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# THE IMPACT OF BASEL II REGULATION IN THE EUROPEAN BANKING MARKET

*- A panel data analysis approach*

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Financial Economics

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# Abstract

This thesis aims to investigate if the improved capital regulatory framework implemented by the Basel Committee on Banking Supervision has had any effect on the capital adequacy ratio of selected banks. A sample of twenty-four European banks was chosen to represent the European banking market as a whole, and a panel data approach was used. To evaluate if any difference occurred between the time period before and after the implementation, a multiple regression analysis using Ordinary Least Squares and Fixed Effects was carried out. Capital adequacy ratio was set as the dependent variable, and Equity ratio, Net loans over total assets, Return on assets, Liquid assets over total deposits and Non-performing loan ratio as independent variables. A dummy variable was added to each independent variable to distinguish the ratios before the implementation with those from the period after. Further, a bank-dummy variable for each bank was also added to the model in order to count for bank-specific differences and to not let these bias the result.

The Robust FE result showed that five independent variables had a significant effect on the capital adequacy ratio, and that the effect has changed since the implementation of Basel II. It also showed that the mean value of the capital adequacy ratio has increased by approximately two percent. The model proved that Basel II has had a statistically significant effect, but in reality this effect was quite unpretentious related to how big and expensive the implementation process has been. We consider our regression reliable on the basis of an accurate selection of the econometric methods used and a significant result, even though the effect of Basel II turned out to be minor compared to what we expected it to be.

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# 1. Introduction

*In the introduction, the background to our thesis will be presented together with previous studies within the chosen research field. This is followed by a problem discussion where our research question and hypotheses will be stated. The last section will give the reader an understanding of the purpose and relevance of this study.*

## 1.1 Background

The main purpose of a commercial bank is to work as a financial intermediary between lenders and borrowers. Financial markets all around the world have changed their shape in the recent decades as the providers of financial services have enlarged their breadth of activities provided to the public. At the same time, banking crises have become increasingly frequent with devastating effects for both individuals and societies (Büyükşalvarci & Abdioğlu 2011). This has led to the development of capital regulations, which is supposed to prevent or at least decrease the frequency of banking crises by prohibiting banks from excessive risk-taking behavior (Behr, Schmidt & Xie 2009). A common way to achieve this is by introducing minimum capital requirements that banks need to hold as reserves. These requirements have been initiated in different ways by national regulators, but have reached an international harmonization the last years thanks to the Basel Committee on Banking Supervision, generally mentioned as Basel I and Basel II (Büyükşalvarci & Abdioğlu 2011). The Basel Committee on Banking Supervision was founded in 1974 by the central banks of the Group of Ten countries, G10.[1] The Committee seeks to work as a forum for its member countries, and contribute to cooperation on banking supervisory questions. It has three main ways to attain this: by exchanging information on national regulations, by improving techniques for monitoring international banking, and by setting minimum supervisory standards. Basel I from 1988 defined what capital is and divided it into core capital, Tier 1, and supplementary capital, Tier 2. Basel I explicitly focused on credit risk and required banks to hold a minimum capital, consisting of both Tier 1 and Tier 2, of eight percent of risk-weighted assets. Basel II was created as a continuation of the first accord, but was enlarged to also include operational risk and market risk, and to further increase the requisitions on supervision and market discipline (BCBS 2009).

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[1] G10: Belgium, Canada, France, Italy, Japan, the Netherlands, the United Kingdom, the United States, Germany, Sweden and Switzerland (BCBS 2009).

In recent years, an extensive number of reports and papers have studied the impact of harder capital regulations on profitability, using different variables and techniques. A study done by Schanz, Aikman, Collazos, Frag, Gregory and Kapadia (2010) for the Basel Committee shows that higher requirements regarding capital and liquidity can significantly abate the probability of banking crises in the long term, and clearly raise the security and soundness of the global financial market system. These benefits are also found to considerably go beyond the costs of higher requirements on capital and liquidity.

Büyükşalvarci and Abdioğlu (2011) analyzed determinants of capital adequacy ratio in Turkish banks. This investigation was based on yearly data between 2006 and 2010 from twenty-four Turkish banks and analyzed using a panel data approach. Nine bank-specific variables were used with capital adequacy ratio (CAR) as the dependent variable. The explanatory variables used were bank size, deposits, loans, loan loss reserve, liquidity, profitability (ROA and ROE), net interest margin and leverage. Their results indicate that loans, return on equity (ROE) and leverage have a negative effect on CAR, and loan loss reserve and return on assets (ROA) affect CAR positively. The remaining variables bank size, deposits, liquidity and net interest margin did not appear to have any significant effect on CAR.

Using a panel data regression model, Ahmad, Ariff and Skully (2008) examined how banks in Malaysia set capital ratios and if decisions regarding the size of these are related to their risk-taking and changes in regulatory capital requirements. CAR is used as the dependent variable. The independent variables were the following: Non-performing loans, a risk index, a low capital bank-dummy, a year-dummy, net interest margin, total equity ratio, a dummy for the year 1996, and total assets. Their study showed that non-performing loans and risk index indicated a significant correlation between bank capital and risk-taking behavior.

In this thesis, the same econometric angle of approach as Büyükşalvarci and Abdioğlu (2011) and Ahmad, Ariff and Skully (2008) will be used, but applied to selected banks in Europe. An OLS multiple regression will be created based on annual data between the years 2003-2012 for twenty-four European banks. A dummy variable will be added to each independent variable, where the number one indicates a year after Basel II was implemented, and the number zero if not. The purpose of this is to capture a possible difference before and after the introduction of Basel II. To avoid that internal differences between the banks affect our result, a bank-specific dummy variable was also added to each bank and the technique of Fixed Effects was used (Ahmad, Ariff & Skully 2008). The intention for this was to choose a number of banks that together represent a great part of the total banking market in Europe, and therefore can be seen as an adequate sample representing the European banking market as a total. The question if higher capital requirements have had an impact on the banking market participants is of high interest at the moment partly due to the aftermath of the financial crisis that began in 2008, but also since the Basel Committee has started the implementation of an even more comprehensive accord, Basel III (BIS 2010).

## 1.2 Problem discussion

Previous research within this area together with our research question forms the base of this thesis. Since the implementation of Basel II started in 2007, several studies have been done to evaluate if improved requirements for banks have had any effect on the way that banks handle their internal behavior concerning risk-taking and capital reserves, and if so, how big this difference is. Even though the Basel Committee on Banking Supervision has begun the development of Basel III, Basel II is the current regulatory framework used on an international basis. Member countries will start implementing Basel III 2013, but it will not be fully adopted until 2019 according to the present phase-in-arrangements (BIS 2012). Therefore, it is still of relevance to evaluate the impact of Basel II. By creating and executing a regression analysis with a dummy variable on each independent variable and a bank-specific dummy for each bank, the ambition is to capture and isolate a possible difference that can be derived to the introduction of Basel II. This thesis and its research question can thus be divided into two dimensions; the first one is an econometrical dimension where the aim is to evaluate if the regression model shows a statistically significant result. The second one has a more empirical approach, as the purpose is to discover whether the Basel II implementation has had any effect on European banks based on selected financial ratios. The following research question has been stated:

*How have the expanded capital requirements of Basel II affected the European banking market and its way of holding capital relative to its risk?*

## 1.3 Purpose

By doing a multiple regression with capital adequacy ratio as the dependent variable and Return-on-assets, net loans over total assets, liquid assets to total deposits, equity to total assets and non-performing loan ratio as independent variables, the purpose is to evaluate if and how the implementation of Basel II in the beginning of 2007 has had any measurable effect on these variables. Ahmad, Ariff and Skully (2008) did a similar study on Malaysian banks, and Büyükşalvarci and Abdioğlu (2011) on Turkish banks. By choosing a sample of data from banks in six European countries, our intention is to contribute to the available research within this area, but from a European point of view. The result of our thesis should be of interest for further empirical studies within the area of capital regulations.

# 2. Methodology

*In this section, a full presentation of the methodology used in this thesis will be made. The first section, theoretical background, will present facts about the Basel Committee, Basel I and II. This will be followed by a presentation of the theoretical framework, which is the model that our study is based on and the data collected.*

## 2.1 Theoretical background

*In the theoretical background, the reader will be given an introductory description of the Basel Committee and its history. A presentation of the current legislation "Basel II" will follow, and its impact on the international banking market.*

### 2.1.1 The Basel Committee

The Basel Committee on Banking Supervision, BCBS, was established in 1974 by the central banks of the G10 countries because of severe disturbances in international currency and banking markets. Since the start, the aim with the Committee has been to improve the knowledge of the importance and quality of banking supervision on a global level. Another objective is to provide a forum for regular cooperation between its member countries. The Committee seeks to achieve this in three main ways: by exchanging information on national supervisory arrangements, by improving the effectiveness of techniques for supervising international banking business, and by creating minimum supervisory standards in areas where they are considered to be desirable. One important part of the Committee's work has been to close gaps in international supervisory coverage. The goal is that no foreign banking establishment should escape from supervision, and that the supervision always should be adequate for the purpose of a more stable financial market (BCBS 2009).

