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The relation between banking performance and NPLs: empirical evidence

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Introduction

The credit supply has always been the main activity provided by the banking system. In fact, over the centuries, private and public entities have been able to bring numerous advantages and development not only to the economic system, but thanks to this aid they have been and still are able to bring innovations that have allowed the achievement of a better standard of living. In addition, in times of crisis, the lending activities of credit institutions have enabled them to survive and brought the economic system back into balance. This is why it is possible to state with great certainty the key role played by banks in the specific function of lending.

The credit supply, however, is as useful as it is risky for the banking sector, since it is extremely linked to the risk that the counterparty will not be able to repay the capital received as a loan, due to situations linked to its exposures or to adverse economic conditions. For this reason, it is extremely important for banks to constantly monitor the credit risk to which they are exposed.

In credit risk management, among the most critical indices are non-performing loans, i.e. loans whose recovery is highly unlikely. This category of loans has been the subject of banking supervision for years as it has been found that if they reach high levels in the bank balance sheet, they can affect the smooth running of the banking business.

Moreover, as the trend in non-performing loans is also related to macroeconomic conditions in recessionary periods, their amount has increased considerably, causing serious damage to several banking institutions. Indeed, the major financial crises of the last two decades have witnessed this phenomenon.

Observing the relevance of non-performing loans in bank balance sheets and the attention of supervisory authorities on them, this paper aims to empirically demonstrate the presence of a significant relationship between bank performance and the amount of NPLs in balance sheets.

In order to reach this conclusion, it will first be necessary to explore the fundamental issues underlying NPLs and banking.

For this reason, the first chapter presents the need to use an appropriate level of credit risk measurement through an in-depth study of the subject by analyzing its fundamental components and appropriate valuation methods. At the end of the first chapter, it will be possible to focus on the importance of impaired loans in risk assessment.

The second chapter, on the other hand, aims to illustrate the regulation of non-performing loans where it will also be possible to fully understand the main determinants and highlight what leads to the condition of credit deterioration. Secondly, the chapter focuses on the importance of determining adequate provisions and other hedging instruments in order to avoid situations of high non-performing loans that could burden the credit institution.

The third chapter, instead, is focused on the quantitative analysis aimed at demonstrating the impact of Non-Performing Loans on bank performance. This analysis was carried out by means of a linear regression model using a sample of 9 of the main European banks over a period of time ranging from 2007 to 2020. The dependent variable Y, identified as performance, will be explained by dependent variables internal and external to the banking business. Subsequently, in the light of the results obtained, focus on possible strategies to alleviate the problem of non-performing loans.

Chapter I: Credit Risk

The credit supply has historically been at the heart of the banking business, acting primarily as the intermediate between those who offer capital and those who require it, and as the main driver of development for the economy. In fact, the credit function performed by banks supports the process of economic growth and development by ensuring that those who invest receive funds. Moreover, without the supply of credit, consumption would suffer and businesses would not be able to raise the funds needed to make investments, finance innovation and create jobs. The importance of credit activity is relevant not only for the economic system but also for the internal dynamics of banking institutions. In fact, lending is decisive for bank management, contributing significantly to the level of profitability and also affecting financial dynamics by allowing optimal liquidity conditions.

Lending is not a low-risk activity; on the contrary, it is linked to different types of financial risks. The most important associated risk component is undoubtedly credit risk.

1.1 Overview of credit risk

Credit risk is the possibility of unexpected changes in the value of a credit position due to adverse movements in risk factors related to the creditworthiness of the counterparty. Basically, it is the risk that the borrower will be unable to meet its obligations to pay interest and repay principal.

As a result, credit risk is linked to all bank lending activities and is therefore a very important variable when evaluating an investment or opening a position. Within the definition there are several risk categories related to it:

- **Default risk**: occurs when the loss results from the complete default of the counterparty. Default occurs when the bank considers it highly unlikely that the borrower will be able to meet its obligations or when 90 days have elapsed since the maturity of the position;
- **Recovery risk**: in this case the risk arises when the recovery rate (RR) of a given loan transaction turns out to be lower than expected due, for example, to delays in legal proceedings;
- **Spread risk**: the risk of sudden increases in the market risk premium under rating conditions;

- **Migration risk**: occurs when there is a deterioration in the creditworthiness of the counterparty that can be estimated through a down grade by rating agencies or a bank analysis;
- **Exposure risk**: the risk of sudden increases in counterparty exposure in the period prior to default (may occur in the case of overdraft facilities).

As we can derive from the various categories mentioned above, the concept of credit risk is very complex and does not only concern events related to the debtor but can also occur due to macroeconomic causes. In particular, historically credit risk tends to decrease in periods of economic expansion and increase in periods of recession.

For this reason, both debtor and industry-specific factors are considered when assessing the credit risk associated with a given financial position.

As will be analyzed in the following paragraphs, as far as the analysis of the debtor is concerned, it's necessary firstly to make a financial assessment by studying its financial position, performance and capital adequacy. Secondly, it's important to observe the levels of operations through the evaluation of the relative market position and operational efficiency. Finally, it's also relevant to assess the quality of the management through a study of the track record, payment record.

Instead, in the case of industry specific credit risk, the assessment is made by first considering the characteristics of the industry, economic growth and government policies related to the specific market. Other very important variables to be valuated secondarily are: the competitiveness and financial characteristics of the sector, analyzing operating margins, profitability and earnings stability.

In more detail, when a private consumer or a company approaches a credit institution, the bank reserves a few days to assess the feasibility of the transaction by analyzing the customer's creditworthiness before granting the loan. The bank's decision to grant credit is made on the basis of internal policies first and then following a careful assessment of the customer's ability to repay the lender in the future.

Reliability assessment is a practice that was made mandatory in 2010 by the Basel Agreements underlining the importance of the mandatory status mainly for three important reasons:

1- **To protect the entire banking system**: limit the risk of granting non-performing loans, i.e. loans that are unrecoverable over time. Consequently, limiting the decrease in bank liquidity.

2- **To safeguard customers**: help consumers avoid becoming over-indebted.

3- **Ensure the protection of the global financial market**: make it compulsory to assess creditworthiness, the aim is to prevent apparently safe products from being placed on the international market which, however, end up proving to be risky and causing difficulties for the entire system.

Furthermore, Article 18 of Directive 2014/17/EU, emphasizes the obligation to check the consumer's creditworthiness, stating that "*Member States shall ensure that, before the conclusion of a credit agreement, the creditor carries out a thorough assessment of the consumer's creditworthiness. This assessment shall take appropriate account of factors relevant to the assessment of the prospects of the consumer meeting his obligations under the credit agreement.* "[1]

1.2 Credit risk components

In order to carefully analyze credit risk, it is important to focus on its components. First, a distinction must be made between expected loss and unexpected loss. Unexpected loss, because it cannot be known before an event occurs, is the principal risk the bank bears with respect to the exposure. Expected loss, on the other hand, is foreseeable and calculable in advance by the bank and does not constitute a risk.

