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Quantitative research of bank rating determinants

Evidence for European banks

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Abstract

Since the burst of the recent global financial crisis, credit rating agencies (CRAs) and their rating process in financial markets and international developments has been a subject of great controversy. Rating agencies are considered to have contributed to this economic recession and huge European debt crisis, by upgrading or downgrading country economies, banks and their derivatives, either due to incompetence, questionable methodologies or serving certain personal and financial players' interests. Banks, while constituting the basis of global finance, are receiving the credit ratings of the famous agencies and as a result their personal investment and financing decisions, clients, investors and characteristics in general are affected by them.

A brief and comprehensive summary is firstly conducted referring to their historical background, functions and evolving role through the last century in order to provide crucial information on their growing and evolution from simple statistical organizations to financial giants affecting global economy. Moreover, an analysis of the quantitative determinants of credit ratings is conducted, based on the banks of five European countries, widely known in the world of finance as PIIGS. Bank-specific characteristics, such as credit risk, size, liquidity, profitability, efficiency and capital adequacy, are the main aspects of credit rating determinants that are going to be examined in this study.

This study constitutes an examination of the hotly debated issue of credit rating agencies and an effort to provide information on an area in finance that is quite unknown to the public. Certain conclusions are finally reached regarding the bank credit rating process and its methodology in relation with the strong arguments about the lack of creditworthiness and value of the agencies as statistical and financial organizations.

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1. Introduction

1.1 Introduction

Since the 2008 global financial crisis, credit rating agencies (CRAs) and their actual role in financial markets and international developments has been a subject of great controversy. Rumors, debates and scenarios about conflicts of interests and games under the table are continuously enhanced. Rating agencies are considered to have contributed to the current economic recession and huge European debt crisis, by upgrading or downgrading country economies, banks and their derivatives, either due to incompetence, questionable methodologies or serving certain personal and financial players' interests. Banks, while constituting the basis of global finance, are receiving the credit ratings of the famous agencies and as a result their personal investment and financing decisions, clients, investors and characteristics in general are affected by them (Ulinski and Girasa, 2011). Liquidity, efficiency, profitability and operating problems have been widely revealed in the banking sector since the burst of the global recession, undermining the credit rating and raising several research questions. Have rating agencies properly evaluated European banks in their reports, since the period when the first signs of the economic crisis were shown up until now? Are credit rating agencies and their evaluations valuable and trustworthy? Which determinants and criteria should be used in their rating methodologies? These are some of the basic questions that this study examines and tries to provide proper explanations.

In this effort, for answering and understanding the abovementioned remarks, an analysis is performed of the evolving role of the agencies since their establishment and the quantitative determinants of bank ratings for European banks whose countries have succumbed to a severe debt crisis over the last years. Specifically, the banks of Portugal, Spain, Italy, Ireland and Greece are examined since these five country economies, known as the PIIGS¹, are heavily indebted and perceived as either impetus or victims of the crisis. The rating process of these European banks is taken into account over the last years, before and after the crisis, in order to conclude to some

¹ The term has been used since the mid-1990s regarding Ireland, Portugal, Spain, Italy and Greece due to their similar socioeconomic environments and credit default as a result of the crisis. Using the euro as their currency, they were unable to apply the proper monetary policy in order to recover from the economic recession.

explanatory and rational assumptions about the actual methodologies and criteria of the CRAs applied in troublesome cases.

Terms and concepts, such as rating agencies, (the famous Standard and Poor's, Moody's and Fitch), upgrading or downgrading of banks and credit risk rating, familiar only to people in finance, and not the public, about ten years ago, are now part of everyday life. People's lives have dramatically changed over the last few years. The global economic recession has significantly affected the European economy; most of its countries have constantly received negative criticism on their credit quality, mainly coming from the agencies and their credit ratings that evaluate countries and banks, resulting in the huge sovereign debt crisis. Severe monetary measures and methods were applied by governments in order to recover from the terrible losses of the financial and economic chaos created. This situation, just described, is an interesting and current issue of great controversy that one should get the chance to be informed on, since credit rating agencies have brought themselves to light and affect each one's life, especially people in countries who are in serious financial trouble, such as the PIIGS.

This study can be of great utility to anyone in finance, especially amateurs or other students starting to deal with global economic matters, since a scientific, econometric, but rather simple approach is performed in order to provide answers and explanations of the rating agencies evaluation and technique determinants and criteria in their rating methodologies. A fundamental and crucial point of this study is the examination of the quantitative determinants of credit rating processes performed by the agencies, whether they are rational and significant in their interpretation or not and conclude to the amount of credibility and trustworthiness the notorious rating agencies can provide to the public. Qualitative criteria due to their difficulty in being quantified and taken into account in econometric and financial studies are not used in this research. Credit rating evaluation is not a simple procedure based entirely on solid numerical facts and as a result it is quite improbable concluding to a certain unquestionable result since the quantitative aspect of the whole rating procedure is only taken into consideration. Nevertheless, useful and comprehensive results can be deduced from this econometric study providing a clear and solid picture of the banks' characteristics playing an important role in the final rating evaluation performed by the agencies. Apart from the mere quantitative research of this study, a summary

report is also performed on the historical background and evolving role of credit rating agencies since the beginning of their operations until the present.

1.2 Historical background

The bond rating industry celebrated its 100th birthday a few years ago. Credit rating agencies were created in the early 1900s to provide information on the credit quality of bonds first in the railroad industry, and then for utilities and industrials (Purda, 2011). Rating agencies have reported on the creditworthiness of financial instruments and publicly traded companies since then, helping market participants make rational and circumstantial investment decisions (Sack and Juris, 2007). John Moody, in 1909, was the first to issue publicly available bond ratings. Poor's Publishing appeared then in the rating industry in 1916; Standard Statistics followed in 1922. The two companies merged in 1941, forming S&P, which was absorbed by McGraw-Hill in 1966. In 1924, Fitch Publishing also appeared in the industry (White, 2007). Today, there are ten nationally recognized statistical rating organizations (NRSRO) that financial firms may use for regulatory purposes by the U.S. SEC² (Ulinski and Girasa, 2011). The major ratings agencies in the United States are still the first three that made their appearance in the early 1990's, Moody's, Standard & Poor's, and Fitch, dominating the rating industry and financial markets.

The utility of the ratings companies for investors was obvious: the ratings provided more opinions of expertise for bond investors as far as the credit risk and quality of companies is concerned. Consistent with this view, the typical business model at first was for the rating agencies to sell their assessments and risk evaluations to investors. During the 1930s, the first major change appeared that had a significant impact on the industry. Bank regulators began to comment on the integrity and soundness of banks based on the quality of the corporate bonds in which the banks had invested; quality as evaluated by the rating agencies. By 1936, they had settled on a standard requirement, which is still in effect nowadays that banks could not invest in bonds that were below investment grade; the BBB rating is considered to be the "boundary" of an investment grade bond according to the grading scales and

² The U.S. Securities and Exchange Commission (frequently abbreviated SEC) is a federal agency which holds primary responsibility for enforcing the federal securities laws and regulating the securities industry, the nation's stock and options exchanges, and other electronic securities markets in the United States. The SEC was established by United States President Franklin D. Roosevelt in 1934 as an independent, regulatory organization during the Great Depression that followed the Crash of 1929.

definitions provided by the major agencies which were at the time and still are in force (White, 2007).

