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THE USEFULNESS OF BASEL II AND III RISK WEIGHTINGS TO FORECAST BANKS' LOAN LOSSES

Erasmus School of Economics -Erasmus University Rotterdam

Sophie Segre Chiragarhula

Student number: 451155

Supervisor: Prof. Dr. Ferdinand Elfers

ABSTRACT

The aim of this thesis is to test the forecast ability of the Risk weighted assets over the loan losses of a bank. In order to do that, a sample of 57 banks from 8 European countries has been studied from 2008 to 2014. The risk weighted assets are considered as a proxy of the expected loan losses and should be providing information about the future effective loan losses. As a measure of the effective losses, I used the Loan loss provisions first and then the Net charge offs of a bank. Furthermore, after analysing the informative power of the RWA over the LLP and NCO, I will analyse first if the informative power of the RWAs depends on the banking sector risk of a country and secondly if it depends on the level of capitalisation of a bank. The results implicated that the RWAs are a reliable forecast of the banks loan losses and that this forecast ability does not depend on the banking sector risk and neither on the level of capital of a bank.

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1.INTRODUCTION

A. Motivation of the research

Basel II and III capital requirements and risk measures aim to overcome the drawbacks of the previous Basel I directives. In order to make banking system safer, especially after the recent financial crisis, the new directives focus on new capital requirements and more precise risk estimations. In this context, the development of risk measures is a fundamental outcome reached by Basel II accords, but to reach the goal of having a safe banking system those risk measures need to be as precise as possible. Here is the first reason why I am investigating the forecast ability of RWAs.

Furthermore, being well aware of the risk that a bank can face in it's near future, is important for a good functioning of the bank itself and the general banking system. Indeed, It is also important for customers (that are going to trust banks for the administration of their savings) and governments. Thus, it is necessary to have measures that precisely forecast the future risk. Here is why investigating the usefulness of Basel II/III risk weighting is an interesting and actual topic.

Different views surround Basel's risk weighted model but it remains that at least four functions can be identified. First, the RWAs are a prudential tool applicable to a micro (specific bank) and macro (banking system) environment secondly, RWAs provide a common and comparable measure for a bank's risks. RWAs also ensure (or at least aim to ensure) that capital allocated to assets is commensurate with the risk and potentially highlight where destabilizing asset class bubbles are arising.

It is important to determine if RWAs are a reliable forecast of loan losses if we consider that RWAs are derived from Basel's capital requirements: those capital requirements are the parameters imposed to banks in order to ensure that banks are operating with a

sufficient amount of capital to remain profitable and avoid insolvency. Thus, from a microeconomic prospective, RWAs have to provide a precise measure of banking risk as those risk weighted assets are directly related with the computation of bank's capital requirements. Moreover, from a macroeconomic prospective, as the European banking system is overall interconnected, the miscalculation of a single bank's capital requirement – that can possibly end with its insolvency - could rapidly affect other banks and contribute to a general financial crisis or magnify an existing one.

Loan loss provision is an accounting category that can be synthetically defined as the amount set aside to cover potential losses on loans in the future.

The estimation of Loan Loss Provisions (LLP) is a fundamental procedure for many reasons. First, considering that banking loans account for a high portion of a bank's portfolio, the LLP should be a reliable indicator of bank's financial condition and overall performance of a certain period. Hence, it should be carefully computed to avoid any inaccurate forecasts on banks performances.

Secondly, LLPs give also precious information about a bank's capital structure, it's ability of managing credits and it's capacity to cover possible future losses. As a consequence, LLPs are indicators used by financial investors and stakeholders to gain information before investing in a determined bank or for valuation purposes.

In addition, LLPs are subjected to prudential regulations: a certain amount of provisions is required for each bank as a consequence of its loans. Prudential regulations aim to set requirements to ensure that banks operate with a sufficient amount of capital that guarantees safe banking activities and prevent customers from incurring into losses due to bank's insolvency. Two types of risk can be identified: expected and unexpected loss. The prudential regulations focus on the unexpected loss defining capital requirements.

The main assumption underlying this thesis is that the Loan Loss Provision (LLP) of a Bank is a reliable and accurate measure of it's effective loan losses. Indeed, Basel's committee states that "loan loss provisioning should be robust and based on sound methodologies that reflect expected credit loss in the banks' existing loan portfolio over the life of the portfolio". Assuming that, I will first use the RWA ratio (computed as the ration between the RWA of a bank and it's exposure) to predict the loan loss of the following year and then compare the ratio with the LLP to see whether the RWA is a good forecast of the loan losses or not. In addition, I will repeat the analysis using the Net charge-offs as proxy of loan losses to have a double-check on the results.

Despite their fundamental role, it is important to notice that the main drawback with the LLP as a measure for effective loan losses is that LLP can be "seen" only *after* the loss is realized. LLP follows the principle of the "incurred loss", and as a consequence loss impairment can be done at the moment of the "loss event" so after the loss is realized. Hence, it is not a measure that investors can use *ex ante* to determine the solidity of a bank as LLP are available only after the loss is realized. Many criticism have been directed to the "incurred loss" model, mainly claiming that this model is not able to promptly recognize possible losses in the financial institution's portfolios. Another critic strictly related to the first one, is that LLP allows financial institutions to take corrective actions in the worst moment of the lifetime of a loans such as its default, and as a consequence damage the health of the bank as the corrective action is taken too late. In addition the "Financial Crisis Advisory Group", analysing the causes of the 2009 financial crisis, determined that "The incurred loss model for loan-loss provisioning and difficulties in applying the model – in particular, identifying appropriate trigger points for loss recognition – in many instances has delayed the recognition of loss on loan portfolios". In sum, LLP suffers from a "timing problem" and in this context it is

necessary to find another reliable measure to determine the health of a bank *before* the loss is realized. Here is another reason why I am investigating the forecast ability of the RWAs: RWAs, if reliable, could be used as a measure to assess the banks' solidity before the loan losses are realized.

LLP is in some cases distorted by earnings management. As Healy and Wahlen (1999, Accounting Horizon) state, earnings management can be defined as the situation "when managers use judgment in financial reporting and in structuring transactions to alter financial reports to either mislead some stakeholders about the underlying economic performance of the company, or to influence contractual outcomes that depend on reported accounting numbers", in other words, the practice of artificially inflating or deflating revenues or profits using accruals. As LLP can be considered as accrual, loan loss provisions can be subjected to this unethical practice. As I mentioned before, the main assumption of this thesis is that LLP are a reliable measure of effective loan losses, and as a consequence I will not deeply treat the relation between LLP and earnings management.

Here are basically the reasons why I am investigating the forecasting ability of RWAs.

B. Research Questions

The aim of this thesis is to investigate to which extent the risk weightings models developed in Basel II are reliable risk measures. In particular, focusing on European banks from eight different countries, I want to analyse the ability of the Risk Weighted Assets (RWAs) model to forecast bank's loan losses.

Hence, the main research question is as follows:

RQ1: Is the Risk Weighted Asset model a reliable forecast of future bank's loan losses?

Basel II and Basel III accords share the same structure and focus on three pillars: capital adequacy requirements, centralized supervision and market discipline. The main objective of Basel's accords is to design a guidance for risk measurement through the definition of capital requirements.

Even though the tree pillars are strictly related and dependent, the topic I will investigate is mainly included in the third pillar of Basel II (accord published in 2004) and focuses on the credit risk faced by banks. In this context, credit risk can be seen as the sum of Expected losses and Unexpected losses. The second component can be defined as the "real" risk that a bank is facing, as the expected losses should be already incorporated in the estimations done by banks in the budgeting phase. As a measure of the effective loan losses realized by a bank I will use its Loan Loss Provision (LLP), defined as the money a bank sets aside to cover loan losses or an expense that is reserved or defaulted loans or credits. In order to have a double check on the finding of this research, I will also use the Net Charge offs (NCO) of a bank as a proxy for their loan losses.