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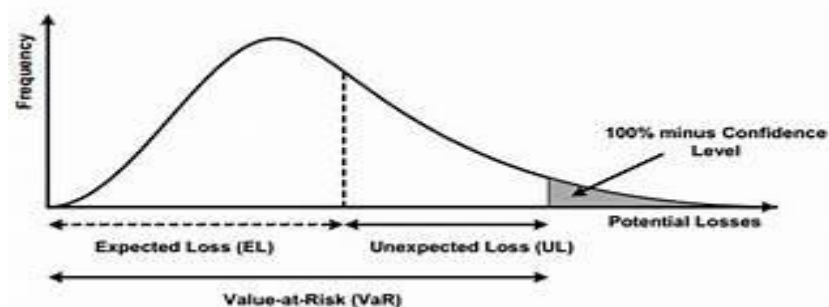
[1] European Union, Directive 2014/17/EU Article 18

1.2.1 Expected loss

In Chapter 5, the Capital Requirements Regulation defines expected loss as "*the ratio of the amount expected to be lost on an exposure over a one-year horizon as a result of a potential default of a counterparty or dilution to the amount of the exposure at the time of default*"[2]. In addition, this term means the average value of the distribution of losses that a credit institution expects to incur on a loan portfolio; thus, it represents the loss, or cost, that the institution expects to incur on the credit exposure.

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

Where:

- PD= probability of default;
- EAD= exposure at default;
- LGD= loss given default.

The loss rate allows the quantification of the known risk for the bank as it combines the riskiness of the borrower and the assessment of the different credit lines. It is possible to derive the expected loss rate through the ratio of the expected loss amount to the total exposure of the counterparty.

The expected loss is therefore not a real risk component as it is already included in the bank's expectations and is charged to the income statement through a corresponding provision.

1.2.1.1 Probability of default

The probability of default is linked to the debtor's creditworthiness and is therefore influenced by factors such as the company's current and prospective financial conditions, the quality of management, the outlook for developments in the production sector and the economic situation in general.

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[2] European Banking Authority, Capital requirements regulation

Therefore, the factors affecting this variable can be grouped into four main categories:

1) The technical characteristics of the financing such as the possible presence of real or financial assets securing the credit and the degree of liquidity and effectiveness of these assets, the state of the exposure, any guarantees provided by third parties and the type of litigation envisaged for recovery.

2) The characteristics of the borrower, taking into account the country or geographical region in which the insolvent debtor is legally located, the production sector to which it belongs, which generally affects the degree of liquidity of the company's assets.

3) Specific characteristics of the creditor company, such as, for example, the policy and procedures implemented by it for the debt collection process, which determines the greater or lesser effectiveness of the quality and quantity of the resources dedicated.

4) External factors such as the state of the economic cycle and the level of interest rates. In fact, the level of interest rates affects the present value of the amount recovered following the insolvency of the debtor.

Three different methodologies can be used to estimate the probability of default: the first takes as reference the probability of default based on capital market data, the second involves the use of analytical/subjective models that consider both quantitative and qualitative aspects, and finally, the third methodology is based on credit ratings that can be formulated by specialized agencies (Standard&Poor's, Fitch Ratings, Moody's) or by the bank itself (internal ratings) through the use of static models.

The most widely used models for risk assessment are those of a statistical nature, better known as scoring models. This methodology estimates the prediction of insolvency by assigning precise weighting levels to the economic and financial indices of the company performance under analysis. In this way, an assessment of creditworthiness, summarized in a numerical value, the score, represents the probability of default.

Logit model

The logit approach is considered best practice as it allows several relevant economic and financial variables to be considered together to assess the health of debtors, thus overcoming the limitations of the univariate approach.

The model is, therefore, a special case of regression analysis that is applied when it is necessary to make the dependent variable dichotomous. Estimates of default, made ex-ante, determine the decision to provide credit or not and the related choice of interest rates to be applied. Therefore, binary choice models can be used for both phases, of which the Logit model is a particular case. The Logit model is a special case. This type of model allows the probability of an event occurring to be described from a linear combination of the explanatory variables. There are four specific steps in the model:

1- Selection of the sample: in this phase it is necessary to select a sufficient number of firms, distinguished in two different groups, i.e. the insolvent firms identified with the binary variable Y=1 and the insolvent firms identified with Y=0. To obtain statistically significant regression results, it is important that the number of insolvent firms is as high as possible. Consequently, a bank with a history of granting a large number of loans to firms that subsequently became insolvent has an advantage in using the logit function as it can obtain highly statistically significant means.

2 - Preliminary selection of explanatory variables: at this stage, random variables (x_k) are calculated to reflect the relevant quantitative information for all firms. The necessary variables are economic-financial and must be as few as possible to obtain a more stable and easily generalizable model. Relevant indicators include balance sheet indicators that can be grouped into three categories: profitability, liquidity and capital strength. It is necessary to underline that the phenomenon can be sensitive to the "multicollinearity" phenomenon that occurs in case of linear dependence between different variables. In fact, in cases of linear dependence between regressors the significance and reliability of the model may be affected.

4- **Model estimation**: in the logistic regression model the dependent variable Y is a Bernoullian random variable that assumes values 0 or 1 and the probability that the variable assumes value 1 is a function of the regressors $x_1, x_2, \ldots, x_k$ through the coefficients $\beta_1, \beta_2, \ldots, \beta_k$.

$$E\left(Y\middle|X_1, X_2, \ldots, X_k\right) = \Pr\left(Y = 1\middle|X_1, X_2, \ldots, X_k\right) = \frac{e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k}}{1 + e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k}}$$

Where $\Pr\left(Y = 1 \middle| X_1, X_2, \dots, X_k\right)$ is equal to:

$$\text{logit}\left(\Pr\left(Y = 1 \middle| X_1, X_2, \dots, X_k\right)\right) = \log\left(\frac{\Pr\left(Y = 1 \middle| X_1, X_2, \dots, X_k\right)}{1 - \Pr\left(Y = 1 \middle| X_1, X_2, \dots, X_k\right)}\right) =$$

$$= \log\left(e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k$$

At this stage it is necessary to define the odds as the ratio between the probability that Y takes on a value of 1 and the probability that Y takes on a value of 0, conditional on the value of the regressors:

$$\text{odds}(X_1, X_2, \dots, X_k) = \frac{\Pr\left(Y = 1 \middle| X_1, X_2, \dots, X_k\right)}{1 - \Pr\left(Y = 1 \middle| X_1, X_2, \dots, X_k\right)}$$

The odds are greater than, equal to or less than 1 depending on whether the conditional probability of Y=1 is greater than, equal to or less than the conditional probability of Y=0. For each of the regressors it is possible to calculate the odds at both the value 0 and the value 1:

$$\text{Odds}(X_1, X_2 = 0, \dots, X_k) = \frac{\Pr(Y=1|X_1, X_2=0, \dots, X_k)}{1 - \Pr(Y=1|X_1, X_2=0, \dots, X_k)} = e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k}$$

$$\text{Odds}(X_1, X_2 = 1, \dots, X_k) = \frac{\Pr(Y=1|X_1, X_2=1, \dots, X_k)}{1 - \Pr(Y=1|X_1, X_2=1, \dots, X_k)} = e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k}$$

The odds ratio for X_2 is:

$$\text{OR}(X_2) = \frac{odds(X_2 = 1)}{odds(X_2 = 0)} = e^{\beta_2}$$

This relationship allows us to evaluate the effect of the variable X_2 on the propensity of the dependent variable Y to take on the value 1.