The rating industry came across its second main modification in the early 1970s, when the business model applied among agencies, investors and corporations changed from the “investor-pays” model to an “issuer-pays” one. Rating agencies began charging issuers of debt rather than investors for their services. Several possible explanations are provided for the evolution of the business model from an investor-pays to an issuer-pays one, such as the expanding use of the photocopier enabling the quick and easy circulation of ratings to anyone interested in, the bankruptcy of Penn-Central Railroad shocking bond markets and the fact that issuers of debt were eager to pay rating agencies so as to reassure investors of their creditworthiness. As a result, no matter the reasoning behind this business model alteration, the movement to an issuer-pays model caused the close interaction of agencies and issuers throughout the credit rating process (Purda, 2011). The other major change of the rating industry occurred during the 1970s. The SEC proposed that investors should be subject to minimum capital requirements and these requirements be linked to the credit risk of the bonds held in their investment portfolios. Under this whole scenery of bonds, ratings and capital requirements, a question of reliability, integrity and rights of the organizations providing the ratings arose. Since the SEC wanted to use bond ratings as the basis for those quality determinations, a decision was taken by the SEC to create a new category aiming at the establishment of a powerful regulatory system: The nationally recognized statistical rating organizations (NRSRO) were created (White, 2007). The SEC recognized only four additional firms as NRSROs in the years that passed up to 2000, reaching today the final number of ten as mentioned.

1.3 Functions

The definition of a rating remains almost unchanged since the beginning of the rating industry in the previous century. According to Standard and Poor’s, ratings “*express opinions about the ability and willingness of an issuer, such as a corporation, state or city government, to meet its financial obligations in accordance with the terms of those obligations*” or under the Securities Exchange Act of 1934 a credit rating is defined as “*an assessment of the creditworthiness of an obligor as an entity or with respect to specific securities or money market instrument*” (Purda, 2011). CRAs provide opinions on the potential bankruptcy or expected losses of

companies, governments and a wide variety of financial products. Probability of default includes the measurement of credit risk, whereas other risks, such as exchange rate, currency or interest rate risk, are not included by the assessments (Johansson, 2010). The three major rating agencies, Moody's, Standard and Poor's and Fitch, use their own methodology and apply different techniques, but all of them agree on a letter scale notation regarding credit risk. Under Fitch and S&P's rating scale, for instance, AAA is the best rating possible, with investments between AAA and BBB regarded as "investment" grade. The lower grades provide indications of volatile and risky investments, the lowest of which widely considered to be "junk" or "toxic" (Sack and Juris, 2007). The general meaning of credit ratings is summarized below.

Table 1: Summary of credit rating scale

	<i>S&P's</i>	<i>Moody's</i>	<i>Fitch</i>
<i>Investment Grade</i>			
Superior financial security - Highest safety	AAA	Aaa	AAA
Excellent financial security - Highly safe	AA	Aa	AA
Good financial security - More susceptible to economic changes than highly rated companies	A	A	A
Adequate financial security - More vulnerable to economic changes than highly rated companies	BBB	Baa	BBB
<i>Non-Investment grade</i>			
Financial security may be adequate, but capacity to meet long-term policies is vulnerable	BB	Ba	BB
Vulnerable financial security	B	B	B
Extremely vulnerable financial security- Questionable ability to meet obligations unless favorable conditions	CCC	Caa	CCC
Very high levels of credit risk - Default of some kind appears probable	CC	Ca	CC
Regulatory action - Placed under an order of rehabilitation and liquidation	C	C	C

Credit rating agencies, by means of the ratings, act as intermediaries regarding information asymmetries between financial players such as issuers, investors and regulators. Providing information is, hence, one of the main functions of CRAs. Moreover, a CRA can serve as a certification body in relation to rating regulation, meaning that the rating is regarded as an official seal of approval. Finally, ratings contribute to standardization, reducing, as a result, possible problems caused by different rules and cultures on controversy (Johansson, 2010).

1.4 Conflicts of interest

A risk for conflicts of interest exists at several stages of the rating procedures deriving from either the relationship between the CRA and the issuer or that between the employee and the issuer. When the CRAs implemented the issuer-pays model, the soundness of the rating might have been affected by the interest of producing new business, specifically when assessing structured finance products due to the high concentration of participants and the significant revenues from these ratings. Nevertheless, it should be highlighted, that alternative payment techniques are not flawless; in an investor-pays model, the investors are aiming at a low rating so as to receive a higher return and publicly financed ratings might deal with similar problems as the governments are keen on making certain that a high rating is provided for corporations that play an important role inside domestic economies. Except for such kind of conflicts, there is also a potential risk for conflicts of interest deriving from the personal needs and ambitions of CRA employees. The independence of an employee could, for instance, be affected if they are compensated for their contribution to the company's profits, have any ownership or other kind of economic or personal influence in the rated entity or are allowed to ask for and receive any kind of reward from the rated entity. However, such types of conflicts have slightly arisen following the crisis and it appears as if they have been properly controlled, if needed, by the CRAs and their employees (Johansson, 2010).

1.5 Regulation of credit rating agencies

Before the crucial time period of 2008 and the burst of the economic recession, there was restricted regulation of CRAs and a general conception and dependence on

the strength of market forces, such as the reputation mechanism³. Nevertheless, the financial crisis has provoked a reforming of the regulatory system and a change in the issue of public intervention. IOSCO is an international organization of securities regulators, aiming at maintaining fair, efficient and opaque financial markets, promoting economic development and establishing proper regulation of international transactions of the great variety of financial instruments and products. Their first report and set of principles referring to CRAs were presented in 2003. A more analytical code of behavior was issued in 2004, known as the Code, revised in May 2008 due to the financial crisis (Johansson, 2010). IOSCO's Statement of Principles Regarding the Activities of Credit Rating Agencies (2003) and Code of Conduct Fundamentals for Credit Rating Agencies (2004) claim four aspects of voluntary principles for rating agencies to adopt and act on accordingly: "*Emphasis was given on quality and integrity of the rating process, independence and avoidance of conflicts of interest, raise of a feeling of public responsibility towards investors-issuers and public disclosure of their own code of behavior*". However, government regulation of rating agencies was not included and rating agencies were not forced or threatened in any way to comply with the code of conduct by IOSCO or any other international regulatory organization. In response to the role of rating agencies following the recent financial mess, IOSCO revised the Code of Conduct Fundamentals for Credit Rating Agencies in 2008 by reinforcing each of the four categories of principles. There were measures included so as to strengthen each of the aspects covered by the set of principles in 2003 and 2004, such as "*ensuring adequate monitoring and timeliness of ratings, prohibiting analysts from participating in the design of structured securities and increasing public disclosures*" (Katz et al., 2009).