As a follow-up to the main research question, I will investigate if the forecast ability of RWAs depends on the banking sector risk of a country. The first research question focuses on the specific banks indicators, with this second research question will consider the different banks of country as a unit. The banking sector risk, as defined and computed by the Economist Intelligence Unit, represents "the risk of a systemic crisis whereby bank(s) holding 10% or more of total bank assets become insolvent and unable to discharge their obligations to depositors and/or creditors." The Economist intelligence unit, assigns a rating to the countries toward this risk, and "the rating can therefore serve as a proxy for the risk of a systemic crisis in the private sector." For the purpose of this thesis, the ratings of Denmark, Germany, Netherlands, Sweden, Italy,

Greece, Portugal and Spain will be considered and will serve as criteria of classification to divide the sample in a "High risk" and a "Low risk" category. The underlying reasoning is that a bank located in a country where the banking sector risk is high should put a lot of attention in their risk forecast to avoid negative unexpected events and to be safe against the risk of becoming insolvent. The high degree of accurancy of the risk forecast in the "high risk" should results in an accurate computation of the risk weighted assets and hence the RWA should be a reliable forecast for the loan losses of the following year and could be less precise for the low risk group, as those countries have stable situation and do not need to deeply focus on risk. Thus the research question will be as follows

RQ2: Does the forecast ability of RWAs for loan losses depend on the banking sector risk of a country?

Finally, I will analyse whether the level of capital of a bank influences the forecast ability of the RWAs or not, in this sub-question the level of capitalisation is measured using the Tier 1 ratio designed in the Basel's accords. Banks having a low level of capital should theoretically be more tempted to manipulate their risk forecast in order to appear less risky. Hence, the third research question is as follows:

RQ3: Does the forecast ability of RWAs for loan losses depend on level of capitalisation of a bank?

C. Main findings and Contribution

Based on the research conducted, I found that the RWAs are a reliable forecast for the banks' loan losses and have an informative power over the loan loss provisions and the net charge offs. Furthermore, I found evidences to determine that this forecast ability does not depend on the banking sector risk of a country and hence the forecast ability of

the Basel's risk weighted assets is valid in conditions of high risk as well as in situations of low risk. Furthermore, the level of capitalisation of a bank does not influence the forecast ability of the RWAs, in other words, the RWAs can be considered as reliable risk indicators for poorly capitalised banks as well as for banks having high levels of capital.

The Basel committee's models and frameworks are widely used to forecast risks and in particular by banks, those frameworks have been widely studied and criticized from several points of views but as Basel's accords are evolving and changing over time, with my thesis I will question once again one of those frameworks, the Risk weighted assets model, using recent data sets. The contribution of this thesis to the actual state of the literature is that it provides results on a precise item, the loan losses and do not consider only the general framework of the RWA but focus precisely on the loan losses. Furthermore, the previous studies analysed a data set related to previous years, whereas I used the data available until 2014 and this can be interesting as the period of time from 2008 to 2014 is characterised by a low stability and by the financial crisis that affected obviously also the banks.

The results of this research can be useful for banks as Risk weighted assets can be considered as a reliable forecast and measure of future loan losses. In addition, the risk weighted assets can be used by stakeholders to have a general idea on the level of risk of the loan portfolio of a bank.

2.THEORETICAL FRAMEWORK

A. Literature Review And Hypothesis Development

This research is related to two fields of literature regarding firstly the Basel's requirements and measures and secondly the bank's credit risk measurement.

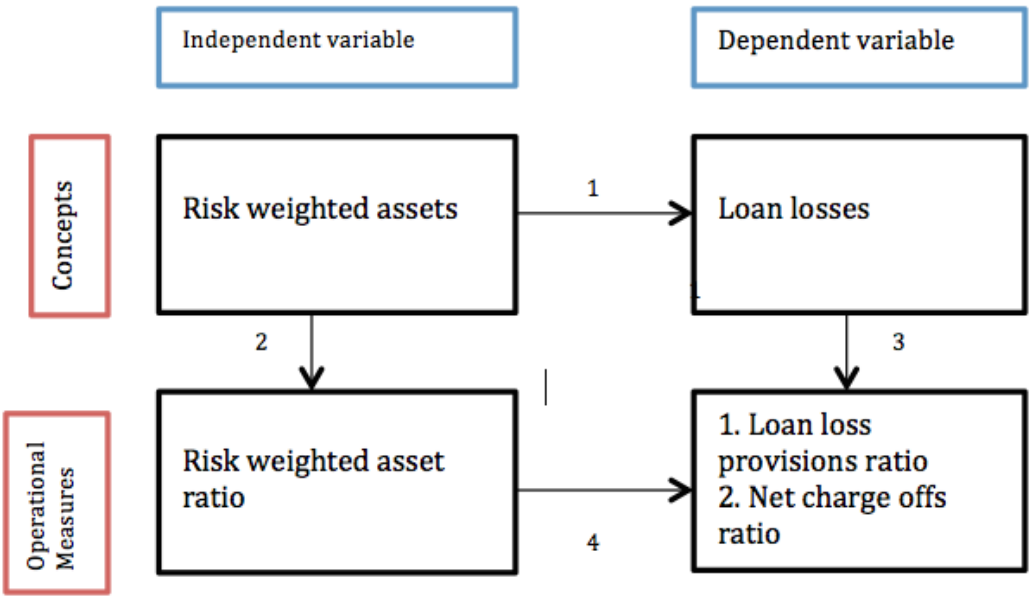
Many studies focused on a comparison between Basel I risk measures and Basel II risk measures as for instance Barakova and Palvia (2014). They investigate the relation between several Basel's risk measures and several proxies to measure the risk of a bank's loan portfolio. Their results indicate that Basel II/III AIRB risk weights are more adaptive than the methods introduced with Basel I in evaluating the expected loan losses and thus more sensitive to risk. Regarding my thesis, I will not compare Basel I and Basel II regulations but I will focus on Basel II.

As Behn, Haselmann and Vig states Basel II regulations permits banks to integrate their internal risk models and thus avoid the possible penalization of banks for holding very safe assets on the balance sheets that could arise under Basel I. As a consequence, Basel II should be a good forecast of loan losses.

Here comes my first hypothesis and its Libby boxes:

H1: RWAs provide precise and reliable forecast of bank's loan losses.

Table 1: Libby boxes



On the other hand, Basel RWAs received many critics, for example because of their level of regulatory complexity. Some researches as Glaeser and Shleifer (2001) or Koijen and Yogo (2015,2016) argue that such methodologies defined by extremely sophisticated rules are often dominated by simpler regulations, due to the high costs of implementing complex regulations. The cost of implementation could also be an incentive for some companies to find ways around the regulation that could bias the results obtained with the RWAs.

As Barakova and Palvia (2014) highlight, a general scepticism around Basel II risk weighted model is mainly based on the fact that differences in Basel risk weights can't always be explained by differences in risk. The Basel Committee on Banking Supervision (2013) published a study showing that estimated risk parameters vary widely across banks, even for the same exposures. In addition to that, Hau, Langfield, and Marques-Ibanez (2012) state that 'Basel risk-weights applied to claims on institutions do not reflect underlying relative risk.'

Following this view, different RWAs for different banks would not determine different – credit– risk and could thus be a bad forecast of loan losses for the reason that those measures do not represent real risk but are influenced by other internal factors.

Furthermore Embrechts, Paul, et al. in "An academic response to Basel 3.5." (2014) address strong criticisms to Basel's RWA. For instance, following the view of Daníelsson et al. in "An academic response to Basel II" (2001), they state that: "Statistical models used for forecasting risk have been proven to give inconsistent and biased forecasts, notably underestimating the joint downside risk of different assets. The Basel Committee has chosen poor quality measures of risk when better risk measures are available." Daníelsson et al. in their paper are deeply concerned by the destabilising effects and the negative impact on the general financial system that the poor risk

measurement could cause. In particular they disagree with the method of calculation and the use of Value At Risk to compute RWAs. The authors criticize the fact that Basel's committee fails to consider risk as endogenous, and while could be negligible in stable financial periods, it can cause important damages in times of crisis. In their view Basel's method of risk forecasting should integrate the endogeneity of risk and liquidity. To support this view Daníelsson et al. use various examples such as the crash of US dollars against yen during October 1998, stating that in those cases the use of VaR to compute RWAs is not optimal because one of its basic assumptions (the stationarity of the underlying stochastic process) is violated. In addition, the authors tear both into the standard and the internal approach, claiming that the credit rating-furnished by rating agencies and used in the SA- are not entirely capturing the credit risk of an institution.

