial tamper, and the analysis of these data is processed by computer software. Therefore, we minimize the influence of bias and strictly obey the critical rules. Besides, during the period of this research, our supervisor and colleagues provide valuable feedback and impartial opinions, which help us enhance the quality of this work. Thirdly, after four years university studies, we have taken courses such as Statistics, Business Administration, Economics and law. Thus, our knowledge background of business and finance will also affect our choice and decision on the research topic, methods and the way we interpret the findings.

2.2 Perspectives

The choice of perspectives should be decided before researchers start their actual research of a certain topic. Normally, the perspective determines to whom the research will target at. In this research, we intend to adopt the perspective from bank managers. This will guide the whole report and especially the theories in literature review part. In addition, as we have mentioned before, this research broadens the subject to private investors and supervisors. The increasing credit risk management and complex financial market have put the investors, bank managers and supervisors under a continuous strain. And our study will give all of them a conclusive view of the relationship between credit risk management and profitability of commercial banks.

2.3 Scientific Approach

Before researchers start doing their research, they need to consider the scientific
approach that they are using when conducting a research. Before the choice of data collection techniques and analysis, there are some other important aspects need to be taken into consideration (Saunders et al., 2009, p. 106). All the aspects are summarized in Figure 1. We will explain each aspect of our research choices in following parts.

**Figure 1** The possible research layout

### 2.4 Research philosophy

Research philosophy relates to the development of knowledge and the nature of that knowledge (Saunders et al., 2009, p. 107-109). That is to say, it contains the assumptions about the way researchers view the world. These assumptions will underpin the research strategy and the chosen methods as part of that strategy. Specifically, it will influence the particular view of relationship between knowledge and the process by which it is developed (Saunders et al., 2009, p. 107-109). There are two major ways of thinking about research philosophy: epistemology and ontology.
2.4.1 Epistemology

According to Bryman and Bell, epistemological consideration refers to the issue of what is (or should be) regarded as acceptable knowledge in a discipline (Bryman & Bell, 2011, p. 15). It concerns with how people could understand the world and communicate this as knowledge to fellow human beings (Burrell and Morgan, 1979, p.1). Crorry (1998) explained like this: "how we know what we know". Two positions are associated with this consideration: positivism and interpretivism.

Positivists always try to build knowledge of a reality that exists beyond the human mind. They hence support the idea that the objective reality is a reflection of human's experience of the world. The independent reality should be the foundation of human knowledge (Weber, 2004, p.4). Therefore, Bryman and Bell indicate positivism is one of an epistemological position which advocates the application of the methods of the natural sciences to the study of social reality. “But the term stretches beyond this principle, though the constituent elements vary between authors” (Bryman & Bell, 2011, p.15). Positivism is also taken to include other principles. For example, one of the principles is the principle of phenomenalism which demonstrates that only phenomena confirmed by the sense can actually be guaranteed as knowledge (Bryman & Bell, 2011, p.15). In addition, the principle of deductivism rises the purpose of theory is to generate hypotheses which can be tested and thereby allow explanation of rules assessed. And another principle, inductivism, means knowledge is arrived at through gathering facts, which provide the basis for the principle (Bryman & Bell, 2011, p.15). Based on the above discussion, the verification of positivism could either go through analysis of those matters which are able to be internal verified (e.g. mathematical equations), or through the gathering of data of those things which cannot be verified from their own terms (Crotty, 1998, p. 25).

On the contrast, interpretivism is an alternative epistemological position. Interpretivists intentionally build knowledge and the knowledge they build should reflect their particular goals, culture, experience, history, that is, persons' lived experience (Weber, 2004, p.3&4). Consequently, interpretivism advocates respecting the difference between individuals and the objects of the natural science (Bryman & Bell, 2011, p. 17). Therefore, it requires the social scientist to grasp the subjective meaning of social action (Bryman & Bell, 2011, p. 17). It assumes that researchers cannot study the human world in a way that positivists prefer to use (use hard science methods to pursue their investigations) (Brand, 2009, p.433). This means the social scientists need to understand the differences between humans in their role as social actors. And it emphasizes the variety of conducting research among individuals rather than objects like trucks and computers. “We interpret our social roles in accordance with the meaning we give to these roles.”(Saunders et al., 2009, p. 116). Hence interpretivist philosophy requires researchers to enter the social world of their research subjects and understand others’ points of view (Saunders et al., 2009, p. 116). That is to say, interpretivism is concerned with understanding on an individual level.
Consequently, our epistemological position is positivistic. The positivism focuses on the explanation of social reality, and interpretivism concentrates on the understanding of the subjective meaning of social actions. According to our research question, we aim on finding the relationship between the credit risk management and profitability rather than how the relationship is. The results we are pursuing are not how the relationship is but if the relationship exists. It is the procedure of applying scientific method to study social reality. And the study is independent from the difference of individual’s subjective opinions. So the mind of generating hypothesis, testing through statistical program and generating the explanation of laws matches the concept of positivism position. Moreover, the interpretivism emphasizes the individuals rather than objects. Nevertheless, our research is a study of objects, not individuals. The study topic mentioned management concept, but the study is undertaken through objective financial ratio valuation and statistical test. From this perspective, our research is not interpretivism, but positivism.

2.4.2 Ontology

Ontology is concerned with nature of social entity (Saunders et al., 2009, p. 110). It raises questions of the assumptions that researchers have about the way the world operates and the commitment held to particular views (Saunders et al., 2009, p. 110). Specifically, it concerns whether social entities can be considered as objective and thus have a reality external to social actors or whether they should be considered as a social construction which is built up from perceptions and actions of social actors (Bryman and Bell, 2007, p. 22). This leads to the two positions of ontology: objectivism and constructivism (subjectivism).

Objectivism, according to Bryman and Bell (2007, p.22), “is an ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors. It implies that social phenomena and categories that we use in everyday discourse have an existence that is independent or separate from actors.” Therefore, the focus of objectivism would be to find the causes and effects of social phenomena. Besides, researchers holding objectivistic view believe that studies can be done independently of what is being observed (Holden & Lynch, 2004, p.403). Their interests, values and beliefs will have no influence on what they study or what methods they use (Holden & Lynch, 2004, p.403). They strongly argue that they made their research choice and methodological choice objectively. In other words, the researcher is able to put aside his own set of interests, values, and skills (Holden & Lynch, 2004, p.403).

In contrast to objectivism, constructionism “is an ontological position which asserts that social phenomena and their meanings are continually being accomplished by
social actors. It implies that social phenomena and categories are not only produced through social interaction but that they are in a constant state of revision.” (Bryman and Bell, 2007, p.23). Saunders et al. (2009) also explain that in constructionism, social phenomena are created from consequent actions of social actors. Hence, causes and effects are not the concentration of constructionism but the inheritance, meaning and interaction behind the social phenomena. In addition, the choice of what to study, and how to study it are driven by researchers’ own interests, beliefs, skills, and values (Holden & Lynch, 2004, p.403). This is because individuals will perceive distinctive situations in various ways as a consequence of their own view of the reality. These different interpretations may in turn affect their social interaction with others.

One example from Saunders et al. (2009, p.111) and Smircich (1983) clearly demonstrate the differences between two positions: Objectivists view the culture of an organization as something that the organization “has” while the subjectivist’s view would be that the culture of organization is something that “is” a result of a process of continuing social enactment. Objectivists are treating organization culture as a variable that can be manipulated and changed in order to produce a state desired by managers. The subjectivist’s viewpoint is that culture is inherited through a complex array of phenomena which includes many social interactions and physical factors such as office layout, rituals and myths.

In our research, we tend to examine the causes and effects of social phenomena; therefore we stand on the side of objectivism. We consider profitability as something that bank “has” and it is something that independently exists in the world, can be observed, categorized and measured. Therefore, we want to measure how it could be determined by credit risk management but not the point that how it is inherited from social factors’ interaction. Thus, we choose objectivism as our ontological standing point.

2.5 Research Approach

When conducting a research it is necessary to determine which approach is being implemented, because “scientific inquiry in practice typically involves alternating between deduction and induction. Both methods involve interplay of logic and observation. And both are routes to the construction of social theories” (Babbie, 2010, p.53).

Research can be done in a deductive way in order to answer questions brought out by theoretical considerations (Bryman & Bell, 2011, p.11). Alternatively, theory can be viewed as something that occurs after the collection and analysis of data related to a project (Bryman & Bell, 2011, p.11). Deductive approach is the theory, and the hypotheses deduced from it come first and drive the process of gathering data (Bryman & Bell, 2011, p.11). While in inductive stance, theory is the outcome of research (Bryman & Bell, 2011, p.13). The essential differences between deductive
The choice of research approach is important when deciding the research design. It enables us to make more learnt decision about research design, which is more than just the techniques by which data are collected and procedures by which they are analyzed (Saunders et al., 2009, p. 126). It is the overall configuration of research question about what type of subject is gathered, from where and how to interpret it in order to provide an answer to the initial questions (Saunders et al., 2009, p. 126). Additionally, it may help researcheres to think about whether research strategy will work or not. For example, if researcher is interested in understanding the reason behind happening things rather than being able to describe one event, it may be more appropriate to take inductive approach rather than deductive approach (Saunders et al., 2009, p. 126). Knowledge of different research traditions allows researchers to adapt their research design to meet constraints, because there may be limited in gathering data or lacking prior knowledge of certain subject (Saunders et al., 2009, p. 126). Researcheres may not be in a position to frame a hypothesis if they do not have sufficient understanding of the topic to do it (Saunders et al., 2009, p. 126).

Deductive approach requires us develop hypothesis (Saunders et al., 2009, p. 125). In our research, we wish to study the relationship between credit risk management and
profitability in commercial banks in Europe. Therefore, we generate a hypothesis which states there is a certain relationship between credit risk management and profitability. To test this hypothesis, we plan to collect financial ratios (ROE, ROA, NPLR and CAR) of the largest 50 banks in Europe from their annual reports. This approach reflects a deductive stance. Besides, deduction indicates the researcher should be independent of what is being observed (Saunders et al., 2009, p. 125). Our research only involves quantitative data based on our collection. Hence, we are independent of what we observed and the way we gather data is objective. Another additional significant characteristic of deductive approach is it enables facts to be measured quantitatively (Saunders et al., 2009, p. 125). Obviously, in our research, we use purely quantitative data which is explicit and clear defined. The final characteristic of deduction according to Saunders is generalization which means to generate statistical results it is necessary to select sample in a sufficient numerical size (Saunders et al., 2009, p. 125). Our research is intended to be based on the largest 50 banks in Europe. We believe these banks are more representative because they are large enough to influence the economy and dominate market in the banking industry. Certainly, a giant number of small and median commercial banks would also influence the market in European Union but the data for them are usually difficult to get. Especially in our study, we cover the time span from 2007 to 2012 and most of the small and median banks lack annual report before 2009. Thus we involve large banks which have more resources to cover this absence. Therefore, our research approach is consistent with deductive approach.

In the inductive approach, researchers are in a purpose to feel what is going on (Saunders et al., 2009, p. 126). They tend to have a better understanding with the nature of the problem (Saunders et al., 2009, p. 126). Mostly, the researchers need to collect interview data. And by analyzing those data the result is to formulate the theory (Saunders et al., 2009, p. 126). Theory follows data rather than vice versa as our research. However, the way that we collect data is not through interview as we talked before (Saunders et al., 2009, p. 126). In addition, inductive approach focuses on small sample of subjects but our study involves 6 years’ 50 banks’ ratios which is relatively larger than the inductive requirement. So that inductive approach does not match our research. Our research approach should be a deductive approach.

2.6 Research Design

Many research designs could be used to study business problems (Hair et. al., 2011, p. 147). Depending on the way in which researchers ask their research questions and present their purpose, the research design could be classified into three groups, namely exploratory, descriptive and explanatory studies (Saunders et al., 2009, p. 138 & 139).

According to Hair et. al., exploratory study is performed when the researcher has little information. This accords with Ghauri and Grønhaug (2005, p.58) who state: “When
the research problem is badly understood, a (more or less) exploratory research design is adequate.” It is particularly useful if you wish to clarify your understanding of a problem, such as if you are unsure of the precise nature of the problem (Saunders et al., 2009, p. 139). Therefore, exploratory research must be flexible and adaptable to change. That is to say, researchers are willing to change their direction as a result of new data that appear and new insights that occur to them (Saunders et al., 2009, p. 140). A number of researchers have claimed that the exploratory approach leads to new and useful theories. But there is also the danger that the research will produce false leads or useless theories (Armstrong, 1970, p.2). Bobbie (2004) in another way states that the major shortcoming of this research design is that it seldom provides satisfactory answers to the research question.

As to the descriptive studies, they are designed to obtain data that describe the characteristics of the topic of interest in the research (Hair et al., 2011, p.148). The objective of descriptive study is to represent an accurate profile of persons, events or situations (Robson, 2002, cited in Saunders et al., p. 140). In descriptive research, the research problem is structured and well understood (Ghauri and Grønhaug, 2005, p. 58). Saunders et al. (2007) expanded the idea like “it is necessary to have a clear picture of the phenomena on which you wish to collect data prior to the collection of data.” Compared with exploratory study, descriptive study would give the readers a comforting answer addressed to the research question. In other words, it is used for testing hypothesis (Hair et al., 2011, p.149).

The last category is explanatory study (Saunders et al., 2009, p. 140) or in some books called “causal research design” (Hair et al., 2011, p.147). In this research, the problems are well structured as in descriptive studies. In contrast to descriptive studies, the researcher is facing with “causes-and-effects” problems. The main task is to separate such causes and to say to what extent do they lead to such effects (Ghauri and Grønhaug, 2005, p. 59). In other words, it is to explain the causal relationship between variables (Saunders et al., 2009, p. 140).

Based on the study of three research designs and the purpose of our research, we decide that the explanatory study is the most suitable for our topic. Even though our research starts with the description about credit risk management and profitability of commercial banks, our ultimate goal is to test if the relationship exists and how the credit risk management could impact on profitability of commercial banks. That is to say, the aim is to find causes and effects mentioned in Ghauri and Grønhaug (2005). Hence, we consider explanatory study as our research design.

2.7 Research Strategy

Research strategy includes experiment, survey, case study, action research, grounded theory, ethnography and archival research. These research strategies are inherently equally superior to each other and should not be considered as mutually exclusive
The importance of research strategy is whether it will enable researchers to answer their research questions and meet their objectives. This means the choice of research strategy will be guided by research questions and objectives (Saunders et al., 2009, p. 141). Also the extent of existing knowledge, the amount of time and other resources have the influence on determining research strategy (Saunders et al., 2009, p. 141).

- Experiment focuses on the study of causal links whether a change in one independent variable produces a change in another dependent variable (Saunders et al., 2009, p. 142). The simplest experiments concern whether the link exists between two variables (Saunders et al., 2009, p. 142). More complex experiments also concern the size of the change and the relative significance of two or more independent variables (Saunders et al., 2009, p. 142). It is a form of research that owes much to the natural science (Saunders et al., 2009, p. 142).

- Survey strategy is usually linked with deductive approach (Saunders et al., 2009, p. 144). It is a popular and common strategy in business and management research (Saunders et al., 2009, p. 144). And it allows the collection of a large amount of data from a sizeable population in a highly economical way (Saunders et al., 2009, p. 144). It often obtained by using a questionnaire administered to a sample; these data are standardized that allow easy comparison (Saunders et al., 2009, p. 144).

- Case study is an empirical in depth research about an individual, family, group or organization and is mostly used when “how” and “why” questions are asked (Fridlund, 1997, p.3). It is mainly used to explain those causal links in real-life interventions that are too complex for other research strategies (Fridlund, 1997, p.3). Case study is most often used in explanatory and exploratory research (Saunders et al., 2009, p. 146). And the data collection method may be various and are likely to be used in combination (Saunders et al., 2009, p. 146). Cases involved in this strategy can be a unique case or multiple cases. Alternatively, case study can regard an organization as a unit or investigate a number of logical sub-units within the organization (Saunders et al., 2009, p. 146).

- Action research focuses on the research, which means it is the research "in" action rather than the research "about" action. For example, “the research is concerned with the resolution of organization issues such as the implication of change together with those who experience the issues directly.” (Saunders et al., 2009, p. 147). It emphasizes the involvement of practitioners in research while the researcher also needs to be part of the organization where the research is taking place. And the process of action research has iterative nature (Saunders et al., 2009, p. 147).