1.6 General remarks

The agencies underestimated the credit risk related to structured credit products and didn't manage to adjust their ratings quickly enough as financial markets and worldwide economies in general were deteriorating. CRAs were to blame for both methodology errors and conflicts of interests still in progress, contributing to the market participants' loss of confidence in the creditworthiness of ratings. It is not a shock certainly, regarding this whole negative situation and unfavorable market

³ Widely known as a technique for building trust and promoting the cooperation in online marketplaces, such as eBay, these mechanisms are balanced to have a wider impact on organizations.

conditions, for a heated debate to rise about the rating process, rating agencies, competition, and liability rules, enhancing the government and public demand for greater regulation and monitoring of CRAs (Utzig, 2010).

The Dodd-Frank Act⁴ significantly changes the frame wherein CRAs act. They will no longer have the right to claim almost unlimited liability from lawsuits from investors and others who rely on credit ratings provided by them. They will be considered responsible for; regarding accountants, lawyers and other professionals whose expertise remarks may force them to undergo any legal action taken by people affected by them. Banks and CRAs have to present publicly from now on more information on the rating process. Banks, in specific, are required to reveal all initial ratings received so as to prevent any potential cooperation between them. CRAs must also reveal more information about past ratings so that investors can decide on their relative performance. The expansion of CRAs, dominated by the major three organizations of S&P's, Moody's and Fitch, should contribute at least to the improvement of the ratings' accuracy. The Dodd-Frank Act aims at enabling CRAs to interact with banks in a more reliable, transparent and opaque manner (Ulinski and Girasa, 2011).

⁴ The Dodd–Frank Wall Street Reform and Consumer Protection Act came into force by President Barack Obama on July 21, 2010. Serving as a reply to the late-2000s recession, it introduced the most significant changes to financial regulation in the United States since the regulatory reform that followed the Great Depression.

2. Literature Review

Numerous studies have focused and dealt with the controversial case of credit rating agencies and their ratings regarding the credit risk of sovereign entities or corporations. Sovereign entities, such as a national government, have mainly been examined and analyzed by most financial researchers, scientists and market players for a great period of time. However, corporate credit ratings regarding the credit risk of a certain instrument of the corporation, rather than the whole corporation, have only been a subject of analysis for the last decades, from the end of the previous century until the present. Existing literature in ratings criteria and determinants mainly concentrates on sovereign ratings, including political and several others types of risk. This study is an example of a corporate credit rating analysis, focusing on the banking sector in particular and the long term issuer rating provided by the credit rating agencies. Despite the fact of the limited examination of bank ratings, an adequate and satisfying amount of researchers have dealt with this issue, providing the necessary feedback and literature.

Emawtee Bissoondoyal-Bheenick and Sirimon Treepongkaruna (2011) performed a quantitative research of the determinants of bank ratings for the banking sector in the United Kingdom and Australia. Both long and short term ratings provided by the three major rating agencies, Standard and Poor's, Moody's and Fitch, were the case of their econometric analysis. They studied which determinants play a significant role in the rating agencies' methodologies and models, concluding to the reliability, value and impartiality of the rating evaluation procedures. Specifically, financial ratios and indicators regarding asset quality, liquidity, capital adequacy and profitability performance were the main independent variables examined in their model. Non-performing loans, total capital ratio, liquid assets to total assets and return on assets prove to be significant determinants across the rating agencies' models and techniques, whereas macroeconomic variables, such as inflation and gross domestic product (GDP), do not appear to contribute to determining the bank ratings.

Winnie P.H. Poon et al. (1999) performed a multivariate analysis of the determinants of Moody's bank financial strength ratings. Their econometric analysis tested the safety and soundness of banks for over 50 countries examining mainly

bank-specific accounting and financial characteristics. Variables of risk dimensions, loan provision and profitability ratios all prove to significantly contribute to the financial strength ratings, whereas country risk ratings don't have a significant impact, providing another sign that key determinants of bank ratings are mainly bank-specific characteristics and general market or country indicators play a less important role. Bank financial strength ratings (BFSR) were an alternative type of rating that Moody's introduced, besides the traditional long-term debt rating (LTDR), long and short-term deposit rating and other bank credit ratings. Nevertheless, similar accounting and financial variables are taken into account for the estimation of all these types of ratings focusing on bank-specific characteristics, such as profitability, operating, liquidity and efficiency indicators and ratios.

Anatoly Peresetsky and Alexander Karminsky (2008) undertook a project of studying the long-term deposit and bank financial strength ratings of Moody's, performing an econometric analysis based on bank characteristics, time dummies and country-specific variables. Apart from the typical quantitative research of bank-specific characteristics, an attempt was made to test the external support factors that Moody's might take into consideration in assessing deposit ratings and which macroeconomic factors are significant. Profitability, liquidity and loan provision were taken into account as major and vital bank characteristics, whereas macroeconomic factors, such as inflation or gross domestic product were neglected or proved to be insignificant. However, an interesting finding of corruption revealing its significance in model evaluation came in the spotlight. Country corruption, as assessed and provided by the Corruption Perceptions Index⁵, which infests numerous governments around the globe, highly affects rating agencies in their credit rating models as shown in this study, since banks in countries with higher levels of levels of corruption, tend to receive lower credit ratings.

Credit rating determinants were also studied by Guglielmo Maria Caporale et al. (2012), regarding the bank ratings provided by Fitch Ratings. The focus of this econometric study, based on ordered choice models, was the analysis of Fitch's individual ratings, a certain type of the four categories of ratings that the organization provides to issuers. Bank-specific characteristics were also used as financial variables

⁵ Since 1995, Transparency International (TI) publishes the Corruption Perceptions Index (CPI) annually ranking countries "by their perceived levels of corruption, as determined by expert assessments and opinion surveys." The CPI defines corruption as "the misuse of public power for private benefit." As of 2010, the CPI ranks 178 countries on a scale from 10 (very clean) to 0 (highly corrupt).

of the model, including total assets, net interest margin, return on equity, liquid to total assets ratio, operating expenses and non-performing loans. The interesting part of this analysis was the examination of country-specific factors by incorporating a country index. Overall ratings appear to reflect a bank's financial position, however liquidity and net interest margin appeared to be rather insignificant in the test results for determining and affecting credit ratings. As far as the country index is concerned, there is strong evidence of affecting bank ratings such that banks in some countries have systematically higher ratings than others. However, an important thing to be mentioned is that inclusion of the country aspect raises the possibility of a model to predict with accuracy bank ratings relative to models that exclude country effects. This suggests that international studies attempting to predict ratings, and not just identifying determinants, have to include country indices in their models.

Fotios Pasiouras et al. (2006) studied the impact of bank regulation, supervision and market structure on bank ratings, apart from the traditional bank-specific characteristics in all similar analysis. Data from the sample used and the Fitch individual bank ratings showed that banks with higher profitability, liquidity and efficiency performance receive higher credit ratings, whereas problems and inadequacy among these crucial performance aspects tend to provoke the downgrading of banks. As far as regulation and supervision are concerned, which are expressed through capital requirements, restrictions on bank activities, disciplinary power, auditing and entry requirements and economic freedom seem to play an important role in rating models and procedures. Market structure variables, such as the percentage of banks owned by governments or foreign owned, also prove to be quite significant when examined in credit rating assessment.