In sum both papers of Daníelsson et al. and Embrechts, Paul et al. sustain that RWAs are not a reliable risk measure (mainly because of the drawbacks of using VaR) and thus are not a reliable forecast of effective loan losses, in particular in times of crisis.

The null hypothesis is as follows and is based on the previous reasonings:

H0: RWAs do not provide any information on the bank's loan losses

The third and fourth hypothesis are:

H3: RWAs model provides a reliable forecast of loan losses when the banking sector risk is high

H4: RWAs forecast ability does not depend on the banking sector risk.

The hypothesis 3 follows the reasoning that a bank operating in a country where the banking sector risk is high should accurately compute its risk forecast to avoid negative unexpected events and to be safe against the risk of becoming insolvent. This high degree of accuracy of the risk forecast should results in an precise computation of the

risk weighted assets and hence the RWA should be a reliable forecast for the loan losses of the following year.

Another factor that could influence the forecast ability of the Risk Weighted Assets is the level of capital of a bank. The underlying reasoning is that a bank having low capital has incentives to manipulate its risk forecast in order to appear untruthfully less risky than how it really is and thus the expected loan losses and the effective loan losses would be really different. Indeed, low capitalisation means more risk of insolvency and is a negative sign for investors and savers. Hence, the hypothesis are the following:

H5: RWAs model provides a reliable forecast of loan losses when the level of capitalisation is high

H6: RWAs forecast ability does not depend on the level of capitalisation.

B. Regulatory Background

B.1.Basel's framework

Banking activities have a fundamental role in the economic system of a country, especially for their role of financial intermediary and their ability to transfer resources from "surplus" subject (savers or depositors) to subjects in a condition of financial deficit (investors). A strong and resilient banking system is the foundation for sustainable economic growth, as banks are at the centre of the credit intermediation process between savers and investors.

This peculiar activity permits to reallocate financial resources where those resources are needed and through that mechanism banks contribute to the financial and economic development of a country. It is important to notice that banks operate with a high degree of leverage, meaning that the financial resources they use for their activities are taken from the deposits of their customers. Here arises one of the reasons why banking

supervision is needed, customers (depositors) who trust the bank, have to be protected against unexpected losses. Hence, in order to avoid losses for customers, banks are supervised and have to follow strict regulations to ensure that their leverage remains at an acceptable level and their level of capital is sufficient to support their activities without the risk of insolvency. Furthermore, as different banks in the same country and also across Europe are strictly linked, one bank's default is likely to affect others banks. Worst case scenario, widespread banking problems can lead to a financial crisis or cause broad damage to the economy because of the failure in the banking role of intermediary. Therefore, the need of supervision arises also to maintain financial stability. Basel's Committee on Banking Supervision (BCBS) has as a primary goal to "strengthen the regulation, supervision and practices of banks worldwide with the purpose of enhancing financial stability."

We can define "prudential" regulation as the part of supervisory activities that focuses on maintaining financial stability (macroeconomic objective) through the control of the single financial subject that operates in the market (microeconomic tool). Prudential regulation usually involves setting capital adequacy ratios, liquidity ratios, systems for managing various risks, limits on large credit exposures and so on to guarantee that banks operate in conditions of solvability and solidity. Prudential supervisors are concerned with ensuring a prudent behaviour of financial institutions. BCBS "is the primary global standard setter for the prudential regulation of banks and provides a forum for cooperation on banking supervisory matters". Basel's prudential regulation has a macroeconomic and a microeconomic focus. The macroeconomic focus has a "general objective" and focuses on the stability of the financial system, whereas in the microeconomic focus the attention is directed to individual financial institutions and prevents them from undertaking too high risks. The recent financial crisis has

strengthened the need and the importance of banking supervision. In particular, the high leverage of European banks in the pre-crisis period, has been identified as one of the causes of the financial and economic crisis. This high level of leverage and the progressive erosion of capital observed during the crisis emphasized the need of supervision and requirements to avoid another similar situation in the near future. Basel's third accord is integrating the lessons learned from the crisis with a new reform package.

Another reason why banking supervision is needed is information asymmetry. Information asymmetry can take different forms and could be in disadvantage of customers but could also have a negative impact on a bank itself. BCBS with the definition of international standards and requirements can reduce the information asymmetry, as those requirements are equal for all banks customers can easily compare different banks. Furthermore, using Basel's explanatory frameworks customers can find detailed explanations on the requirements and the ratio used in bank's reports. As a results, they can have a better understanding of the requirements and the risk level of banks measured through Basel's methods and thus the information asymmetry between banks and customers is reduced.

Basel Committee from 1988 aims to set standards for the prudential regulation of banks, notably with its accords ("Basel I" published in 1988, "Basel II" published in 2004 and "Basel III" published in 2009)

Basel II accord is built around three pillars: capital adequacy requirements, centralized supervision and market discipline.

Even if the tree pillars are strictly related, I will center my thesis on the first pillar and in particular on the credit risk faced by banks. The credit risk, as defined by The Committee on Payments and Market Infrastructures (CPMI) is "the risk that a counterparty,

whether a participant or other entity, will be unable to meet fully its financial obligations when due, or at any time in the future".

Before Basel's I (1988) accord, every bank had its own risk estimation and capital requirements. This has obviously many drawback especially related with the emerging trend of financial globalization and the growth of interrelated financial markets. Basel's I aimed to provide some general norms in order to align the different practices (regarding for instance risk measurement and supervisory) used across the countries. The final objective is to promote and maintain financial stability and create a level playing field for internationally active banks.

In this context, Basel's I introduced a first set of capital requirements in order to provide a buffer against bank losses, protects creditors in the event of bank fails and create disincentive for excessive risk taking. In addition, this accord introduces a method to measure risk. This "standard" methodology is based on a solvability coefficient where the ratio between capital and weighted risk assets (RWA) could no be inferior to 8%. The basic formula is as follows:

$$\text{Solvability ratio} = \text{Capital} / \text{RWA} \geq 8\%$$

In this first definition of risk weighed assets only the credit risk is taken into account. Every type of exposures has a predetermined coefficient. For the assets in and off-balance sheet a coefficient from 0% to 100% is determined, the more the asset is risky the higher the coefficient will be. Then, to calculate its capital requirements, a bank for instance would multiply the assets in each risk category by the category's risk weight and then multiply the result by 8%.

This standard approach received many critics in particular for its non-sensibility regarding the type of assets in the institutions portfolio and for using a too simple approach for the categorization of the assets. Risk weights did not flow from any

particular insolvency probability standard, and were for the most part, arbitrary. In other words, this standard approach is not able to differentiate between exposures under the same asset class and this would negatively affect banks with a high degree of portfolio differentiation.

Furthermore Basel's I accord considers only the credit risk, while other types of risk affecting banks health conditions can be identified, as for example the operational risk.

Basel's II accord aims to overcome Basel's I drawbacks, including a larger set of risk in the risk measurement and designing a new methodology in order to be more sensitive to banks' specific risk characteristics.

The first pillar present capital requirements, not only for credit risk but also for market and operational risk. The total capital ratio has to be, as in Basel I, not lower than 8%. The calculation of the total RWAs is done by multiplying the capital requirements for market risk and operational risk by 12.5 (i.e. the reciprocal of the minimum capital ratio of 8%) and adding the resulting figures to the sum of risk-weighted assets for credit risk:

Risk Weighted Assets (RWA)= 12.5 x K x EAD

Where K is the capital requirement and EAD the exposure at default.

With the objective of being more risk sensitive, Basel's II accord presents two different methodologies that banks can adopt to measure risk. The Basel's II standard approach is basically a revision of the methodology presented in in Basel's I accord, including more precise class assets and different specifications for special exposures. As it is stated in Basel's II explanatory framework "the revised approach to CRM [credit risk mitigation] allows a wider range of credit risk mitigants to be recognised for regulatory capital purposes than is permitted under the 1988 Accord."