- Glaser and Strauss (1967, p.1) have defined grounded theory as “the discovery of theory from data systematically obtained from social research”. It major aim is to generate or discover a theory (Glaser and Strauss, 1967, p.8).
is collected without the formation of an initial theoretical framework (Saunders et al., 2009, p. 149). Then these data lead to a generation of prediction which will be tested by further observations (Saunders et al., 2009, p. 149). It is particular helpful to predict and explain behavior, the emphasis being upon developing and building theory (Saunders et al., 2009, p. 149).

- Ethnography is a research strategy which derives from the field of anthropology (Saunders et al., 2009, p. 149). It is rooted firmly in the inductive approach (Saunders et al., 2009, p. 149). The purpose of this strategy is to describe and explain the social world the research subjects inhabit in the way in which they would describe and explain it (Saunders et al., 2009, p. 149). It is a strategy which is time consuming because the researchers need to immerse themselves in the social world being researched as completely as possible (Saunders et al., 2009, p. 149).

- Archival research is a research that uses archives as the source of data (Saunders et al., 2009, p. 150). For many social scientists, using archives might be relatively unexciting compared to employ fieldwork which is fresh and vibrant (Lewis et. al., 2004, p. 21). Original source materials may be discussed and analyzed to ask new questions of old data (Lewis et. al., 2004, p. 21). It provides a comparison over time or among geographic areas to verify or challenge existing findings (Lewis et. al., 2004, p. 21). Or the researchers draw together evidence from different sources in order to provide a bigger picture (Lewis et. al., 2004, p. 21). Actually, archival research enables the social scientist to both enhance and challenge the established methods of defining and collecting data (Lewis et. al., 2004, p. 21).

Our research should be archival strategy which involves the data from administrative records. The data are collected from the annual report of each bank, one type of documentary secondary data. So we consider that archival strategy is more appropriate for our study. Other research strategies we introduced have clear distinctions from our research. Specifically, we do not insert survey research but collect data directly from annual report in our study. Even though we aim on the valuation of credit risk management in the study, only ratios are used as indicators to measure the performance of risk management. Action strategy focuses management research such as resolution of organizational issues while our research purpose is testing the existence of relationship between credit risk management and profitability. Action strategy is too excessive to be adopted in this research. Besides, action strategy emphasizes the involvement of researcher as a practitioner in the organization. But we are actually “outsiders” of these banks so that action research should not be taken here. And ethnography fits better for inductive research not in deduction approach as our study.

Compared with archival strategy, experiment strategy owes much to the natural sciences which is not our concern (Saunders et al., 2009, p. 142). The classic experiment strategy involves two groups which will have exactly the same relevance
to the research. One of them will be defined as experimental group and the alternative one is control group (Saunders et al., 2009, p. 142). Some form of planned intervention or manipulation will be made to experimental group and research measure the change before and after the manipulation (Saunders et al., 2009, p. 142). This process is not similar with what we plan. The experimental and control group are not set in this research, neither the intervention nor manipulation. Hence experiment strategy is unsuitable for us.

We focus our subject on European area, but this is not a case study strategy. Case study emphasizes on one unit or limited variables to gain rich understanding of the context in the research (Morris & Wood, 1991, p. 79). However, our study relates to 50 banks with 4 financial ratios in 6 years which contents more observations weight against case study. This research is not focused on deep understanding to one specific case thus case study is inappropriate. Moreover, the data in our research will be only used once and without further test. To this extent, our research strategy is not grounded theory.

2.8 Time horizon

Time horizon is another vital factor that should not be neglected when researchers are planning their work. Depending on whether researchers want to take their research at a particular time or to be a representation of events over a certain period, Saunders et al. (2005) have given two categories, namely cross-sectional studies and longitudinal studies.

Cross-sectional studies concern with a particular phenomenon (or phenomena) at a particular time (Saunders et al., 2009, p. 155). These studies often take the survey strategy and may also use qualitative method (Easterby-Smith et al. 2008; Robson 2002, cited in Saunders et al., 2009, p. 155). As to longitudinal studies, they represent a distinct form of research design that is typically used to map change in business and management research over a given period (Bryman & Bell, 2007, p. 60). That is to say, data need to be collected in at least two periods for the same variables on the same people or organizations. Therefore, time and cost are consuming to some extent (Bryman & Bell, 2007, p. 60 & 61).

Although our main research question is to find if there exists a relationship between credit risk management and profitability of commercial banks, we still aim to explore if the relationship is stable or fluctuating over different sub-periods. Hence, we also examine the change of relationship over year 2007 to 2012. Considering that the longitudinal studies examine the change and development over a given period, it leaves no doubt that we should conclude our research follows longitudinal studies.
2.9 Research Method

Research method can be distinguished into quantitative and qualitative research. According to Bryman & Bell (2007, p.28), quantitative research emphasizes quantification of the data collection and analysis. Usually, quantitative research conducts a deductive approach to the relationship between theory and research which focus on testing of theory (Bryman & Bell, 2011, p. 28). It combines practices and norm of the natural scientific model in positivism position and embodies a view of social reality as an external, objective reality. (Bryman & Bell, 2011, p. 28)

On the contrary, qualitative research emphasizes the words rather than quantification with data. It prefers conducting an inductive approach to the relationship between theory and research which aims on the generation of theories (Bryman & Bell, 2011, p. 27). Qualitative research rejects the combination of practice and norms of natural science model (Bryman & Bell, 2011, p. 27). It emphasizes the interpretivism option which refers to the way that individuals interpret the social world (Bryman & Bell, 2011, p. 27). And it embodies the view of social reality as a constantly changing property of individual’s creation (Bryman & Bell, 2011, p. 27).

In our research, we have selected the deductive approach which means what we focus is testing a theory rather than generate theory. In order to test the hypothesis, we collect data of four indicators (ROE, ROA, NPLR and CAR) which are described in a numerical way. The data are collected directly from annual report of target banks with largest total assets in Europe. Other methods of data collection such as using questionnaire or interview are not involved into this study. As a result, the quantitative data and statistical analysis maintain the objective conception in a study of social reality. Therefore, quantitative research is more appropriate for this topic.

2.10 Literature and Data source

Literature and data source are the base for a research. The literature sources will help researchers to develop a good understanding of previous research and can be divided into three categories: primary, secondary and tertiary (Saunders et al., 2009, p. 68).

Saunders et al. (2009, p.67) has explained in his book “Primary literature sources are the first occurrence of a piece of work.” They include published sources such as reports, some central and local government publications such as White Papers and planning documents, unpublished manuscript sources such as letters, memos and committee minutes. Secondary literature sources are the subsequent publication of primary literature. They include therefore books and journals. Tertiary literature sources are also referred to “search tools” and include indexes and abstracts as well as encyclopedias and bibliographies. They are utilized either to help to locate primary and secondary literature or to introduce a topic.
In our research, we mainly use secondary sources including scientific articles from journals, books from Umeå University library and data obtained from financial reports. The scientific articles are searched and collected from databases Emerald and Business Source Premier (EBSCO) and Web of Science which are available at Umeå University Library. The key words we have used for searching are credit risk, credit risk management, NPLR, CAR, ROE, ROA, profitability, commercial banks, Basel Committee, Basel I, Basel II and Europe. In order to make our research scientific, we have used only peer-reviewed articles from social and science journals.

For the data we need to collect, we have downloaded all the annual reports and risk reports (some banks may have their risk reports inside their annual reports) for those commercial banks we have chosen from year 2007 to 2012, which was a time-consuming and effort-consuming work. We then have calculated ratio of ROE, ROA, CAR and NPLR from the numbers we picked up from financial reports and made our own “database”.

The majority of the articles used are peer-previewed and published in reputable journals, which provide a high quality of credibility of our research. However, what cannot be neglected is that the authors of the scientific articles might influence the content of their work by their own perception of the subjects they are studying. This could have a negative effect on the objectivity. To avoid such potential problem, this research strives to keep an objective side of the information with authors’ endeavor. As to the statistical part, the data used to test the hypotheses comes from financial reports of commercial banks. The content and transparency of those reports are governed by standardized regulations, including IFRS and Basel Accords, which mean a strong evidence of credibility of their reports as secondary sources.

2.11 Summary of theoretical Methodology
2.12 Societal and Ethical Considerations

The consideration of issues of ethics within business has provided an interesting and potentially important stream of organizational research in recent years (Crane, 1999, p.237). According to Saunders et al. (2009), “ethical refers to the appropriateness of your behavior in relation to the rights of those who become the subject of your work, or are affected by it.” Considering our research will be based on quantitative method, it is likely to involve less ethical concerns in comparison with qualitative research (Saunders et al., 2009, p.202).

According to Diener & Crandall (1978), there are four main areas of ethical principles: whether there is harm to participants, whether there is a lack of informed consent, whether there is an invasion of privacy and whether deception is involved. Since the purpose is to study the relationship between credit risk management and profitability of commercial banks, our research should include no individual participants. Therefore, the problem of harming participants and deception do not exist. As we have explained before, the data will be collected from annual reports published on
websites for calculating NPLR, CAR, ROE and ROA. All the data sources are publicly available; hence there is no problem about invasion of privacy and lack of informed consent.

Other ethical considerations when doing a research include data collection, processing and protection, reciprocity and trust, affiliation and conflicts of interest (Bryman and Bell, 2007, p. 142-146). Our data is obtained only for thesis purpose and will be processed lawfully and fairly. The data are collected accurately and fully that we avoid exercising subjective selectivity and will be no missing data. All the data are collected transparently from reports of banks and we will not make up any information from reports and databases. To maintain the objectivity, we will keep honesty in reporting and analysis the result of our data to keep them statistically accurate. In addition, for the data storage our research does not violate the relative laws and regulations. (Data Protection Act in 1998) Besides no participants in our research means there will not be a problem of reciprocity and trust. Since we are not in receipt of any funding, the problem of affiliation and conflicts of interest will not exist as well.

Except for ethical aspects, societal issues should also be taken into consideration. This is about the societal effects that a research might have on the society and economy. Although our research is conducted from bank managers’ perspective, other stakeholders (investors and supervisors) could also benefit from it. It aims to deepen the knowledge of credit risk management regarding the profitability of banks, which in a way will lead to a better overall management of banks, an improved profitability and a more thorough regulation. The strength of banks is an important factor of stability of financial market and economy.

Besides, investors are vulnerable to asymmetric information that is the main source of investment risks. Our research contributes to the transparency of banking industry since it aims at the disclosure of certain kind of relationship between credit risk management and profitability. It provides information to the outsiders for references when they arrange their investment portfolios thus benefit the safety of their investment. These outsiders might include various individuals working within different industries as a crucial part of society. And enhancing protection to these individuals’ benefit or wealth will benefit the solidity of society.

Additionally, the results of our research indicate the efficiency of credit risk management of banks in Europe to its profitability. Banks’ managers can adjust their management strategy according to the relationship observed in our study. The adjustment improves the efficiency of internal management which also might drive up returns to bank. Advanced profitability of banking industry contributes to the wealth accumulation of society. And the prosperity in banking industry inspires new exploitation of tools and techniques which make incentives to the development of society.
Chapter 3 Theoretical Framework

This chapter lays the foundation of our research. Readers will be presented with the relevant theories of our research and framework that lead to the development of the hypotheses in the next chapter. The chapter will start with a brief review of development of banking regulations. Thereafter, profitability of banks will be discussed, which then followed with the credit risk management of banks. These different concepts and discussion will then be used to frame our final research model.

3.1 Regulations: The Evolving Basel Accord

Banks involve businesses of taking and managing risks. The management of banking risks has become more important to financial stability and economic growth in modern economies (Ferguson, 2003, p. 395). And under the condition that Latin American debt crisis has hit the economy heavily, the Basel Committee, backed by the G10 Governors, “resolved to halt the erosion of capital standards in their banking systems and to work towards greater convergence in the measurement of capital adequacy. This resulted in a broad consensus on a weighted approach to the measurement of risk, both on and off banks’ balance sheets” (BCBS, 2013, p.2).

3.1.1 Basel I: The Basel Capital Accord

On December 1987, a capital measurement system which referred to the Basel Capital Accord (or the 1988 Accord) was approved by the G10 Governors and later released to banks in July 1988 (BCBS, 2013, p. 2). The Accord has two fundamental roles. The first one is the promotion of soundness and stability of the international banking system by encouraging international banking organizations to improve their capital positions. And the second one is to provide fairness for competitions among banks (Patricia, 1999, p. 1). It was signed by all 12 members of Basel Committee and paved the way for a significant increase in the resources banks devote to measure and managing risks (Hull, 2012, p. 258).

The Accord required a minimum capital ratio of capital to risk-weighted assets of 8% to be implemented by the end of 1992 (Ferguson, 2003, p. 396). More specifically, in order to determine the bank’s risk-weighted assets, different types of assets are weighted according to the level of perceived risks that each type of asset presents, and each off-balance-sheet exposure must be calculated to its equivalent amount of assets and weighted as that type of asset must be weighted (Ferguson, 2003, p. 396). In this Basel Accord, the risk-weighted-assets concern only with credit risk and addressed other risks only implicitly (Ferguson, 2003, p. 396). Another important issue related to the capital itself. The capital had two components, Tier 1 capital and Tier 2 capital. The participants agreed to global capital standards: Tier 1 capital was to be applied to
all international banks equally and Tier 2 capital was to be tailored to each country’s unique domestic banking system (Maurice, 2004, p. 22).

However, the Accord has been criticized by its simplicity and to some extent arbitrary (Ferguson, 2003, p. 396). For example, it has only assigned four risk weights to different asset categories. That is to say, loans that are assigned same risk weighted could have different credit qualities (Ferguson, 2003, p. 396). For example, all loans by a bank to a corporation have a risk weight of 100% and require the same amount of capital. A loan to an AAA credit rating corporation should need the same amount of regulatory capital as the loan to a BB credit rating corporation. This kind of limited differentiation indicated that the calculated capital ratios could be uninformative and may provide misleading information about bank’s true capital adequacy (Ferguson, 2003, p. 396). Moreover, the limited differentiation has created incentives for banks to get into arbitrage activities and take advantage by selling, securitizing risky assets (Ferguson, 2003, p. 396 & 397). Banks therefore can otherwise avoid exposures for which required capital is higher than the market requires and pursues those for which the capital requirement is lower than the market would apply to those assets (Ferguson, 2003, p. 396 & 397). As a result, some banks can hold too little capital for their risky assets even though they have met the 8% risk-weighted-assets requirement.

3.1.2 1996 Amendment

In order to address risks other than credit risk, which is the main focus of Basel I (Basel Accord), the Basel committee issued a consultative document to amend the Basel Accord. This became known as the “1996 Amendment”, which should be taken effect at least at the end of 1997 (BCBS, 2013, p.2). The amendment involves keeping capital for the market risks associated with trading activities including foreign exchange, traded debt securities, equities, commodities and options (Hull, 2012, p.265). An important aspect of this amendment is that banks are allowed to use internal value-at-risk models as a basis to calculate the capital they need to keep to absorb losses resulted from market risks, subject to both strict quantitative and qualitative standards (BCBS, 2013, p.3).

3.1.3 Basel II

There have been significant developments in the theory and practice of measuring and managing risks since the implementation of Basel I. A lot of new financial instruments, such as credit derivatives, have improved banks’ ability to control and mitigate risks from trading activities (Lind, 2005, p. 23&24). Besides, there has been a rapid development towards larger and more complex banking groups with broader operations, from a global perspective (Lind, 2005, p. 23&24). Thus, a thoroughly revised framework for capital requirements was necessary. A new framework for bank capital was introduced in 2004 and should be implemented in 2007 and applied
to “internationally active” banks. The Basel II is built on three pillars:

1. Minimum Capital requirement
2. Supervisory Review
3. Market Discipline

Pillar 1 addresses the minimum capital requirement, that is, the rule which a bank calculates its regulatory capital. The minimum required capital ratio (8%) remained unchanged under Basel II while the way to calculate the risk-weighted-assets has been changed. (Figure 4) Specifically, Basel II made extensive changes to the treatment of credit risk. It specified three approaches to measure the credit risk: the standardized approach for banks that are not sophisticated which is similar to Basel 1 but containing more risk weights, the internal ratings based (IRB) approach meaning the risk weights and the capital requirements are partly based on the individual bank’s internal estimates, the advanced IRB approach which an even larger part of the capital requirements is influenced by the banks’ own calculations (Ferguson, 2003, p. 398; Lind, 2005, p.27&28).