5- **Evaluation of model significance**: After estimating the model, it is necessary to ensure that the estimates are as close as possible to the observed values of the response variable and therefore the discrepancy between the values must be minimal. The assessment of significance can be carried out by means of the evaluation of the overall model, the Pseudo-R2 statistic of Mcfadden (1974), the evaluation between nested models, the Wald statistic or by means of the assessment of predictive ability. In the case of evaluation of the overall model, the estimated model is compared with the saturated model, i.e. containing as many parameters as there are observations, providing the best possible fit. The comparison can be observed using the D(deviance) statistic defined by:

$$D = -2log\left\{\frac{L_k}{L_{sat}}\right\}$$

Where:

- L_k refers to the estimated model;
- L_{sat} refers to the satured model.

Analyzing the formula we can notice that if L_k is lower than L_{sat} the ratio between the two constants will be lower than one and as a result D will be higher than 0.

The closer Lk is to Lsat, the greater the fit and thus small values of the D statistic indicate a good fit. However, the fit improves and is therefore more likely when approaching the saturated model, i.e. when the explanatory variables are numerous.

On the other hand, in the case of McFadden's Pseudo- R^2 statistic, the assessment of significance is done by extending the coefficient of determination R^2 for linear regression, which measures the proportion of total data variability explained by the model and varies between 0 and 1; where 0 indicates a model with no predictive value and 1 a model that fits the data perfectly.

$$Pseudo - R^2 = 1 - \frac{logL_k}{\log L_0}$$

Where:
- L_0 is the verisimilitude of the model with only the intercept;

- L_k refers to verisimilitude of the model with k covariates.

This statistic takes on a value of 0 if all coefficient estimates are equal to 0, it can take on a value of 1 if the model is able to generate forecasts that exactly match the observed values. It should be noted that in practice this limit situation is not reached and consequently the indicator does not usually take on a value of 1.

The result of the Logit model is the probability of default of a client, which is called a score and ranges between 0 and 1. Depending on the score obtained, the company will be considered more or less risky. Once the scores have been calculated, the bank may proceed to set a threshold value (called cut-off score), which represents the maximum probability of default tolerated by the bank. This threshold allows the sample to be divided into two types of customers: all companies with a probability lower than the threshold value will be considered "not at risk" and therefore credit will be accepted; vice versa, they will be considered "highly likely to default" and therefore the bank will refuse to grant the loan. The setting of the cut-off score depends on the risk appetite of the banking institution: a higher level of the threshold value leads to a lower chance of losses but at the same time increases the risk of pushing back a substantial number of "healthy" firms.

Probit model

The probit model can be used as an alternative to the Logit model. It differs from the latter in the form of the distribution function, which in the probit model is not a logistic but the standardized normal.

In fact, it is expressed in the formula as follows:

$$\Pr(Y_i = 1 | X = x_i) \, \Phi(x^{'}_i \beta) = \frac{1}{2\pi} \int_{-\infty}^{\beta x^{'}_i} e^{-z^2} \, dz$$

t is then possible to perform the significance test, the F-test such that $H_0 : \beta = 0$

External rating

Typically, the external rating is taken as the standard method. It is carried out by ECAI agencies (external credit assessment institutions), private or public agencies that are specialized and authorized by the Bank of Italy on the basis of the criteria laid down in current legislation. The agencies' judgments summarize the credit risk implicit in financial instruments

and are the result of a complex process of analysis based on a combination of quantitative assessments and qualitative findings. For rating purposes, credit rating agencies have full autonomy to develop the methodologies, models and underlying assumptions used in their rating activities, provided that they disclose the assumptions and processes used.

The formulation of the rating is based on two main methodologies:

- analyst-driven rating: a relational approach based on the interaction between analysts and the subject to be rated;
- model-driven rating: in which specific mathematical and statistical models are used.

The relational approach is associated with the issuer-pay model in that the process is originated by the issuer and the issuer undertakes to cooperate with the rating agency to make available all relevant information for the assessment.

The assignment of a credit rating process may be triggered at the instigation of the issuer (solicited rating) or at the initiative of the rating agency (unsolicited rating).

In the case of solicited ratings, the mechanism is activated when the economic entity submits its application. Once the application has been accepted, the rating agency appoints an analyst responsible for the project who, assisted by a team of collaborators, is charged with carrying out research and analysis in order to arrive at a rating proposal. In the preliminary analysis phase, the team collects, studies and processes all the information and data concerning the issuer.

The method of rating tends to be based on the analysis of a series of parameters, such as

- Financial situation of the entity to be rated;
- General economic context of the country in which the subject operates;
- sector of activity to which it belongs and positioning of the subject on the basis of efficiency and competitiveness requirements.

The industrial risk and the financial risk are then measured. Industrial risk refers to all aspects that are detected in relation to the current and future position of the company through the quantification of the following indicators:

a) Risk of the sector in which the company operates, through the analysis of the life cycle, the degree of cyclicality, the composition of the competition, the barriers to entry.

b) The competitive position, by identifying and verifying the strengths and weaknesses of the company as a whole. At this stage it is also necessary to check qualitative aspects such as the composition of management, size, number of employees, etc.

c) The type of documentation available: the completeness of the information in the management report, the transparency of the financial statements and communications, the existence of reports, etc. are checked.

Financial risk, on the other hand, is relevant for determining the financial standing of the company under review by investigating values such as:

a) Income capacity of the company;

b) The degree of indebtedness;

c) The characteristics of cash flow;

d) The degree of liquidity;

e) Financial strategies.

Information for financial risk is obtained through the reclassification of the balance sheet and through the method of preparing the cash flow statement.

Once the balance sheet has been reclassified, the key indicators for assessing businesses are identified with the aim of ascertaining the ability of the business to generate income and meet financial commitments on a timely basis.

For short-term solvency, liquidity ratios are used:

- Current ratio: current assets/current liabilities;

- Quick ratio: (immediate liquidity + deferred liquidity)/current liabilities;

- Immediate liquidity/current liabilities.