In the standard approach (SA), ratings are computed by external agencies to define the risk faced by banks with its assets. Those ratings are then used and with the general risk weights prescribed for every type of exposure to compute the RWAs.

The other possibility is to adopt the internal rating based approach (IRB) where banks could use their own internal measures for key drivers of risk credit are afterwards subjected to approval for use. Thus, the IRB approach should be more risk sensitive. The IRB itself presents a distinction between Foundation IRB (FIRB) and Advanced IRB (AIRB). In the FIRB model banks estimate the probability of default (PD) using internal models, while the other parameters are the results of supervisory estimates whereas in the AIRB model all the risk weight and estimations are internally computed by banks.

The classes of assets considered in the IRB approach are as follows: Corporate, Estate, Sovereign, Bank, Retail and Equity. Within the corporate asset class, five sub-classes of specialised lending are separately identified and within the retail asset class, three sub-classes are separately identified. Finally, within the corporate and retail asset classes, a distinct treatment for purchased receivables may also apply provided certain conditions are met. Banks have to proceed with the classification of assets and then apply risk weights.

The RWAs calculation is based on one of the two approaches. Banks subjected to the IRB are required to quantify three risk measures to describe the exposure of their portfolio.

First, the Probability of Default (PD) that is the average percentage of obligors that default in a rating grade in the course of one year. The second one is the Loss Given Default (LGD) that represents the credit loss incurred if an obligor of the bank defaults. Finally, the Exposure At Default (EAD), an estimate of the outstanding amount (drawn amounts plus likely future draw-downs of yet unused lines) in case the borrower defaults. In addition to these three parameters another measure as to be taken into

account: the effective maturity (M) of the exposure. Maturity adjustments are important components in the calculation of capital requirements and RWAs. The general guideline is that capital requirements should increase with maturity. First, because long-term credits are usually riskier than short terms credits. Thus, long-term credit probability of default is higher and as a consequence their capital requirement is higher. Second, downgrades are more likely to occur in case of a long term credit. Lastly, loans with high PD have a lower market value today than loans with low PDs with the same face value (market-to-market valuation).

Furthermore, maturity effects are stronger with low PDs than high PDs, this is because low PD borrowers have more "potential" for downgrades. In sum maturity adjustments depend upon assets maturity and probability of default.

Those four elements can also be considered as risk drivers for a bank, it is thus consistent with the internal computation as a bank itself has a better knowledge of its risk source than an external agency.

Considering the risk measures of the probability of default, the loss given default and the exposure at default, Basel's II capital requirement is equal to:

Capital requirement (K) = [LGD * N [(1 - R)^-0.5 * G (PD) + (R / (1 - R))^0.5 * G (0.999)]- PD * LGD] * (1 - 1.5 x b(PD))^ -1 × (1 + (M - 2.5) * b (PD)

Where the maturity adjustment is represented by:

(1 - 1.5 x b(PD))^ -1 × (1 + (M - 2.5) * b (PD)

Basel's framework define two types of risk: the expected loss (EL) and the unexpected loss (UL). The expected loss is the estimated during forecast and planning activities and can be managed through a number of means, first of all provisioning.

The unexpected loss is the unplanned part of losses, institutions know that they will occur but it is impossible to know in advance their timing and severity. Basel's II

regulation requires banks to hold capital against unexpected losses, that we could define as the "real" risk faced by bank. Regarding the expected losses, no capital requirement by BCBS is set, but banks have to demonstrate that they posses an adequate provision against expected losses.

B.2.IAS 39, IFRS 9 and loan losses

Loan losses have been historically regulated by the IAS 39, however, this accounting standard has recently been reformed with the new directives of the IFRS 9. Loan loss P&L Expense is frequently the single biggest expense item in a bank's P&L, so it is really important to have optimal regulations.

In general, loan loss provisions should lead to a reliable measurement of financial assets without overestimations and should avoid hidden reserve or earning management practices. In addition LLP should lead to a timely recognition of risk provisioning in order to provide a capital buffer against losses.

I will first briefly explain the IAS 39, then the reasons for the definition of the new IFRS 9, and finally the content of this new standard that will be mandatory from the first of January 2018. As the IFRS 9 is not yet implemented, the data on loan losses provisions I will use in my theses are still a result of IAS 39.

The accounting standard IAS 39 has first been defined in 1998 and it defines all the accounting practices (classification, first recognition, removal and successive valuation) for all the financial instruments in an institutional portfolio. Indeed, also for loans and receivables.

IAS 39 impairment model is based on the " incurred loss", this means that credit losses can be recognized only when there is a substantial evidence of a loss event. Furthermore, financial instruments have to be recorder at cost. The main objective of

the incurred loss model is to avoid or at least reduce the possibility of earning management practices.

Regarding the loan loss provision, at initial recognition no provision is set, the provision can be recognized only after a trigger event (i.e. the evidence of a loss event)

The drawbacks of the IAS 39 became more visible with the 2009 financial crisis. Different aspects of the IAS regulation have been identified as a cause or at least as factors that augmented the magnitude of the crisis.

First of all, the "incurred loss model" and the need of trigger event in order to recognize the loss present a "timing" problem. In practice this method delayed the recognition of credit losses associated with loans. As a consequence, losses and impairments were recognized too late. The financial stability forum, in an analysis on the causes of the financial crisis, identified in particular this aspect of the IAS 39 as a cause of the financial crisis. This delayed recognition of losses has a procyclical negative effect and is not characterized by a long-term view. In fact, IAS 39 has been criticized for not being forward looking as the provisions set against losses were not created before the actual loss.

Despite the initial objective of reducing illegal accounting procedures, the "loss event" needed to recognize a loan loss has in some cases been voluntarily retarded in order to delay losses and thus permitted earning management practices.

Furthermore, IAS 39 is characterized by a high level of complexity. In fact, numerous frameworks and explanations have been published after the first IAS edition to make the IAS 39 more understandable. Some authors also argue that this high level of complexity leads to imprecise application of the IAS 39 and that a more simple regulation is needed.

The new IFRS 9 standard aim to overcome the limitations of the previous regulation IAS 39. As one of the main drawback was the incurred loss model for the impairments, IFRS

9 is based on an expected credit loss model that applies to debt instruments (such as bank deposits, loans, debt securities and trade receivables) recorded at amortised cost or at fair value through other comprehensive income, plus lease receivables, contract assets and loan commitments and financial guarantee contracts that are not measured at fair value through profit or loss. In November 2009, the initial design of IFRS 9 considers that expected credit losses have to be recognised over the life of a financial asset (by including them in the effective interest rate) from the initial recognition. Since then, an allowance for credit loss will be created and a result this allowance would mimic the change in the risk of the financial asset. The ratio behind the expected credit loss model is to have a deeper understanding of the quality of the loans for instance in a banks' portfolio. In the final design of IFRS 9 in July 2014, the IASB determined that the provision has to be set as follows:

- A provision equal to the 12 months expected credit loss for the financial instruments that had not yet seen an increase in the credit risk since initial recognition,
- A provision equal to the lifetime expected credit loss for the financial instruments that had a significant increase in credit risk.

This method aims to promptly recognize possible credit losses and thus overcome the timing issue in the IAS 39 model. Furthermore, the different provisions criteria related to different financial instruments, permit to determine whether a financial instrument is characterizes by a high level of risk or not. Provisions can be here considered as real risk indicators for financial instruments.

The provision set for loan losses depends on the credit deterioration since the initial recognition, whereas in the IAS 39 the provision is created only when the loss is realized. In other words, entities are required to set an allowance for expected credit

losses if there has been a significant increase in the credit risk since the initial recognition, the provision is constantly updated as a result of asset's risk changes. The use of "expected" credit losses aims to incorporate a forward-looking valuation to optimally capture the quality of the assets in a long-term perspective. Some will may argue that using "expected" credit losses will require a higher degree of personal judgment compared to the previous incurred loss model, and as a consequence it could be more difficult to compare results across different entities. However, entities are required to give explanations about their calculation techniques in order to maintain a high degree of transparency and avoid the possible difficulties in comparing the results.