![Figure 4 Calculation of capital ratio under Basel II](image)

Source: Ferguson, 2003, p. 398

As to the Pillar 2 of Basel II, it concerns with the supervisory review process and has been a supplement to the minimum capital requirement. Therefore, it requires a regular interaction between banks and supervisors in the assessment and planning of capital adequacy (Lind, 2005, p.30). The last pillar seeks to complement these activities through a stronger market discipline by disclosure of bank’s key information of risk assessment procedures and capital adequacy (Ferguson, 2003, p. 398). This, to some extent, could enable market participants to assess the bank’s risk profile and level of capitalization.
3.1.4 Basel III

The lesson from the financial crisis which began in 2007 has reminded regulators of the existence of moral hazard and forbearance in bank regulation (Feess & Hege, 2012, p.1043). Many banks failed during the crisis while many others, including some of the largest banks in the world, only survived by the substantive government “bailout” (Feess & Hege, 2012, p.1043). As a result, the Basel Committee realized that the prudential regulation of banks has come under renewed scrutiny and a major overhaul of Basel II was on the call. This led to the new Basel III Accord with enormously stricter capital requirements and new rules.

The Basel III framework imposes tighter capital ratios and new criteria, but majorly follows the direction adopted by the Basel II Accord. However, the capital requirements became more accurate which subject to the true credit risk afforded by each individual bank asset (Feess & Hege, 2012, p.1044). According to Hull (2012), the final version of Basel III was published in 2009 and there are six parts in the regulations:

1. Capital definition and requirements
2. Capital conservation buffer
3. Countercyclical buffer
4. Leverage ratio
5. Liquidity ratio
6. Counterparty credit risk

The crisis demonstrated that credit losses and write-downs come out of retained earnings, which is part of banks’ tangible common equity base (BCBS, 2011, p.2). Besides, the inconsistency in the definition of capital across jurisdictions and the lack of disclosure that could have enabled the market to fully assess and compare the quality of capital between institutions are other aspects that need to be considered during the crisis (BCBS, 2011, p.2). Therefore, the new Basel Accord requires that a bank's total capital should consist of Tier 1 equity capital (at least 4.5% of risk-weighted-assets at all times), additional Tier 1 capital and Tier 2 capital. Tier 1 capital includes share capital and retained earnings but does not include goodwill or deferred tax assets (Hull, 2012, p. 290). The additional tier 1 capital then consists of non-cumulative preferred stocks which are previously tier 1 capital but are not common equity. Tier 2 capital includes debt that is subordinated to depositors with an original maturity of five years (Hull, 2012, p. 290).

Capital conservation buffer is designed to ensure that banks build up capital buffers outside periods of stress which can be used to absorb losses when things happen (BCBS, 2011, p.54). Countercyclical buffer aims to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate (BCBS, 2011, p.57). In addition, Basel III requires a non-risk based leverage ratio that
is designed to act as a credible supplementary measure to the risk based capital requirements (BCBS, 2011, p.61). Another major improvement of Basel III is that it introduces a global liquidity standard including two liquidity ratios that are designed to make sure banks can have sufficient high quality liquid resources to survive under acute stress scenarios. The two ratios are Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFL) (BCBS, 2011, p.9). The last part of Basel III is the CVA, which is the expected loss due to the possibility of a default by the counterparty. Then the reported profit is reduced by the total of the CVAs for all counterparties (Hull, 2012, p.295).

In the years before the Basle Accord, large banks in major countries seemed to hold insufficient capital relative to the risks they were taking, especially in light of the aggressive competition for market share in the international market (Federal Reserve Release, 2002). According to the description of Basel Regulations, the development has showed an important role of credit risk management in the banks' operations. A measure of credit risk in most banks that major in commercial lending and related activities became the foundation of the Basle Accord. Therefore, capitals to absorb risks are one of the most essential parts that banks need to consider. To harmonize the different levels of approaches to capital among countries, capital ratios are introduced to demonstrate the strength of the risk management. As a consequence, the inspiration of the vital role of capital ratio has led us to use indicators to measure the strength of credit risk management, which lays the foundation of our research.

3.2 Profitability of Commercial Bank

Profitability is an indicator of banks’ capacity to carry risk and/or increase their capital. It indicates banks’ competitiveness and measures the quality of management (Waifem, p. 16). Profitability is one of the key concepts in our research. This is due to the topic of this research is about the relationship between the profitability and credit risk management. Clear explanation to the profitability of commercial banks is crucial for readers to understand the research procedure and meanings. In this section, we will involve a specific discussion of profitability and two indicators (ROE and ROA) of profitability in our research.

The determinants of commercial banks' profitability can be concluded into two categories, namely those that are management controllable (internal determinants) and those are beyond the control of management (external determinants) (Guru et.al, 1999, p.3; Kosmidou et.al, 2005, p.3). The internal determinants reflect upon banks' management policy and decision concerning sources and uses of funds management, capital and liquidity management and expenses management (Guru et.al, 1999, p.3). This kind of profitability factors can be examined by financial statements of commercial banks (Guru et.al, 1999, p.3). The external factors are environment factors and firm-specific ones (Guru et.al, 1999, p.4). This research mainly focuses on the analysis of internal determinants because our purpose is to test the impact of credit
risk management to firm’s profitability. The determinants reflected upon credit risk management should be included into internal policy and decisions which can be examined by financial statements. On the other hand, bank’s decisions are also affected by external regulation, thus this research also involves the consideration of external factors.

In addition, we use ratios as indicators to represent the profitability of banks. Guru et al. (1999, p.7) indicate the advantages of using ratios. They mention that researchers prefer to use ratios as measurement of profitability since they are inflation invariant so that they will not be affected by changes in price level. Besides, banks are multi-products firms and use ratio measures to eliminate problems associated with cross-subsidization between products and services (Chirwa, 2003, p.567). However, it is crucial to find the appropriate indicators to maintain the accuracy of our test. Due to this problem, we consider DuPont system which has been widely recognized as an efficient tool in the financial analysis literature.

3.2.1 DuPont Model

Dr. Almazari (2012, p.86) measures the financial performance of Jordanian Arab commercial banks by using the DuPont model which is based on analysis of return on equity model (ROE). Almazari (2012, p. 86) introduces that DuPont model was created in the early 1990s but is still useful for assessment of the profitability. The original DuPont method was developed in 1918 by an engineer at DuPont who notice that the product of two common computed ratios, net profit margin and total assets turnover, equals return on assets (ROA). And DuPont method has been widely used for financial analysis due to the elegance of ROA being affected by a profitability measure and efficiency measure (Alimazari, 2012, p.86). In 1970s, the concentration in financial analysis shifted from return on asset (ROA) to return on equity (ROE) (Alimazari, 2012, p.86). Based on this fact, we consider using this model for seeking the appropriate indicators of profitability of commercial banks in Europe.

According to Saunders & Marcia (2011) as well as Rudra (2009), a ROE model for financial institutions based on DuPont system is presented in the following.
As Figure 5 indicates, ROE is firstly decomposed into ROA and equity multiplier (assets/equity). And ROA is decomposed into net profit margin and total asset turnover. The profit margin allows the financial analysts to measure the income statement. And total assets turnover provides financial analysts a measure to evaluate the “assets” (left-hand side) of the balance sheet. And equity multiplier presents the evaluation of the “liabilities and owners’ equity” (right hand side) of the balance sheet (Alimazari, 2012, p. 89). Analysts can project the level of financial structure of financial institutions based on this system (Alimazari, 2012, p. 88). Therefore, DuPont system can provide financial analysts an efficient evaluation by decomposing the most frequently used measure of profitability, ROE, to identify the strengths and weaknesses of the banks’ performance (Saunders & Marcia, 2011, p. 23). Based on the DuPont system, we prefer to choose ROE and ROA which are most important as indicators of profitability.

**3.2.2 Return on Equity (ROE)**

According to the introduction of DuPont model, we illustrate the hierarchy of the ratios. Then we will focus on the specific ratio, ROE and ROA, to expand our explanation. Return on equity (ROE) value the overall profitability of the fixed income per dollar of equity (Saunders & Marcia, 2011, p. 23). It is defined as

\[
ROE = \frac{Net\ Income}{Total\ Equity\ Capital}
\]
This measure the amount of net income after taxes earned for each dollar of equity capital contributed by the bank’s shareholders (Saunders & Marcia, 2011, p. 23).

In general, stockholders of bank prefer higher ROE (Saunders & Marcia, 2011, p. 24). However, the increasing of ROE demonstrates the increasing risk. For example, as the defined equation indicates if total equity capital decreases relative to net income, ROE will have an increase under the constant of net income (Saunders & Marcia, 2011, p. 24). A large drop in equity capital may result in a violation of minimum regulatory capital standards and increases the risk of insolvency for the banks (Saunders & Marcia, 2011, p. 24).

In order to identify potential problems, ROE can be decomposed into two component parts,

\[
\text{ROE} = \frac{\text{Net Income}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Total Equity Capital}}
\]

\[
\text{ROE} = \text{ROA} \times \text{EM}
\]

Where:

\[
\text{ROA} = \text{Return on assets (a measure of profitability linked to the asset size of bank)}
\]

\[
\text{EM} = \text{Equity multiplier (a measure of leverage)}
\]

Net income is the profit after tax (Saunders & Marcia, 2011, p. 24).

ROA determines the net income produced per dollar of assets which we will have further discussion in the following part. EM measures the dollar value of assets funded with each dollar of equity capital (Saunders & Marcia, 2011, p. 24). The higher EM ratio indicates the more leverage (or debt) that is used by banks to fund its assets (Saunders & Marcia, 2011, p. 24). High EM ratio and ROA ratio have positive influence on ROE ratios (Saunders & Marcia, 2011, p. 24). However, the source of high ROE needs to be concerned by the bank’s manager. For example, increasing EM generates increasing ROE ratio while the leverage of bank has also enhanced, which causes solvency risk (Saunders & Marcia, 2011, p. 24).

### 3.2.3 Return on Assets (ROA)

ROA, which is the ratio of net income to total assets, measure how profitable and efficient a bank's management is, based on the total assets (Guru et.al, 1999, p.7). As mentioned in the equation of ROE, in the next step, ROA can be disintegrated into the
following elements.

\[
\text{ROA} = \frac{\text{Net income}}{\text{Total operating income}} \times \frac{\text{Total operating income}}{\text{Total assets}}
\]

\[
\text{ROA} = \text{PM} \times \text{AU}
\]

Where:
PM = Net income generated per dollar of total operating income.
AU = Amount of interest and noninterest income generated per dollar of total assets (Saunders & Marcia, 2011, p. 25).

Therefore, higher value of PM and AU ratios generate higher ROA and ROE. PM measures the capacity of bank on the expense controlling (Saunders & Marcia, 2011, p. 25). And expense control and bank’s profit have positive relationship. AU values the bank’s capacity to generate income from assets (Saunders & Marcia, 2011, p. 25). But high PM and AU value also demonstrate the potential risks. For example, PM will have an improvement when a bank reduces its expense of salaries and profits (Saunders & Marcia, 2011, p. 25). While if the reduction of expense is due to the loss of high skilled employees, the raise of PM and ROA might exist an underlying “labor quality” problem (Saunders & Marcia, 2011, p. 25).

According to Fathi et al. ROA can be also disintegrated into the following elements (2012, p.218):

\[
\text{ROA} = \frac{\text{II} - \text{IE}}{\text{TA}} + \frac{\text{NII} - \text{NIE}}{\text{TA}} - \frac{\text{Provisions}}{\text{TA}}
\]

Where:
II = Interest Income
IE = Interest Expense
NII = Non-Interest Income
NIE = Non-Interest Expense
TA = Total Assets

Then this equation can be stated as

\[
\text{ROA} = \text{Net interest margin} + \text{Non interest margin–Provision to total assets}
\]

Based on the equation of ROE, we can restate ROE as

\[
\text{ROE} = (\text{NETIM} + \text{NONIM} – \text{PROV}) \times (\text{EM})
\]

Where NETIM is net interest margin, NONIM is non-interest margin, PROV is provision to total assets and EM is equity multiplier. This equation indicates that bank can maximize stockholders’ wealth through maximizing NETIM, NONIM and EM as
well as minimizing PROV (Fathi et al., 2012, p.218).

ROE and ROA are commonly used as indicators of the profitability and financial performance. Chirwa mentions that in the previous studies, various indicators are used, including ROE, ROA and return on capital (ROC) (2003, p.567). Al- Khouri (2011) assesses the risk and performance of Gulf Cooperation Council (GCC) banking sector which involves ROA and ROE as dependent variables and credit risk, liquidity risk, capital risk and bank size as the independent variables. This research found a positive relationship between credit risk and ROA. And a significant relationship between size of banks and ROA was also founded in the same study. Al Khatib (2009) evaluated the financial performance of five Palestinian Commercial Banks by using ROA, price-to book value of equity ratio and economic value added. And his study found a positive correlation between ROA and the size of banks. In our research, size of bank is not considered as the independent variable. But based on the previous study, we consider it as control variable which we will discuss later in the following chapters. Moreover, in the Tafri et al. (2009) test of financial risk’s influence to the profitability of Malaysian commercial banks also uses ROA and ROE as indicators of profitability. Ruziqa (2013) developed the similar topic to the Indonesian Conventional Banks by still using ROA and ROE to represent the financial performance. Among all the measurements, ROA and ROE are the major ones (Ongore & Kusa, 2013, p. 239; Chirwa, 2003, p.567). As previous studies that we list before, ROE and ROA are commonly used as the indicators of profitability. Hence, in our research, we will use ROA and ROE as our profitability measures.

3.3 Bank’s Risk Management

In the last part, we explain the indicators of profitability. Now we will mainly discuss the credit risk management ratios of commercial banks. Before we introduce our indicators, capital adequacy ratio (CAR) and non-performing loan ratio (NPLR), we believe it is necessary to start from the introduction of risks as well as risk management in banks to provide overview of bank’s credit risk management for readers.

3.3.1 Risks in banks

According to Koch and MacDonald (2009, p. 108), banks’ risks can be identified as six types: credit risk, liquidity risk, market risk, operational risk, reputation risk and legal risk. Each of these risks might generate harmfully influence the financial institution’s probability, market value, liabilities and shareholder’s equity. We provide a brief introduction of each risk in the following.

- Liquidity risk can be described as the risk of funding which is related to an unexpected event, for example large charge off or currency crisis (Santomero,
1997, p. 89). Specifically, a bank is reducing the ability to meet expected and unexpected current and future cash flows which indicates the liquidity risk (The Joint Forum, 2006, p. 1). Or it is unable to meet collateral needs without impacting regular operations and financial condition of the institutions (The Joint Forum, 2006, p. 1).

- Market risk can be hedged but cannot be diversified completely away. In fact, it can be regarded as undiversifiable risk (Santomero, 1997, p. 88). It comes from many different forms such as variation in interest rate and relative value of currencies (Santomero, 1997, p. 88).

- Operational risk relates to the issues of precisely processing, settling and taking delivery on trades for the exchange of cash (Santomero, 1997, p. 89). It also involves the record keeping, processing system failures and fulfillment the diversified regulations (Santomero, 1997, p. 89). So that, individual operating problem is small portion for a well-managed institution but causes effect which may be quite costly (Santomero, 1997, p. 89).

- Reputational risk arises from negative opinions which may affect the profit and value of institutions (Protiviti, 2013, p. 1). It demonstrates a decreasing value of institution’s brand or a lack of ability to persuade (Protiviti, 2013, p. 1).

- Legal risk generally happens in financial contracting which is separated from the legal implication of credit, counterparty and operational risk (Santomero, 1997, p. 89). New status, tax legislation, court opinions and regulations can lead formerly well-established transaction into contention (Santomero, 1997, p. 89). For example, environmental regulation has affected the value of real estate for elder properties which cause risk to lending institutions (Santomero, 1997, p. 89). Another type of legal risk can come from the actives of bank’s management or employees such as fraud and violation of regulations or laws (Santomero, 1997, p. 89).

- Credit risk has commonly been identified as a greatest risk on bank’s performance (Boffey& Robson, 2007, p.66). It is a risk that counterparties in loan transactions and derivatives transactions might default, which means counterparties fail to repay the principal and interest on a timely basis (Koch& MacDonald, 2000, p. 109).