### 2.1.2 Basel I and Basel II

In recent years, the Committee has focused heavily on the capital adequacy in large financial institutions. In the early years of the 1980s, the Committee became concerned that the capital ratios of the most important international banks were decreasing just at the time when international risks were growing. This led to a decision to prevent further decrease of capital standards and to start working towards larger convergence in the measurement of capital adequacy. In 1988, The Basel Committee implemented a capital measurement system referred to as the Basel Capital Accord, or Basel I. This system included a framework with a minimum capital ratio of capital to risk-weighted assets, which all the G10 countries met at the end of 1993 (BCBS 2009).

The 1988 Accord focused mainly on credit risk, but the Committee continued its work to also include other risks in the framework. In 1999, the Committee proposed a new capital adequacy framework that was supposed to enlarge and replace the one from 1988. After a few years of refinements the New Capital Framework, entitled Basel II, was finally released in June 2004. Basel II consists of three pillars: Minimum Capital Requirements, Supervisory Review Process, and Market Discipline (BCBS 2009).

#### *2.1.2.1 Pillar I – Minimum Capital Requirements*

The first pillar gives details regarding how to calculate minimum capital requirements for credit, market and operational risk. A bank must hold a capital ratio that cannot fall below eight percent.

$$Capital\ adequacy\ ratio = \frac{Tier1 + Tier2}{Risk - weighted\ assets}$$

Banks are in general able to choose between a Standardized and an Internal Rating-Based Approach (IRB) when calculating their capital requirements for credit risk. If a bank chooses the Standardized Approach, capital requirements are calculated based on credit ratings of external rating agencies that have been approved by the Basel Committee. Examples of approved rating agencies are Standard&Poor's and Moody's. If a bank is allowed to use the Internal Rating-Based Approach, it can custom its own internal classifications to calculate the required capital. To be able to use the IRB Approach, a bank must receive an approval from the supervisor in the country where it is located

(BCBS 2004). As an example, the Swedish Financial Supervisory Authority, Finansinspektionen, allows Swedish financial institutions to choose between a Standardized Approach and an Internal Rating-Based Approach. Operational risk is defined as the risk of loss as a result of inadequate or failed internal processes, systems, people, or from external events. Basel II gives three methods for calculating operational risk: The Basic Indicator Approach, The Standardized Approach and Advanced Measurement Approaches, AMA, (BCBS 2004). Concerning market risk, which is the risk of losses caused by movements in market prices and volatilities, Basel II allow banks to choose between a Standardized Approach and an Internal Model Approach (Dierick, Pires, Scheircher & Spitzer 2005).

#### *2.1.2.2 Pillar II – Supervisory review process*

The second pillar aims to control that the capital adequacy position of a bank is consistent with its overall risk profile, and can be seen as a support to the first pillar. It covers guidance concerning risks that is not taken into account by the first pillar, for example interest-rate risk in the banking book, business and strategic risk. If pillar one can be considered as to determine the minimum level of capital, pillar two can be seen as a guidance of a bank's optimal level of capital (Roberts 2008).

#### *2.1.2.3 Pillar III – Market Discipline*

The purpose of the third pillar is to work as a complement to the first and second pillar. The Committee encourages market discipline by implementing disclosure requirements regarding risk assessment processes and capital adequacy of the institution. A bank's disclosures should be homogeneous with how senior management and the board of directors handle the risk (BCBS 2004).

## 2.2 Theoretical framework

*In this section, the basis of econometrics and economic data will be presented. The focus will be on multiple regression analysis which is the most commonly used method in empirical research as well as the approach used for the analysis part.*

### 2.2.1 Regression analysis

Regression analysis is one of the most important tools within the econometric field. Generally, regression is about describing and analyzing the relationship between a certain variable and one or several other variables. Specifically, it is an attempt to explain changes in a variable, usually called the dependent or explained variable, by reference to changes in one or more variables, usually named independent or explanatory variable/-s. If the regression contains only one independent variable, it is called a simple regression. If it is based on more than one independent variable, it is denoted a multiple regression (Wooldridge 2009:22-23).

A simple linear regression is suitable to use if it is believed that the dependent variable can be explained by only one independent variable. This is a restricted situation but can be useful when for example testing a long-term relationship between two assets prices. The model for a perfect simple regression says with complete certainty what the value of one variable would be given any value of the other variable. This is not realistic because it would in reality correspond to a situation where the model fitted the data perfectly and all observations would lay exactly on a straight line. Therefore, in reality, an error term is added to the model. The error term captures random effects on the dependent variable that cannot be modeled or missing data in the sample (Brooks 2008:29-31). The simple regression model has the following look:

$$y = \beta_0 + \beta_1 x + u$$

In reality, the dependent variable depends on more than just one independent. It is therefore appropriate to include more independent variables and expand the simple model to a multiple regression model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + u$$

By adding more independent variables, factors that were earlier included in the error term now is included as independent variables in the model. $\beta_1 \ldots \beta_k$ are the parameters, or coefficients, which quantify the effect that the independent variables have on the dependent variable. Each coefficient gives a measure of the average change in the dependent variable for a one unit change in a certain independent variable. Both the simple and the multiple regression models contain a constant term, $\beta_0$, which is not affected by any independent variable. The constant term can be seen as the intercept, and denoted as the average value that the dependent variable would take if all the independent variables took a value equal to zero (Brooks 2008:88-89).

### 2.2.2 Characteristics of the data

In general, there are three types of data that is suitable when a quantitative analysis is used to solve financial problems: time series data, cross-sectional data and panel data. Time series data are the ones that have been collected on one or several variables over a period of time, and can be either quantitative or qualitative. Cross-sectional data are data collected at a certain point of time, either for one variable or for several depending on the extent of the analysis (Brooks 2008:3-4). Panel data, or longitudinal data, can be seen as a combination of the two previous. It consists of a group of cross-sectional units observed over two or more time periods (Hill, Griffiths & Lim 2011:538). When collecting data for our quantitative analysis, certain specified cross-sectional units are selected and they are observed over time. This method of data collection is consistent with the panel data approach. A panel dataset should contain data on N cases and over T time periods, for a total of N×T observations (Hsiao, Hammond & Holly 2003:14). Applied to the model of this thesis, we have:

$$N \times T = 24 \times 10 = 240 \ observations$$

In this case, N>T which is denoted a short panel. If N<T, it is called a long panel. This panel data is also what is called a balanced panel, which means that each cross-sectional unit has the same number of observations. If the panel data is not balanced, it is called unbalanced and each unit has a different number of observations over time (Hill, Griffiths & Lim 2011:538-539).

#### 2.2.3 Estimating the regression result

In the regression, two different methods are used to interpret the result from the multiple linear regression model; *Ordinary Least Squares* (OLS) and *Fixed Effects* (FE).

OLS is used to estimate the parameters in a linear regression model which shows how big impact the explanatory variables have on the explained variable on average. The OLS minimize the sum of squared residuals for a population data set and create a fitted value for each data point in the model. The residual used is the difference between the real value of the dependent value and its average value (Wooldridge 2009:30-31). To assure that the model is reliable, several important assumptions are stated in econometrics. These are referred to as the Gauss-Markov Assumptions and if the regression model fulfill these assumptions it is unbiased and considered as appropriate to use (Wooldridge 2009:84-87,94,104).

FE regression is used in panel data analysis to capture omitted variables that could affect the dependent variable in the model. This is the effects that vary over units but not over time. Ahmad, Ariff and Skully (2008) states that the FE model is appropriate to use in econometrics when the number of units in the regression is specified and the research result are limited of the behavior of these units. The FE regression uses a different intercept for each of the specific units in the model, and can be used when each unit has data points for two or more years (Stock & Watson 2007:356). To specify the different intercepts in our model, a dummy variable is created for each unit. $D1_t$ is the dummy variable for the first bank, and it takes on the value one if it is the particular bank and zero if it is not. Next variable is $D2_t$, which represents the next bank, and so on. We have twenty-four banks in our regression, and including a dummy variable for each one would create perfect multicollinearity. This is also known as the dummy variable trap, and it would damage our regression. Therefore, we exclude the variable $D1_t$ and use this as a benchmark (Stock & Watson 2007:356).