Regarding the level of allowances, the IFRS 9 will result in larger level of provisions. IAS 39 requires provisions only when the trigger event occurs while IFRS 9 requires an initial provisions and an increase (or a decrease) when there is a significant increase (or decrease) in the risk level compared to the initial state. Furthermore, the amount of provision needed will be not only higher but also more variable compared to the previous regime: with the new regulation the provisions follow the path of the credit risk whereas in the old regime the provisions where only changing whenever there was an incurred loss.

Three different approaches are contemplated by IFRS 9.

The first one is called "The general approach". In this approach, at each reporting date, an entity recognizes a loss allowance if there has been a significant increase in the credit risk of the financial instrument since the initial recognition. In that case provisions will augment for an amount equal to the lifetime expected credit losses. Then, if in the next period the credit risk of the financial asset is reduced and returns to the initial level, the entity can revert the process and set the provision equal to the 12-month expected credit loss.

In the case that there are no substantial changes in the risk profile of the asset, the amount of provisions is set equal to the 12-months expected credit loss. The changes – made at each reporting date- in the provision are recorded in profit or loss as an impairment gain or loss.

To avoid the time-consuming practice of determining for each financial instrument their risk, IFRS 9 provides a framework where assets are categorized and associated with a certain degree of risk.

The second approach is "The simplified" approach. In this case, the provision is an amount equal to the lifetime expected credit risk at each reporting date. The provision does not mimic the change in the financial instrument's credit risk. This approach is suitable for trade receivables and certain contract assets without significant financing components. This approach would reduce some issues related with risk forecast for those entities that do not have a solid risk management system. On the other side, IASB warns that the use of this approach would reduce the possibility of comparing the results with other entities.

The last one is the "The purchased" or "originated credit impairment" approach. This approach requires the entity to determine, at the initial recognition if the financial asset is "credit impaired". A "credit impaired" financial asset is one that has been subjected to one or more events that negatively impacted (reduced) its future cash flows. IFRS 9 states a number of events that can be considered as a cause of "credit impaired" assets. Those events are similar to the event that in the IAS 9 model were considered as the trigger events for the incurred loss model. Here are some examples: a significant financial difficulty of the borrower, a high probability of borrower's bankruptcy, a purchase of a financial asset at a deep discount. This method is quite similar to the IAS 39: for the "credit impaired" assets the provision set is equal to the lifetime expected

credit losses. The provision is set at the moment that those financial assets are considered "credit impaired" and in other words this precise moment corresponds to the "loss event" in the IAS 39 that gave birth to the provision. The logic under this approach is that the losses are already incorporated in the fair values used

3. DATA AND RESEARCH DESIGN

A. Sample and Data set

The overall sample is composed by 57 banks and the data collected covers the period from 2008 to 2014. The studied banks are located in the following countries: Denmark, Germany, Greece, Italy, the Netherlands, Portugal, Spain and Sweden; more precisely, 16 banks are from Germany, 7 from Denmark, 4 from Spain, 5 from Greece, 6 from Italy, 11 from the Netherlands, 1 from Portugal and 7 are from Sweden.

Greece, Italy, Portugal and Spain heavily suffered from the recent financial crisis and are in fact part of the GIPSIs countries considered as the weakest ones during and after the crisis. On the other hand, the North European countries chosen, have been less negatively affected by the crisis.

The data gathered regards the risk weighted assets, the capital requirements and the exposure of different items. First of all, the data has been hand collected from the pillar 3 or annual reports of the banks included in the sample. The research aims to come up with a RWA ratio equal to the total loan exposure of a bank divided by its risk weighted assets:

RWA ratio= Total loan RWA/ Total loan exposure

As the focus of the thesis is on the loan losses, the key factor is to obtain an RWA ratio as close as possible to the loan RWA ratio. In order to obtain that, I identified first the

RWAs, the capital requirements and the exposure of those accounting items that are not included in the category of loans but that are included in the total amounts of the Standard Approach (SA) or Internal Approach (IRB), in the majority of the cases those item were securities, equity investments and investments in funds. Finally, the amounts related to the previously mentioned items other than loans were deducted from total SA/IRB amounts. The result is a (almost) "clean" RWA, capital requirement and exposures reflecting the loan portfolio of a bank that allowed me to compute the RWA ratio as precisely as possible.

The following step concerned the collection of the data regarding the loan losses provisions (LLP) and the Net charge offs (NCO). Using the Orbis bank focus database, I downloaded data from 2009 to 2014. Coming back to the RWA ratio, the last data collected is referred to the year 2013, this is because I will use the 2013 RWA ratio to see whether it is a reliable forecast for the loan losses in 2014. In a general way the RWA ratio at the year t-1 will be used to test if it is a reliable prediction for the loan losses of the year t, with t going from 2009 to 2014. As mentioned before, I will separately use the Loan Loss Provision (LLP) and the Net Charge offs (NCO) of a Bank as a measure it's effective loan losses. The aim is to establish (or not) that the RWA ratio has an informative power over the LLP and NCO and hence determine the ability of the RWA to forecast loan losses.

In general the capital requirements are explicitly stated in the pillar 3 reports of the banks or in their annual reports, if not capital requirements and RWA can de derived from Basel's formulas.

Basel's capital requirement is equal to:

Capital requirement (K) = [LGD * N [(1 - R)^-0.5 * G (PD) + (R / (1 - R))^0.5 * G (0.999)]- PD * LGD] * (1 - 1.5 x b(PD))^ -1 × (1 + (M - 2.5) * b (PD)

And

Risk Weighted Assets (RWA)= 12.5 x K x EAD

Hence, if the capital requirement is stated but not the RWA, it is sufficient to multiply the first by 12,5 and in the case that the RWA is stated, they can be multiplied by 8% to find the respective capital requirement.

B. Research Design

To test the forecast ability of Basel's II Risk Weighted Assets, I implemented different linear regression that resulted in a three-step analysis.

The first step is to define if the RWAs have an explanatory power over the Loan loss provision and the Net charge-offs, to do so I implemented an univariate regression as follows:

(1.a) $\text{LLP ratio}_t = \alpha + \beta_1 \text{ x RWA ratio}_{(t-1)}$

(1.b) $\text{NCO ratio}_t = \alpha + \beta_1 \text{ x RWA ratio}_{(t-1)}$

Where the LLP ratio is equal to the Loan loss provision of the year t divided by the gross loan exposure of the same year, the NCO ratio is equal to the Net charge-offs of the year t divided by the gross loan exposure of the same year. The RWA ratio is computed dividing the Risk Weighted Assets of the previous year (t-1) by its gross loan exposure and where β1 is the RWA ratio coefficient. To run the regression I used the program STATA.

From an Accounting perspective, the NCO are a less timely indicator compared to the LLP (as they only appear after the loss) but more certain contrariwise the LLPs (even if -as previously explained- this item has some drawbacks as it is based on the "incurred loss" principle) are less certain, as they arises after a prevision of expected losses, but for the same reason more timely.

With significant coefficients, I expect to observe a positive relation between the Risk Weighted Asset ratio and both the Loan loss provision and the Net charge off ratio and thus conclude that the RWA have a explanatory power and an informativeness on the expected loan losses. The underlying reasoning is that an increase in the RWA, that stands for an augmentation in the riskiness of a banks' loan portfolio, should result in an increase in the loan loss provision to prevent from the possible losses. On the other hand, the NCO should also increase as a result of the higher probability of a loss due to risk augmentation.

For the purpose of this analysis, the key factor (after assessing the significance of the coefficients) is the coefficient of determination R^2, that has to be different from zero in a first phase to determine that the RWAs have an informative power.

I runned the univariate regressions 1.a and 1.b to from 2009 to 2014 using STATA program on the 57 banks of the sample. The data regarding the Loan exposure, the loan loss provisions and the net charge offs has been collected through the Orbis Bank Focus database. Due to the unavailability of the data on that database, for some years the number of observations is relatively small.