Frank Packer and Nikola Tarashev (2011) perform a general evaluation of the rating methodologies of the three major credit rating agencies and make a comparison of them before and after the 2008 financial crisis. No econometric models are presented in order to examine certain quantitative determinants and factors of the bank ratings. A descriptive analysis is rather made of the grading scales and methodologies of each agency and the upgrading or downgrading of banks across countries with the financial crisis serving as a benchmark for the necessary comparisons. The difficulties in assessing banks' credibility and trustworthiness are highlighted due to the external support banks need, systematic or market risk and volatile earnings' performance that have to be accounted for. Nowadays, the credit

rating agencies seem to reevaluate their methodologies and reconsider certain aspects of their rating procedures and techniques. Differences in their methodologies contribute also to the difficulty in assessing a bank's creditworthiness. Numerous and complex factors and criteria matter for each of the agencies not enabling a firm and dominant model or framework.

Nicholas Apergis et al. (2011) performed an analysis of credit ratings and performance indicators regarding the banking sector. The innovative aspect of this study was the examination of the impact of the credit rating changes on banks' certain variables rather than the impact of these variables on the credit ratings. Nevertheless, the variables and indicators used and examined in their study as dependent variables, constitute the independent ones in this research, proving the interesting and interactive relationship of bank credit ratings and bank-specific characteristics. Once more, common profitability, liquidity and efficiency ratios were used in their econometric analysis, examining their significant changes through time due to the corresponding upgrading or downgrading provided by the credit rating agencies.

Another interesting study regarding credit rating agencies and banks' creditworthiness was performed by Antonio Di Cesare (2006). An analysis is made concerning market-based indicators, such as credit default swap (CDS) spreads, bond spreads and stock prices regarding their ability to anticipate the decisions of rating agencies. The quantitative research of determinants on bank ratings is also not conducted, similarly to the study of Nicholas Apergis mentioned before, mainly focusing on the impact of credit ratings on other market-based aspects and characteristics of the banking sector. It constitutes an alternative approach on the issue of credit ratings and bank performance, reinforcing the general statement and belief of the complexity of the credit rating procedures and difficulty in assessing banks' creditworthiness due to the several factors and aspects of micro or macro-indicators, bank-specific characteristics, systematic risk and market structure nature accounted for.

An important comment, contributing to the literature of this study, has to be made on Stefan Boes and Rainer Winkelmann (2006) in their study about advances in statistical analysis. The ordered response model, based on an underlying latent model with single index function and constant thresholds, is the regression model being used in this study in order to conclude to the significant financial variables affecting and determining credit ratings.

Last, but not least, as far as the theoretical approach of credit rating agencies is concerned, several studies and publications have contributed to the presentation and pointing out of the most important aspects of the rating agencies' background and framework. Tobias Johansson (2010) and Lynnette D. Purda (2011) conducted interesting studies about the evolving role of rating agencies throughout the years, providing important and meaningful facts about the background of the agencies, their initial working framework and their evolving functions and rating process until the present. Moreover, Siegfried Utzig (2010), Michael Ulinski and Roy Girasa (2011) in their working papers dealt with the controversial issue of rating agencies, emphasizing on the regulatory aspect of the story and need for several reforms due to the conflicts of interest provoked and general turmoil under the recent financial crisis.

The study performed in this paper is a quantitative research on the determinants of long-term issuer rating concerning the banking sector. Countries that have succumbed to the 2008 financial crisis, such as the PIIGS (Portugal, Italy, Ireland, Greece and Spain), and their banks are the main focus of the econometric analysis to be followed, due to their severe downgrading following the global recession. Lower credit ratings should be explained at a certain level by bank-specific determinants and the abovementioned literature contributes to the decision and examination of specific key financial and accounting variables serving as credit rating determinants.

3. Methodology

3.1 Modeling framework

The study of the quantitative determinants of the credit ratings is based on an ordered probit regression model rather than following a classic ordinary least squares approach (OLS) which is commonly applied in econometric finance problems. The most powerful benefit of using linear regression is that it leads to easy, simple and applicable mathematical theory. This strength should not be ignored and, in many cases, this reasoning alone is good enough for linearity to be utilized. However, as attractive as its strengths might be, linear regression has very strict assumptions that cannot be violated. Unreasonable conclusions can be reached when the assumption of linearity is made on a dataset that does not support this assumption. There are many restrictions in the linear regression area of research (Brooks, 2008). Apart from the fact that a linear model isn't always the most appropriate relationship, the violation of one or more theoretical assumptions can lead to irrational and inapplicable results. If a model's error structure is in fact multiplicative rather than additive, using linear regression assumes that the error has constant variance when this is not true. This can lead to misestimating the standard error, thus giving extreme values of prediction bounds. Another common violation is the necessity of the errors to be normally distributed. The assumption of error's normal distribution is of crucial importance to the theory development. This violation is common and can alter or weaken the theoretical solutions. When these theoretical assumptions do not hold, factors, estimates and prediction bounds cannot be regarded as trustworthy due to the fact that they are biased or misleading (Feldman, 2009).

In statistics, ordered probit is a generalization of the analysis to the case of more than two outcomes of an ordinal dependent variable. The ordered probit's modeling framework choice has been made on the general theory applied to dependent variables of a discrete and ordinal nature such as credit ratings. Ordinal numbers can be interpreted as providing a position or an ordering. A number of 12 for an ordinal scale may be viewed as better than a number of 6, but could definitely not be considered twice as good. Examples of ordinal numbers would be the position of a runner in a race, for instance, second place is better than fourth one, but it would be pointless to

consider it twice as good, a level reached in a computer game or in the case studied a credit rating assessment. Ordinal numbers come to complete difference with cardinal numbers which can be considered as actual numerical values that a variable might have with equal differences between them. Examples of such numbers can be the price of a share or a building whose differences in values can be interpreted as twice as good or bad (Brooks, 2008).

The use of OLS technique assumes that the underlying dependent variables, the credit ratings, have been categorized into equally spaced discrete intervals rating categories. In this way, it is implied that the risk differential between an A+/A1 and an A/A2 rating is the same as between BB+/Ba1 and BB/Ba2 rating. In simple terms, it can be explained as follows. If the values of the dependent variable are matched to prices of 0, 1, 2, 3, 4, then the linear regression interprets the difference between the value of 4 and the value of 3 as being the same as the difference between a value of 3 and a value of 2. However, this is not valid since a rating of A+/A1 includes different information as compared to a rating of A/A2. The only remark to be made for sure is that as the value increases, there is a constant increase in the credit quality (Bissoondoyal-Bheenick and Treepongkaruna, 2011). Thus, the use of OLS method is argued to be an inapplicable one for certain multivariate regression models, which are naturally ordered, such as credit ratings (Brooks, 2008). As a result, an ordered response model is being used in order to apply a regression model to the credit rating, which serves as the dependent variable in this study.