With these ratios it is possible to obtain an initial quantitative indication of the short-term solvency situation of the company, depending on its size.

To understand whether the company is able to generate income, increase capital, attract new investors and expand its business, the following profitability ratios are analyzed.

- Return On Equity (ROE): net income/net equity;

- Return On Investment (ROI): operating income/ average net invested capital;

- Return On Sales (ROS): operating income/sales revenue.

Finally, the analysis of the degree of leverage can provide us with information about the overall risk profile of the company in relation to the degree of dependence on external sources of financing. In fact, a high level of debt compared to equity indicates a higher degree of risk as the share of capital would be reduced in case of coverage of possible losses. In addition, a high level of debt may imply conditions of financial stress as the interest burden on the debt may be excessive compared to the income capacity.

The leverage ratio is calculated as:

Leverage: total loans/equity;

It is important to emphasize that companies and individuals are not the only ones who seek credit from the banking system, very often sovereign states also do so in order to meet their obligations. As a result, the rating process will be different, as the sovereign rating indicates the risk level of a country's investment environment, which is used by investors wishing to invest abroad, and which also includes political risks. Based on this, the criteria for sovereign ratings are based on the agencies' analyses of these risks:

o the history of sovereign insolvencies;
o the impact of financial crises
o and the strength of creditworthiness of sovereign governments relative to other types of issuers.

In any case, the rating, once assigned, shall be monitored over time to best reflect changes in default risk. The periodic updating of ratings shall be based on the same criteria of independence, transparency and accuracy.

The estimate of PD must then reflect the decrease in the reliability of information over time.

Therefore, in order for the rating to be able to express a judgement on the ability of the company to meet its financial obligations on time, the analysis must aim to assess the quality and predictability of the future cash flows that the company is able to generate.

The main rating agencies are: Moody's, Standard & Poor's and Fitch; they place a company in a rating class within an ordered scale that changes depending on which agency is relied upon.

Moody's	S&P	Fitch	DBRS
Aaa	AAA	AAA	AAA
Aa1	AA+	AA+	AA (high)
Aa2	AA	AA	AA
Aa3	AA-	AA-	AA (low)
A1	A+	A+	A (high)
A2	A	A	A
A3	A-	A-	A (low)
Baa1	BBB+	BBB+	BBB (high)
Baa2	BBB	BBB	BBB
Baa3	BBB-	BBB-	BBB (low)
Ba1	BB+	BB+	BB (high)
Ba2	BB	BB	BB
Ba3	BB-	BB-	BB (low)
B1	B+	B+	B (high)
B2	B	B	B
B3	B-	B-	B (low)
Caa1	CCC+	CCC+	CCC (high)
Caa2	CCC	CCC	CCC
Caa3	CCC-	CCC-	CCC (low)
-	D	D	D

Historically, companies with better ratings have been solvent, but even if they belong to the AAA category, they are not risk-free and will be assigned a positive probability of default. This is because it is an assessment of the ability to honour obligations which is a future event and therefore uncertain.

1.2.1.2 Exposure at default

EAD (exposure at default) represents the exposure at the time of default. It is a type of risk metric that became prominent with Basel II as it is an important risk parameter for determining capital requirements. The amount of exposure can be either certain or uncertain. In the case of products with uncertain exposure, the risk drivers are:

- Credit limit utilisation rates for revolving credit products (credit lines).
- Market factors for derivatives counterparty exposures.

The EAD is obtained by adding the risk already taken on the transaction to a percentage of the risk not taken. This percentage is calculated using the CCF. It is defined as the percentage of the undrawn balance that is expected to be drawn before the default occurs. Therefore, the EAD is estimated by calculating this conversion factor. In addition, for transactions that exceed the limit on a reference date, the relevance of incorporating into the EAD the possibility of using an additional percentage of the limit, according to each product's policy, is assessed.

The definition of exposure changes as the related product changes; in fact, it is possible to distinguish two types of exposure:

- Certain value: when the bank knows the exact amount of the loan granted;
- Uncertain value: when the bank is unable to quantify the amount immediately but only at the time of default.

In order to estimate EAD, it is necessary to know the Drawn Portion and the Updrawn Portion, which is relevant to the debtor's ability to increase exposure at will. Finally, another variable is the percentage of the unused portion that is expected to be drawn down by the borrower at the time of default (UGD - Usage Given Default).

EAD= DP + UP x UGD

To estimate the EAD value we can use two different appraches:
1. F - IRB: basic approach on internal ratings, calculation driven by regulators
2. A - IRB: advanced approach, banks have greater flexibility and autonomy.

1.2.1.3 Loss given default

The loss given default represents the rate of loss that the creditor could experience on the exposure in the event of the debtor's default. Therefore, the rate of loss cannot be estimated ex ante or at the time of default, but an accurate estimate can only be determined at the end of the recovery process.

It can be expressed as:

LGD= 1 – RR

Where RR represents the Recovery Rate. Therefore, for the purposes of calculating the LGD, the phase of estimating the recovery rate is important and is consequently influenced by various factors such as: the technical characteristics of the loan: such as the possible presence of guarantees together with their nature and the ease with which they can be enforced and liquidated to satisfy the creditor, the order of seniority attributed to the exposure which can be classified as senior or subordinated (meaning the priority with which the credits are satisfied, the type of procedure undertaken by the bank to recover the credit.

The characteristics of the borrower: these include the sector in which the debtor operates, the country in which the borrower is based, the territorial context in which the court in question is located and, lastly, also the size of the borrower - if it is a company - in terms of total assets (in which case it is possible to further rely on certain financial indices such as leverage or the ratio between EBITDA and turnover).

internal bank factors: factors such as the efficiency of the workout department, the internal division of competences and responsibilities, the propensity to internalise the recovery process or vice versa to sell disputed receivables to third parties (the so-called "make or buy" choice) and also the frequency with which such positions are resolved through out-of-court settlements. Specifically, as regards the management of impaired loans, this can be carried out by internal structures or can be subject to outsourcing.

External macroeconomic factors: these include, among others, the current trend of the economy (recessionary phases lead to a lower liquidation value for company assets, influencing the LGD) and the trend of interest rates (using a discounted cash flow model, higher rates cause a decrease in the current value of possible future recoveries).

Estimation can be carried out in different ways, a first distinction being made between subjective and objective methods. Notwithstanding this initial distinction, it is important to note that the rules clearly prohibit estimates that are based solely on subjective assessments. Under Basel II, banks must estimate the long-run average LGD for each transaction, focusing on a minimum observation period that ideally covers at least one complete business cycle of a minimum of seven years (five years in the case of retail exposures).