After assessing whether the RWAs have an informative power over the loan losses, the second step is to analyse the quality of the information of the RWA, in other words I will analyse if the RWAs have new information compared to the ones provided by the other accounting items influencing the loan losses. To do that, I included in the regression, as independent variables, the loan loss provisions at time t-1 and the effective interest rate for the same years to predict the loan loss provision at time t as a dependent variable, the same scheme is used for the Net charge offs. Concretely, I used STATA to run the regression and I created a lag variable for the loan loss provision ratio and for the net charge offs ratio, the regressions are as follows:

(2.a) $\text{LLP ratio}_t = \alpha + \beta_1 \times \text{LLP ratio}_{(t-1)} + \beta_2 \text{ Effective interest rate}_{(t-1)}$

(2.b) $\text{NCO ratio}_t = \alpha + \beta_1 \times \text{NCO ratio}_{(t-1)} + \beta_2 \text{ Effective interest rate}_{(t-1)}$

I expect to observe positive R^2 as the loan loss provision and the effective interest rate of one year should strongly influence the loan loss provisions for the following year, same for the net charge offs. The key indicator in the results of the regression is the Adjusted R^2 that will be compared with the results obtained in the following stage of the analysis, the third step.

In this third step, I will add to the regression 2.a and 2.b as an independent variable the RWA ratios at time t-1:

(3.a) $\text{LLP ratio}_t = \alpha + \beta_1 \times \text{LLP ratio}_{(t-1)} + \beta_2 \text{ Effective interest rate}_{(t-1)} + \beta_3 \text{ RWA ratio}_{(t-1)}$

(3.b) $\text{NCO ratio}_t = \alpha + \beta_1 \times \text{NCO ratio}_{(t-1)} + \beta_2 \text{Effective interest rate}_{(t-1)} + \beta_3 \text{ RWA ratio}_{(t-1)}$

I will then compare the Adjusted R^2 obtained with the ones from the step 2, I expect to have higher RWAs in the regression 3 than in the regression 2 and thus conclude that the RWAs have an informative power and provide new information over the loan loss provisions.

The three steps previously explained aim to define whether the RWAs have an informative power or not, and the hypothetical quality of this informative power. The next step changes the perspective used until this point and will analyse whether the RWAs informative power depends on the banking sector risk or not. In order to do that,

I will divide the same sample used in two subgroups, one "High" risk category and one "Low" risk category. The classification is based on the rating of the banking sector risk of the countries in our sample, determined by The Economist Intelligence Unit, if a specific country has a rating equal or superior to A it will be classified as a "Low risk" country, otherwise if the rating is equal or above B, the country is placed in the "High risk" group. The following table presents the countries, their ratings and their groups.

Table 2: Countries and their banking sector risk

Country	**Rating**	**Group**
Denmark	A	Low risk
Germany	A	Low risk
Greece	B	High risk
Italy	BBB	High risk
Netherlands	A	Low risk
Portugal	BB	High risk
Spain	BBB	High risk
Sweden	AA	Low risk

After defining the subgroups I will do the regression 1 for both of the subgroups, the regression are as follows:

(4.a) $\text{LLP ratio}_t = \alpha + \beta_1 \times \text{RWA ratio}_{(t-1)}$

(4.b) $\text{NCO ratio}_t = \alpha + \beta_1 \times \text{RWA ratio}_{(t-1)}$

I expected to obtain positive R^2 in both of the cases.

Then, another subgroup analysis is performed, in this case a specific bank factor is used as criteria to split the sample in two groups, that is the level of capitalisation. To

measure the level of capitalisation of a bank I will use the Tier 1 ratio, that I will download from Orbis bank focus database for each bank. Then, according to the Tier 1 ratio of 2014, I will split the original sample in two subgroups, one characterized by a high tier 1 ratio and the other one with a low ratio. Due to the limited data available on the Orbis bank focus database, the complete sample analysed is reduced to 51 (6 ratios are missing). All the 51 banks have a Tier 1 ratio in 2014 higher than 7% (considered as the minimum acceptable level of Tier 1), hence I decided to categorize all the banks having a ratio inferior to 14% as "Low capitalized banks" and the banks having a level of capitalization equal or superior to 14% as "High capitalized banks".

After defining the subgroups, I will test the hypothesis through the following regressions for each group:

(5.a) $\text{LLP ratio}_t = \alpha + \beta_1 \text{ x RWA ratio}_{(t-1)}$

(5.b) $\text{NCO ratio}_t = \alpha + \beta_1 \text{ x RWA ratio}_{(t-1)}$

The next sessions expose the results.

4.EMPIRICAL RESULTS AND ANALYSIS

A. Descriptive statistics

The sample is composed by 57 banks from 8 European countries and covers the period from 2008 to 2014, more precisely the data regarding the loan loss provisions and the net charge offs goes from 2008 to 2014 whereas the RWA and effective interest rate collected start with the year 2008 and ends in 2013. Theoretically, the loan loss provisions and net charge offs observations should be in total equal to 399 (57 banks per 7 years) but due to data unavailability on the Orbis database, 328 observations for the LLP and 248 observation for the NCO are available. For the RWA and the effective

interest rate, the number of observation should be equal to 342, but for the same reason we observe 303 RWAs observations and 237 effective interest rate.

The following table summarizes the data for the Loan loss provision ratio, Net charge of ratio, Risk weighted asset ratio and effective interest rate used in the regressions.

Table 3: Descriptive statistics

Variable	LLPratio	NCOratio	RWAratio	Effective interest rate
Observations	328	248	303	237
Mean	.0118315	.00526	.3857165	.0471338
Std. Dev.	.0197564	.0117432	.1693541	.0176211
Min	-.0088222	-.0080135	.0044522	.0168000
Max	.2576531	.098824	.9221474	.1428000

For the loan loss provision ratio, the mean is equal to 0.118 implying that on average, the 57 banks in our sample have loan loss provisions equal to 1,18% of their total gross loans. The Net Charge offs ratio varies from -0.008 to a maximum of 0.988, the mean is equal to 0.005. The Risk weighed asset ratio is on average equal to 38.6% and the lowest RWA ratio is equal to 0.004 whereas the highest is equal to 0.922, the large difference between the highest and the lowest values implies that the 57 banks studied have different level of risk weighted assets. The effective interest rate is on average equal to 0.0471.

Regarding the subgroup analysis, it is interesting to describe the sample and data related to the level of capitalization of banks. The following table describes the overall sample.

Table 4: Descriptive statistics with the Tier 1 ratio

Variable	Tier 1 Ratio 2014 (%)
Observations	51
Mean	18.23
Std.Dev.	14.98
Min	8.46
Max	108.30

As previously mentioned, the sample is restricted to 51 banks as the data for 6 banks was missing. The mean of the Tier 1 ratio in 2014 is equal to 18,23%. The following tables describe the subgroups, the low capitalization group is composed by banks having a tier 1 ratio inferior to 14% and the high capitalization group is composed by banks having A Tier 1 ratio equal or superior to 14%.

Table 5: Descriptive statistics- Low capitalization group

Variable	Tier1 ratio 2014 (%)
Observations	22
Mean	11.85
Std. Dev.	1.49
Min	8.46
Max	13.90

Table 6: Descriptive statistics- High capitalization group

Variable	Tier1 ratio 2014 (%)
Observations	29
Mean	23.07
Std. Dev.	18.51
Min	13.30
Max	108.30

The low capitalized banks are 22, the lowest Tier 1 ratio is equal to 8,46% and the highest is 13,90%. In addition, 6 banks are from Germany, 1 is from Denmark, 2 are from Spain, 2 from Greece, 6 from Italy, 3 from the Netherlands, 1 from Portugal and from Sweden.

The other group, composed by banks highly capitalized, counts 29 banks with the lowest Tier 1 ratio equal to 14,10% and the highest equal to 108,30%. More precisely, 7 banks are from Germany, 6 from Denmark, 2 from Greece, 1 from Italy, 6 from the Netherlands and 7 from Sweden.

B.Univariate regression

The first step of the analysis is to run an univariate regression with as a dependent variable the loan loss provision in one case and the net charge-offs ratio at time t in the other case, and as an independent variable the Risk weighted asset ratio at time t-1. The

yearly data collected covers the period from 2008 to 2014, hence seven Loan losses are predicted. In other words the RWA ratio of the year t-1 (from 2008 to 2013) is used to forecast the Loan loss provision ratio and net charge offs ratio of the year t (from 2009 to 2014), as an example the RWA ratio of 2008 will be compared with the loan loss provision and net charge offs ratio of 2009. The results of the regressions are shown in the following table.