Our research focuses on the credit risk of banks. Considering the credit risk, credit default becomes a key influential factor for bank’s credit risk. Van Gestel & Baesens mention that there can be many reasons for credit default. Mostly, the obligor is in a financial stressed situation and may be facing a bankruptcy. He can also refuse to comply with its obligation of debt service in the case of a fraud or legal dispute. Technical defaults are generated by the flaw in the information system (Van Gestel &
Credit risk can also be a risk of loss on credit derivative market. It can be credit migration such as a downgrade in credit rating (Choudhry, 2011, p. 131). Or when the bank invests in debt to high-quality borrower whose risk profile has deteriorated (Choudhry, 2011, p. 131). In the case of liquidation, the price at which the debt is sold is lower than the price at which the debt was bought by the bank, which induces a net loss of bank on the market (Van Gestel & Baesens, 2008, p.25). In a full default, the extent of loss can be observed immediately to be the full from the administrators which is known as “recovery value” (Choudhry, 2011, p. 131). Generally, the loss for the bank does not have to be high. The loss of default relies on the percentage that one can recover from the defaulted counterpart and the total exposure to the counterpart (Van Gestel & Baesens, 2008, p.25). The recovery may depend on the presence of collateral and guarantees (Van Gestel & Baesens, 2008, p.25).

Afriyie & Akotey (2012, p. 6) indicates that credit risk situation of a bank can be exacerbated by inadequate institutional capacity, inefficient credit guidelines, inefficient board of directors, low capital adequacy ratios and liquidity, compulsory quota lending as a result of government interference and lack of proper supervision by the central bank. Therefore, efficient risk management is crucial and valuable for banks to improve the performance and reduce the damage caused by risks. In the next part, we will introduce the risk management of banks then narrow it to the credit risk management.

### 3.3.2 Risk Management

Risk management is mainly focused on reducing earning volatility and avoiding large losses. One proper risk management procedure needs to identify the risk, measure and quantify risk then develop strategy to manage risk (Van Gestel & Baesens, 2008, p. 39). Figure 5 illustrates the risk management process.
As Figure 4 indicates, risk management process includes identification, measurement, treatment and implementation. The most important step of risk management, identification, can begin from analyzing the sources of potential risks or defining threats.

Secondly, measurement needs to quantify the risk which has been identified in the identification step (Van Gestel & Baesens, 2008, p.42). For example, individual needs to measure the real default probability and how much the change of risk drivers influence the default probability. In this step, statistical analysis is analysis needed for the risk measurement (Van Gestel & Baesens, 2008, p.42).

The third step in risk management is treatment (Van Gestel & Baesens, 2008, p.43). Risk can be treated through four ways: risk avoidance, risk reduction, risk acceptance and risk transfer (Van Gestel & Baesens, 2008, p.43). Risk avoidance is a simple way of treatment which refers to individual investing in the products that are not too risky (Van Gestel & Baesens, 2008, p.43). Avoidance does not imply avoiding all risks. One strategy can be investing in counterparts with low exposure risk or investing only small proportion in counterparts with high default (Van Gestel & Baesens, 2008, p.43). Risk reduction states reducing the portion of risk taken which means use collateral to reduce the actual loss. Risk acceptance is commonly applied for low-risk assets (Van Gestel & Baesens, 2008, p.43). It emphasizes the diversification of investments in various sectors and countries. And risk transfer implies transfer risk to other institutions such as banks, insurances or companies. This treatment provides a
guarantee to credit risk such as credit derivatives (Van Gestel & Baesens, 2008, p.43).

After finishing the treatment in the risk management procedure, risk management strategy should be implemented (Van Gestel & Baesens, 2008, p.43). Implementation should put people, statistical model and IT infrastructure to measure the underlying risk of current and future investment (Van Gestel & Baesens, 2008, p.42). It also needs a guideline for risk treatment to select counterparts in which to invest or not; which limit exposure of risky product should be determined; whether collateral for specific loans is mandatory or not and whether individual buys financial protection to secure investment (Van Gestel & Baesens, 2008, p.4). Such implementation of risk management is usually supervised by senior management and the risks need to be continuously reported and monitored (Van Gestel & Baesens, 2008, p.43). In the end, effective risk management process is usually evaluated frequently. This step refers to check whether the final risk taking keeps in line with the strategy and in a correct way of application. Specifically, it means the evaluation of risk drivers and measurement process (Van Gestel & Baesens, 2008, p.43).

The reason for conducting risk management is due to banks and banking activities have evolved significantly over the time (Van Gestel & Baesens, 2008, p.42). With the introduction of money, financial services such as deposit taking, lending money and money transfer have gradually become important. So that banks are exposed to credit, market, operational, interest rate and liquidity risk. Efficient management on these risks is necessary for banks to reduce its losses on earning, insolvent and those depositors cannot be refunded (Van Gestel & Baesens, 2008, p. 2). Another reason why banks need to carefully monitor risk is that regulators require them to do it (Hull, 2012, p. 16). However, it is error to believe that meeting regulatory requirements is the sole for establishing a sound, scientific risk management system.

Managers need reliable risk measures to direct capital to activities and estimate the size of potential losses to stay within limits imposed by available capital, creditors and regulators (Pyle, 1997, p. 2). They need mechanisms to monitor positions and create incentives to be prudent in taking risk. Consequently, risk management is the process by which managers satisfy these needs by identifying key risks, obtaining consistent, understandable, operational risk measures, deciding which risks need to be manage and by which methods, and establishing procedures to monitor the resulting risk position (Pyle, 1997, p. 2).

### 3.3.3 Credit Risk Management

Credit risk management in financial institutions has become crucial for the survival and growth of these institutions (Afriyie & Akotey, 2012, p. 3). It is a structured approach of uncertainty management through risk assessment, development of strategies to manage it and mitigation of risk using managerial resources (Afriyie & Akotey, 2012, p. 3). The strategies of credit risk management involves transferring
risk to other parties, avoiding risks, reducing the negative influence of risk and accepting some or all of the consequences of a particular risk (Afriyie & Akotey, 2012, p. 3).

According to Van Gestel and Baesens, credit risk is managed in various ways. The most important method starts with appropriate selection of the counterparts and products (Gestel & Baesens, 2008, p.43). And good risk assessment model and qualified credit officers are key requirements for selection strategy (Gestel & Baesens, 2008, p.43). For counterparts with higher default risk, banks may need more collateral to reduce risk. And the pricing of product should be in line with the estimated risk. Secondly, limitation rule of credit risk management restricts the exposure of bank to a given counterpart (Gestel & Baesens, 2008, p.43). It avoids the situation that one loss or limited number of losses endangers the bank’s solvency (Gestel & Baesens, 2008, p.43). Bank’s determinants on how much credit a counterpart with a given risk profile can take need to be limited. Thirdly, the allocation process of banks provides a good diversification of the risks across different borrowers of different types, industry, and geographies (Gestel & Baesens, 2008, p.43). As a result, diversification strategy spreads the credit risk thus avoids a concentration on credit risk problems. Last but not least, banks can also buy credit protection in forms of guarantees through credit derivative products (Gestel & Baesens, 2008, p.43). By the protection, the credit quality of guaranteed assets has been enhanced. These techniques are translated in the daily organization by written procedures and policies which determine how counterparts are selected, risk profile loans are granted and above which level an expert evaluation is required (Gestel & Baesens, 2008, p.43).

In summary, a strong credit risk management avoids significant drawbacks like credit concentrations, lack of credit discipline, aggressive underwriting to high-risk counterparts and products at inadequate prices (Gestel & Baesens, 2008, p.44). And an effective credit risk management is verified by internal risk control and audit which monitor credit discipline, loan policies, approval policies, facility risk exposure and portfolio level risk (Van Gestel & Baesens, 2008, p. 44).

###  3.3.4 Credit Risk Management Indicators

For the indicators of credit risk management, we choose CAR and NPLR. The reason we involve them is based on their properties related to the credit risk management and their frequency of occurrence in previous studies.

According to Ara, Bakaeva & Sun’s research (2009, p.13), Basel Accord links the minimum regulatory capital to the underlying risk exposure of banks, which refers to the greater risk bank exposed relates to the higher amount of capital bank needs. This regulation indicates the importance of capital management in risk management and the compliance with the regulatory requirement can be expressed as risk management indicators. Brewer et al. (2006) regards non-performing loan ratio (NPLR) as a
significant economic indicator. It implies that lower NPLR is related with the lower risk and deposit rate. Meanwhile, there might be a positive relationship between deposit rate and NPLR based on the possibility that bank’s deposit base will be increased by the high deposit rate for funding high risk loans. And the increasing high-risk loans might enhance the probability of higher NPLR. So that the allocation of banks risk management deeply relies on the diversification of credit risk to decrease the NPL amount. NPL is also a probability of loss which requires provision. The amount of provision is “accounting amount” which can be further subtracted from the profit. Thus high NPL increases the provision while reduces the profit.

The research of Boudriga, Taktak& Jellouli (2009) illustrates this research found that CAR seems to reduce the level of problem loans which means higher CAR leads to less credit exposures. However, Rime (2001) observed a positive relationship in his research between bank risk and capital ratio of Swiss banks during the period 1989-1995. Goddard et al. (2004) study the influential factors of profitability of banks in Europe. They found a positive relationship between the CAR (bank capital and reserves to total assets) (The World Bank, 2014) and profitability. And Samy and Magda (2009) investigate the effects of capital regulations on the performance of banks in Egypt. The research provides a comprehensive framework to measure the impact of capital adequacy on two indicators of bank performance: cost of intermediation and profitability. The result of the research indicates that higher capital adequacy “increase the interest of shareholders in managing bank’s portfolio” which generates “higher cost of intermediation and profitability” (Samy and Magda, 2009, p. 70).

Previous studies also show a close relationship between NPLR and credit risk management. For example, Brewer& Jackson (2006) involves non-performing loans (NPLs) to total assets ratio (NPLR) as an indication of efficient management of credit risk. In addition, Tafri et al. (2009) examine the relationship between credit risk and profitability of the conventional and Islamic banks in Malaysia between the periods from 1996 to 2005. And found a significant relationship among them. The researcher use “proportion of allowance for the loan loss to total assets” (Tafri et al., 2009, p.6) which has a close relationship with NPLR to represent the credit risk. And in the beginning of Tafri et al. (2009) research, they emphasize that profitability as an “ultimate” test for the effectiveness of risk management. According to Boudriga, Taktak& Jellouli (2009), NPLs are also involved to assess the role of regulatory supervision on credit risk and they found a positive relationship between them. Salas and Saurina (2002) indicate the tendency of state-owned banks to take risker projects then to provide more favorable credits for small and medium firms. So that it will encourage the development of economy. But such risk taking behavior will lead to higher level of NPLs.

Some researchers also examine the relationship between the ROA and NPLR. Godlewski (2004) uses ROA as a measure of profitability and find a negative
relationship between ROA and NPLR. In the later discussion of our research, we will present a regression analysis of NPLR as independent variables and ROA as dependent variables. Therefore, NPLR seems appropriate as an indicator to our research.

Conclusively, the choice of CAR and NPLR are based on their properties and frequency of occurrences in previous studies. CAR measures the amount of bank’s capital which is related to the amount of risk weighted credit exposure. It is also regulated in Basel regulation and must be a crucial factor for bank managers to concern in credit risk management. As for NPLR, it is relevant with bank loans. Bad loans have close relationship with banks credit risk and influence the efficiency of credit risk management. Thus, we consider it would be reasonable to use CAR and NPLR in our research, and further discussion for these two variables will be present in the following sections.

### 3.3.4.1 Capital Adequacy Ratio (CAR)

Capital adequacy ratio (CAR) is defined as the ratio of capital to the risk-weighted sum of bank’s assets (Hyun & Rhee, 2011, p. 325). It measures the amount of a bank’s capital relative to the amount of its risk weighted credit exposures (Reserve Bank of New Zealand, 2007, p.1). Capital-based regulation has become a major issue in the banking industry after financial crisis in 2007 caused by subprime mortgage problems. Losses on mortgages and other mortgage-related securities significantly decrease the capital base of many banks (Hyun & Rhee, 2011, p. 323). To keep the minimum capital adequacy ratio and secure against underlying losses, capital-constrained banks began to collect outstanding loans or became reluctant to grant new lending (Hyun & Rhee, 2011, p. 323). The specific calculation of capital adequacy ratio is estimated by dividing total capital by total risk-weighted-assets (Reserve Bank of New Zealand, 2007, p.11). More detailed estimation associated to the capital and risk-weighted-assets will be discussed further in the following.

Generally, two types of capital are measured for use in capital adequacy ratio (Reserve Bank of New Zealand, 2007, p.1). Tier 1 capital can absorb losses without a bank being required to cause trading such as ordinary share capital (Reserve Bank of New Zealand, 2007, p.1). Tier 1 capital is essential because it safeguards the survival of the bank and the stability of the financial system (Reserve Bank of New Zealand, 2007, p.1). Tier 2 capital absorbs losses in the event of a winding-up and provides a lower level of protection to depositors (Reserve Bank of New Zealand, 2007, p.1). For example, subordinated debt means that the subordinated debt holders will only be repaid after all other creditors have been repaid (Reserve Bank of New Zealand, 2007, p.1).
Minimum capital adequacy ratio has been developed to ensure banks can absorb a reasonable level of losses before insolvency and before depositor funds lost (Reserve Bank of New Zealand, 2007, p.2). Applying minimum capital adequacy ratio aims to protect depositors and promote the stability and efficiency of the financial system (Reserve Bank of New Zealand, 2007, p.2).

The minimum capital adequacy ratios encouraged by supervisory authorities are:

- Tier one capital to total risk-weighted-assets is no less than 4%.

- Total capital (Tier 1+ Tier 2) to total risk-weighted-assets to be no less than 8% (Hull, 2012, p. 262)


**Step One: calculation of capital**

The calculation of capital illustrates in the following. Capital includes:

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<table>
<thead>
<tr>
<th><strong>Tier 1 capital generally comprises:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The ordinary share capital (or equity) of the bank</td>
</tr>
<tr>
<td>Audited revenue reserve</td>
</tr>
<tr>
<td>Current year’s losses</td>
</tr>
<tr>
<td>Future tax benefits</td>
</tr>
<tr>
<td>Intangible assets</td>
</tr>
</tbody>
</table>

**Table 1 Tier 1 Capital**

*Source: Reserve Bank of New Zealand, 2007, p.6*

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<table>
<thead>
<tr>
<th><strong>Tier 2 capital generally comprises:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper Tier 2 ratio</strong></td>
</tr>
<tr>
<td>Unaudited retained earnings</td>
</tr>
<tr>
<td>Revaluation reserves</td>
</tr>
<tr>
<td>General provisions for bad debts</td>
</tr>
<tr>
<td>Perpetual cumulative preference shares</td>
</tr>
<tr>
<td>(i.e. preference share with no maturity date whose dividends accrue for future payment even if the bank’s financial condition does not support immediate payment)</td>
</tr>
<tr>
<td>Perpetual subordinated debt</td>
</tr>
</tbody>
</table>

**Perpetual subordinated debt**

(i.e. debt with no maturity date which ranks in priority behind all creditors)
except shareholders)

**Lower Tier 2 ratio**
- Subordinated debt with a term of at least 5 years
- Redeemable preference shares which may not be redeemed for at least 5 years

**Table 2 Tier 2 Capital**
*Source: Reserve Bank of New Zealand, 2007, p.6*

**Total capital sum Tier 1 and Tier deduct following items**
- Equity investments in subsidiaries
- Shareholdings in other banks that exceed 10 percent of that bank’s capital
- Unrealized revaluation losses on securities holdings

**Table 3 Total Capital**
*Source: Reserve Bank of New Zealand, 2007, p.6*

**Step Two: calculation of total risk-weighted-assets (RWA)**

As other important element when calculating CAR, risk-weighted-asset (RWA) has been developed from Basel I to Basel II. Under Basel II, the total risk-weighted-asset is determined by multiplying the capital requirement for credit risk, market risk and operational risk by 12.5 (i.e. the reciprocal of the minimum capital ratio of 8%) (BCBS, 2006, p.12).

\[
\text{Total RWA} = \text{credit risk RWA} + \text{market risk RWA} + \text{operational risk RWA}
\]

Where:

- Credit risk RWA = 12.5* credit risk capital requirement
- Market risk RWA = 12.5* market risk capital requirement
- Operational risk RWA = 12.5* operational risk capital requirement

**Step Three: calculation of capital adequacy ratios**

Consequently, capital adequacy ratios are:

- Tier 1 capital to total risk-weighted-assets = Tier 1 capital/Total Risk-weighted-assets
- Total capital to total risk-weighted-assets = Total capital/Total Risk-weighted-assets
3.3.4.2 Non-performing loan ratio (NPLR)

An extraordinary meltdown of banking sector during 2007 led to many banks’ severe loss on credit portfolios (Boudriga, 2009, p. 286). Many banks experienced failure and global financial markets faced systemic crisis. The experience of crisis increases further concerns on financial system stability and the need for better control and supervision on lending activities and institutions, Diversified and periodical assessments are made to timely predict undesirable exposure (Boudriga, 2009, p. 286). The aggregate rate of non-performing loans (NPLs) is commonly measured as a soundness indicator (Boudriga, 2009, p. 286).