Objective methods can in turn be distinguished into:

- Explicit methods: based on the presence of a reference dataset that collects LGD data on defaulted exposures. The effective loss rate on exposures is calculated through two alternative methodologies: Market LGD and Workout LGD. Subsequently, the rate is appropriately assigned to each exposure through the use of a model: simpler models involve assigning the simple average of loss rates to each exposure, while more elaborate models are able to obtain an estimate of LGD for each individual exposure.
- Implicit methods: in this case the loss rate is extracted from data on total loss and default probability. The theoretical basis for such an approach is that the price of a fixed income bond issued by private companies, or of a derivative instrument, also reflects the loss rate in the event of default. The implicit methods under Basel II are called Implied Market LGD and Implied Historical LGD.

Market LGD

Through this approach, the loss rate is estimated on the basis of market prices of defaulted exposures. The most widely used model in this field is LossCalc™ , developed by Moody's KMV agency, whose first version dates back to 2002 and was followed by two further releases called LossCalc™ V2 and LossCalc™ V3 respectively.

The LossCalc™ V2 is a multifactor statistical model that aims to predict the loss rate in the event of default for government securities, bank loans and preferred shares by distinguishing them in terms of security. In fact, government bonds are classified as industrial revenue bonds, corporate mortgage bonds, senior secured, senior unsecured, senior subordinated, subordinated, junior subordinated, while for bank loans the subdivision provides as seniority classes senior secured and senior unsecured loans. Within the model, the endogenous variable is the market price of the instrument one month after default. Practically, by including factors such as the type of debt, the level of seniority, the typical characteristics of the individual firm and the sector in which it operates, together with other macroeconomic factors, the model returns the estimated LGD for that particular asset.

Implied market LGD

It can be interpreted as a variant of Market LGD as it refers to the prices of bonds traded on the market but unlike the previous case these bonds are not in a state of default. Underlying the model is the theory that spreads on risky securities also reflect the expected loss on those securities. In fact, the spread is a function of the expected loss on the security because it is considered in relation to risk-free government securities and, in addition to incorporating

liquidity risk, it is also a function of the probability of default and the rate of loss in the event of default. Therefore, it will be possible to derive PD and LGD on the basis of the CAPM-type model.

Workout LGD

Underlying the model is the consideration that not all exposures are priced in the market: while it is common to find quotations for bonds issued by companies of a certain size, this is very rarely the case for traditional loans issued by commercial banks, hence the need for a model that is not based on market prices, but on discounting the recovery flows after default. Such a methodology requires the presence of an archive containing data on past defaults; these, in turn, must be subdivided according to the procedure carried out, the time it took, the amounts that the bank managed to recover, etc. The result consists of a series of groupings of defaults, which are then calculated on the basis of the number of defaults. The result is a series of clusters, each with similar characteristics and similar LGDs, that can be used as a reference for estimating the default loss rate on future defaults. The Workout LGD model therefore requires the calculation of the present value of cash flows during the recovery process, i.e. between the onset of default and the closure of the process, net of recovery costs incurred by the bank. Once all cash flows have been discounted using a certain rate, the loss will be calculated as a percentage of the EAD. The final objective is to determine the LGD incurred on each exposure belonging to a given reference cluster and, using a backward-looking approach, estimate the loss given default for each cluster.

According to the Basel Committee, three essential components can be identified for the calculation of Workout LGD: monetary and non-cash recoveries, direct and indirect costs, and the discount rate. The latter must be calculated accurately as different rates lead to different LGD values. The doctrine has also long wondered about the most appropriate rate to apply, identifying three possible solutions:
- The contractual rate applied to the client;
- The risk free rate;
- The risk-adjusted rate of return estimated using a monofactor approach.

However, none of the three can effectively reflect the full risk inherent in the recovery operation because the risk free rate underestimates the risk too much, the contractual rate is not consistent, the rate obtained with the monofactorial approach neglects the possible influence of ideosyncratic factors other than the business cycle. As a solution to the problem,

a multi-factor approach can be used to provide more accurate results, taking as additional inputs variables such as the debtor's sector, the competent court and the type of recovery action.[3]

the absence of an agreed discounting methodology is evident. In order to fill this gap, the Basel Committee found it meaningful to formulate two possible calculation systems for discounting cash flows:

- The amounts recovered and the costs incurred for their recovery are discounted through a risk-adjusted discount rate, obtained as the sum of the risk free rate and a spread that reflects the randomness of the recovery and cost flows;

- The amounts recovered and the costs incurred for their recovery are transformed into their certain equivalents, subsequently discounted by a risk free rate.

- In addition, the Bank of Italy has established criteria to which all banks must adhere when choosing a precise discount rate:

- While some factors may vary - type of transaction, modus operandi chosen to carry out the recovery, market in which the bank operates - the definition of the rate must be uniform for all exposures of the same type;

- - In the case of certainty in recovery, the present value may reflect only the financial value of time;

- - In the presence of uncertainty in recovery flows, in addition to the monetary value of time, the discount rate must also reflect the risk associated with the volatility of recovery flows;

- - In the presence of uncertainty in recovery flows, in addition to the monetary value of time, the discount rate must also reflect the risk associated with the volatility of recovery flows; and Banks must be able to provide an appropriate explanation of the reasons and procedures that led to the choice of rate.

Implied Historical LGD

Alternatively, it is also possible to estimate the long-run loss given default through past case analysis starting with the default probability values for the entire portfolio held. The result is an estimate of the LGD for each period associated with the portfolio; the various estimates are then used to obtain the long-run loss. In any case, such an opportunity is limited to retail

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[3] Gibilaro L., Mattarocci G., (2006), "La selezione del tasso di attualizzazione nella stima della loss given default: un'applicazione al mercato italiano", Newfin working paper, n°6, Milano.

exposures. The expected loss on the portfolio, containing both performing and non-performing exposures, is:

$$EL = \sum_{i=1}^{D}(EAD - (\sum_{j} R_j(r) - \sum_{k} P_k(r)))$$

Where:

- I: number of credits in default;
- J: number of recoveries on the claim;
- K= number of recovery costs.

LGD being calculated as the ratio of the expected loss (EL) times the product of the exposure at default and the probability of default (EAD * PD), the default loss rate on the entire portfolio can be calculated as:

$$LGD_t = \frac{\sum_{i=1}^{D}(EAD_j - (\sum_{j} R_j(r) - \sum_{k} P_k(r)))}{\sum_{i=1}^{N} EAD_i \times PD}$$

1.2.2 Unexpected Loss

It represents the true credit risk, i.e. the risk that the loss turns out ex-post to be higher than initially expected. In fact, it measures the variability of the loss rate around its expected value. The occurrence of the unexpected loss may depend on two main elements:

1) The possibility that the default rate turns out ex-post to be higher than originally estimated;
2) The possibility that the default recovery rate will be lower than estimated.