This study summarizes and examines a sample data of five European countries (PIIGS) which have severely suffered from the global financial crisis and are heavily indebted. In order to provide a grater sample of observations for the econometric analysis, all ratings are taken into account that a bank might have received during a particular year as well as the corresponding figures of the variables for the previous year, i.e. for a bank rating received on 15th May 2005, 18th September 2005 and 10th November 2005, the bank ratios of 2004 were used (Caporale et al., 2012). The ratings for the banks of these countries, provided by Standard and Poor's (or Moody's and Fitch in some cases of unavailable data of the S&P long-term issuer rating) over the period of time studied, are replaced by a numerical equivalent grade into all the individual categories (AAA, AA+, AA, AA-, etc.) which provides a rating 1-21 category as follows.

Table 2: Agencies rating and grading scale

Standard and Poor's Long Term Issuer Rating	Moody's Long Term Issuer Rating	Fitch's Long Term Issuer Rating	Rating Grade
AAA	Aaa	AAA	1
AA+	Aa1	AA+	2
AA	Aa2	AA	3
AA-	Aa3	AA-	4
A+	A1	A+	5
A	A2	A	6
A-	A3	A-	7
BBB+	Baa1	BBB+	8
BBB	Baa2	BBB	9
BBB-	Baa3	BBB-	10
BB+	Ba1	BB+	11
BB	Ba2	BB	12
BB-	Ba3	BB-	13
B+	B1	B+	14
B	B2	B	15
B-	B3	B-	16
CCC+	Caa1	CCC+	17
CCC	Caa2	CCC	18
CCC-	Caa3	CCC-	19
CC	Ca	CC	20
C	Ca	C	21
SD or D	C	SD or D	-

In order to interpret and apply the ordered response model, the latent variable model should be considered.

$$y_i^* = x_i b + e_i$$

y_i^* is an unobservable latent variable that measures the risk level, x_i is a vector of independent variables, b is a vector of unknown coefficients and e_i is a random disturbance term. If the distribution of the disturbance term is chosen to be normal,

then ultimately this produces an ordered probit model; y_i^* , the unobserved variable, is related to the observed variable, which in this study is the long-term issuer rating provided by the S&P's in the following way.

$$\begin{aligned}
 y_i &= 0 \text{ if } y_i^* < e_0 \\
 y_i &= 1 \text{ if } e_0 < y_i^* \leq e_1 \\
 y_i &= 2 \text{ if } e_1 < y_i^* \leq e_2 \\
 y_i &= 3 \text{ if } e_2 < y_i^* \leq e_3 \\
 &\vdots \\
 y_i &= 21 \text{ if } e_{20} < y_i^*
 \end{aligned}$$

e_i ($e_0 < e_1 < e_2 < e_3 < \dots < e_{20}$) are unknown, threshold parameters to be estimated (Boes and Winkelmann, 2006).

3.2 Regression model

Having explained the theoretical framework of the regression model to be used, the model form for the banks of the countries of Portugal, Italy, Ireland, Greece and Spain is as follows

$$\begin{aligned}
 y_i &= b_1 \times \frac{\text{non-performing loans}}{\text{total assets}} + b_2 \times \frac{\text{reserves for loans and losses}}{\text{non-performing loans}} + b_3 \times \\
 &\text{capital adequacy ratio} + b_4 \times \frac{\text{total loans}}{\text{total deposits}} + b_5 \times \text{efficiency ratio} + b_6 \times \\
 &\text{ROE} + b_7 \times \text{ROA} + b_8 \times \text{total assets}
 \end{aligned}$$

Finally, after having concluded to the regression model, tests and equations are ran in the econometrics software of EViews in order to test and check on the relationship of the independent variables with the dependent one and decide on which actually play the most significant role on affecting and determining the final credit rating assessments. All independent variables chosen as potential explanatory ones of the dependent variable of the credit rating do not necessarily indicate any significance on their own. An examination of their correlation is performed, using the correlation matrix method, for instance, as a vital step in order to decide on statistically significant variables that would potentially explain for the credit rating. Several regressions are then run with alternative independent variables' mixes so as to

conclude to the final one that would best and most appropriately explain the examined dependent variable or, if not possible, comments to be made on all results accordingly.

4. Data Analysis and Discussion

4.1 Interpretation of data sample

Credit rating agencies, according to their methodologies and rating process, indicate a variety of criteria and determinants for assigning bank credit ratings. However, it is extremely unlikely to use the same criteria for several reasons. Rating agencies provide little information on the relative weight assigned to each of the independent variables. Moreover, the choice of the variables indicates that data were available for each of the banks due to the large amount of available resources and databases an organization, such as Standard and Poor's or Moody's, can have at their disposal. This analysis, which is based on a number of limited databases and mainly internet available resources, surely meets across several limitations and lacks in its search and gathering of banks and ratings historical data. Key bank ratios or rating assignments were not available for all banks or years of examination resulting in a smaller sample and less observations, but still enough so as to conclude to results.

This study focuses on the long-term debt ratings provided by the Standard and Poor's for the banks of the five European countries, widely known in finance as PIIGS. The similar economic environments of these countries and the fact that they are heavily indebted support the examination of them as a group. These ratings cover a wide period of time, but only the period of 2004 to 2011 is studied, in terms of covering a time analysis before and after the 2008 financial crisis. Data for this part of the study was mainly taken from the Thomson1 database, since it provides information on different types of ratings for an adequate number of banks. In cases of non-available data for the long-term issuer rating of S&P, the equivalent counterpart in Moody's and Fitch rating scale was used as presented in Table 2 of previous section.

The initial sample of banks for Portugal, Ireland, Italy, Greece and Spain was 57 banks as shown in the available databases. The data was then discarded to ensure that the ratings across the agencies and the long-term issuer rating category were available, while a check was also performed on availability of bank-specific characteristics regarding the observed independent variables for the time studied. As a result, the final sample of banks for which ratings across the ratings agencies and

information from balance sheets and other bank characteristics were available includes 38 banks for the time period examined.

Moreover, an important aspect of this study that has to be presented is a descriptive analysis of the bank-specific characteristics used as independent variables in the ordered response model. General instructions provided by the rating agencies for the assessment of credit ratings include some of the major bank specific elements: the competitive and regulatory environment, management and strategy, funding and liquidity, financial leverage, capital adequacy, earnings sources and risk management. The assessment includes both qualitative and quantitative criteria that should be taken into consideration (Bissoondoyal-Bheenick and Treepongkaruna, 2011). However, in this study, as mentioned earlier, there is a restriction in examining only quantitative factors, since qualitative data is a difficult task to quantify. As a result, the determinants of the ratings focus on financial variables regarding the balance sheet, operating performance and key bank ratios. Macroeconomic variables, such as inflation and gross domestic product (GDP), considered being rather insignificant in credit rating estimation as already mentioned in literature, are not a part of this analysis. Balance sheet elements and key bank ratios indicate major characteristics managed by banks regarding their operating, investing and financing needs. These include credit risk, liquidity, capital adequacy, profitability performance and size. All the data and figures regarding this part of the study were downloaded from Bloomberg.