### 2.2.4 Hypothesis testing and interpretation of the result

Before a regression is done, it is of importance to first set up hypotheses that states the aim of the test. Two hypotheses is normally formed, one called the null hypothesis which states that there are no statistical significance in the observations. Before the test is done, a significance level must also be chosen. The significance level is the probability that the null hypothesis is rejected when it is in fact true. The most conventional significance level within finance is five percent, thus both ten percent and one percent are used. When the null hypothesis is rejected wrongly something called Type One error arises. Every time the null hypothesis is rejected, a Type One error may have been made (Hill, Griffiths & Lim 2011:102). The goal is to either reject or accept the null hypothesis. To be able to reject the null hypothesis, the regression must show that there occurs statistical significance between the variables that were selected for the test. If the null hypothesis is rejected, an alternative hypothesis is accepted instead which indicates that the regression analysis have shown that there occur a statistically significance between the dependent and independent variable/-s. Hypothesis testing is usually used to apply a sample result of a hypothesis test to a whole population, or to determine if the mean value of a population is the same as the mean value of the sample that were tested. (Wooldridge 2009:120-122).

To test whether an estimated coefficient is statistically significant or not, a t-test is used. A t-value is calculated by the estimated coefficient and its error term. This calculated value is compared to the chosen significance level and if the t-value for the estimated coefficient is more positive or more negative than the critical t-value the coefficient is statistically significant at this point. If this conclusion is reached, we can reject the null hypothesis. There are two different tests that could be made by t-statistics. The first one is the One-Sided test and it is used when the relationship between the dependent and independent variable is known to be either positive or negative (Wooldridge 2009:122-123). The second test is called Two-Sided Alternative and is used when the alternative hypothesis is not specifically determined (Wooldridge 2009:128). The significance test using p-value is useful to determine the lowest significance level where the null hypothesis can be rejected. The p-value is a probability measure and because of that it always takes on a value between zero and one. The stated significance level is compared to the calculated p-value and if the p-value is below this level the null hypothesis are rejected. The calculation of the p-value requires detailed t-statistics tables but many of the regressions data programs calculate the p-value when the OLS regression is made. The calculation is based on the area under the probability density function in the t-distribution (Wooldridge

2009:133). F-statistics are used for testing the overall significance or for a chosen group of independent variables when the other variables already have been tested in a regression model. Compared to the t-statistics, which test if a single variable has a significant impact on the dependent variable, the F-value tests the jointly significance of all the chosen variables. The hypothesis in the F-test is built up on a null hypothesis which says that none of the independent variables have an effect on the variable tested for. The alternative hypothesis for an F-test says that at least one of the explanatory variables has an effect on the dependent variable (Wooldridge 2009:134). When making a test for a group of the independent variable the regression model is called restricted. The calculation of the F-value shows the increase in sum of squared residuals when moving from a non-restricted model to a restricted one. This F-value is compared to the F-statistics and the critical value at the chosen significance level. If the calculated F-value is larger, the null hypothesis can be rejected (Wooldridge 2009:145-147).

### 2.2.5 Possible problems in a regression model

A number of common but undesired outcomes that might affect the usefulness of a linear regression model occur. This section is focusing on two of these possible outcomes, namely *heteroskedasticity* and *multicollinearity*.

Heteroskedasticity appears in a regression model when the variance of the error term, conditional on the explanatory variables, is not constant. The problem with heteroskedasticity is that the usual t- and F-statistics becomes unreliable and this problem is not corrected with a large sample of data. The heteroskedasticity do not affect the coefficient of determination and causes no biasness in the regression. A method for making an OLS regression with heteroskedasticity a useful model is to estimate the robust standard errors (Wooldridge 2009:264-265). These adjusted standard errors are often referred to as White, Huber or Eicker standard errors in econometrics (Wooldridge 2009:267). The calculations of the robust standard errors are advanced but most of the statistical software packages are calculating it. When the robust errors are computed, the t- and F-test can be calculated as the normal OLS coefficients (Wooldridge 2009:265-266).

Multicollinearity arises when the independent variables in the regression model are strongly correlated with each other. If two independent variables are highly correlated, they basically communicate the same information and one should be removed. The test can then show that a variable is insignificant when it is in reality significant (Hill, Griffiths & Lim 2012:240-241). Multicollinearity can be tested by calculating the variance inflation factor, VIF. This provides a measure of the austerity of the multicollinearity in an OLS regression analysis, and how much the variance of a coefficient is increased because of collinearity. If any of the VIFs surpass five or ten, it is an indication that multicollinearity exist in the model (Montgomery, Peck & Vining 2012:117-118, 296).

## 2.3 Dependent variable - Capital Adequacy Ratio

Capital Adequacy Ratio, CAR, is a measure where the capital of the bank is related to different categories of risk exposures. The numerator of CAR contains Tier 1 and Tier 2 capital. The Tier 1 includes equity capital, retained earnings and non-cumulative preference shares. This is the most important reserves against losses in the bank on current basis and it is also an important measure of banks' ability to manage risk (Van Greuning & Brajovic Bratanovic 2009:127-128). The equity capital and the retained earnings are defined as Core Capital. According to the Basel Committee, the Core Capital is the most important part of a bank's capital because it is completely reported in the financial statement. Further, it does not differ between different countries accounting systems. Many assessments of a bank's performance and adequacy are calculated using the Core Capital (BCBS 1988).

Tier 2 capital includes General provisions/loss reserves, debt/equity capital instruments and subordinated term dept. Asset revaluation reserves can also be included if they are carefully assessed and totally reflects the possible price fluctuation or compelling sales. Tier 2 is not classified as Core Capital but is still used to assess the capital adequacy of a bank. Tier 2 is based on capital obligations that will bring a future income but have a mandatory fee, or that finally would be redeemed. This capital may not exceed 100 percent of the Tier 1 capital (Van Greuning & Brajovic Bratanovic 2009: 129).

The Tier 1 capital and Tier 2 capital together is defined as the Regulatory Capital and to calculate CAR the this capital is divided by the bank`s risk-weighted assets. The risk-weighted assets have three components: credit risk, market risk and operational risk. These three risk components are weighted into different probabilities of default either by a Standardized Approach or an Internal risk model (Van Greuning & Brajovic Bratanovic 2009:130-131). The calculation which includes different types of risk-weights is considered by the Basel Committee to improve the bank's capital adequacy (BCBS 1988).

$$CAR = \frac{Tier1\ capital + Tier2\ capital}{Total\ risk - weighted\ assets} * 100$$

## 2.4 Independent variables

### 2.4.1 Equity Ratio – EQTA

The equity ratio is a financial ratio over the proportions of equity applied to finance the total assets. This ratio gives an indicative about the solvency position that the bank holds. A low equity ratio indicates a high leverage and because of that a higher risks (Kandil & Naceur 2007:77). For banks, financial ratios focusing on equity is of great importance. High equity implies that the bank hold more liquid capital for example future expansions or dividends to its shareholders. Equity and reserves are expensive since it does not generate any income, so it is always a consideration between holding liquid reserves and increasing the return (Eakins & Mishkin 2012:452).

$$EQTA = \frac{Equity}{Total\ assets} * 100$$

### 2.4.2 Net Loans over Total Assets - NLTA

Net loans over total assets is a liquidity ratio that gives a measure of the part of total assets that is fixed in loans. The greater this ratio is the greater is the part of total assets that consists of loans (Bankscope). This indicates a less liquid company. There is a risk of having a great amount of loans relative to total assets, because it takes longer time to transform loans into liquid resources compared with other forms of assets. By having a big part of the assets bounded in loans, the risk of illiquidity increases largely (Elliott & Elliott 2002:423).

$$NLTA = \frac{Net\ loans}{Total\ assets} * 100$$

### 2.4.3 Return on Assets - ROA

ROA is a profitability measure which indicates how well the bank performs relative to its full potential. The total after tax income is divided by the total assets. The ROA indicates how well a bank is managed because it shows how much profit it makes on average per unit of asset (Eakins & Mishkin 2012:451). ROA is an often used measure since it allows comparison between banks of different sizes because the way it is calculated (Eakins & Mishkin 2012:459).

$$ROA = \frac{Net\ income}{Total\ assets} * 100$$

### 2.4.4 Liquid Assets to Total Deposits - LATD

A common way to express liquidity risk is liquid assets over total debt and borrowing. This shows the capacity of the bank to pay their debt without taking new loans or raise equity capital. A low liquidity can force the bank to make necessary and expensive loans and therefore raise the risk (Angbazo 1997).