Table 7: Results of the univariate regressions

VARIABLES	(1) LLP ratio$_t$	(2) NCO ratio$_t$
RWA ratio$_{(t-1)}$	0.0280*** (0.00446)	0.0143*** (0.00370)
Constant	-3.84e-05 (0.00181)	-0.000531 (0.00156)
Observations	243	187
R-squared Adjusted R-squared	0.141 0.138	0.075 0.070

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

t goes from 2009 to 2014

The data has been collected through the Orbis database, and concerning the loan loss provisions and the net charge offs the data is not always available for all the banks of the sample and for all the year, this is why the number of observations is equal to 243 in the first case and 187 in the second.

When the dependent variable is the loan loss ratio at time t, the R^2 is different from zero and equal to 0,141 meaning that the RWA ratio explains 14,1% of the change in the Loan Loss Provision ratio for the following year. Hence, we can here reject, with a 99% confidence, the null hypothesis that the RWAs do not have any explanatory power over the loan losses.

For the second regression, where the dependent variable is the net-charge off ratio, we observe again an R^2 different from zero and equal to 0,075. As in the previous case we can reject the null hypothesis with a 99% confidence, and state that the RWAs have an explanatory power over the loan losses.

In general, we can reject the null hypothesis that the RWAs do not have an explanatory power over the Loan losses for the following year. As it is shown by the R^2, the RWAs have a higher impact on the variation of the loan loss provisions than on the net charge offs but in both of the cases this impact is positive.

C. Multivariate regression

The second step of the analysis is to analyse the quality of the information provided by the RWA and assert whether the RWAs provide new information.

The table 8, shows the results of the regressions of this second step.

Table 8: Results of the multivariate regression

VARIABLES	(1) LLP ratio$_t$	(2) NCO ratio$_t$
LLP ratio$_{(t-1)}$ (1), NCO ratio$_{(t-1)}$ (2)	0.537***	0.512***
	(0.0660)	(0.0554)
Effective interest rate$_{(t-1)}$	0.175**	0.101**
	(0.0714)	(0.0446)
Constant	-0.00201	-0.00159
	(0.00311)	(0.00209)
Observations	154	117
R-squared	0.372	0.463
Adjusted R-squared	0.364	0.454

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The coefficients for the loan loss provision ratio and the effective interest at t-1 are both significant and the R^2 for the first regression is positive and equal to 0.372 and the Adjusted R^2 to 0.364. Hence, the loan loss provision ratio and the effective interest rate at t-1 have an informative power over the loan loss provisions at time t. The same result is observed for the net charge offs ratio, where the R^2 is equal to 46.3% and the adjusted one to 45.4%.

After analysing that the independent variable loan loss ratio, in the first case, net charge offs ratio, in the other case, and the effective interest rate influence the dependent variable and thus have an informative power over the banks' loan losses, I will now compare the adjusted R^2 previously found with the adjusted R^2 resulting from the next multivariate regression where the RWA ratio at t-1 are added. This is the third step of

the analysis and the aim of this comparison is to determine whether the RWAs have new information on the loan losses or not.

The table 9 exposes the results of the regression.

Table 9: Results of the multivariate regression including the RWA ratios

VARIABLES	(1) LLP ratio$_t$	(2) NCO ratio$_t$
LLP ratio$_{(t-1)}$ (1), NCO ratio$_{(t-1)}$ (2)	0.509***	0.577***
	(0.0642)	(0.0624)
Effective interest rate$_{(t-1)}$	0.152**	0.0928**
	(0.0652)	(0.0449)
RWA ratio$_{(t-1)}$	0.0156**	0.00236
	(0.00599)	(0.00453)
Constant	-0.00688**	-0.00211
	(0.00317)	(0.00248)
Observations	137	107
R-squared	0.466	0.535
Adjusted R-squared	0.454	0.521

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The first regression has as a dependent variable LLP ratio at time t and the independent variables are the LLP ratio, the effective interest rate and the RWA ratio at time t-1, the coefficients are significant and the R^2 is not equal to zero but equals 0.466 whereas the Adjusted R^2 is equal to 0.454. Compared to the results obtained in the previous step, the Adjusted R^2 is higher when the RWA ratio is included as an independent variable. More precisely, the Adjusted R^2 grows from 0.364 to 0.454, hence with a 95% confidence we

can conclude that the RWA have new information -compared to the ones provided by the LLP ratio and effective interest rate- over the loan loss provisions and thus the null hypothesis that the RWAs do not provide new information can be rejected.

For the results considering the Net charge-offs the coefficient for the RWAs is not significant, this is probably due to the number of missing values of the NCOs, as a consequence no reliable conclusion can be drawn from those results.

D. Subgroups analysis

This part is dedicated to the analysis of the results concerning the subgroups of the previously used sample, divided in two categories according to their banking sector risk. The following tables expose the results for the low risk group first and then for the high risk group.

Table 10: Results of the univariate regressions for the low risk group

VARIABLES	(1) LLP ratio$_t$	(2) NCO ratio$_t$
RWA ratio$_{(t-1)}$	0.0289***	0.0174***
	(0.00362)	(0.00362)
Constant	-0.00273*	-0.00130
	(0.00140)	(0.00148)
Observations	173	131
R-squared	0.272	0.152

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11: Results of the univariate regressions for the high risk group

VARIABLES	(1) LLP ratio$_t$	(2) NCO ratio$_t$
RWA ratio$_{(t-1)}$	-0.0316*	-0.00351
	(0.0163)	(0.0133)
Constant	0.0321***	0.00649
	(0.00736)	(0.00602)
Observations	70	56
R-squared	0.053	0.001

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The High risk countries are Greece, Italy, Portugal and Spain and the Low risk are Denmark, Germany, Netherlands and Sweden. For both of the groups the R^2 is different from zero meaning that the RWAs have an informative power on the banks' loan losses when the banking risk sector is high but also when it is low. Furthermore, focusing on the results of the regression including the Loan loss provision, the R^2 for the low risk countries is higher than the one corresponding to the other group, more precisely the first one is equal to 0.272 and the other one to 0.053. This could suggest that the informative power of the RWA or the quality of the information provided by the RWA in the low risk countries is higher compared to the power of the forecasting ability of the RWAs in the high risk countries. However, this is not certain and reliable as other factors differ in the two groups and also from a statistical point of view the number of observation is not comparable. Hence, in order to assess that, the same test should be done on a larger sample.

With the previous subgroup analysis I determined that the forecast ability of the RWAs does not depend on the country's banking sector risk, now I will move on to the analysis according to the level of capitalization of each bank.

The results of the univariate regressions 5.a and 5.b are in the following tables first for the Low capitalized banks and secondly for the high capitalisation group.

Table 12: Results of the univariate regressions for the low capitalisation group

VARIABLES	(1) LLP ratio$_{(t)}$	(2) NCO ratio$_{(t)}$
RWA ratio$_{(t-1)}$	0.0277***	-0.000446
	(0.00754)	(0.00513)
Constant	-0.000537	0.00411**
	(0.00268)	(0.00193)
Observations	88	69
R-squared	0.135	0.000

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13: Results of the univariate regressions for the high capitalisation group

VARIABLES	(1) LLP ratio$_{(t)}$	(2) NCO ratio$_{(t)}$
RWA ratio$_{(t-1)}$	0.0286***	0.0171***
	(0.00598)	(0.00520)
Constant	-0.000525	-0.000966
	(0.00269)	(0.00243)
Observations	121	96
R-squared	0.161	0.103

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For the low capitalised banks, the regressions using as a dependent variable the loan loss provision ratio gave significant results with a R^2 different from zero and equal to 13.5% whereas for the regression with the NCO ratio as an dependent variable the results are not significant, hence I can't draw any conclusions from this specific regression. For the high capitalised banks in both of the regression the R^2 are significant and different from zero, in the first regression (the one considering the LLP ratio as a dependent variable), the coefficient of determination is equal to 16,1% and in the second one the R^2 is 10.3%. Hence, the RWAs have an informative power over the LLP in both of the cases analysed, I can thus reject with a 99% confidence the hypothesis that the RWAs' forecast ability depends on the level of capitalisation of a bank. Furthermore, we can observe differences in the R^2, in particular the R^2 for the highly capitalized banks is higher, an interesting analysis could focus on the factors that could drive this difference, my aim in this thesis is only to assess whether the RWAs have a forecast ability and if this forecast ability is maintained in conditions of high and low capital. As previously shown, I can conclude that in both of the cases analyzed the RWAs have a

forecast ability.