As banks have very different operating structures than regular industrial companies, it appears reasonable for investors to have a different set of fundamental factors to consider when evaluating banks. Except for the typical performance ratios, such as return on equity (ROE) and return on assets (ROA) providing significant information for all types of industries, specific alternative ratios are being preferred in the banking sector examining certain aspects.

4.2 Descriptive analysis of variables

✓ Credit quality (risk): A significant risk, which is of vital importance to banks, is related to the quality of its assets, specifically its loan assets. The importance of credit quality indicators is somehow self-explanatory. If a bank's credit quality is deteriorating due to non-performing loans and assets, the bank's earnings and capital may be at risk. A non-performing loan is a loan where payments of interest or

principal are overdue by 90 days or more. In this study, the non-performing loans to total assets ratio is used as an indicator of the historical performance of a bank's credit portfolio. Moreover, the loan and losses reserves to non-performing loans ratio is also taken into account as a factor of a bank's credit risk. Loan loss reserves are accounting entries, which banks create to cover estimated losses on loans due to defaults and nonpayment. Loan loss reserves are useful information for analysts and investors because they indicate a bank's perception of the stability of its lending base. It is important to comment on the fact that banks are flexible when it comes to deciding on how much of a loan to write off and when, making comparisons among banks difficult. Loan loss reserves are revised quarterly. An increase in the balance is called a loan loss provision. A decrease in the balance is called a net charge-off.

✓ Operating margin: A bank's efficiency ratio is essentially equivalent to a regular company's operating margin, in the sense that it measures how much the bank pays on operating expenses, like marketing and salaries. This study includes the efficiency ratio as a standard way to analyze how well a company or bank uses its assets and liabilities internally. Efficiency ratios are important because an improvement in the ratios usually indicates improved profitability.

✓ Liquidity: The loan/deposit ratio is a commonly used statistic for assessing a bank's liquidity by dividing the banks total loans by its total deposits. This number, also known as the LTD ratio, is expressed as a percentage, estimates a bank's liquidity, and by extension, the aggressiveness of the bank's management. If the loan/deposit ratio is too high, the bank could be vulnerable to any unexpected severe changes in its deposit base, whereas if the loan/deposit ratio is too low, the bank is stuck with unproductive capital and earning less than it could.

✓ Capital adequacy: There are a lot of ratios that bank regulators and investors use to assess the level to which the bank is vulnerable to a sudden increase in bad loans and the riskiness of a bank's balance sheet. The capital adequacy ratio, examined in this study, is expressed as a percentage of a bank's risk weighted credit exposures. This ratio is used to protect depositors and promote the stability and efficiency of financial systems around the world. Two types of capital are measured: tier one capital, which can absorb losses without a bank having the obligation to stop trading, and tier two capital, which can absorb losses in the case of a winding-up and as a result provides a lower level of protection to depositors. Despite not being a particularly popular ratio before the 2008 financial crisis, it does offer an adequate

estimation of the level of loss a bank can withstand, before turning into shareholder equity. Capital ratios can be thought of as proxies for a bank's error margin. Nowadays, capital ratios also play a larger role in determining whether regulatory unions will agree on acquisitions and dividend payments.

✓ Size: Total assets are everything that a company or an individual owns. Total assets measure the financial size of a company or corporation. For a company, total assets are listed on a balance sheet. These assets are valued based on their purchase prices, not the current market value of them. Assets can easily be transformed from a physical item into cash. The state, in which an asset can be turned into money, is widely known as liquidity. Assets can take several forms, ranging from real estate and investment securities to property, equipment or inventory. Cash is also included in the sum of assets. In this study, the logarithm of total assets is taken into account in the econometric analysis, a technique commonly being used and providing a significant factor in most financial and statistical models.

✓ Profitability: Return on equity (ROE) is widely considered as the net income to equity ratio, while return on assets (ROA) as the net income to average assets one. ROE usually indicates how efficiently a company is exploiting its equity or capital. It has become the most popular and widespread indicator for several reasons; in specific, the most preferred measure at larger banks. The main reason for the growing popularity of ROE is clearly its independence from total assets. ROE can be applied to any section of business or product. ROA tends to inform on how effectively an organization is making good use of its base of assets. This used to be the most popular way of comparing banks to each other and for banks to control and monitor their own performance from time to time. Many banks and bank executives still prefer to use ROA, though commonly at the smaller banks regarding the matter of asset size.

Having conducted a necessary theoretical approach on the independent variables, a descriptive analysis and explanation of the econometric results is presented regarding the explained variable of the credit ratings and the explanatory variables of bank-specific characteristics. As mentioned before, underlying the observed alphabetic grade for a bank, there is an unobserved numerical score y_i^* . The value of this numerical score (grading scale of 1-21) is determined by the set of explanatory variables according to the regression model.

4.3 Correlation of independent variables

Having concluded to the independent variables to be tested, a correlation test is run in order to test for potential multicollinearity among them. In the world of finance, correlation is a statistical measure of how two securities move in relation to each other. Correlation is used in advanced portfolio management. When dealing with a regression model instead, the term multicollinearity is also met referring to the correlation of explanatory variables between them. In statistics, multicollinearity is the occurrence of several independent variables in a multiple regression model that are closely correlated to one another. Multicollinearity or simple correlation can be the reason of wrong or unjustified results when studying the level of significance of independent variables trying to explain the dependent one (Brooks, 2008).

The number of several explanatory variables in the ordered probit model amplifies the probability of multicollinearity. However, the estimation of their correlation as shown in the correlation matrix (Table 4) is not significantly high except for the variables in the same categories, such as the return on equity and assets (profitability measures). An interesting showing of the correlation matrix includes also the negative correlation of both ROE and ROA with the non-performing loans to total assets ratio. The correlation of the independent variables is not high in this econometric study. A sufficient number of non-correlated variables exist in order to proceed to the regression model to be run. The three variables that present values of perfect positive or negative correlation (ROE, ROA and non-performing loans to total assets ratio) are not included with the rest in one plain regression.

4.4 Estimated regression models

As a result, a couple of regressions are run, including a different mix of explanatory variables. The first regression run by the econometrics software of EViews includes all the considered variables of the general model, apart from the profitability ratios of return on equity and assets due to their correlation with the non-performing loans to total assets ratio. The corresponding equation is as follows

$$y_i = b_1 \times \frac{\text{non-performing loans}}{\text{total assets}} + b_2 \times \frac{\text{reserves for loans and losses}}{\text{non-performing loans}} + b_3 \times \text{capital adequacy ratio} + b_4 \times \frac{\text{total loans}}{\text{total deposits}} + b_5 \times \text{efficiency ratio} + b_8 \times \text{total assets}$$