It can be defined as:

$$UL = \sqrt{\sigma_{PD}^2 \times PD + \sigma_{LGD}^2 \times LGD}$$

1.3 Capital requirements

Knowing that the concept of credit risk can be broken down into several drivers, including: default risk, settlement risk, credit deterioration risk, collateral recovery risk, and exposure risk. The dispersion around the average of each of the above risk declinations contributes to an increase in the unexpected loss component of the credit extended.

The orientation of the Basel Committee, over the years, has always been towards achieving a greater risk sensitivity of the capital requirement with respect to the amount of risks present. When measuring regulatory capital, the credit intermediary may choose the most appropriate methodology from among:

- Standardized approach

- Advanced internal rating-based approach

- Foundation internal rating- based approach

Under current regulations, a bank's regulatory capital must have a minimum level of:

$$PV \geq 8\% \, RWA + PV_{rm} + PV_{ro}$$

Where:

- PV= regulatory capital
- RWA= risk weighted assets
- PV_{rm}= capital required for market risk
- PV_{ro} = capital required for operation risk

1.3.1. Standardized approach

In this approach, the formalization of the three risk drivers (PD, LGD, EAD) is not used since a single risk driver is used, represented by the rating produced by an external agency to be taken into account as a variable to specify the risk weight of the exposure. There are several types of exposures and each is associated with a different risk weight. Pursuant to Article 178

of the CRR, the default exposure is assigned a 150% weight if specific adjustments are less than 20% of the unsecured portion of the exposure, or a 100% weight if specific adjustments are at least 20% of the unsecured portion of the exposure. The standardized approach provides for credit risk mitigation (CRM) mechanisms to reduce the amount of the exposure to which the risk weight applies. In particular, there are two CRM methodologies:

- **Simplified model:** collateral is used to mitigate risk if it is pledged for at least the entire duration of the loan and revalued at market prices with a minimum market frequency of six months. The portion of the loan supported by the market value of the collateral will be assigned the specific risk weight attributable to the instrument provided, with a minimum risk weight of 20%.

- **Integral approach**: both the exposure and the value of the collateral are adjusted by deducting appropriate haircuts to take account of the volatility of the market value of the collateral and the value of the credit claim. These haircuts can either be provided directly by the supervisor (standard supervisory haircuts) or be estimated internally (estimated haircuts). For a collateralized transaction, the exposure value including CRM effects is calculated as:

$$E^* = \max\{0; [E \times (1 + H_e) - C \times (1 - H_c - H_{fx})]\}$$

Where:

- E^*: exposure current value;
- H_e: appropriate haircut for exposure;
- C: current value of the guarantee;
- H_c: appropriate haircut for the guarantee;
- H_{fx}: haircut against currency mismatch between collateral and exposure.

Specific provisions are recognized by applying risk weight to the amount of the exposure net of provisions. For defaulted exposures, the risk weight to be assigned to the unguaranteed portion varies by the amount of specific provisions made (RWA factor).

1.3.2 Internal rating- based approach

The IRB approach significantly increases the variables specifying the risk of a position, making the capital charge more risk sensitive. Given the relationship EL= PD x LGD x EAD, since the PD variable is calculated over a one-year time horizon, the maturity variable (M) is introduced to account for the increased riskiness of a longer duration exposure.

In the IRB Approach, exposures are divided into:

(a) Exposures to central governments or central banks;

(b) Exposures to institutions;

(c) Exposures to corporates;

(d) Retail exposures;

(e) Equity exposures;

(f) Items representing positions in securitization; and

g) Other assets other than loans.

What differentiates IRB-advanced and IRB-foundation is the discretion of the parameters that can be estimated internally. In fact, the foundation approach only estimates PD internally, while the other risk factors are provided by the supervisor.

In the case of the IRB foundation approach to estimating PD, the minimum value that the parameter can take is 0.03%, except for equity exposures where minimum PDs are applied depending on the marketability and duration of the relationship with the client. For defaulted exposures, the PD is 100%. With respect to LGD, senior exposures without eligible collateral must report a value of 45% while subordinated exposures without eligible collateral have a standard value of 75%. For the estimation of EAD, the recognition of specific provisions is done ex-post when calculating capital. For the advanced approach, LGD is calculated analytically as a percentage of EAD. It starts with a central value of 45% but may be subject to a demultiplying process depending on the strength of the ratio of the adjusted exposure amount to the current exposure amount. With a high current collateral amount and low supervisory haircuts, this will result in a ratio close to zero and thus a lower level of LGD to be applied.

1.4 Credit risk importance for BCE

As we have seen, credit risk is of extreme relevance to banking activity, as lending always carries the risk of non-repayment and is therefore at the core of the ECB's supervisory activity. In relation to this, the ECB constantly analyses the development of impaired loans on bank balance sheets as they can have a major impact on the soundness of banks.

In fact, according to the ECB's supervisory banking statistics, from 2016 to 2020 this strong focus on the issue has allowed the amount of impaired loans to decrease steadily. However, the presence of the economic crisis caused by the pandemic foreshadows a very negative scenario, estimating that NPLs could reach €1.4 trillion by the end of 2022.

Chapter II: Non performing loans

Non- performing loans are defined as that kind of loans that are considered in default or close to default. In general, a non-performing loan (NPL) is a loan that is considered to be in default or is approaching default. In the banking sector, commercial loans are classified as non-performing if the borrower has made either zero interest or principal payments within 90 days, or is 90 days past due. In contrast, for a consumer loan, 180 days past due classifies it as a NPL.

According to the definition of Bank of Italy, non-performing loans are "*exposures to parties who, due to a deterioration in their economic and financial situation, are unable to meet all or part of their contractual obligations[4]*".

2.1 Overview of NPLs phenomenon in Europe

The amount of NPLs have considerably increased in all the European Union countries and they are playing a crucial role in the banking sector. In fact, they have a huge impact on a bank's balance sheet and, as we will analyze in following chapter, on its performance.

Banking performance has turned upside down over the last decades, diverging a lot from that of the US banking system, and it has been put under significant pressure since the 2007 -2008 financial crisis. In fact, since the terrible occurrence of the Wall Street stock market crash, the European banking sector has experienced a period of severe contraction and a significant decline of its performance. The social, financial and cultural consequences of the crisis have damaged, in part irreversibly, the vision of European banks. The events overseas and the subsequent European sovereign debt crisis have generated strong discontent and a high degree of suspicion towards institutions. Also, in terms of reliability, banks are no longer considered as safe places but are associated, unfortunately in many cases, to the causes of the economic decline of several member states but above all to the cause of the poverty of several European citizens.

In fact, the crisis and all the events that have occurred have substantially decreased the national GDPs causing a slowdown in the growth and economic wealth of the various member states.

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[4] Bank of Italy, "Non- performing loans in Italy banking system"

Obviously also the portfolios of small savers have been damaged and people have not been able to repay their debts to the banks.