A loan is normally defined as non-performing when customer’s payments are arrears (Kauko, 2012, p.196).

Generally, default can be defined in the following ways:

- Non-payment of interest 90 days after the interest due date;
- Non-payment of a loan 90 days after the loan maturity date;
- Restructuring of the borrower’s loans;
- Filing for bankruptcy, the appointment of administrators, liquidation, and so on.

Late payment is often characterized a non-performing loans (NPLs) rather than a defaulted loan if the borrower is still undertaking business (Choudhry, 2011, p. 131). Nevertheless, at some point, irrespective of the state of the borrower, an NPL will be written off as a default loss (Choudhry, 2011, p. 131). The write-down which must be funded out of the bank’s capital is often at 100% of outstanding notional value. The bank might recover a percentage but at some later date (Choudhry, 2011, p. 131).

NPLR is the ratio of non-performing loans to total loans (Yang, 2010, p.2019). The equation can be defined as:

\[
\text{NPLR} = \frac{\text{NPLs}}{\text{Total Loans}}
\]

Where:

NPLR= Non-Performing Loan Ratio

NPLS= Non-Performing Loans.

NPLR is a financial soundness indicator which demonstrates the quality of bank loans (Park, 2012, p. 909). The quality of bank loans plays an essential role in the overall
bank soundness because one of the core activities of banking institutions is to make loans even though its importance has been gradually decreasing over the past decades (Park, 2012, p. 909). According to Yang, NPLRs can adversely influence the efficiency of risk management and investment (2010, p. 2019). Commercial banks expose themselves to the risk of default from loan borrowers. Quality credit risk assessment, risk management and creation of adequate provisions for bad and doubtful debts can reduce the banks credit risk (Kwambai& Wandera, 2013, p. 169). When the level of non-performing assets is high, the assets provisions made are not adequate protection against default risk (Kwambai& Wandera, 2013, p. 169).

The determinants factors of NPLs can be attributed to both macroeconomic conditions and banks’ specific factors. Rinaldi and Sanchis-Arellano (2006) has found that disposable income, unemployment and monetary conditions have strong impacts on NPLs. And Berge and Boye found that problem loans are highly sensitive to the real interest rates and unemployment in the Nordic banking system (2007, p.65). Lawrence (1995) examines a model and introduces explicitly the probability of default. This model indicates that borrowers with low income have higher rates of defaults because of increased risk of facing unemployment and being unable to settle their obligation. Rinaldi and Sanchis-Arellano extend the Lawrence’s model through assuming that agents borrow in order to invest in real or financial assets (2006, p. 5). And they argue that the probability of default depends on current income and the unemployment rate which is linked to the uncertainty of future income and lending rates.

Klein also finds NPLs are sensitive to bank-level factors. Better level of the bank’s management which is measured by the profitability in previous period generates smaller NPLs (2013, p.20). Excessive risk taking valued by loans-to assets ratio and growth rate of bank’s loans lead to higher NPLs in the subsequent periods. And these bank-level effects are significant during both the pre-crisis and post-crisis periods (Klein, 2013, p.20).

Conclusively, the relationship between risk management and profitability will be summarized in this paragraph. Profit is the ultimate goal of commercial banks so that all strategies designed and activities performed are meant to realize this grand objective (Ongore& Kusa, 2013, p. 239). Improving financial performance requires improved functions and activities of commercial banks (Nimalathasan, 2008, p. 141). However, when a bank increases and maximizes its profit, it must either increase risk or lower its operating cost (Ruziqa, 2013, p. 94). Koch and MacDonald (2000) argue that a bank’s profitability will generally vary directly with the riskiness of its portfolio and operations. As a result, in order to increase the return, banks need to know which risk factors have greater impact on profitability which eventually leads to bank financial performance. And as we mentioned in previous section, credit risk is the most significant factors for commercial banks. This means the probability where the credit risk influences the profitability is large. According to Tafri et al. (2009, p. 1),
risk management is important both for banks and policy makers because a strong banking system can promote financial stability of a country and increase economy’s resilience in facing economy crisis. Therefore the study and measure of effect of risk management to bank’s profitability are crucial for financial institutions.

3.4 Our research model

The theoretical framework used in our study can be illustrated in the following research model:

**Figure 7 Our Research Model**

ROA: Return on Assets, ROE: Return on Equity, CAR: Capital Adequacy Ratio, NPLR: Non-performing loan ratio
It is apparent from the model: the foundation of this research is built on risk management of commercial banks, specifically credit risk management. It is the foundation which makes us interested in the study of the relationship between risk management and profitability.

And more specifically, we want to find the relationship between credit risk management and profitability. We need to quantify credit risk management as well as profitability to disclose the relationship in a statistical and objective method. To achieve this, we actually investigate the relationship among two indicators chosen to represent or measure credit risk management and two indicators chosen to represent profitability. Credit risk management can be disclosed from two perspectives: CAR and NPLR, which became the first level of cornerstones in this model. And profitability of commercial banks can be represented into ROA and ROE which lies upon the indicators of credit risk management (CAR and NPLR). As the information will be useful for investors and bank managers, they are the “outsiders” concerned by the profitability of banks.

In conclusion, the concept of credit risk management can be viewed as the foundation of this research. Four indicators (NPLR, CAR, ROA, and ROE) frame the research. The combination of ratios representing credit risk management and ratios disclosing profitability which will be measured in the research is the main body of our research model. The highest level of the model after testing all indicators’ relationships is linked to profitability of commercial banks. The “outsiders” who might use this information are investors and bank’s managers.
Chapter 4: Practical method

The core of this chapter is to present the practical method of our research and the variables we used in statistical tests. We will describe the population and sample in the beginning, and then the time horizon and proxies will be discussed. Finally, the statistical tests which will be used in our research will be presented.

4.1 Population and Sample Data

The relationship between the population and sample can be described as:

“The population in a statistical study is the entire group of individuals about which we want information” (Moore et al., 2009, p. 178).

“A sample is the part of the population from which we actually collect information used to draw conclusions about the whole” (Moore et al., 2009, p. 178).

According to this definition of population and sample, our research’s population consists of all commercial banks in Europe. And the sample is the largest 47 (we will explain why it is 47 but not 50 in later part) banks in Europe.

The purpose of the research is to test the relationship between credit risk management and profitability of commercial banks in Europe from 2007 to 2012. Thus our target is all commercial banks from different countries in Europe. Nevertheless, in the research, we focus on large commercial banks according to total assets in Europe as sample. The reason we choose large banks is that large banks usually have higher level of transparency and stricter regulations. Most of large banks are listed which increase the reliability of the information they published. Therefore it also improves the reliability of our research when we use such information. Commonly, large banks have published their annual report on official website which is available for us to acquaint with bank’s information. Besides, large banks in Europe always have dominant influence on Europe economy and greater share in banking industry. They are more representative to the whole commercial banks in Europe.

There is a ranking list of top 50 European big banks provided by SNL Financial which is the premier provider of financial data and expert analysis on business sectors including banking (SNL, 2014). We aim to find the data of all largest 50 banks in Europe. However, we could only find information of 47 banks among the largest 50 banks. Considering 3 less banks will not cause a significant influence on the research, we finally keep 47 banks as our sample. The 47 largest commercial banks in Europe by total assets are summarized in Appendix 1. Total assets are recorded on 31st December 2012. All data reported in the local currency has been converted to euros.
with relevant exchange rate at the end of 2012, which would be easier for us to compare.

4.2 Time Horizon

We collect data from annual report of each bank. Not all of the banks have published the annual report of 2013 and some of the banks only have archival documents from 2007. In order to achieve the feasibility of the study, we consider years from 2007 to 2012 when collecting the annual reports for the data in our research. This period covers the financial crisis around 2008 which is a quite unique time of economic development. Many researchers have to regard it as a special time and consider it independently. However, what we are concerned in our research is if the relationship between credit risk management and profitability exists, not the exact correlation coefficient. The correlation coefficient between credit risk management and profitability might be significantly influenced by the shock of crisis but the relationship itself will not be impacted. Considering our major goal is to test the existence of relationship between credit risk management and profitability, we decide to involve periods of financial crisis in our time span to test if the relationship exists.

In order to go deep into the relationship and make our research more accurate, we will also divide 6-year period into 6 sub-periods. Each sub-period will contain data from one year. We will firstly base on the whole 6-year observations to test if the relationship exists. Then the 6 sub-periods will be used for seeking whether the relationship is stable or fluctuating.

4.3 Data Collection

In order to perform our regression analysis, we need to collect the data for the variables that we are going to use. The variables that we are going to use are ROE, ROA, CAR, NPLR and Size of the bank. To collect data from annual reports, all sample banks’ websites were examined. The manual search was started from the web pages of “investor’s relationship”. Under the page of “investor’s relationship”, we seek the “annual reports” or “financial results” of banks. We look through both the current documents in 2012 and archives in previous years (2011-2007). After we have downloaded each annual report, the search was performed on the search engines on the web pages or by downloading pdf file. The searched words used in annual reports include “non-performing loans”, “non-performing loans ratio”, “NPLs”, “NPLR”, “total loans”, “capital adequacy ratio”, “capital ratio”, “ROE”, “return on equity”, “ROA”, “return on assets”, “net income”, “total shareholder’s equity”, “total assets”. The annual reports we use are results from whole group of banks and not specific sectors or branches.
4.3.1 Proxies for credit risk management

In our research, we use two indicators to measure the credit risk management: capital adequacy ratio (CAR) and non-performing loans ratio (NPLR), which are main indicators used to assess the soundness of the banking system (Bhavani & Bhanumurthy, 2012, p. 10). The calculation of CAR follows three steps as we have discussed in the previous chapter. There are two methods to calculate CAR; one is using the total capital while another one is using only Tier 1 capital. In our research, we plan to use the model as previous researchers (Kargi, 2011; Epure and Lafuente, 2011; Ara, Bakaeva and Sun, 2009). Therefore, we will use the former one as the formula for calculating CAR. That is,

\[ CAR = \frac{Total\ Capital}{Risk- weighted - assets} \]

As to NPLR, it is calculated as:

\[ NPLR = \frac{NPLs}{Total\ Loans} \]

Where NPLR is non-performing loan ratio, NPLs is non-performing loans.

Non-performing loans (NPLs) are defined as the loans overdue by more than 90 days (Louzis et al., 2011, p. 1016). It should be the gross value of the loan as recorded in the balance sheet not just the amount that is overdue, according to World Bank (2013).

4.3.2 Proxies of Profitability

Return on equity (ROE) and return on assets (ROA) are two measures for commercial banks’ profitability. The data used to calculate these two ratios are retrieved from the financial statements from year 2007 to 2012 of commercial banks which are publicly available online. All the values that we have retrieved are book values. The information we retrieved is each bank’s Net Income (profit for the year), Total Assets, and Total Equity. When calculate the ROE, we use the function as:

\[ ROE = \frac{Net\ Income}{Total\ Equity\ Capital} \]

Where Net Income means the net income after tax Total equity capital is contributed by the bank’s shareholders.

The estimation of ROA follows the formula as:

\[ ROA = \frac{Net\ Income}{Total\ Assets} \]

Where net income can be collected from income statement Total assets and total equity are available from the balance sheet.
4.3.3 Excluding Outliers

As we are observing the scatterplots of our data (See Appendix 2), we find that there are a few values that are extremely bigger or extremely smaller than the other data; we hence suspected that they could be outliers. Outliers may have significant impact on the outcome of tests and should therefore be excluded in order to eliminate their biasing effect. We, as a consequence, decide to exclude those outliers.

We use the interquartile range (IQR) as a benchmark to find out what should be seen as outliers. The IQR is calculated in Excel by subtracting percentile 1 (Q1) from percentile 3 (Q3). Multiplying it by 3 and adding these values to the Q3 and subtracting these values from the Q1 to get the cut off value for the outliers (Park, 2011). According to the Appendix 3, we can assume that all the variables demonstrate a normality but with some possible outliers. Consequently, we decide to exclude those observations that lie outside of our sample.

4.4 Hypotheses

Previous researches have been inclusive in the relationship between credit risk management and profitability of commercial banks in Europe. Therefore, it becomes a topic that is worth studying. We will perform our study based on the data we have collected from annual reports of 47 largest banks in Europe, from year 2007 to 2012. In the previous chapters, we have explained all the indicators which have been selected to present credit risk management and profitability of commercial banks. All of these have led to the following hypotheses:

**Hypothesis 1:**

Null hypothesis: *There is no correlation between CAR and NPLR and ROE of commercial banks.*

Alternative hypothesis: *There is a correlation between CAR and NPLR and ROE of commercial banks.*

H$_0$: $\beta_2 = \beta_3 = 0$
H$_a$: $H_0$ is not true

As we stated before, CAR and NPLR are indicators of credit risk management and ROE is one of the indicators of profitability. This hypothesis is used test if the relationship between ROE and CAR and NPLR of commercial banks exists.

**Hypothesis 2:**
Null hypothesis: *There is no correlation between CAR and NPLR and ROA of commercial banks.*

Alternative hypothesis: *There is a correlation between CAR and NPLR and ROA of commercial banks.*

\[ H_0: \beta_2 = \beta_3 = 0 \]
\[ H_1: H_0 \text{ is not true} \]

The hypothesis has similar expression as hypothesis 1 but uses ROA as the independent variable, which is another indicator of profitability.

**Hypothesis 3:**

Null hypothesis: *The correlation between CAR and NPLR and ROE is stable over time.*

Alternative hypothesis: *The correlation between CAR and NPLR and ROE is fluctuating over time.*

\[ H_0: \beta_{2,t} = \beta_{2,t-1}, \beta_{3,t} = \beta_{3,t-1} \]
\[ H_1: H_0 \text{ is not true} \]

This hypothesis is used to test the stability of relationships between CAR and ROE and between NPLR and ROE.

**Hypothesis 4:**

Null hypothesis: *The correlation between CAR and NPLR and ROA is stable over time.*

Alternative hypothesis: *The correlation between CAR and NPLR and ROA is fluctuating over time.*

\[ H_0: \beta_{2,t} = \beta_{2,t-1}, \beta_{3,t} = \beta_{3,t-1} \]
\[ H_1: H_0 \text{ is not true} \]

This hypothesis is aimed to test the stability of relationship between ROA and CAR and between ROA and NPLR.
4.6 Statistical Tests

4.6.1 Control variable and summary of variables

According to a study conducted by Halsem (1968), profitability of a bank depends on factors including management, size, locations and time. Gure et. al (1999) also concluded that bank’s profitability is influenced by internal determinants and external determinants. In our study, we aim to study only one of internal determinants of commercial banks’ profitability -- credit risk management. In order to avoid the possibility that the relationship is due to some other factors, we need to introduce control variable. Following the model of Samy and Magda (2009), we decided to select bank’s size as our control variable. In previous researches, firm size has been measured on many different grounds and it is said that it does not matter which measure of firm size is used. One common measure that is proven the most interchangeable to use as a measure for firm size is the natural log of total assets (Shalit & Sankar, 1977).