$$LATD = \frac{Liquid\ assets}{Total\ dept\ and\ borrowing} * 100$$

### 2.4.5 Non-Performing Loan Ratio - NPL

NPL is a measure of default risk where the impaired loans in a bank`s loan portfolio is divided by the total loans in the bank. NPL is often used to investigate how big credit risk exposure the bank is facing and this ratio is used in many working papers as a risk measure. An impaired loan appears when a borrower fails to pay his obligations, interest or principal payments over a ninety days period (Ahmad, Ariff & Skully 2008). The non-performing loan ratio is most likely positively correlated with a bank`s probability of default (Barrios & Blanco 2003).

$$NPL = \frac{Non - performing\ loans}{Gross\ loans} * 100$$

### 2.4.6 Dummy variables for implementation of Basel II and bank-specific effects

A dummy variable is an independent variable that takes on the value one or zero, and is used to indicate the absence or presence of a categorical effect that might change the outcome of the regression. To evaluate if any difference occur between the years before and after the implementation of Basel II, a dummy variable is added to the regression model. This is used to categorize data from the years before the implementation of Basel II in the beginning of 2007, and the years after. Data from a year when Basel II has already been implemented is labeled one in SPSS, and data before is labeled zero (Wooldridge 2009:225-226). For the FE regression, the model was expanded to also include twenty-three bank-specific dummy variables. The purpose of these is to capture firm-specific effects that might exist in the model. The bank-dummies are programmed in the same way in SPSS, were the dummy takes on the value one for the particular bank's data points and zero otherwise. This gives all specific banks, besides one which are used as benchmark, an own coefficient and capture omitted effects in the regression (Stock & Watson 2007:356). 225-226).

## 2.5 The model

When the dependent and the independent variables are put together, the regression models can be created. These are used in the analysis as a tool to answer the hypotheses and the research question. The OLS regression model gets the following look:

$$CAR = \beta_0 + \beta_1 ROA_{it} + \beta_2 NPL_{it} + \beta_3 EQTA_{it} + \beta_4 NLTA_{it} + \beta_5 LATD_{it} + \beta_6 \delta_{it} + \beta_7 (ROA_{it} * \delta_{it}) + \beta_8 (NPL_{it} * \delta_{it}) + \beta_9 (EQTA_{it} * \delta_{it}) + \beta_{10} (NLTA_{it} * \delta_{it}) + \beta_{11} (LATD_{it} * \delta_{it}) + u_{it}$$

And with the bank-specific effects added, the FE model is formed as:

$$CAR = \beta_0 + \beta_1 ROA_{it} + \beta_2 NPL_{it} + \beta_3 EQTA_{it} + \beta_4 NLTA_{it} + \beta_5 LATD_{it} + \beta_6 \delta_{it} + \beta_7 (ROA_{it} * \delta_{it}) + \beta_8 (NPL_{it} * \delta_{it}) + \beta_9 (EQTA_{it} * \delta_{it}) + \beta_{10} (NLTA_{it} * \delta_{it}) + \beta_{11} (LATD_{it} * \delta_{it}) + \gamma_2 D2_t + \gamma_3 D3_t + \cdots + \gamma_{24} D24_t + u_{it}$$

$\boldsymbol{D_t}$ **–** Bank specific dummy variable for time *t*
$\boldsymbol{\delta_{it}}$ – Basel II dummy variable for bank *i* at time *t*
$\boldsymbol{CAR_{it}}$ – Capital Adequacy Ratio for bank *i* at time *t*
$\boldsymbol{ROA_{it}}$ - Return-on-assets for bank *i* at time *t*
$\boldsymbol{NPL_{it}}$ – Non-performing loans for bank *i* at time *t*
$\boldsymbol{EQTA_{it}}$ – Total equity over total assets for bank *i* at time *t*
$\boldsymbol{NLTA_{it}}$ – Net loans over total assets for bank *i* at time *t*
$\boldsymbol{LATD_{it}}$ – Liquid assets to total deposits for bank *i* at time *t*
$\boldsymbol{u_{it}}$ – Error term for bank *i* at time *t*

All the independent variables are tested both separately with a t-test and together using an F-test. Before the regressions were executed, the following two hypotheses were stated for the F-test;

$\boldsymbol{H_0}$ - *The independent variables have no statistically significant effect on bank's Capital Adequacy Ratio.*
$\boldsymbol{H_1}$ - *At least one of the independent variables has a statistically significant effect on bank's Capital Adequacy Ratio.*

# 3. Data

*In this section, a short explanation of the data and program used will be given. Expected directions and a summary statistics will also be presented here to give the reader a broader understanding of the data sample before the regression is done.*

## 3.1 Description of the data

The data is collected annually between the years 2003-2012 from the four biggest banks in each of the following countries: France, Germany, Italy, Spain, Sweden and United Kingdom. The reason why these countries are used is because they together represent a large part of the total banking market in Europe. All the banks are commercial and listed on an exchange, and our ambition is that the sample result will be applicable to the banking market in Europe as a whole. All the data collected are expressed in percent, which helps to reduce the problem caused by the fact that the banks used are of different sizes.

The reason why annual data is used instead of quarterly or monthly, which would have provided us with a larger sample, is because we thought that many financial decisions that banks take are on yearly basis. They might take financial decisions that are not meant to be shown in the result before the end of the year due to time lags in the implementation processes. Further, it is much easier to find annual data ten years back in time compared with monthly data which is not always stated. Because of this, we thought that yearly data were the most adequate to use for the aim of our analysis.

All the data has been collected from the databases Bankscope and Orbis, which both are frequently used worldwide. We consider these sources trustworthy as they are public and available for everyone so any person who intends to collect the same numbers as we have done can do so by using the same sources. All the banks are using standardized accounting systems accepted by International Accounting Standards, IAS, and International Financial Reporting Standards, IFRS, for exchange listed companies (2002/1606/EC). All the numbers are also calculated at least twice to minimize the risk of errors caused by us.

The choice of variables for the regression analysis was based on earlier studies within the same research area as this one. Several authors have used CAR as the dependent variable in their studies. The same is valid for the independent variables, which are all frequently used ratios both in finance and accounting as measures of stability or profitability (Büyükşalvarci & Abdioğlu 2011; Ahmad, Ariff & Skully 2008; Banarjee 2012).

## 3.2 Description of the program used

The statistical program SPSS was used for the regression. SPSS is a broadly used program for statistical surveys, and the reliability of it has been proved by many researchers before. We have used both course books and articles that describe how to use the program in the best suitable way. We have also done a correlation (Table 5) to see that there is no multicollinearity between the independent variables used.

## 3.3 Expected direction of the independent variables

| **Independent variable** | **Predicted sign** | **References** |
|---|---|---|
| Return on assets (ROA) | **+** | Büyükşalvarci, Abdioğlu (2011:11204) |
| Non-performing loan ratio (NPL) | **+ / -** | Ahmad et al. (2008:262) |
| Equity ratio (EQTA) | **+** | Kandil, Naceur (2007:77) |
| Net-loans over total assets (NLTA) | **-** | Büyükşalvarci, Abdioğlu (2011:11207) |
| Liquid assets to total deposits (LATD) | **+** | Ahmad et al. (2008:263) |

*Table 1. Expected direction of the independent variables*

ROA is a measure of profitability, and is expected to be positively related to CAR. We believe that a bank in general need to increase its asset risks in order to increase returns, but earlier studies has shown that more capitalized banks tend to raise higher profits and therefore these two measures are expected to be positively related to each other (Büyükşalvarci & Abdioğlu 2011). NPL measures credit or default risk, and we first thought it would have a negative relation with CAR. Higher risk exposures most likely affect risk-weighted assets negatively and therefore should have a negative impact on CAR. It has been hard to find any previous studies which declare a clear direction of the outcome of the NPL impact on CAR. We therefore believe it to have either a positive or negative impact on CAR (Ahmad, Ariff & Skully 2008). EQTA is expected to be positively related to CAR, because an increased equity-ratio affects Tier 1 and Tier 2 and therefore increase CAR in a positive direction. Higher equity to asset ratio indicates a lower leverage and less risky bank (Kandil & Naceur 2007). NLTA is predicted to be negatively related to CAR because increased loans are expected to increase the riskiness of the bank's assets (Büyükşalvarci & Abdioğlu 2011). LATD might be positively related to CAR because as capital regulations increases, the harder is the requirements to hold a greater share of liquid assets (Ahmad, Ariff & Skully 2008).