Table 5 (see Appendix) shows which of the explanatory are significant or not so as to conclude to the ones that actually play an important role in credit rating and can be considered as significant quantitative determinants of the credit ratings assessments. According to the z-statistic and the probability values, estimated in the econometric software of EViews, non-performing loans to total assets, reserves for loans and losses to non-performing loans, efficiency ratio and total assets prove to be significant with values above the assumed levels of significance. As a result, the bank characteristics of credit risk and size, having been described in previous section for their role in banks' performance and operations, can be considered as important aspects regarding credit rating determinants. As expected, there is a positive relationship between the non-performing loans and the credit ratings, shown by the positive coefficient of the variable. As non-performing loans increase, so does the numerical grade of the rating (the actual credit rating assessment is lower). On the other hand, reserves for loans and losses and total assets follow a different direction as shown by the negative relationship with the credit rating. As these two variables increase, the credit grade decreases (the actual rating assessment is higher). As far as the rest of the variables are concerned, capital adequacy ratio and loans to deposits ratio do not seem to play an important role in affecting credit rating evaluations. The statistical values of their estimation don't show any significance at all levels of confidence. Capital adequacy and liquidity do not seem to be standard parameters of rating assessment for all the agencies. As examined in the literature section, these two characteristics are either neglected or not taken into account for all the types of rating that an agency provides. Fitch doesn't consider capital adequacy an important determinant, while liquidity is probably significant for some the several kind of ratings assigned (Caporale et al., 2012).

The exact equation for the second regression run is as follows

$$y_i = b_2 \times \frac{\text{reserves for loan losses}}{\text{non-performing loans}} + b_3 \times \text{capital adequacy ratio} + b_4 \times \frac{\text{total loans}}{\text{total deposits}} + b_5 \times \text{efficiency ratio} + b_6 \times \text{ROE} + b_8 \times \text{total assets}$$

This alternative choice of independent variables excluded non-performing loans to total assets ratio and ROA, but included ROE as a profitability parameter in the credit rating assessment. As seen in Table 6 (see Appendix), reserves for loans and losses, efficiency ratio and total assets present once more significant values in their estimates of significance making us conclude to their important nature regarding the rating process. The new included variable, ROE, also appears to be quite significant, according to the showings of the regression output. The negative relationship to the dependent variable is justified, since the decrease of an entity's profitability, a bank's in specific, causes the increase of the credit grading in the model and as a result, the lowering of the actual rating. Similarly to the previous variable choice, capital adequacy and loans to deposits ratio do not prove to be significant, as the regression output indicates.

The third and final choice of variables appears in the following equation

$$y_i = b_2 \times \frac{\text{reserves for loan losses}}{\text{non-performing loans}} + b_3 \times \text{capital adequacy ratio} + b_4 \times \frac{\text{total loans}}{\text{total deposits}} + b_5 \times \text{efficiency ratio} + b_7 \times \text{ROA} + b_8 \times \text{total assets}$$

This particular mix of explanatory variables excludes once again the non-performing loan parameter and replaces the return on equity variable with the return on asset one. The interesting point of the regression output, demonstrated in Table 7 (see Appendix), concentrates on the insignificance of the efficiency ratio, despite the significant appearance of reserves for loans and losses and total assets for the third equation once again. The profitability ratio, ROA in particular, proves to be quite significant according to the showings of the probability value and z-statistic, following the same interpretation as the ROE variable regarding profitability and its impact on the rating process. Similarly to both of the previous regressions run, capital adequacy and loans to deposits ratio aren't significant, enabling a conclusion of certainty of their unimportance as aspects in determining banks' credit ratings.

To sum up, the regression outputs of the three alternative models, applied for the explanation of the dependent variable of credit rating, definitely agree on the significance of reserves for loans and losses and total assets in explaining the dependent variable of credit rating. Credit risk and size, as bank-specific characteristics, appear to be important determinants in bank credit rating from the rating agencies' perspective. Profitability ratios, presented in the form of return on equity and assets, prove themselves also to be significant determinants of bank credit ratings despite their correlation when tested in relation to non-performing loans. Moreover, efficiency appears to be an important aspect in the bank rating process, as shown by the outputs of two of the regressions estimated.

5. Conclusion

This study constitutes an examination of the hotly debated issue of credit rating agencies and an effort to provide information on an area in finance that is quite unknown to the public. Credit rating agencies play an important role in financial markets for a long period of time, but until recently their operating procedures as organizations and true character were only familiar to people in finance. The recent financial recession has brought them to light and provoked a lot of controversy regarding their value and credibility as plain financial and statistical organizations providing assessments on the credit risk of nations, banks and other financial instruments.

A brief and comprehensive theoretical approach is firstly attempted on their historical background, their functions and evolving role through the last century in order to provide a presentation of their growing and evolution from simple statistical organizations to financial giants affecting global economy and, as many experts believe, significantly contributing to the crisis due to irresponsibility and lack of creditworthiness. Secondly, an examination and analysis of the quantitative determinants of credit ratings is conducted, based on the banks of five European countries, widely known in the world of finance as PIIGS. The similar socioeconomic environments of these countries and financial losses they have succumbed to due to the 2008 crisis have inspired the effort to examine their bank's ratings. Quantitative determinants include only bank-specific characteristics, such as credit risk, liquidity, profitability, efficiency and capital adequacy, whereas qualitative criteria, such as ownership structure, management strategy, regulations and risk management are also applied by agencies in their assessments and credit risk evaluations (Bissoondoyal-Bheenick and Treepongkaruna, 2011). The fact that such kind of information is hard to quantify makes it difficult for a research to take them into account and as a result is not a part of this econometric study, causing a certain limited area of research and not enough space for integrated conclusions about the credit rating procedures. Such a research would be a further step of a similar econometric study in order to conclude to a more descriptive and circumstantial image of the actual rating procedures and methodologies of rating agencies.

As far as the evolution of rating agencies is concerned, it seems reasonable for a simple statistical company to transform to an international financial organization, considering all the changes that have happened during the last century. The key function of these agencies was initially the information provided to investors on investment grade bonds and other financial instruments and the credit risk assessment of issuers of debt since the shift from investor-pays model to issuer-pays one. Both kind of information are of crucial importance to financial players and markets, since the whole game of financial investments and decisions is based on reliable information and creditworthiness. The players, from simple investors to large financial and investment corporations, are eager to pay for this information. Agencies, on their behalf, were smart enough, obviously, to realize the power they possessed, affecting and controlling the decision making of everyone with their assessments. As a result, these transactions of services and economic rewards for the services ended in the evolving role of the agencies, the conflicts of interest among several parties and the need for regulatory and supervisory interference of independent bodies to restore the potential mess created. In a situation, where governments, financial institutions and rating agencies interacted, while taking care of their personal interests, it is reasonable for the rating agencies to affect the global economy with their credit risk opinions.

Certain conclusions are also reached, regarding the quantitative section of the study and the determinants of bank credit rating. Credit risk or asset quality is an important aspect of banks that rating agencies take into account in the credit rating process. Non-performing loans and loan loss provision are significant bank-specific characteristics affecting the rating assessments, providing an alternative and differential picture of the banking sector compared to other industries. Moreover, the size of the banks, expressed in pure assets possessed by a financial institution, plays an important role in the whole procedure, while profitability also pays its share in the credit rating methodology. Returns, expressed either in the form of equity or assets, definitely prove themselves to be crucial factors. Finally, efficiency is also contributing to the credit rating process in the terms of a bank's internal handling of assets and liabilities. Usually, efficiency comes improved profitability; both contributing as seen in the determining of rating criteria.