As we have mentioned before, the variables we will use are ROE, ROA, CAR, NPLR and Bank Size. ROE and ROA are dependent variables while independent variables include CAR and NPLR. They are summarized in the following table:

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Calculating Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variables</strong></td>
<td></td>
</tr>
<tr>
<td>ROE</td>
<td>net income/ total equity</td>
</tr>
<tr>
<td>ROA</td>
<td>net income/ total asset</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
</tr>
<tr>
<td>CAR</td>
<td>Total capital/RWAs</td>
</tr>
<tr>
<td>NPLR</td>
<td>NPLs/total loans</td>
</tr>
<tr>
<td><strong>Control Variable</strong></td>
<td></td>
</tr>
<tr>
<td>Bank Size (LNTA)</td>
<td>Natural logarithm of total assets of banks</td>
</tr>
</tbody>
</table>

Table 4 Summary of variables

4.6.2 Multivariate regression analysis

To test the hypotheses we have made in the last part, we need to build regressions to measure the relationships of dependent and independent variables. "The regression analysis tests the statistical strength of the model as hypothesized" (Parramore & Watsham, 1997, p. 188). The technique we decide to use to build to the model is Ordinary Least Squares (OLS). The general form of OLS uses a set of data to create an estimated equation like:

\[ Y_i = \beta_0 + \beta_1 X_i + \epsilon_i \]
Where:
I goes from 1 to N and indicates the observation number
X, is the independent variable
Y, is the dependent variable
β, is the intercept
β, is the slope
ε, is the residuals

The OLS is a regression estimation technique that "The least squares regression line of y on x is the line that makes the sum of the squares of the vertical distances of the data points from the line as small as possible" (Moore et al, 2009, p.120). That is to say, OLS minimizes \( \sum_{i=1}^{N} e_i^2 \)

We will employ the model that previous researchers have used, considering that we have more than one independent variable. Therefore, we need to move from single-independent-variable regressions to equations with more than one independent variable. That is to say, multivariate regression model needs to be introduced:

\[
Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + \epsilon_i
\]

Where:
I goes from 1 to N and indicates the observation number
X, is the independent variable
Y, is the dependent variable
β, is the intercept
β, is the slope
ε, is the residuals

A multivariate regression coefficient indicates change in dependent variable associated with one unit increase in one independent variable, holding other independent variables constant (Studenmund 2011, p.40). Based on all the information above, we therefore we will perform the following regressions:

\[
ROE_t = \alpha + CAR_t + NPLR_t + LNTA_t
\]

\[
ROA_t = \alpha + CAR_t + NPLR_t + LNTA_t
\]

Where,
ROE is the return on equity at time t
ROA is the return on asset at time t
CAR is the capital adequacy ratio at time t
NPLR is the non-performing loan ratio at time t
LNTA is the natural log of total assets of banks
According to Studenmund (2011, p.94), there are 7 assumptions to make for OLS estimators to be best available:

- The regression model is linear, is correctly specified, and has an additive error term.
- The error term has a zero population mean.
- All explanatory variables are uncorrelated with the error term.
- Observations of the error term are uncorrelated with each other (No serial correlation).
- The error term has a constant variance (No heteroskedasticity).
- No explanatory variable is perfect linear function of any other explanatory variables (No perfect multicollinearity).
- The error term is normally distributed. (Optional)

Hence, we need to test the multicollinearity and heteroskedasticity in the later parts.

4.6.3 \( R^2 \)

When evaluating the overall fit of a regression equation, we need to take a look at a measure named \( R^2 \) or the coefficient of determination. \( R^2 \) is the ratio of the explained sum of squares to the total sum of squares:

\[
R^2 = 1 - \frac{\sum e_i^2}{\sum (Y_i - \overline{Y})^2}
\]

The higher \( R^2 \) is, the closer the estimated regression equation fits the data. \( R^2 \) measures the percentage of the variation of Y around \( \overline{Y} \) that is explained by the regression equation. \( R^2 \) lies between 0 and 1, the closer the value to 1, the better the overall fits (Studenmund, 2011, p. 49).

4.6.4 Multicollinearity

Considering both CAR and NPLR are indicators of credit risk management, there is a risk of multicollinearity. Multicollinearity happens when one or more explanatory variables are highly linearly related to each other. Perfect multicollinearity means one explanatory variable is a perfect linear function of any other explanatory variables, which is fairly easy to avoid. Imperfect multicollinearity is defined as "a linear functional relationship between two or more independent variables that is so strong that it can significantly affect the estimation of the coefficients of the variables." Multicollinearity will cause the variances and standard errors of the estimates to increase and the t-scores to decrease. However, it will not bias the estimate and the overall fit of the equation (Studenmund, 2011, p. 248-254). In our research, we therefore will test the multicollinearity of CAR and NPLR. Since there are only two explanatory variables, the simplest way to detect
multicollinearity is to examine the simple correlation coefficients between CAR and NPLR. If the r is high in absolute value, then the two variables are quite correlated and multicollinearity is a potential problem. Some researchers pick an absolute value of 0.80, and concern about multicollinearity when the correlation coefficient exceeds 0.80 (Studenmund, 2011, p. 258).

4.6.5 Heteroskedasticity

Heteroskedasticity exists if the variance of the distribution of error terms changes for each observation or range of observations (Studenmund, 2011, p. 98). Heteroskedasticity although does not bias the estimate of coefficient, it could cause the OLS estimates of SE ($\hat{\beta}$)s to be biased, leading to unreliable hypothesis testing. In order to test for heteroskedasticity, we will perform the White test for our data. It is an approach for detection of heteroskedasticity by running a regression with the squared residuals as the dependent variable (Studenmund, 2011, p. 343-351). It will be performed by Chi-square test and the appropriate test statistic is $\text{NR}^2$. If $\text{NR}^2$ is larger than the critical Chi-square value, it is likely to face the problem of heterokedasticity (Studenmund, 2011, p. 343-351).
Chapter 5: Empirical Findings

In this section, we will present our empirical findings into two parts. Firstly, we discuss the descriptive statistics for our research in order to provide better understanding for the data. Then the results of statistical tests will be presented and described.

5.1 Descriptive Statistics

As we have mentioned in previous chapter, we noticed that a few values in our observations were much bigger or smaller than the others from the scatterplots. We suspected them could be outliers which may cause bias on the outcome of our test. So we use IQR to calculate the cut off values for our data and then exclude those outliers from our observations.

In order to give a brief overview of our data, we present the following table 5 which contains the descriptive statistics of our variables (CAR, NPLR, LNTA, ROA and ROE) of 47 commercial banks in Europe from 2007 to 2012. From the histogram of all the variables (Appendix 3), we assume that all the variables follow a normal distribution.

<table>
<thead>
<tr>
<th>Variable</th>
<th><strong>N</strong></th>
<th><strong>Min</strong></th>
<th><strong>Max</strong></th>
<th><strong>Mean</strong></th>
<th><strong>Std. dev.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR%</td>
<td>275</td>
<td>5.90</td>
<td>34.70</td>
<td>14.00</td>
<td>3.66</td>
</tr>
<tr>
<td>NPLR%</td>
<td>275</td>
<td>0</td>
<td>16.11</td>
<td>2.79</td>
<td>2.40</td>
</tr>
<tr>
<td>LNTA</td>
<td>275</td>
<td>3.82</td>
<td>7.78</td>
<td>6.07</td>
<td>0.91</td>
</tr>
<tr>
<td>ROA%</td>
<td>275</td>
<td>-1.95</td>
<td>3.58</td>
<td>0.25</td>
<td>0.56</td>
</tr>
<tr>
<td>ROE%</td>
<td>275</td>
<td>-74.50</td>
<td>38.40</td>
<td>6.14</td>
<td>11.35</td>
</tr>
</tbody>
</table>

Table 5 Descriptive Statistics of variables excluding outliers

CAR, NPLR, ROA and ROE are presented with their nominal values

Where:
N – Number of observations
CAR- Capital Adequacy Ratios
NPLR- Non-performing loans Ratios
LNTA- Natural log of total assets of banks
ROA- Return on Assets
ROE- Return on Equity

The variables in Table 5 include four ratios. ROA and ROE measure the performance of banks’ profitability and CAR and NPLR represent the credit risk management.
number of observations for each variable is 275 after we excluded the outliers. From the standard deviation we can observe the indicator with widest spread is ROE which has standard deviation of 11.35. Other indicators’ standard deviations are lower than 3. The difference between the highest and lowest value of ROE ratio is 112.90. The largest ratio reaches to 38.4 percent and the smallest one is -74.5 percent which means sample banks in our study have greater diversification on their ROE ratio.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR%</td>
<td>282</td>
<td>5.90</td>
<td>34.70</td>
<td>14.06</td>
<td>3.76</td>
</tr>
<tr>
<td>NPLR%</td>
<td>282</td>
<td>0</td>
<td>16.11</td>
<td>2.83</td>
<td>2.45</td>
</tr>
<tr>
<td>LNTA</td>
<td>282</td>
<td>3.82</td>
<td>7.78</td>
<td>6.02</td>
<td>0.91</td>
</tr>
<tr>
<td>ROA%</td>
<td>282</td>
<td>-57.84</td>
<td>23.40</td>
<td>0.24</td>
<td>4.07</td>
</tr>
<tr>
<td>ROE%</td>
<td>282</td>
<td>-687.29</td>
<td>38.40</td>
<td>1.29</td>
<td>47.90</td>
</tr>
</tbody>
</table>

Table 6 Descriptive Statistics of variables including outliers

Table 6 summarizes four ratios including outliers. The average value of ROE is 6.14 after excluding the outliers with 4.85 changes when including the outliers. We also observe the spread of ROA is 5.53 with a maximum observation of 3.58 percent and minimum observation of -1.95 percent. The standard deviation of ROA is 0.56 percent which is affected by the extreme value in a slightly pattern. CAR has value change from 34.7 percent to 5.9 percent. And the mean of CAR is 14 percent. Before we exclude the outliers, the mean of CAR is almost same as the 14.06 which indicates little influence of outliers to CAR indicator. The biggest value of NPLR is 16.11 percent and the smallest value is zero percent which means the spread among value of NPLR is equal to its biggest value.
We have selected the natural log of banks’ total assets to be our control variable. Therefore, it is necessary to provide a picture with the total assets of banks to deepen the understanding of our research. Figure 8 demonstrates the distribution of the commercial banks according to the total assets in year 2012. We divide 47 commercial banks into 4 groups based on the amount of total assets: banks with total assets larger than 2000 billion, banks with total assets from 2000 to 1000 billion, banks with total assets from 1000 to 500 billion and banks with total assets smaller than 500 billion. As Figure 8 shows, banks with total assets which are greater than 2000 billion only represent 6% of all 47 banks. Banks have total assets from 2000 billion to 1000 billion take account of 19% of 47 banks which is slightly larger than the banks with total assets around 1000 to 500 billion, 15%. 60% of the banks have total assets smaller than 500 billion. Conclusively, only small amount of banks have total assets larger than 2000 billion in Europe. Most of them have total assets lower than 500 billion. The amount of banks with 2000-1000 billion total assets and 1000-500 billion total assets are quite similar.

Location classification will also provide an overview regarding the characteristics of all banks. The distribution of countries among 47 banks has been showed in Figure 9. Countries include: Austria, Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Norway, Russia, Spain, Sweden, Switzerland and UK. 17% banks which is the largest portion among 47 banks come from Germany. It demonstrates that Germany has the greatest number of large banks in Europe. Meanwhile, only 2% of these banks originate from Ireland whose portion is as small as Norway. The rate of banks born in UK which is the second country owning highest amount of large banks.
is 13 percent. France and Spain have the equal number of large banks which take about 11% in each of them. Besides, countries keeping identical portion of banks are also include Austria, Denmark, Russia and Switzerland with 4%, respectively. Belgium, Italy and Netherlands separately own 6%.

5.2 Multicollinearity and Heteroscedasticity Test

Before presenting the regression analysis, we test our model for multicollinearity and heteroscedasticity. The following tables are the results for multicollinearity test:

<table>
<thead>
<tr>
<th></th>
<th>CAR</th>
<th>NPLR</th>
<th>LNTA</th>
<th>ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPLR</td>
<td>-0.0720</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNTA</td>
<td>0.0266</td>
<td>-0.0510</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>ROE</td>
<td>-0.0652</td>
<td>-0.3078</td>
<td>-0.0503</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 7 Correlation Matrix for the regression 1 (ROE)

<table>
<thead>
<tr>
<th></th>
<th>CAR</th>
<th>NPLR</th>
<th>LNTA</th>
<th>ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPLR</td>
<td>-0.0720</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNTA</td>
<td>0.0266</td>
<td>-0.0510</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>ROA</td>
<td>-0.0266</td>
<td>-0.2218</td>
<td>-0.1812</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 8 Correlation Matrix for the regression 2 (ROA)

Multicollinearity is a situation where the explanatory variables are nearly linear dependent (Jurczyk, 2011, p. 262). In table 7 and table 8, we can observe that the highest correlation among all the variables is -0.3078 which is the correlation between NPLR and ROE. However, researchers always prefer an absolute value larger than 0.8 to be enough to cause multicollinearity (Studenmund, 2011, p. 258). Considering that 0.3078 is quite far from 0.8, we conclude that there is no problem of multicollinearity among our variables.

After the test for multicollinearity, we also performed a White test for heteroscedasticity. Heteroscedasticity concerns if the variance of the residuals are homogenous or not. It is another requirement for conducting OLS regression. The results of White test for regression 1 and 2 are presented in Appendix 4. The results demonstrate a Chi value that is larger than the critical value, meaning that we could reject the hypothesis for homoscedasticity. That is to say, our observations have the problem of heteroscedasticity and we need to make remedies of it. We have used the most popular way, heteroscedasticity–corrected standard error to adjust the estimation.
of SE ($\hat{\beta}$) for heteroscedasticity. The logic behind that is to use an improved estimation of SE ($\hat{\beta}$) based on the fact that heteroscedasticity does not affect $\hat{\beta}$s. We will present our results with the remedy for heteroscedasticity in the following part.

5.3 Regression Results

In order to answer our research question, we have established eight different hypotheses in Chapter 4. And to test for those hypotheses, we have conducted two regression analyses. The results of the hypotheses are summarized in the following part and the original table from STATA is presented in Appendix 2.

5.3.1 Hypothesis 1

The first regression analysis was performed to test for the first hypothesis:

$$ROE_t = \beta_1 + \beta_2 \times CAR_t + \beta_3 \times NPLR_t + \beta_4 \times LNTA_t$$

Hypothesis 1 is about the correlation between CAR and NPLR and ROE of commercial banks.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef.</th>
<th>Std.Err.</th>
<th>T</th>
<th>P &gt; (t)</th>
<th>95% confidence interval</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>-0.25</td>
<td>0.17</td>
<td>-1.50</td>
<td>0.135</td>
<td>-0.60, 0.81</td>
<td>0.1065</td>
</tr>
<tr>
<td>NPLR</td>
<td>-1.45</td>
<td>0.26</td>
<td>-5.50</td>
<td>0.000</td>
<td>-1.97, -0.93</td>
<td></td>
</tr>
<tr>
<td>LNTA</td>
<td>-0.72</td>
<td>-0.65</td>
<td>-1.12</td>
<td>0.265</td>
<td>-2.00, 0.55</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>18.29</td>
<td>4.71</td>
<td>3.88</td>
<td>0.000</td>
<td>9.00, 27.57</td>
<td></td>
</tr>
</tbody>
</table>

Table 9 Results of regression 1

The first regression analysis shows that the p-value for CAR is 0.135 and for NPLR is 0.000. Under the condition that the level of significance is 5 percent, a p-value less than the 5 percent should be required to reject null hypothesis. Therefore, the first part of null hypothesis 1 that “there is no correlation between CAR and ROE” should not be rejected while the second part of hypothesis 1 that “there is no correlation between NPLR and ROE” should be rejected. This means that we are unable to exclude the possibility that the effect we have observed between CAR and ROE is caused by chance while it is possible to exclude that the effect between NPLR and ROE is caused by chance. In other words, the results for regression analysis 1 demonstrate that the relationship between CAR and ROE is insignificant while the relationship between NPLR and ROA is significant. As to the LNTA, the p-value more than 0.05 shows that we cannot reject that the relationship between bank size and ROE is not significant.
5.3.2 Hypothesis 2

The second regression analysis was performed to test for the second hypothesis:

\[ ROA_t = \beta_1 + \beta_2 \times CAR_t + \beta_3 \times NPLR_t + \beta_4 \times LNTA_t \]

Hypothesis 2 is about the correlation between CAR and NPLR and ROA of commercial banks.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coef.</th>
<th>Std. Err</th>
<th>t</th>
<th>P &gt; (t)</th>
<th>95% confidence interval</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>-0.007</td>
<td>-0.009</td>
<td>-0.73</td>
<td>0.465</td>
<td>-0.024, 0.111</td>
<td>0.0887</td>
</tr>
<tr>
<td>NPLR</td>
<td>-0.056</td>
<td>-0.015</td>
<td>-4.05</td>
<td>0.000</td>
<td>-0.083, -0.003</td>
<td></td>
</tr>
<tr>
<td>LNTA</td>
<td>-0.121</td>
<td>0.036</td>
<td>-3.34</td>
<td>0.001</td>
<td>-0.192, -0.050</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.336</td>
<td>0.470</td>
<td>-0.72</td>
<td>0.000</td>
<td>0.719, 1.743</td>
<td></td>
</tr>
</tbody>
</table>

Table 10 Results for regression 2

The second regression analysis shows that the p-value for CAR is 0.465 and for NPLR is 0.000. Under the condition that the level of significance is 5 percent, a p-value less than the 5 percent should be required to reject null hypothesis. Therefore, the first part of null hypothesis 2 that “there is no correlation between CAR and ROA” should not be rejected while the second part of null hypothesis 2 that “there is no correlation between NPLR and ROA” should be rejected. This means that we are unable to exclude that the effect between CAR and ROA is caused by chance and we are able to exclude that the effect between NPLR and ROA is caused by chance. In other words, the results for regression analysis 2 demonstrate relationship between CAR and ROE is insignificant while the relationship between NPLR and ROA is significant. Besides, the p-value of LNTA is less than 0.05, which demonstrates that the relationship between bank size and ROA is significant.