5.CONCLUSIONS AND LIMITATIONS

A. Conclusions

The aim of the thesis is to analyse the forecast ability of the risk weighted assets for the bank loan losses. In order to do that I studied 57 banks from 8 different European countries from 2008 to 2014. In practice I related the RWAs with two accounting items representing the loan losses: the loan loss provisions and the net charge offs, all the indicators have been scaled using the total gross loan exposure of the bank in order to obtain coherent and comparable ratios. The data regarding their Risk weighted assets has been hand collected from their Pillar 3 reports and financial statement while the loan loss provisions and the net charge offs have been downloaded from the Orbis bank focus database. Furthermore, the hypothesis tested are as follows:

H1: RWAs provide information on the future bank's loan losses

H0: RWAs do not provide any information on the bank's loan losses

H2: RWAs provide new information on the future bank's loan losses

After running the regressions and analysing the results, the null hypothesis that the RWAs do not provide any kind of information can be rejected, hence we can accept the alternative hypothesis that the RWAs provide information and that those information are new and useful in order to predict future banks' loan losses.

Secondly, I divided the sample in two subgroups based on the country's banking sector risk, one group was characterised by a high risk (with a rating equal to B, BB or BBB) and the other group by a low risk (with a rating equal to A, AA or AAA), the hypothesis tested are as follows:

H3: RWAs model provides a reliable forecast of loan losses when the banking sector risk is high

H4: RWAs forecast ability does not depend on the banking sector risk.

The results of the respective regressions showed that the hypothesis 4 can be accepted, thus that the RWAs provides information for banks located in high risk countries as well as for banks located in low risk countries.

Finally, I spilled the total sample in two groups according to their level of capitalisation, in order to test the following hypothesis:

H5: RWAs model provides a reliable forecast of loan losses when the level of capitalisation is high

H6: RWAs forecast ability does not depend on the level of capitalisation.

A bank is considered highly capitalized when their Tier 1 ratio is equal or superior to 14%, otherwise the bank will follow in the low capitalisation group.

After analysing the result of the regressions, the hypothesis 5 can be rejected and the hypothesis 6 can be accepted. As in the previous analysis, the forecast ability of the RWAs remains valid and thus the RWAs can be considered as reliable risk forecasts in both of the cases.

The hypothesis testing process and the statistical results permits me to assess that the risk weighted assets have a forecast ability on the banks' loan losses and are able to partially predict future losses.

B. Limitations

The sample is composed by 57 banks from eight different European countries, hence the results of this study could be extended to the general European context, but it could be interesting to analyse how the Risk weighted assets are able to forecast losses in other

context such as third world countries characterized by a highly unstable financial situation.

Furthermore, the main limitation, and also issue I faced during the research, was the data availability on the Orbis bank focus database, for instance data on net charge offs was not always available for all the years and banks in the sample and the limited number of data could have biased the research. This is also why I decided to double check the results using two accounting items (the loan loss provisions and the net charge offs), as in general the results of the two were confirming each other I can say that the results remain reliable even though not all the data is available.

In addition, the data regarding the RWAs has been hand collected through pillar 3 reports and annual financial reports of the banks, the objective was to obtain a RWA ratio as close as possible to a "pure" loan risk weighted ratio. To obtain it, I took out from the total exposures and risk weighted assets under either the IRB or the standard approach all those exposure that are not loans, as for example equity investments or securities. It is important to notice that those elements that could deviate the risk weighted ratio from the pure loan risk weighted ratio are not always clearly stated in the pillar 3 or annual reports. This means that I found some reports were the "non-loan" items were precisely specified but in other cases, different items were classified into categories named as "other exposures" without any further specification. Hence, the ratios obtained are not always "pure" and could incorporate some non-loans related amounts that could not be subtracted due to the non-transparent banks report.

6. APPENDIX

I. Complete sample

Bank Index Number	Bank name	Country code	Currency
13109	Bayerische Landesbank	DE	EUR
13190	Commerzbank AG	DE	EUR
13216	Deutsche Bank AG	DE	EUR
13222	Aareal Bank AG	DE	EUR
13306	Landesbank Hessen-Thueringen Girozentrale - HELABA	DE	EUR
13584	Norddeutsche Landesbank Girozentrale NORD/LB	DE	EUR
14021	Portigon AG (2)	DE	EUR
15517	Landesbank Berlin Holding AG-LBB Holding AG (2)	DE	EUR
15668	MLP Ag	DE	EUR
16116	Volkswagen Financial Services AG	DE	EUR
16697	Hypo Real Estate Holding AG	DE	EUR
17881	DZ Bank AG-Deutsche Zentral-Genossenschaftsbank	DE	EUR
19978	HSH Nordbank AG	DE	EUR
43719	Bank für Arbeit und Wirtschaft und Österreichische Postsparkasse AktiengesellschaftBAWAG PSK Group	DE	EUR
44096	Raiffeisen Zentralbank Oesterreich AG RZB	DE	EUR
47734	Landesbank Baden-Wuerttemberg	DE	EUR
10307	Bankaktieselskabet Alm. Brand Bank	DK	DKK
10380	FIH Erhvervsbank A/S-Finance for Danish Industry A/S - FIH Group	DK	DKK
10489	Nykredit Realkredit A/S	DK	DKK
10607	Danske Bank A/S	DK	DKK
10609	Jyske Bank A/S (Group)	DK	DKK
10612	Spar Nord Bank	DK	DKK
43630	BRF Kredit A/S	DK	DKK
22628	Banco Bilbao Vizcaya Argentaria SA	ESP	EUR
23355	Caja de Ahorros y Pensiones de BarcelonaLA CAIXAbank	ESP	EUR
23370	Banco de Sabadell SA	ESP	EUR
47560	Banco Santander SA	ESP	EUR
31583	Hellenic Bank Public Company Limited	GR	EUR
41109	Alpha Bank AE	GR	EUR
43085	National Bank of Greece SA	GR	EUR
44317	Piraeus Bank SA	GR	EUR
49514	Eurobank Ergasias SA	GR	EUR
16185	Unione di Banche Italiane ScpaUBI Banca	ITL	EUR
21413	Banca Monte dei Paschi di Siena SpAGruppo Monte dei Paschi di Siena	ITL	EUR
21937	Banco Popolare	ITL	EUR
45296	Mediobanca SpA	ITL	EUR
46616	Intesa Sanpaolo	ITL	EUR
47295	UniCredit SpA	ITL	EUR
12060	ABN AMRO Group N.V.	NL	EUR
22225	Bank Nederlandse Gemeenten NV, BNG	NL	EUR

22232	GE Artesia Bank	NL	EUR
22273	Van Lanschot NV	NL	EUR
22304	ING Groep NV	NL	EUR
22317	Rabobank Nederland-Rabobank Group	NL	EUR
40053	Demir-Halk Bank (Nederland) N.V-DHB Bank	NL	EUR
44090	Credit Europe Bank N.V.	NL	EUR
45620	SNS Reaal NV	NL	EUR
46570	LeasePlan Corporation NV	NL	EUR
49668	NIBC Holding NV	NL	EUR
22541	Banco Comercial Português, SAMillennium bcp	PT	EUR
29189	Länsförsäkringar AB	SWE	SEK
30723	Svenska Handelsbanken	SWE	SEK
31268	Swedbank AB	SWE	SEK
33297	Skandinaviska Enskilda Banken AB	SWE	SEK
43637	SBAB Bank AB	SWE	SEK
44502	Landshypotek AB	SWE	SEK
49434	Nordea Bank AB	SWE	SEK

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