The interesting finding of the study concentrates on the non-significance of capital adequacy and liquidity. Previous research on these two aspects, as examined in

literature, provides also questionable results regarding their significance in the matter. They don't seem to be a standard case in the agencies' evaluations regarding all the different types of ratings. Each agency and each type of rating provided by them, from long to short-term or domestic to foreign, uses alternative criteria in the included assumptions, methodologies and applications. This remark on the study's showings constitutes a point of potential further investigation on liquidity and capital adequacy, as aspects of the credit rating process. Other ratios expressing the two variables might prove to be significant; more types of ratings could also be examined or certain country elements could be used related to the aspects of liquidity and capital adequacy. Macroeconomic variables of inflation and GDP were neglected due to the examined literature, but other figures and variables could be tested for correlation with the bank-specific characteristics and explanation of the examined variable of credit rating. Limited available resources and unavailable data from the databases at the studier's disposal crossed certain limitations regarding the previous aspects of potential investigation in the future.

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7. Appendix

Table 3: List of independent variables

<i>Symbol</i>	<i>Definition</i>
x_1	<i>Non-performing loans/Total Assets</i>
x_2	<i>Reserves for loans and losses/Non-performing loans</i>
x_3	<i>Capital Adequacy Ratio</i>
x_4	<i>Total Loans/Total Deposits</i>
x_5	<i>Efficiency Ratio</i>
x_6	<i>ROE(Return on Equity)</i>
x_7	<i>ROA(Return on Assets)</i>
x_8	<i>Total Assets(Log)</i>

Table 4: Correlation Matrix

	NPLS_TO_T OTAL_ASSE TS	RESERVE_L OAN_LOSSE S_TO_N	CAPITAL_A DEQUACY_R ATIO	TOT_LOAN_ TO_TOT_DP ST	EFF_RATIO	RETURN_CO M_EQY	RETURN_ON _ASSET	BS_TOT_ASS ET
NPLS_TO_T								
OTAL_ASSE	1.000000							
TS								
RESERVE_L								
OAN_LOSSE	-0.276630	1.000000						
S_TO_N								
CAPITAL_A								
DEQUACY_	-0.059380	-0.054944	1.000000					
RATI								
TOT_LOAN_								
TO_TOT_DP	0.143922	0.108407	0.084765	1.000000				
ST								
EFF_RATIO	0.271212	-0.034452	-0.365085	-0.126794	1.000000			
RETURN_CO								
M_EQY	-0.889812	0.076578	0.163014	-0.141506	-0.431700	1.000000		
RETURN_O								
N_ASSET	-0.903082	0.112244	0.150193	-0.147571	-0.479539	0.990296	1.000000	
BS_TOT_AS								
SET	-0.171072	-0.094002	0.216638	0.198257	-0.531367	0.303961	0.303963	1.000000

Table 5: Regression Output (1)

Dependent Variable: CREDIT_RATING				
Method: ML - Ordered Probit (Quadratic hill climbing)				
Sample: 1-215				
Included Observations: 169				
Number of ordered indicator values: 15				
Convergence achieved after 7 iterations				
QML (Huber/White) standard errors & covariance				
Independent Variables	Coefficient	Std. Error	Z-statistic	Prob.
NPLS_TO_TOTAL_ASSETS	7.855403	2.157650	3.640721	0.0003
RESERVE_LOAN_LOSSES_TO_N	-0.624083	0.110678	-5.638714	0.0000
CAPITAL_ADEQUACY_RATIO	1.446687	4.013136	0.360488	0.7185
TOT_LOAN_TO_TOT_DPST	-0.246887	0.194269	-1.270852	0.2038
EFF_RATIO	1.191068	0.347501	3.427522	0.0006
BS_TOT_ASSET	-0.294308	0.058473	-5.033193	0.0000

Table 6: Regression Output (2)

Dependent Variable: CREDIT_RATING				
Method: ML - Ordered Probit (Quadratic hill climbing)				
Sample: 1-215				
Included Observations: 169				
Number of ordered indicator values: 15				
Convergence achieved after 6 iterations				
QML (Huber/White) standard errors & covariance				
Independent Variables	Coefficient	Std. Error	Z-statistic	Prob.
RESERVE_LOAN_LOSSES_TO_N	-0.748364	0.112435	-6.655964	0.0000
CAPITAL_ADEQUACY_RATIO	1.985649	4.238871	0.468438	0.6395
TOT_LOAN_TO_TOT_DPST	-0.251882	0.188387	-1.337045	0.1812
EFF_RATIO	0.731993	0.385593	1.898355	0.0576
RETURN_COM_EQY	-0.951410	0.343782	-2.767478	0.0056
BS_TOT_ASSET	-0.275651	0.060115	-4.585431	0.0000

Table 7: Regression Output (3)

Dependent Variable: CREDIT_RATING				
Method: ML - Ordered Probit (Quadratic hill climbing)				
Sample: 1-215				
Included Observations: 169				
Number of ordered indicator values: 15				
Convergence achieved after 6 iterations				
QML (Huber/White) standard errors & covariance				
Independent Variables	Coefficient	Std. Error	Z-statistic	Prob.
RESERVE_LOAN_LOSSES_TO_N	-0.724193	0.113561	-6.377107	0.0000
CAPITAL_ADEQUACY_RATIO	1.238618	4.245268	0.291764	0.7705
TOT_LOAN_TO_TOT_DPST	-0.292223	0.193138	-1.513024	0.1303
EFF_RATIO	0.501601	0.422114	1.188306	0.2347
RETURN_ON_ASSET	-26.34510	8.648816	-3.046093	0.0023
BS_TOT_ASSET	-0.287146	0.059376	-4.836030	0.0000

Table 8: Summary of variables significance for estimated regressions

	Regression (1)	Regression (2)	Regression (3)
<i>Non-performing loans/Total Assets</i>	0.0003 (3.647201)***		
<i>Reserves for loans and losses/Non-performing loans</i>	0.0000 (-5.638714)***	0.0000 (-6.377107)***	0.0000 (-6.377107)***
<i>Capital Adequacy Ratio</i>	0.7185 (0.360488)	0.7705 (0.468438)	0.7705 (0.291764)
<i>Total Loans/Total Deposits</i>	0.2038 (-1.270852)	0.1812 (-1.337045)	0.1303 (-1.513024)
<i>Efficiency Ratio</i>	0.0006 (3.427522)***	0.0576 (1.898355)*	0.2347 (1.188306)
<i>ROE(Return on Equity)</i>		0.0056 (-2.767478)***	
<i>ROA(Return on Assets)</i>			0.0023 (-3.046093)***
<i>Total Assets(Log)</i>	0.0000 (-5.033193)***	0.0000 (-4.585431)***	0.0000 (-4.836030)***

(Probability values for each variable; values in parenthesis indicate z-statistic; * denotes significance at 10% level; ** denotes significance at 5% level; ***denotes significance at 1% level)