5.3.3 Hypothesis 3

To test the stability of those relationships, we make further regression analyses. We have divided the time horizon 6 years to 6 sub-periods; each sub-period will contain one-year’s observations. Therefore, we have performed 6 regression analyses for each sub-period. The following are regression 3 to 8:

\[ ROE_1 = \beta_1 + \beta_2 \times CAR_1 + \beta_3 \times NPLR_1 + \beta_4 \times LNTA_1 \]
\[ ROE_2 = \beta_1 + \beta_2 \times CAR_2 + \beta_3 \times NPLR_2 + \beta_4 \times LNTA_2 \]
\[ ROE_3 = \beta_1 + \beta_2 \times CAR_3 + \beta_3 \times NPLR_3 + \beta_4 \times LNTA_3 \]
\[ ROE_4 = \beta_1 + \beta_2 \times CAR_4 + \beta_3 \times NPLR_4 + \beta_4 \times LNTA_4 \]
\[ ROE_5 = \beta_1 + \beta_2 \times CAR_5 + \beta_3 \times NPLR_5 + \beta_4 \times LNTA_5 \]
\[ ROE_6 = \beta_1 + \beta_2 \times CAR_6 + \beta_3 \times NPLR_6 + \beta_4 \times LNTA_6 \]

The regression 3 contains observations in year 2012, the regression 4 contains observations in year 2011, the regression 5 contains observations in year 2010, the regression 6 contains observations in year 2009, the regression 7 contains observations in year 2008 and the regression 8 contains observations in year 2007. The correlation coefficients for the 6 sub-periods are revealed in the following table and figure:

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>-0.26</td>
<td>-0.33</td>
<td>-0.23</td>
<td>-0.14</td>
<td>-0.17</td>
<td>0.44</td>
<td>-0.115</td>
<td>0.280</td>
</tr>
<tr>
<td></td>
<td>(0.135)</td>
<td>(0.324)</td>
<td>(0.337)</td>
<td>(0.767)</td>
<td>(0.894)</td>
<td>(0.471)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPLR</td>
<td>-1.45</td>
<td>-1.46</td>
<td>-1.14</td>
<td>-0.46</td>
<td>-1.35</td>
<td>-1.44</td>
<td>-1.217</td>
<td>0.390</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.008)</td>
<td>(0.743)</td>
<td>(0.497)</td>
<td>(0.312)</td>
<td>(0.033)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 11** Correlation coefficient for CAR, NPLR and ROE across years (the p-values are in the brackets)

**Figure 10** Trend for correlation coefficient of CAR, NPLR and ROE across years

From the standard deviations and the trend figure of the correlation coefficients of CAR and NPLR, it is obvious that relationships between CAR and ROE and between NPLR and ROE are never constant, and always in change. In addition, we observe that the correlation coefficients of CAR and NPLR have no obvious pattern. Correlation coefficient of CAR has fluctuated among positive and negative, with the...
highest value in financial crisis (2007) and lowest value in 2011. Correlation coefficients of NPLR are always negative, with the fact that the highest results of correlation were in the post-crisis (2009), and the lowest value is in 2007. These lead us to infer that our variables are more aligned in periods of high instability.

From the p-values of correlation coefficients, we find that all the p-values for CAR are larger than 0.05 which is accordance with the results from the one with 7-year observations. As to the p-values for NPLR, it is surprising that not all the p-values are significant as the one we did with 7-year observations. P-value exactly following the financial crisis has showed a p-value larger than 0.05. In words, the relationship between CAR, NPLR and ROE is not stable.

5.3.4 Hypothesis 4

According to the results that are presented by hypothesis 3 and hypothesis 4, we have concluded that there is a correlation between CAR and ROA and between NPLR and ROA of banks. To test the stability of such relationship, we did the same as in hypothesis 5 and hypothesis 6. That is, to make regressions of 6 sub-periods. The following are regressions 9 to 14:

\[
ROA_1 = \beta_1 + \beta_2 \times CAR_1 + \beta_3 \times NPLR_1 + \beta_4 \times LNTA_1
\]
\[
ROA_2 = \beta_1 + \beta_2 \times CAR_2 + \beta_3 \times NPLR_2 + \beta_4 \times LNTA_2
\]
\[
ROA_3 = \beta_1 + \beta_2 \times CAR_3 + \beta_3 \times NPLR_3 + \beta_4 \times LNTA_3
\]
\[
ROA_4 = \beta_1 + \beta_2 \times CAR_4 + \beta_3 \times NPLR_4 + \beta_4 \times LNTA_4
\]
\[
ROA_5 = \beta_1 + \beta_2 \times CAR_5 + \beta_3 \times NPLR_5 + \beta_4 \times LNTA_5
\]
\[
ROA_6 = \beta_1 + \beta_2 \times CAR_6 + \beta_3 \times NPLR_6 + \beta_4 \times LNTA_6
\]

The regression 9 contains observations in year 2012, the regression 10 contains observations in year 2011, the regression 11 contains observations in year 2010, the regression 12 contains observations in year 2009, the regression 13 contains observations in year 2008 and the regression 14 contains observations in year 2007. The following table and figures are the results of those 6 regressions:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.23</td>
<td></td>
<td>-0.04</td>
<td>0.007</td>
<td>-0.05</td>
<td>-0.002</td>
<td>0.05</td>
<td>-0.044</td>
<td>0.098</td>
</tr>
<tr>
<td></td>
<td>(0.342)</td>
<td>(0.240)</td>
<td>(0.654)</td>
<td>(0.222)</td>
<td>(0.954)</td>
<td>(0.093)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NPLR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.085</td>
<td></td>
<td>-0.121</td>
<td>0.069</td>
<td>-0.054</td>
<td>0.009</td>
<td>-0.009</td>
<td>-0.030</td>
<td>0.069</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.002)</td>
<td>(0.029)</td>
<td>(0.120)</td>
<td>(0.779)</td>
<td>(0.790)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 12 Correlation coefficient of CAR, NPLR and ROA across years (the p-values are in the brackets)

![Correlation Coefficient of CAR, NPLR and ROA](image)

Figure 11 Trend for correlation coefficient of CAR, NPLR for ROA across years

Compared with the regressions of dependent variable ROE, the regressions of ROA seems to experience large waves from 2007 to 2012. The patterns for both CAR and NPLR are fluctuating between negative numbers and positive numbers. Therefore, the relationships between CAR and ROA and between NPLR and ROA are not constant, and always in change. The figure indicates no obvious pattern of the two broken lines. The highest result of correlation coefficient of CAR is in the beginning of financial crisis (2007), while the lowest result is in year 2012, respectively. Moreover, the highest value of correlation coefficient of NPLR is in year 2010, while the lowest is in year 2011. In addition, the correlation coefficient of CAR and NPLR for ROA has demonstrated a more violate trend than for ROE, therefore indicates a higher instability of the relationship.

As to the p-values for those correlation coefficients for CAR, all of them have a number larger than 0.05 which show an insignificant relationship. This is accordance with regression 1. The p-values for NPLR in and followed with the financial crisis are larger than 0.05, while the p-value begins to be less than 0.05 from 2010. In words, the relationship between CAR, NPLR and ROA is not stable.
Chapter 6 Discussion of Results

In this chapter we will discuss our findings which have been presented in the previous chapter. We will first start with the insignificant results of our regression followed by the significant results followed. Then we will discuss the hypotheses regarding to the stability of relationships.

6.1 Insignificant results

Firstly, we will start our discussion with the insignificant results:

**Hypothesis 1**: There is no correlation between CAR and NPLR and ROE of commercial banks.

**Hypothesis 2**: There is no correlation between CAR and NPLR and ROA of commercial banks.

From the previous chapter, the results (see tables 9 and 10) show that the p-value for CAR with dependent variable ROE is 0.135 and the p-value for CAR with dependent variable ROA is 0.465. Therefore, we cannot reject the first part of hypothesis 1 and hypothesis 2. That is to say, we are unable to find a significant relationship between existence of CAR and ROE and between CAR and ROA. As to the control variable, we are also unable to find a significant relationship between ROE and LNTA.

This result is not accordance with some of the previous researches, including the research conducted by Ara, Bakaeva and Sun (2009) in Sweden, the research conducted by Tibebu (2011) in Ethiopia and the research conducted by Samy and Magda (2009) in Egypt. All of these researches found a positive relationship between CAR and ROE or between CAR and ROA. It is natural to consider that the CAR internalized the risk for stakeholders and hence faces lower cost of funding and further supports for higher ROE and ROA. However, there are some other researches that found no relationship between CAR and ROA and between CAR and ROE, including the one conducted by Kithinji (2010) in Kenya. Kithinji could not find a relationship between CAR and ROA based on the data from 2004 to 2008 of 43 commercial banks in Kenya.

One thing which is interesting from our result is that, although the relationship is not significant, the correlation coefficient of CAR for both ROE and ROA is negative. That is to say, the CAR could negatively affect the banks’ profitability. From the theoretical framework we know that CAR is total capital to the risk-weighted sum of bank’s assets (Hyun & Rhee, 2011, p. 325). Therefore, the negative number could mean that in order to keep a higher CAR, banks will restrict their activities which
could be negatively associated with bank development, adversely affecting banks’ expansion and growth. In addition, this kind of regulation on banks’ activities may increase banks net interest margins or overhead costs (Samy & Magda, 2009, p. 72). The blocked development, the increased overhead cost or net interest margin could lead to the adverse effect of profitability of commercial banks. In this way, the CAR could negatively affect the profitability of commercial banks.

As to the insignificant results, they could possibly come from the type II error. It is an error that occurs when one fails to reject a hypothesis when it in fact should be rejected (Bryman & Bell, 2007, p. 370). This means that our alternative hypothesis could be actually true, but our model is not able to detect this relationship. It cannot be neglected that the two regressions have a $R^2$ only to be 0.08 and 0.10. This is a signal that our model does not have a good overall fit. Further, it could attribute to omitted variables that we need to take into account in order to make the results significant, such as location variables. This could be one possible explanation that we found an insignificant relationship between CAR and ROE and CAR and ROA.

As we have mentioned before, the determinant of profitability of commercial banks is attributed to internal control and external control. The external determinants of profitability contain factors such as economic environment. As we have known, our time horizon stretches across financial crisis periods that have enormous effects on the European economy. During the financial crisis, the system risks play an important role in the profitability of commercial banks which is not controllable by humans. Therefore, the variable ROE and ROA could be affected abnormally during such periods. This could be another explanation of the insignificant relationships.

6.2 Significant results

Secondly, we will discuss the significant results of the two regressions. The results (see tables 9 and 10) show that the p-values for NPLR for both ROE and ROA are 0.000 and the p-value for LNTA and ROA is 0.001. They are therefore signals that we can reject the second part of the hypothesis 1 and hypothesis 2. That is to say, the relationships between NPLR and ROE and between NPLR and ROA truly exist. Besides, there is a negative relationship between bank size and ROA. According to the correlation coefficient from table 7 and 8, we conclude that for every one percent increase in NPLR, holding other things constant, ROE and ROA for commercial banks will decrease by 1.45 percent and 0.056 percent.

The negative correlations between NPLR and ROE and NPLR and ROA are in accordance with most of the previous researches which are conducted in one specific country, including the one conducted by Kargi (2011) in Nigeria, one conducted by Epure and Lafuente (2012) in Costa-Rican banking industry, one conducted by Ara, Bakaeva and Sun (2009) in Sweden and one conducted by Felix and Claudine (2008). All the mentioned researches have found an inverse relationship between the NPLR
From the theoretical framework, we know that NPLR is a financial indicator that demonstrates the quality of bank loans. Commercial banks are exposed themselves to the risk of default or late payment from loan borrower. The core activity of commercial banks is to make loans. Banks make money from a series of activities of borrowing and deposit. NPL is considered as losses when happens. Higher NPLR means higher losses, which adversely influence the banks’ available capital for further borrowing. Hence, the efficiency of banks’ investment is affected, further influencing the profitability. On the contrary, lower NPLR is related with the lower risk and deposit rate, meaning a positive impact on banks’ operations. Consequently, higher NPLR plays a negative role on commercial banks’ profitability.

The negative relationship between bank size and ROA seems surprising for us since previous researches have found a positive relationship (Demirgüç-Kunt & Huizinga, 2012; Kupiec & Lee, 2012). The incompletion of our model could be the potential explanation to the result. Therefore, improving our model will be suggested in the further research. In addition, another explanation of this could be that the larger the bank is, the more managerial inefficiencies and risks it will face, which could inversely affect the ROA of commercial banks.

6.3 Stability of relationship

As to test the stability to of those relationships, we have presented hypothesis 3 and hypothesis 4:

**Hypothesis 3:** The correlation between CAR and NPLR and ROE is stable over time.

**Hypothesis 4:** The correlation between CAR and NPLR and ROA is stable over time.

It is obvious from results (see tables 11 and 12, figures 10 and 11) that the relationships between CAR and ROE and between CAR and ROA are not stable, always in change. All the relationships with independent variable CAR are insignificant at 95% confidence level. Moreover, the correlation coefficient of CAR fluctuates from positive to negative. These could be explained by the contradictory prediction of the relationship between CAR and ROE and ROA. Higher CAR could internalize the risk for stakeholders and hence banks face lower cost of funding and further support for higher ROE and ROA. However, banks would restrict their activities which could be negatively associated with bank development in order to keep higher CAR and this could increase banks’ net interest margins or overhead costs. The mixed effects can lead to the fluctuating correlation coefficients among positive and negative numbers.

As to the relationship with NPLR and ROE (see table 11 and figure 10), we found that
the relationship stays most moderately except for 2009, showing a peak. The relationship between NPLR and ROA (see table 12 and figure 11) seems to be more violating than the relationship with ROE, with correlation coefficients fluctuating from negative to positive in year 2008 and then fell back to negative in 2009 with a positive peak followed in 2010. We consider that one explanation to the strange pattern could be due to the effect of financial crisis, making the regression biased to some extent by the systematic risks. This could make the independent variable ROE and ROA affected heavily by turmoil financial environment. Another fact that confirms with the explanation is that the one-year relationship around periods of financial crisis seems to be insignificant. Another reason for this could be that the one-year observation is too limited. For a regression with only 47 observations, the results could be not significant and therefore demonstrate a strange pattern.

There is no previous research that has related its study to the stability of results as far as what we have read. Thus, we cannot relate our research to the previous researches.

To conclude, the relationships between CAR and ROE and between CAR and ROA are inconclusive. The relationships between NPLR and ROE and between NPLR and ROA are negative but not stable.

6.4 Improved research model

According to the previous discussion, we make some adjustments to our research model.
In this model, we use red color to represent little relationship between CAR and ROA and ROE. Due to the insignificant result, we also delete the errors between them. Meanwhile, we use green color to show the significant impact of NPLR to ROA and ROE. Green “explosion” shape indicates the unstable relationship between NPLR and ROA and ROE. And natural logarithm of total assets (LNTA) of banks is control variable for the whole test.

**Figure 12 Improved research model**
Chapter 7: Conclusions and Recommendations

The chapter we will make the conclusions for our research and provide suggestions for further research. We begin with the summary of empirical findings and discussion of results, and then present the quality assessment of our study and contributions of our research. The further research’s recommendations will be provided in the end of this chapter.