## 3.4 Descriptive statistics

Table 2 shows descriptive statistics with number of observations, minimum, maximum, mean value and standard deviation for the total period of data. Table 3 show descriptive statistics but for both the period before and the period after Basel II was implemented. As seen in the table, there are some smaller differences between the two periods and these will be interpreted further in the analysis.

| **Independent variable** | **Obs** | **Mean** | **Std. Dev** | **Min** | **Max** |
|---|---|---|---|---|---|
| Capital Adequacy Ratio (CAR) | 231 | 0,1223 | 0,02447 | 0,0810 | 0,2121 |
| Return on Assets (ROA) | 235 | 0,0040 | 0,00444 | -0,0195 | 0,0147 |
| Non-performing loan ratio (NPL) | 225 | 0,0353 | 0,02780 | 0,0017 | 0,1670 |
| Equity over total assets (EQTA) | 236 | 0,0456 | 0,01607 | 0,0108 | 0,0987 |
| Net-loans over total assets (NLTA) | 236 | 0,4859 | 0,17513 | 0,1033 | 0,8093 |
| Liquid assets to total deposits (LATD) | 236 | 0,2790 | 0,13433 | 0,0499 | 0,7279 |

*Table 2. Descriptive statistics of the variables in the regression model*

| | **Before implementation** | | | **After implementation** | | |
|---|---|---|---|---|---|---|
| **Independent variable** | **Obs** | **Mean** | **Std. Dev** | **Obs** | **Mean** | **Std.Dev** |
| Capital Adequacy Ratio (CAR) | 115 | 0,1113 | 0,0167 | 116 | 0,1331 | 0,0261 |
| Return on Assets (ROA) | 119 | 0,0056 | 0,0037 | 116 | 0,0022 | 0,0045 |
| Non-performing loan ratio (NPL) | 110 | 0,0238 | 0,0196 | 115 | 0,0462 | 0,0301 |
| Equity over total assets (EQTA) | 120 | 0,0445 | 0,0164 | 116 | 0,0468 | 0,0157 |
| Net-loans over total assets (NLTA) | 120 | 0,4853 | 0,1751 | 116 | 0,4866 | 0,1759 |
| Liquid assets to total deposits (LATD) | 120 | 0,3073 | 0,1535 | 116 | 0,2497 | 0,1038 |

*Table 3. Descriptive statistics before and after Basel II*

# 4. Results

*This section will start with a presentation of the model used for the regression, continued by the complete results of the regressions.*

## 4.1 Model Approach

As in previous studies by Büyükşalvarci and Abdioğlu (2011) and Ahmad, Ariff and Skully (2008) we chose to have Capital Adequacy Ratio as the dependent variable. The aim with this is to investigate how higher capital regulations affect how banks hold capital relative to its risk. Five independent variables were chosen: ROA as a profitability measure in line with Büyükşalvarci and Abdioğlus (2011) model, NPL as proxy for the level of risk-exposure as Ahmad, Ariff and Skully (2008), and EQTA as a measure of financial strength as used by Kandil and Naceur (2007). In Kandil and Naceurs (2007) report this variable is labeled Capratio but express the same ratio. NLTA is used as a risk measure for the loan portfolio and NLTD as liquidity measure but in their report they name the variable LACSF (Ahmad, Ariff & Skully 2008). We also chose to include a Basel II dummy which aims to capture the difference between the two time periods (Ahmad, Ariff & Skully 2008). Before the regression was executed, the model was tested to reveal if correlation or multicollinearity existed in the independent variables (Büyükşalvarci & Abdioğlu 2011). This was accomplished to prove that the model was qualified as an unbiased OLS regression model and therefore reliable. Then the OLS regression was done using a panel data approach just as Ahmad, Ariff and Skully (2008) and Kandil and Naceur (2007). We included five interaction-terms, which are the main variables multiplied with the Basel II dummy to show the difference in the slope coefficient before and after Basel II regulation (Wooldridge 2009:225-226). Twenty-three bank-specific dummy variables were also included to count for bank-specific effects. The technique for FE is the same as for the standard OLS regression but with these extra bank-specific variables. To adjust for a possible heteroskedasticity problem in the model, the FE model was used which estimated the robust standard errors with the generalized least squares function in SPSS (Stock & Watson 2007:356).

#### 4.1.1 Variance inflation factor and correlation

Before the regression, the model was tested for multicollinearity. The result from SPSS show that all variables have a variance inflation factor, VIF, that is between one and three. The result indicates that the independent variables are weakly correlated with each other, and there is no need to change any of the variables in the regression model.

| **Multicollinearity** | | |
|---|---|---|
| **Independent variable** | *Tolerance* | *VIF* |
| ROA | 0,560 | 1,785 |
| NPL | 0,546 | 1,833 |
| EQTA | 0,494 | 2,023 |
| NLTA | 0,334 | 2,995 |
| LATD | 0,411 | 2,433 |

*Table 4. Multicollinearity*

Table 5 shows a correlation matrix to get a summary of the correlation between all the variables (Büyükşalvarci & Abdioğlu 2011). The correlation matrix discovers that none of the variables are perfectly correlated with each other. The highest correlation is between the variables NLTA and LATD which are negative correlated by -0.759. None of the independent variable has a higher correlation than 0.253 against the dependent variable.

| | **CAR** | **ROA** | **NPL** | **EQTA** | **NLTA** | **LATD** |
|---|---|---|---|---|---|---|
| **CAR** | 1 | | | | | |
| **ROA** | -0,175 | 1 | | | | |
| **NPL** | 0,253 | -0,479 | 1 | | | |
| **EQTA** | 0,055 | 0,284 | 0,289 | 1 | | |
| **NLTA** | -0,223 | 0,249 | -0,042 | 0,532 | 1 | |
| **LATD** | 0,162 | -0,033 | -0,057 | -0,382 | -0,759 | 1 |

*Table 5. Correlation Matrix*

#### 4.1.2 Results of the OLS regression

The OLS regression output (Table 7) shows that two of the independent variables are significant. These are ROA and the interaction-term ROA_Basel2, which are significant at the ten percent and five percent levels respectively. ROA has a positive relation to CAR with a slope coefficient of 1.286 and the interaction-term has a negative outcome of -1.85. This means that the relationship between ROA and CAR has changed between the two periods, before and after the Basel II implementation. The relationship was positive the first period but then showed a negative relationship the period after. All the other independent variables, including the Basel2 dummy variable, are statistically insignificant. Three of our main variables in the model are positively related to CAR, these are ROA, NPL and LATD. EQTA and NLTA both have negative coefficients in the OLS regression but it is only ROA that is reliable statistically measured. The F-test demonstrates a high overall significance in the model with a value of 9.245. The R-squared of the OLS regression is 0.324 which mean that the independent variables in our model can explain 32.4 percent of CAR. The full SPSS regression outcome is attached as Appendix 1.

#### 4.1.3 Results of the FE regression

The FE regression result, where a dummy variable was included for every specific bank, turned out to be different compared to the OLS. The output now includes five significant variables and three of them are significant at the one percent level. Three of our main variables are significant; ROA, EQTA and LATD. ROA was significant at the ten percent in the OLS regression and now at the five percent level. The beta coefficient appears to be larger in the FE model by 0.246 percentage points. The ROA coefficient is positive and this result was also found by Büyükşalvarci and Abdioğlu (2011) as they got a positive significant relation between ROA and CAR. Kandil and Naceur (2007) also found a positive significant relationship between ROA and CAR. EQTA, which goes from being insignificant in the OLS regression to be significant in the FE estimation, also changed sign on the coefficient from a negative -0.012 to a positive 0.715. The positive relation between CAR and EQTA was explained by Kandil and Naceur (2007) as a possible proxy for capital adequacy. Ahmad, Ariff and Skully (2008) included EQTA in the calculation of their Z-score variable which is a risk index were EQTA is present to show how well the bank can handle unexpected losses. Even though they used this variable as part of their Z-score, it could explain a positive relation between EQTA and CAR even in our model. The third significant variable is LATD; this variable has both a positive coefficient and a positive effect on CAR. When LATD increased by one unit, CAR increases by 0.053 percentage points. This result is in the same direction as Ahmad, Ariff and Skully (2008), as they found that the variable named LACSF indicated a positive effect on CAR.