Moreover, since the 2007-08 crisis, the European banking system has been marked by a low interest rate environment, in fact during these years some central banks (such as Sweden and Denmark) set their policy rates below zero. Moreover, the interest margins have also experienced a contraction providing a negative impact on banks that rely more on net interest income. The increase of non-interest activities such as mergers and acquisitions have been encouraged by this lower interest rate environment changing the core driver of banking profitability.

All these events also affected the banks' capital structure which needed to be compliant with the new regulatory requirement under the Basel agreements: prudential supervision requires higher regulatory capital at impaired loans to ensure that the higher risk factors are balanced. Following the financial crisis, the total regulatory capital ratios have been raised from 8% to 10.5% of risk-weighted assets to account for the capital conservation buffer. Although this has made the sector more resilient to withstand unexpected shocks through de-leveraging and de-risking of banks' balance sheets, it has also limited their capacity to generate returns via riskier activity.

Moreover, after the Sovereign debt crisis, interventions made by authorities have helped to make significant progress in the reduction of NPLs level across all banks in Europe. Median bank's NPL ratio has halved from a peak of nearly 5% (as a share of all loans) in 2013 to under 3% in 2018-20.

Despite all the progress made during these years, the interventions of governments to reduce the NPL ratio, in 2019-2020 another crisis had risen. The Covid 19 pandemic has caused a new decline of the European banking system and the increase of NPLs. Even if the crisis was not originated by a financial or macroeconomic event, the impact of the Coronavirus was extremely similar to the already seen crisis.

It has happened because the reduction of NPL amounts are not sufficient to solve the issues of NPLs because the resolution of NPLs is directly correlated to the economic growth of each country and more in particular to the occurrence of crisis.

During crises, NPLs generally follow an inverted U-shaped pattern. According to an ECB report, "*Looking at all crises, we see that NPL levels peak on average at about 20% of total loans, but the variance is large: in developing countries in particular, NPLs can exceed 50%*

of total loans. Only less than one-fifth of banking crises avoid high levels of NPLs - which we define as NPLs exceeding 7% of total loan.[5]"

2.3 Key determinants

There has been much debate in the academic literature on the key determinants of NPLs. Different strands agree on different types of drivers:

(a) Macroeconomic conditions

b) Institutional factors

c) Bank-specific elements

Among the macroeconomic conditions, the real change in GDP emerges as the main determinant. In fact, empirical analyses carried out in the literature show the presence of a significant inverse correlation between GDP and NPLs variables and consequently the quality of banks' assets is strongly correlated with the macroeconomic performance of a country.

As for the institutional determinants, the efficiency of the judicial system and the quality of auditing activities are relevant with respect to the dynamics of NPLs. In fact, the presence of an inverse relationship between the efficiency of the judicial system and the level of NPLs has been demonstrated.

Finally, there is substantial bank-specific evidence correlating several bank characteristics with the dynamics of impaired loans. The first variable considered is profitability, which supports two opposing theses. On the one hand, profitable banks have less incentive to enter into very risky businesses and consequently it is possible to justify an inverse relationship between profitability and NPLs. On the other hand, there is an opposite thesis according to which the lending policies of a bank are influenced by both profit maximization and the short-term reputation of the management. Consequently, the latter may have an incentive to take more risks in order to improve short-term profitability at the expense of loan quality.

Another relevant variable is the growth rate of loans, which affects the bank's riskiness. According to various theories, an acceleration of the portfolio growth rate can be achieved by narrowing the credit spreads charged by the bank and lowering the minimum credit standards. This inevitably leads to a higher amount of NPLs. This effect is all the more pronounced when

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[5] European Central Bank, "COVID-19 and non-performing loans: lessons from past crises", 27 May 2020

the increase in volumes occurs through entry into new territorial markets. The new entrant bank is subject to an adverse selection phenomenon as the incumbent banks will abandon their bad customers while making predatory rates on their better customers.

Finally, two opposing theories also differ on the size of the credit institution. According to the first strand, which associates bank size with the propensity towards a defined lending technology, there is an inverse relationship between size and NPL ratio. On the other hand, there are opposite relationships according to another strand. According to the latter, large banks can significantly increase leverage and take excessive risks that are difficult for regulators to contain.

2.3 European and Italian regulations

At the European level, the Regulatory sources related to Non-Performing Loans are of an accounting origin, set out in IAS 39/ IFRS 9 and of a regulatory origin, which converges the notion of non-performing exposure to that of default, expressed by prudential supervision in accordance with the provisions of Article 178 of Regulation (EU) No. 575/2013.

Within the aforementioned regulation, exposures that meet at least one of the following two conditions are considered non-performing exposures:

1. Relevant exposures past due by more than 90 days

2. The debtor is considered unlikely to meet its credit obligations in full without the enforcement of guarantees, regardless of the existence of past due amounts or the number of days in arrears.

In accordance with this criteria, on January 21, 2015 the Bank of Italy, with the issuance of the seventh review of Circular no. 272 of July 2008 (update of January 20, 2015) reformulated the "credit quality" section by implementing the guidelines provided by the EBA ITS. In this way it delineated the reporting categories:

- Bad loans: exposures, both on and off-balance sheet, to parties in a state of insolvency (even if not judicially ascertained), regardless of the bank's loss forecasts and the presence of any guarantees that support the exposure;

- Unlikely to pay: this category includes exposures to debtors which, in the opinion of the bank, are unlikely to be paid in full, in terms of principal and interest, without recourse to actions such as the enforcement of guarantees. Therefore, the positions of parties who are very likely to meet financial difficulties in the near future such as to make it necessary to enforce guarantees in order to repay the loan are considered probable defaults. The unlikely to pay position has replaced the category of substandard loans . In the light of the classifications

proposed up to now, it is important to underline the substantial difference between non-performing loans and unlikely to pay: in the first case, the debtor is considered permanently insolvent, while, in the second case, the latter is in a situation of temporary difficulty that could be resolved and consequently return to bonis.

- Impaired past due and/or overdue positions: these include cash receivables not classified among probable defaults and non-performing receivables and must be reported for each individual debtor for all positions with the exception of those relating to the retail portfolio, for which it is possible to opt for the reporting of the individual past due/overdue line. On the other hand, with regard to exposures not included in the retail portfolio, the overdue or overlimit must be of a continuous nature.