7.1 Conclusions and Recommendations

In the beginning of our research we have explained that our purpose is to investigate the relationship between credit risk management and profitability of commercial banks in Europe. This was done by collecting data from the largest 47 banks’ annual reports from 2007 to 2012. In order to test the relationship for two abstract concepts, we used proxies for them. We have chosen the ROE and ROA as the proxies for profitability, and CAR and NPLR as proxies for credit risk management. After we have finished the data collection, we used statistic program STATA to test for our research question. We hence made four hypotheses and two regression tests for the two independent variables, ROE and ROA, based on the 6-years data. The second part of our test is concerned with the stability of such relationship. Therefore, we use 6 sub-periods to make more regressions to investigate if the correlation coefficients have large fluctuations.

The research question “What is the relationship between the credit risk management and profitability of commercial banks in Europe from 2007 to 2012?” should be answered after we have made a series of regression analyses. With the statistical evidence, we are able to conclude that there exists a relationship between credit risk management and profitability.

Firstly, our empirical findings show that the relationship between CAR and ROE and CAR and ROE is not significant. This could due to the controversy theoretical prediction of the relationship between CAR and banks’ profitability. The imperfection of our model modification could be another reason for the lack of significant relationships. In addition, the impact of systematic risks during the financial crisis should not be neglected.

Secondly, we found that there is a negative relationship between NPLR and ROE and between NPLR and ROA. This is in accordance with most of the previous researches that conducted in one specific country. The higher the NPLR is, the less the available capital for banks to invest.

Thirdly, the findings of trend for the relationships demonstrate a fluctuating
relationship between all the four variables. This could be explained by the effect of financial crisis which makes the profitability influenced by more economic factors.

Combined with the findings from the two proxies (CAR and NPLR) for credit risk management, we conclude that there is a positive relationship between credit risk management and profitability of commercial banks. That is to say, the better the credit risk management is, the higher the profitability of commercial bank is.

After we have concluded our research, we would like to give some recommendations to commercial banks. Considering there is a positive relationship between credit risk management and profitability, we recommend the bank managers put more efforts to the credit risk management, especially to control the NPL. That is to say, managers should evaluate more accurately regarding the ability to pay back when borrowing. Even though we could not find a relationship between CAR and proxies for profitability, we do not mean that CAR is not important. It is yet an essential aspect when managing risks of commercial banks and should be paid great attention to.

7.2 Quality of the Results

Our study involves indicators to measure concepts. It is crucial for researchers to consider whether or not measures are reliable and whether they are valid representations (Bryman & Bell, 2011, p. 157). In this case, we present the empirical result of investigation on the relationship between credit risk management and profitability in previous chapters for stakeholders. And the purpose of it is to help bank managers and investors to improve the accuracy of their decisions and reduce the inefficiency. Thus the credibility of our research is important. To assess the credibility of research, two aspects will be discussed in this section: reliability and validity.

7.2.1 Reliability

Bryman & Bell refer to reliability is “the consistency of a measure of a concept”. One of the important factors when considering whether a measure is reliable is stability. It focuses on the stability of measure over time, therefore the results from that measure will have little variation (Bryman & Bell, 2011, p.158). In our research, the data we use is numerical and objectively collected. Thus our study is stable because it would be impossible to get different results from identical research in any other times. In addition, to maintain the accuracy of this, the test must be conducted in the consistent method and identical source of data (Bryman & Bell, 2011, p.41). Another very similar criterion to reliability is replication which emphasizes the capacity of replication to the research (Bryman & Bell, 2011, p.41). It needs us “spell out” our research procedure in a great detail so that allowing replication becomes impossible.
for someone else (Bryman & Bell, 2011, p.41). In this research, we discuss our research process in detail and try to present a clear and reasonable procedure for readers. Thereby it is possible to replicate our research and obtain the same results.

7.2.2 Validity

Carmines and Zeller (1979, p.12) mention the validity is regarded as an indicator of “abstract concept” and is measured exactly to what it intend to measure. It is also regarded as the most important criterion of research by Bryman & Bell (2011). Validity has several types. Measurement validity concerns whether or not a measure devised of a concept exactly indicates the concept (Bryman & Bell, 2011, p.42). Internal validity focuses on the question of causality which essentially means the causal relationship between two or more variables (Bryman & Bell, 2011, p.43). Besides, validity also has type as external validity. It relates to the capacity of results which can be generalized beyond the specific research context (Bryman & Bell, 2011, p.43). In other words, it means whether the sample of the research can represent the whole population. Ecological validity is another type of validity. Cicourel (1982) discusses that commonly ecological validity is more appropriate in the studies using interviews or surveys and Bryman & Bell (2011, p. 43) also mention the significant influence of social scientist intervention (such as laboratory or interview) to the ecological validity of findings. This study focuses on the objective data analysis, thus we omit the discussion about this term.

In our research, the main concepts are credit risk management and profitability. We use NPLR and CAR to reflect the credit risk management and use ROE and ROA to measure profitability. In banking industry, Basel II has built linkage between minimum regulatory capital and underlying credit risk exposure of banks. And Brewer et al. (2006, p.1045) indicates that lower NPLR may be symbolic of a stronger economic environment and more efficient credit risk management. So that both CAR and NPLR can be considered to correctly reflect the credit risk management. According to Kuan (2008), ROE can be used to measure the efficiency of future profits for banks. And Goddard, Molyneux & Wilson (2004) use ROE and ROA as profitability measure to study the determinants of banks’ profitability in Europe. Therefore, ROE and ROA are valid as profitability measures.

Besides, the causal relationship in this study is to find out whether the independent variables, CAR and NPLR, have any impact on the dependent variables, ROE or ROA. To ensure the relationship is authentic, we perform the statistical tests to measure multicollinearity and heteroscedasticity. The results from statistical tests show that our data does not have problem of multicollinearity but has the problem of heteroscedasticity. However, we have made remedies for the heteroscedasticity which ensure our estimation would not be biased. Moreover, there might have other factors which may affect the relationship and cause bias so that we also include control variables. We choose size of firms as control variable according to Halsem (1968).
And specifically, as Shalit& Sankar (1977) indicates, we use natural log of total assets as the measure of bank’s size.

For external validity, our purpose of the study is to investigate the relationship between credit risk management and profitability of commercial banks in the whole Europe. Hence the population should be all commercial banks in Europe. Our research considers 47 largest banks in Europe. Banks in large size have bigger share in the European banking market which means higher portion of domain to influence the market. Small banks have tiny influences to the whole European banking market. Therefore our sample is the most representative group and has no problem with external validity.

### 7.3 Theoretical and Practical Contribution

We managed to fill a gap in the previous research of testing the relationship between profitability and credit risk management in Europe. And we provide bank managers and investors further understanding by testing how the measures of profitability are affected by the measures of credit risk management. All of these contribute valuable information for bank managers, financial analysts, investors and supervisors when they make relevant decisions.

Another contribution of our research is that companies currently have better knowledge and understanding of the impact of credit risk management to bank’s profitability. They are supposed to reconsider how to manage and allocate the capital and non-performing loans, at least until further research has established. It also provides supervisors with an expression whether the regulated ratio has effect on banks’ profitability. Since there is a negative relationship between non-performing loan ratios and profitability’s indicators, supervisors might have the requirements to strengthen the non-performing loans to help banks to operate more efficiently.

### 7.4 Suggestions for Further Research

Based on our findings, we want to draw several suggestions for further research.

One of the recommendations that can be done to the research model is to include more indicators. As we mentioned before, our model is referenced from other researches with same topic but only specified in one country. Our model has a quite low $R^2$ based on data from Europe, which shows that our model does not have a satisfying overall fit. Therefore, we consider the model needs to be improved. Adding more variables could be one suggestion. In our research, we use CAR and NPLR to represent credit risk management and use ROE and ROA as profitability indicators. Except the indicators we involved in the research, other measures can also indicate the profitability and credit risk management. Therefore, if could be more interesting to
include more indicators to test the relationship. Meanwhile, it can help researchers to enhance the accuracy of the research model with the most suitable variables.

In addition, we recommend including more companies for this research. In our research, we involve 47 banks in Europe which we believe are the most representative. We initially intend to cover 50 banks but finally we only get access to the data of 47 banks. If the time and resources are available, it could be more convincing to involve more samples in the study. However, many commercial banks in Europe are too small to publish their annual reports or key figures. Some of them only have influence to their local market but hard to represent the whole Europe. To collect more data, the connection with the banks or authorities might be necessary.

Another way to develop the existing research would be performing similar research but on a different area. In the previous studies, Ara, Bakaeva & Sun (2009) have studied the same topic in Sweden. And Tefera (2011), Afriyie & Akotey (2012) and Kithinji (2010) have independently developed this research in Ethiopia, Ghana and Kenya, etc. In our research, we apply this topic to the Europe. Therefore, extending this research to other area, for example global banking industry, would be more interesting to uncover the impact of credit risk management to the profitability of banks. Besides, the results of the same topic in different areas are not same. Thus comparing the similar research by discussing the differences among these researches is also valuable.

We focus on credit risk management and profitability of commercial banks. Further research suggestion could be move the core of credit risk management to other risks management. For the banking industry’s development, diversified types of banks have built to satisfy the demand of innovation in financial markets. In our research, we focus on commercial banks while many of them are also investment banks. Further research can focus on the risk management measurement of the investment banks. Except the credit risk management, liquidity risk, market risk, operational risk or reputational risk can also be taken into consideration. In addition, profitability is only one aspect of banks’ financial performance. Exploring the other aspects of financial performance is also an interesting expansion for this research.
Reference list:


Kargi, H.S. (2011). *Credit Risk and the Performance of Nigerian Banks*. AhmaduBello University, Zaria


## APPENDIX 1: 47 Largest Commercial Banks in Europe by Total Assets

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Country</th>
<th>Total Assets (€B) Dec. 31, 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSBC Holdings Plc</td>
<td>UK</td>
<td>2041.3</td>
</tr>
<tr>
<td>Deutsche Bank AG</td>
<td>Germany</td>
<td>2022.3</td>
</tr>
<tr>
<td>Credit Agricole Group</td>
<td>France</td>
<td>2008.2</td>
</tr>
<tr>
<td>BNP Paribas SA</td>
<td>France</td>
<td>1907.2</td>
</tr>
<tr>
<td>Barclays Plc</td>
<td>UK</td>
<td>1833.3</td>
</tr>
<tr>
<td>Royal Bank of Scotland Group Plc</td>
<td>UK</td>
<td>1616.2</td>
</tr>
<tr>
<td>Banco Santander SA</td>
<td>Spain</td>
<td>1280.2</td>
</tr>
<tr>
<td>Societe Generale SA</td>
<td>France</td>
<td>1250.7</td>
</tr>
<tr>
<td>Lloyds Banking Group Plc</td>
<td>UK</td>
<td>1149</td>
</tr>
<tr>
<td>Group BPCE</td>
<td>France</td>
<td>1147.5</td>
</tr>
<tr>
<td>UBS AG</td>
<td>Switzerland</td>
<td>1043.8</td>
</tr>
<tr>
<td>UniCredit SpA</td>
<td>Italy</td>
<td>927.1</td>
</tr>
<tr>
<td>ING Bank NV</td>
<td>Netherlands</td>
<td>836.1</td>
</tr>
<tr>
<td>Credit Suisse Group AG</td>
<td>Switzerland</td>
<td>1043.8</td>
</tr>
<tr>
<td>Rabobank Group</td>
<td>Netherlands</td>
<td>752.4</td>
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<tr>
<td>Nordea Bank AB</td>
<td>Sweden</td>
<td>677.3</td>
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<tr>
<td>Intesa Sanpaolo SpA</td>
<td>Italy</td>
<td>673.5</td>
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<tr>
<td>Banco Bilbao Vizcaya Argentaria SA</td>
<td>Spain</td>
<td>637.8</td>
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<tr>
<td>Commerzbank AG</td>
<td>Germany</td>
<td>636</td>
</tr>
<tr>
<td>Standard Chartered Plc</td>
<td>UK</td>
<td>482.7</td>
</tr>
<tr>
<td>Danske Bank A/S</td>
<td>Denmark</td>
<td>467.1</td>
</tr>
<tr>
<td>DZ Bank AG</td>
<td>Germany</td>
<td>407.2</td>
</tr>
<tr>
<td>ABN AMRO Group NV</td>
<td>Netherlands</td>
<td>393.8</td>
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<tr>
<td>La Caixa</td>
<td>Spain</td>
<td>380.6</td>
</tr>
<tr>
<td>OAO Sberbank of Russia</td>
<td>Russia</td>
<td>375.1</td>
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<tr>
<td>Dexia SA</td>
<td>Belgium</td>
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<tr>
<td>Landesbank Baden-Wurttemberg</td>
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<td>DNB ASA</td>
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<td>Bayerische Landesbank</td>
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<td>KBC Group NV</td>
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<td>243.6</td>
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<tr>
<td>Nationwide Building Society</td>
<td>UK</td>
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<td>Norddeutsche Landesbank Girozentrale</td>
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<td>Banca Monte dei Paschi di Siena SpA</td>
<td>Italy</td>
<td>218.9</td>
</tr>
<tr>
<td>Name</td>
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<td>Score</td>
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<td>-----------------------------------</td>
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</tr>
<tr>
<td>Swedbank AB</td>
<td>Sweden</td>
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</tr>
<tr>
<td>Erste Group Bank AG</td>
<td>Austria</td>
<td>213.8</td>
</tr>
<tr>
<td>Belfius Banque SA</td>
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<td>212.9</td>
</tr>
<tr>
<td>Landsbank Hessen-Thuringen Girozentrale</td>
<td>Germany</td>
<td>199.3</td>
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<tr>
<td>La Banque Postale</td>
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<tr>
<td>Nykredit Realkredit A/S</td>
<td>Denmark</td>
<td>192.1</td>
</tr>
<tr>
<td>OAO VTB Bank</td>
<td>Russia</td>
<td>184.2</td>
</tr>
<tr>
<td>Hypo Real Estate Holding AG</td>
<td>Germany</td>
<td>169</td>
</tr>
<tr>
<td>Banco de Sabadell SA</td>
<td>Spain</td>
<td>167.5</td>
</tr>
<tr>
<td>Banco Popular Espanol SA</td>
<td>Spain</td>
<td>157.6</td>
</tr>
<tr>
<td>Bank of Ireland</td>
<td>Ireland</td>
<td>148.1</td>
</tr>
<tr>
<td>Raiffeisen Zentralbank Osterreich AG</td>
<td>Austria</td>
<td>146</td>
</tr>
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</table>

*Source: SNL Financial*

**APPENDIX 2: Scatterplots of variables including outliers**

![Scatterplots](image-url)
APPENDIX 3: Histograms for variables including outliers
APPENDIX 4: Whit tests for heteroscedasticity

Exhibit 4.1: Test for heteroscedasticity for return on assets (ROA)

White’s test for Ho: homoskedasticity against Ha: unrestricted heteroskedasticity

\[
\text{chi}^2(9) = 81.17 \\
\text{Prob} > \text{chi}^2 = 0.0000
\]

Cameron & Trivedi’s decomposition of IM-test

<table>
<thead>
<tr>
<th>Source</th>
<th>chi2</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroskedasticity</td>
<td>81.17</td>
<td>9</td>
<td>0.0000</td>
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<tr>
<td>Skewness</td>
<td>28.43</td>
<td>3</td>
<td>0.0000</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>2.31</td>
<td>1</td>
<td>0.1282</td>
</tr>
<tr>
<td>Total</td>
<td>111.92</td>
<td>13</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Exhibit 4.2: Test for heteroscedasticity for return on equity (ROE)

```
. imtest, white
```

White’s test for Ho: homoskedasticity against Ha: unrestricted heteroskedasticity

\[
\text{chi}^2(9) = 20.46 \\
\text{Prob} > \text{chi}^2 = 0.0153
\]

Cameron & Trivedi’s decomposition of IM-test

<table>
<thead>
<tr>
<th>Source</th>
<th>chi2</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroskedasticity</td>
<td>20.46</td>
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<td>0.0153</td>
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<tr>
<td>Skewness</td>
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<tr>
<td>Kurtosis</td>
<td>1.44</td>
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<tr>
<td>Total</td>
<td>30.66</td>
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<td>0.0038</td>
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