Two of the interaction terms, ROA_Basel2 and LATD_Basel2, are significant. The ROA_Basel2 is significant at the one percent level. It has a negative sign which imply that the impact that ROA has on CAR has decreased since the implementation of Basel II. The slope coefficient for ROA when the Basel II framework is implemented goes from positive 1.532 to negative -0.816 in our model. LATD_Basel2 is positive and significant at the ten percent level, which indicates that LATD has a bigger effect on CAR after the implementation of the Basel II compared with the period before. When LATD increases by one percentage point, CAR increases by 0.104 instead of 0.053 as in the period before. The calculations in table 6 show how the slope coefficients in the model have changed since the Basel II implementation. The model is highly significant according to the F-test with a value of 15.466. The R-squared is 0.736 which indicates that the independent variables together explain 73.6 percent of the dependent. The full output of the FE regression in SPSS is attached as appendix 2.

| | | |
|---|---|---|
| **ROA** | 1,532+(-2,348)= | *-0,816* |
| **NPL** | (-0,017)+0,054= | *0,037* |
| **EQTA** | 0,715+(-0,096)= | *0,619* |
| **NLTA** | (-0,019)+0,009= | *-0,01* |
| **LATD** | 0,053+0,051= | *0,104* |

*Table 6. Calculation of the FE coefficient after Basel II*

| **Independent variable** | **Dependent variable: Capital adequacy ratio (CAR)** | | | | | |
|---|---|---|---|---|---|---|
| | **OLS** | | | **FE** | | |
| | *Beta* | *T-value* | | *Beta* | *T-value* | |
| Intercept | 0,098 | 5,975 | | 0,059 | 3,757 | |
| ROA | 1,286 | 1,78 | * | 1,532 | 2,886 | *** |
| NPL | 0,195 | 1,631 | | -0,017 | -0,16 | |
| EQTA | -0,012 | -0,061 | | 0,715 | 4,373 | *** |
| NLTA | -0,012 | -0,566 | | -0,019 | -0,833 | |
| LATD | 0,025 | 1,103 | | 0,053 | 3,04 | *** |
| ROA_Basel2 | -1,85 | -2,072 | ** | -2,348 | -3,603 | *** |
| NPL_Basel2 | -0,211 | -1,398 | | 0,054 | 0,463 | |
| EQTA_Basel2 | 0,357 | 1,313 | | -0,096 | -0,461 | |
| NLTA_Basel2 | -0,004 | -0,145 | | 0,009 | 0,453 | |
| LATD_Basel2 | 0,061 | 1,606 | | 0,051 | 1,835 | * |
| Basel2 | 0,007 | 0,314 | | 0,018 | 1,158 | |
| R-squared | 0,324 | | | 0,736 | | |

****, ** , * Significant at the 1%, 5% and 10% level.*

*Table 7. Regression result from OLS and FE*

### 4.1.4 Results of the Robust FE Regression

As the test for heteroskedasticity indicated that there could have occurred heteroskedasticity in the model, it was appropriate to also do the regression with robust standard errors. The FE with robust standard errors (Table 8) gives a result quite similar to the normal FE. The exceptions are that ROA now is significant at the five percent level instead of one percent, and that LATD_Basel2 now is significant at the five percent level compared with the standard FE where it was significant only at ten percent. The rest of the coefficients show the same outcome regardless if they are significant or not. EQTA, LATD and ROA_Basel2 are all significant at the one percent level, and the rest of the coefficients are not significant at all. The R-squared is the same as for the standard FE, 0.736, which indicates that the independent variables together explain approximately 74 percent of the value of CAR. Even though the result of FE robust show a small difference compared to the standard FE it is motivated to use because heteroskedasticity might, if not taken into account, seriously affect the reliability of the test results in a negative way. Some of the bank-specific variables were statistically significant in the regression result. Thus, they all showed beta values that was too small to be relevant for an analysis. Therefore, we will not analyze these variables further within the frame of this thesis. The full Robust FE regression with all the banks represented is presented as Appendix 3, and the test for heteroskedasticity as Appendix 4.

| Independent variable | Beta | Std.Error | Sign.level | |
|---|---|---|---|---|
| Intercept | 0,059 | 0,0152 | 0,000 | |
| ROA | 1,532 | 0,676 | 0,023 | ** |
| NPL | -0,017 | 0,1207 | 0,888 | |
| EQTA | 0,715 | 0,2154 | 0,001 | *** |
| NLTA | -0,019 | 0,0229 | 0,417 | |
| LATD | 0,053 | 0,0157 | 0,001 | *** |
| ROA_Basel2 | -2,348 | 0,7807 | 0,003 | *** |
| NPL_Basel2 | 0,054 | 0,1221 | 0,661 | |
| EQTA_Basel2 | -0,096 | 0,227 | 0,672 | |
| NLTA_Basel2 | 0,009 | 0,021 | 0,653 | |
| LATD_Basel2 | 0,051 | 0,0238 | 0,033 | ** |
| Basel2 | 0,018 | 0,0138 | 0,185 | |

****, **, * significant at the 1%, 5 % and 10 % level*

*Table 8. Robust regression output*

# 5. Analysis

The descriptive statistics (Table 3) that declare the differences between the two periods covered indicate that CAR has increased by 2.18 percent since the implementation of Basel II. ROA and LATD have decreased with 0.34 and 5.76 percent respectively. NPL, EQTA and NLTA have increased by 2.24, 0.23 and 0.13 percent. The fact that CAR has increased is consistent with the constrained legal requirements that the banks have been obliged to meet since 2007, and it would have been quite delusive if our result indicated a decrease in spite of this. Thus, it is relatively remarkable that the increase is not higher than 2.18 percent. We expected the increase to be greater related to how comprehensive the new legal framework of Basel II is. It makes sense that ROA and LATD both have decreased, even though the decrease of the first-named is highly modest. These ratios both are dependent on the liquidity of the bank's assets, so if these become less liquid due to constraints and higher requirements to hold assets as reserves it is obvious that they should be affected in a negative direction. The high increase of NPL, which is a measure of credit risk exposures, is most likely a consequence of the financial crisis rather than Basel II. During the financial crisis, many borrowers defaulted to fulfill their payment obligations which affect this ratio in a positive way. Harder capital requirements could also make the banks more risk-averse, with the consequence that banks become more restricted in the control of their creditors compared with the previous period. If the total lending would decrease because of harder control, NPL is affected in a positive way. Thus, if they only become more restricted regarding which borrowers they accept, NPL would most likely decrease.

The regression results in Table 8 present three significant variables which all affect CAR positively. ROA is in line with Büyükşalvarci and Abdioğlus (2011) positive result which tells us that the higher the earnings are for the banks, the higher the CAR should be. This could be explained by the fact that more capitalized banks can issue loans at a lower cost and might be more selective regarding the choice of clients. It was no surprise that EQTA has a positive impact on CAR when the equity capital is one important component when calculating CAR. This can state that if banks raise their equity capital during this period, they can be more resistant against credit risk related failures. LATD is also positively related to CAR which can arise from the fact that higher capital regulations force the banks to hold higher levels of capital reserves. This relation is also showed in the result of Ahmad, Ariff and Skully (2008) where they reach the conclusion that this measure is positively correlated to CAR. We also got two significant interactions terms, the variable ROA_Basel2 show a negative impact on the dependent variable. Because the independent variable ROA was positively correlated to CAR, the negative sign of the interaction term indicate that as capital requirements increased due to the implementation of Basel II the profitability decrease. This result is logical and goes in line with the fact that commercial banks earn the major part of their revenue on money-lending business operations. If the legal requirements force the banks to hold higher levels of reserves relative to the total amount of emitted loans, it is reasonable to assume that their profitability decreases. The second significant interaction term is LATD_Basel2. This variable has doubled compared to the period before Basel II. The new regulations regarding capital led to more strict rules concerning liquidity reserves in banks. Because these are in the numerator of LATD, increased liquid assets affect this measure in a positive way both before but certainly after Basel II which explain the large increase.

As stated in the beginning of this analysis, the mean value of CAR has increased by approximately two percent. This average increase between the two time periods can be an indicator that the implementation of harder capital adequacy regulation is efficient in the European banking market. In our model, an increase in CAR would lead to a higher EQTA and LATD for the European banks due to the signs of the coefficients. According to the descriptive statistics this is not the case for LATD which decreases. This fact goes against our model and indicates that the chosen banks do not become more liquid with harder regulations under this time period. EQTA display a small increase which goes in line with our expectations. Higher capital regulations would most likely increase the solvency position in the banks with a higher equity capital. The interaction term ROA_Basel2 shows that after the implementation of the Basel II regulation our model signifies that the ROA will have a negative relation to CAR. This is also the case according to the descriptive statistics. CAR increases between the two time periods and ROA decreases. This relationship in our model suggests that European banks increase its capital adequacy because of the new regulation at the cost of lower profits. NPL and LATD which are not significant in our regression are predicted to have a negative relation to CAR according to earlier studies. The descriptive statistics display the opposite with a markedly increase in NPL and a small increase in NLTA as the outcome. These are indicators that the European banks do not have become less risky after the implementation of Basel II framework. These thoughts about the Basel II regulations being ineffective can explain the fact that the Basel Committee started to work on a new regulation called Basel III after the financial crisis that began in 2008.

It is of importance to be aware of the restricted width of this thesis. Our results could have been reached by reasons others than the ratios used in the regression model. One of the main arguments for this is with no doubt the financial crisis which began approximately one year after the implementation of Basel II, and especially affected the banking markets worldwide. This makes it hard to determine if the effects revealed from both previous studies and from this thesis can be derived from the fact that Basel II was implemented, or from the presence of the global financial crisis. The big decline in the US capital market that initiated, what today is known as, the financial crisis spread to the European financial institutions when the mortgage-backed securities were downgraded in credit rating. A big liquidity problem occurred in the European banks when a lot of banks needed to borrow money to handle their obligations but very few banks were willing to lend some money. This problem in banks liquidity could have affected our result greatly.

Other components could have affected the results, and with the FE model the aim was to capture those that could be derived from internal firm-specific differences. These effects could differ in the way the banks are governed. One example of this is Asset Management, which is the technique of operating and diversifying assets within the company. The main purpose is to reach a gain as high as possible on loans and other activities which generate profits, and at the same time hold enough liquid assets to handle unexpected losses. Banks do want as high returns as possible but at the lowest possible risk exposures. This is made by an accurate selection of clients, diversification in the asset portfolio and of finding ways to raise profits from the liquid assets. The way of doing this most likely differs between different banks. The results could also have been affected by the fact that we only used big, commercial banks that are publicly noted on European stock exchanges and thereby owned and controlled by its shareholders. Because the board and directorate of these banks are highly affected by and dependent of the opinions of these shareholders, it is not unreasonable to assume that the shareholders might have an impact on the capital decisions together with the legal requirements. The volatility of CAR, measured as standard deviation (Table 3), has increased after the implementation of Basel II. The standard deviation of CAR the period 2003-07 was approximately 1.67 percent, and increased to approximately 2.61 percent the period 2008-12. NPL do also display an increase in standard deviation. This could be a consequence of the financial crisis. Higher constraints with the aim to create a more stable and less volatile banking market would reasonably decrease the volatility. This is not the case in our calculations which indicate that the financial crisis has affected the standard deviation.

Macro factors could also impact our result in the regression. Low interest rates in the economy can cause a decreasing trend in saved capital and raise borrowing in the society. This could lead to an increase in our dependent variable CAR, because when banks are lending more they might be able to raise the profitability. If the interest rates increase, this could cause an increasing risk for the banks if their clients cannot fulfill their obligations and the banks are facing higher cost to obtain funds and this can lead to insolvency. Higher inflation could create a lower demand for credits in the economy. A lower demand for loans from the public and companies could lead to a decrease in banks profitability and reduce CAR in our model. The business cycle can also have an impact on CAR. During a boom the demand for credits in the economy is most likely high. This could raise the banks' profits when they can take higher charges for the intermediation of capital and the opposite in a recession when demand for credits decreases.

# 6. Conclusion

*How have the expanded capital requirements of Basel II affected the European banking market and its way of holding capital relative to its risk?*

CAR has increased with approximately two percent during the research period. CAR, EQTA and ROA show the same direction in the descriptive statistics as in the regression model. This relationship indicates that the expanded capital requirements of Basel II have led to a change in the financial statements of the selected banks. The independent variables ROA, EQTA, LATD, ROA_Basel2 and LATD_Basel2 does all show a statistically significant effect on CAR, and we can thence reject the null hypothesis at a five percent level for all and even at a one percent significance level for three of the five variables. Remaining variables, NPL, NLTA, NPL_Basel2, EQTA_Basel2, NLTA_Basel2 and Basel2, do not indicate a significance that is statistically reliable. Consequently, they do not seem to have any significant effect on CAR and we cannot reject the null hypothesis for these variables.

With the regression model, and with the analysis and conclusions drawn from the result of this, we are able to answer our research question stated in the beginning of this thesis. We can draw the conclusion that when the legal framework Basel I was replaced by Basel II, this led to a positive increase in the capital held as reserves relative to risk-weighted assets. Although our research and result can display an increase, this increase is more modest compared to what we thought when we stated our research question and began this thesis. The model proves that Basel II has had a statistically significant effect but this effect is in reality quite unpretentious related to how big and expensive the implementation process has been. This could be the reason why Basel III at present is ready to be implemented as a further enlargement to Basel I and Basel II. Hopefully, the Basel III will be more well-turned-out compared to its predecessors. We selected banks from six European countries with well-developed banking systems, and did a FE regression analysis to eliminate that bank-specific difference would affect the result as much as possible. We are aware of the limitations of our thesis, and the fact that the Global Financial Crisis that led to a global recession might have had an impact on the financial statements of the banks and therefore on the financial ratios used in this thesis. Hence, the satisfactory result regarding statistical significance does validate this conclusion and answer to our research question.

| Independent variable | Sign | Reject null hypothesis | Significance level |
|---|---|---|---|
| ROA | + | Yes | 5% |
| NPL | - | No | - |
| EQTA | + | Yes | 1% |
| NLTA | - | No | - |
| LATD | + | Yes | 1% |
| ROA_Basel2 | - | Yes | 1% |
| NPL_Basel2 | + | No | - |
| EQTA_Basel2 | - | No | - |
| NLTA_Basel2 | + | No | - |
| LATD_Basel2 | + | Yes | 5% |
| Basel2 | + | No | - |

*Table 9. Summary result of the Robust FE hypothesis testing*

## 6.1 Suggestions for further studies

As a suggestion for further studies, it would be interesting to add several independent variables to the regression model to see if this would generate a different result. One restriction is that our model does not contain any macro variables. It would therefore be of interest to expand the model with a GDP index, a stock index or an interest rate to see how these are correlated with the capital adequacy ratio. A further suggestion would be to either include several banks or several years to get a greater sample. We chose the time period 2003-2012 due to restrictions on the data available but there might exist other data bases that contain financial data from additional years. All the banks used in our sample are among the biggest in their country, so it would also be interesting to do a comparison between these big banks and smaller banks in the same countries.

At the time of writing, The Basel Committee on Banking Supervision has started the implementation of the new Basel III. This will likely be fully implemented in a couple of years, so it would be truly interesting to see if the effect of these regulations will have a greater impact on the banking market than our study showed that Basel II has had.

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Bankscope (data base)
Orbis (data base)

# Appendix 1. OLS regression

This appendix presents the full SPSS outcome of the OLS regression. We tested for eleven different variables and their impact on the dependent variable CAR. In our analysis, the focus lay on R-Squared, F-statistics, Beta coefficient, t-value and the significance level (p-value).

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,569[a] | ,324 | ,289 | ,0207776 |

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | ,044 | 11 | ,004 | 9,245 | ,000[b] |
| | Residual | ,092 | 212 | ,000 | | |
| | Total | ,135 | 223 | | | |

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | ,098 | ,016 | | 5,975 | ,000 |
| | ROA 12-03 | 1,286 | ,722 | ,235 | 1,780 | ,076 |
| | NPL 12-03 | ,195 | ,120 | ,220 | 1,631 | ,104 |
| | EQTA 12-03 | -,012 | ,193 | -,007 | -,061 | ,951 |
| | NLTA 12-03 | -,012 | ,021 | -,086 | -,566 | ,572 |
| | LATD 12-03 | ,025 | ,023 | ,135 | 1,103 | ,271 |
| | Basel 2 (dummy) | ,007 | ,022 | ,142 | ,314 | ,754 |
| | ROA_Basel2 | -1,850 | ,893 | -,257 | -2,072 | ,039 |
| | NPL_Basel2 | -,211 | ,151 | -,270 | -1,398 | ,164 |
| | EQTA_Basel2 | ,357 | ,272 | ,375 | 1,313 | ,191 |
| | NLTA_Basel2 | -,004 | ,029 | -,048 | -,145 | ,884 |
| | LATD_Basel2 | ,061 | ,038 | ,359 | 1,606 | ,110 |

a. Dependent Variable: CAR 12-03

## Appendix 2. FE regression

The tables below show the full result of our FE regression where all the banks dummy variables were added. The specific bank dummy coefficient is not interpreted in our analysis as they are present just to capture differences among the banks and not over time (Stock, Watson 2007:356). In our analysis part, we focused on R-Squared, F-statistics, B coefficients, t-value and the significance level (p-value).

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,858[a] | ,736 | ,688 | ,0137639 |

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | ,100 | 34 | ,003 | 15,466 | ,000[b] |
| | Residual | ,036 | 189 | ,000 | | |
| | Total | ,135 | 223 | | | |

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | ,059 | ,016 | | 3,757 | ,000 |
| | ROA | 1,532 | ,531 | ,280 | 2,886 | ,004 |
| | NPL | -,017 | ,106 | -,019 | -,160 | ,873 |
| | EQTA | ,715 | ,163 | ,444 | 4,373 | ,000 |
| | NLTA | -,019 | ,022 | -,132 | -,833 | ,406 |
| | LATD | ,053 | ,018 | ,286 | 3,040 | ,003 |
| | ROA_Basel2 | -2,348 | ,652 | -,326 | -3,603 | ,000 |
| | NPL_Basel2 | ,054 | ,116 | ,069 | ,463 | ,644 |
| | EQTA_Basel2 | -,096 | ,209 | -,101 | -,461 | ,646 |
| | NLTA_Basel2 | ,009 | ,021 | ,105 | ,453 | ,651 |
| | LATD_Basel2 | ,051 | ,028 | ,300 | 1,835 | ,068 |
| | Basel2 | ,018 | ,016 | ,372 | 1,158 | ,248 |
| | Handelsbanken | ,001 | ,007 | ,009 | ,149 | ,882 |
| | Swedbank | ,002 | ,007 | ,014 | ,232 | ,817 |
| | Nordea | -,005 | ,007 | -,040 | -,732 | ,465 |
| | Deutsche_Bank | ,015 | ,009 | ,122 | 1,706 | ,090 |
| | BNP_Paris | ,000 | ,008 | -,004 | -,061 | ,951 |
| | Barclays_Bank | ,019 | ,007 | ,162 | 2,651 | ,009 |
| | BANK_OF_SCOTLAND | ,012 | ,007 | ,097 | 1,611 | ,109 |
| | SOCIETE_GENERALE | -,013 | ,008 | -,096 | -1,648 | ,101 |
| | HSBC_bank | ,004 | ,007 | ,032 | ,569 | ,570 |
| | UniCredit | -,011 | ,008 | -,087 | -1,470 | ,143 |
| | Credit_Agricole | -,003 | ,009 | -,019 | -,297 | ,767 |
| | Intesa_Sanpaolo | -,019 | ,009 | -,144 | -2,172 | ,031 |
| | Banco_Bilbao | ,003 | ,007 | ,029 | ,471 | ,638 |
| | Commerzbank_AG | ,032 | ,007 | ,270 | 4,468 | ,000 |
| | UniCredit_Bank_AG | ,043 | ,008 | ,365 | 5,677 | ,000 |
| | Banca_Monte_dei_Paschi | -,013 | ,008 | -,104 | -1,649 | ,101 |
| | Banco_de_Sabadell | -,005 | ,009 | -,036 | -,521 | ,603 |
| | Deutsche_Postbank | ,013 | ,007 | ,109 | 1,848 | ,066 |
| | Natixis | -,011 | ,008 | -,089 | -1,289 | ,199 |
| | Banco_Espanol_de_Crédito | -,010 | ,007 | -,086 | -1,567 | ,119 |
| | BANCA_NAZIONALE_DEL_LAVORO | -,002 | ,009 | -,016 | -,228 | ,820 |
| | Santander_UK | ,057 | ,007 | ,457 | 8,354 | ,000 |
| | Banco_Santander_SA | ,005 | ,007 | ,040 | ,654 | ,514 |

a. Dependent Variable: CAR

# Appendix 3. Robust FE Regression

This table shows the full outcome of the robust estimated FE regression. This is made to handle the problem of heteroskedasticity in the model. The slope coefficients are the same as in the normal FE regression but the significance level has changed due to the change in the estimated standard errors.

**Parameter Estimates**

| Parameter | B | Std. Error | 95% Wald Confidence Interval Lower | Upper | Hypothesis Test Wald Chi-Square | df | Sig. |
|---|---|---|---|---|---|---|---|
| (Intercept) | ,059 | ,0152 | ,030 | ,089 | 15,340 | 1 | ,000 |
| ROA | 1,532 | ,6760 | ,207 | 2,857 | 5,137 | 1 | ,023 |
| NPL | -,017 | ,1207 | -,254 | ,220 | ,020 | 1 | ,888 |
| EQTA | ,715 | ,2154 | ,292 | 1,137 | 11,005 | 1 | ,001 |
| NLTA | -,019 | ,0229 | -,063 | ,026 | ,658 | 1 | ,417 |
| LATD | ,053 | ,0157 | ,023 | ,084 | 11,522 | 1 | ,001 |
| ROA_Basel2 | -2,348 | ,7807 | -3,878 | -,817 | 9,042 | 1 | ,003 |
| NPL_Basel2 | ,054 | ,1221 | -,186 | ,293 | ,193 | 1 | ,661 |
| EQTA_Basel2 | -,096 | ,2270 | -,541 | ,349 | ,180 | 1 | ,672 |
| NLTA_Basel2 | ,009 | ,0210 | -,032 | ,051 | ,202 | 1 | ,653 |
| LATD_Basel2 | ,051 | ,0238 | ,004 | ,097 | 4,562 | 1 | ,033 |
| Basel2 | ,018 | ,0138 | -,009 | ,045 | 1,759 | 1 | ,185 |
| Handelsbanken | ,001 | ,0058 | -,010 | ,012 | ,031 | 1 | ,860 |
| Swedbank | ,002 | ,0058 | -,010 | ,013 | ,085 | 1 | ,771 |
| Nordea | -,005 | ,0044 | -,014 | ,004 | 1,164 | 1 | ,281 |
| Deutsche_Bank | ,015 | ,0073 | ,001 | ,030 | 4,353 | 1 | ,037 |
| BNP_Paris | ,000 | ,0075 | -,015 | ,014 | ,004 | 1 | ,948 |
| Barclays_Bank | ,019 | ,0059 | ,008 | ,031 | 10,795 | 1 | ,001 |
| BANK_OF_SCOTLAND | ,012 | ,0056 | ,001 | ,023 | 4,296 | 1 | ,038 |
| SOCIETE_GENERALE | -,013 | ,0058 | -,024 | -,001 | 4,732 | 1 | ,030 |
| HSBC_bank | ,004 | ,0075 | -,011 | ,019 | ,256 | 1 | ,613 |
| UniCredit | -,011 | ,0063 | -,024 | ,001 | 3,314 | 1 | ,069 |
| Credit_Agricole | -,003 | ,0079 | -,018 | ,013 | ,117 | 1 | ,732 |
| Intesa_Sanpaolo | -,019 | ,0093 | -,037 | -,001 | 4,258 | 1 | ,039 |
| Banco_Bilbao | ,003 | ,0064 | -,009 | ,016 | ,289 | 1 | ,591 |
| Commerzbank_AG | ,032 | ,0055 | ,021 | ,043 | 33,714 | 1 | ,000 |
| UniCredit_Bank_AG | ,043 | ,0070 | ,030 | ,057 | 38,073 | 1 | ,000 |
| Banca_Monte_dei_Paschi | -,013 | ,0074 | -,028 | ,001 | 3,095 | 1 | ,079 |
| Banco_de_Sabadell | -,005 | ,0079 | -,020 | ,011 | ,333 | 1 | ,564 |
| Deutsche_Postbank | ,013 | ,0077 | -,002 | ,028 | 2,867 | 1 | ,090 |
| Natixis | -,011 | ,0083 | -,027 | ,006 | 1,616 | 1 | ,204 |
| Banco_Espanol_de_Crédito | -,010 | ,0054 | -,021 | ,000 | 3,667 | 1 | ,056 |
| BANCA_NAZIONALE_DEL_LAVORO | -,002 | ,0090 | -,020 | ,016 | ,047 | 1 | ,828 |
| Santander_UK | ,057 | ,0084 | ,041 | ,074 | 46,302 | 1 | ,000 |
| Banco_Santander_SA | ,005 | ,0065 | -,008 | ,017 | ,536 | 1 | ,464 |
| (Scale) | ,000[a] | 1,5104E-005 | ,000 | ,000 | | | |

Dependent Variable: CAR
Model: (Intercept), ROA, NPL, EQTA, NLTA, LATD, ROA_Basel2, NPL_Basel2, EQTA_Basel2, NLTA_Basel2, LATD_Basel2, Basel2, Handelsbanken, Swedbank, Nordea, Deutsche_Bank, BNP_Paris, Barclays_Bank, BANK_OF_SCOTLAND, SOCIETE_GENERALE, HSBC_bank, UniCredit, Credit_Agricole, Intesa_Sanpaolo, Banco_Bilbao, Commerzbank_AG, UniCredit_Bank_AG, Banca_Monte_dei_Paschi, Banco_de_Sabadell, Deutsche_Postbank, Natixis, Banco_Espanol_de_Crédito, BANCA_NAZIONALE_DEL_LAVORO, Santander_UK, Banco_Santander_SA

a. Maximum likelihood estimate.

# Appendix 4. Scatter plot

The scatter plot from the outcome in SPSS, with the Standardized residual in our OLS regression on the y-axes and the Standardized Predicted value of the regression on the x-axes, indicates that there is no constant variance between the data points. This is an indicator of heteroskedasticity in our regression model (Wooldridge 2009:264-265).