- In addition, the EBA has introduced an additional tool for the European supervisory authorities to assess the quality of assets on a comparable basis by harmonising the definitions of impaired exposures (NPE) and exposures subject to concessions (forbone exposures). In fact, according to some analyses conducted by the EBA, the modification of contractual conditions, even without the occurrence of a formal restructuring, reveals situations of real difficulty of the debtor that affect the risk profile of the creditor bank. Therefore, a position is deemed to be forbone exposures when there is a concession by the bank regarding modifications to the original contractual conditions (e.g. payment terms and/or economic conditions) put forward by a client in financial difficulty. The real innovation introduced by these forborne exposures relates to the fact that forbearance concerns the individual credit exposure and not the entire debtor. For a line of credit to be classified as forborne, two conditions must be met simultaneously: 1. The customer is requesting a favorable modification to a credit agreement 2. The customer is in financial difficulty, objectively assessed using the impartiment triggers proposed by IAS 39 and summarised by the ECB instructions for the asset quality review. The bank's measure of forbearance is presumed if a) the bank implements a contractual modification that entails a total or partial cancellation of the debt; b) the bank implements a contractual modification on a client classified as non-performing c) the contract envisages clauses whose exercise is left to the discretion of the debtor and these clauses are exercised, with the bank's consent, by a non-performing debtor or one that would have been classified as such in the absence of their exercise; d) the bank provides a new loan that allows the simultaneous or subsequent fulfilment of another obligation classified as non-performing or one that would have been classified as such in the absence of the new loan. Therefore, the forbearance measure only takes place if a pre-existing contract is being modified or a maturing position is being refinanced, and, simultaneously, this concession is made in the face of financial difficulty on the part of the customer to be appropriately assessed. The financial

difficulty, if assessed on a performing position, should be of a transitory nature, in order to bring the exposure back into the category of performing forborne. In the presence of a situation of structural financial difficulty, in fact, it would be necessary to evaluate the migration of the same to a higher risk status and, if necessary, place the exposure among the impaired forborne. For the purposes of determining the client's financial difficulties, the ITS propose the same criteria used in the Asset Quality Review. Pursuant to art. 178 of Regulation (EU) no. 575 /2013 among the elements to be considered indicative of unlikely fulfilment are: (a) the bank classifies the loan as non-performing or non-accrued status; (b) the bank makes a specific adjustment to the loan resulting from a significant deterioration in creditworthiness; (c) the bank sells the loan incurring a significant economic loss; (d) the bank agrees to an onerous restructuring of the loan, which is likely to involve a reduced financial obligation due to a substantial debt forgiveness or deferment of principal payments of interest or, if applicable, fees; e) the bank has filed for bankruptcy for the debtor or has initiated similar proceedings in relation to the debtor's obligation; f) the debtor has filed for or has been placed in bankruptcy or a similar situation, where this prevents or delays repayment of the obligation to the bank. In addition, according to IAS 39, minimum impairment triggers are included:

- - Significant financial difficulties of the issuer or debtor: Internal and/or external rating deterioration indicating default or proximity to default, debtor in default (according to the previous definitions), 5Y CDS > 1000 bps in the last 12 months, 50% reduction in debtor's equity as a result of operating losses, extraordinary financing request, significant past due debts to employees/public administration, drastic reduction in debtor's turnover or loss of principal customer, drastic reduction in value of collateral, drastic reduction in estimates of future cash flows, current debt service coverage ratio < 1.1;

- Loan Agreement Violation: less than 90 days past due on any of the loan facilities, covenant violation not approved by the bank, ISDA credit event.

- Bankruptcy or financial restructuring: the debtor declares bankruptcy or enters into other insolvency proceedings, a company belonging to the group is likely to declare bankruptcy or enter into other insolvency proceedings.

- Disappearance of an active market for financial assets: listed corporate bonds are suspended due to rumors of financial difficulties of the client, disappearance of an active reference market.

The termination of the forfeiture condition occurs in a different way depending on whether it has been proposed for a performing customer or for a clinic classified as impaired. According to the exit criteria in the case of a performing forborne, the ITS envisage that the termination

of the forbearance status occurs when all the following conditions have been verified: the analysis of the client's economic-financial situation excludes the possibility of classifying the client among non-performing exposures; if a period of at least 24 months (probation period) has elapsed from the date of preconcession of the forbearance measure; the principal and interest payments have been made for an aggregate value that is more than significant for at least half of the probation period; none of the debtor's outstanding exposures is more than 30 days overdue at the end of the probation period.

If all of these conditions are not met at the end of the probation period, the exposure will continue to be classified as forborne. If, on the other hand, a performing forborne exposure, during the probation period, benefits from an additional forbearance measure or becomes past due for a period of more than 30 days, it must be classified as a non-performing exposure with forborne measures. On the other hand, if the client is in an impaired credit status and has benefited from a forbearance measure, the return to performing status of the exposure is subject to compliance with the following rules: a) 12 months must have elapsed since the forbearance measure, b) the debtor must not have expired exposures or overdue exposures, regardless of the amount, or there must be no fears regarding full payment of the agreed amount after the forbearance measure.

As can be seen from what has been said so far, the introduction of the forborne discipline acts not only in the signalling area but also in the management of credits.

Finally, the ITS also envisage exit criteria for the non-performing exposure category, that is, in the case where the client has not benefited from any forbearance measure. For migration from non-performing exposure to performing exposure it is necessary that he exposure complies with the exit criteria in the default classifications of prudential supervision and impairment loans in accordance with IAS 39; that the economic situation of the debtor has improved and the debtor must be able to repay the entire debt as agreed and, finally, that the debtor does not have debts that have been overdue for more than 90 days.

- Impaired concessional exposure: this represents a single line of credit for cash or by signature granted to a client in financial difficulty.

- Other exposures subject to concessions: this category includes all the lines subject to a concession by the bank to a performing client who shows clear signs of financial difficulty.

Summing up what has been said, we can say that there are various stages of debtor default. For the bank, the alarm bells go off in the light of certain criteria. In particular, therefore, a debtor is to be considered in a state of default when at least one of the following conditions occurs:

- Objective condition: ("past-due criterion") - the debtor is in arrears for more than 90 consecutive days in the payment of a relevant obligation;

- Subjective condition ("unlikeliness to pay") - the bank judges it unlikely that, without recourse to actions such as the enforcement of collateral, the debtor will fulfil his obligation in full.

In the case of an objective condition, the obligation is considered significant when the default significance thresholds are exceeded, which include an absolute component and a relative component:

1. the absolute component is represented by the maximum amount that can reach the sum of all overdrafts on cash risks granted by the institution to the customer or that can reach the sum of all unpaid past due receivables. For SMEs with exposures to the institution totalling less than 1 million euros, the maximum amount does not exceed 100 euros.

2. the relative component is represented by the percentage that expresses the ratio between the overrun of an individual line of credit (or the amount of an individual past due loan) and the amount of a single overdue loan (unpaid) and the aggregate amount of all exposures the customer has to the bank, excluding equity exposures. The percentage is currently set at 1%.

2.3 Receivables Accounting

During the financial crisis of 2008 it was widely believed that the accounting models used had accelerated and worsened the effects of the crisis on credit institutions. For this reason, in 2009, following the G20 meeting, the inefficiency of the accounting model used up to that moment, i.e. IAS 39, was highlighted. In particular, the following were blamed on the accounting principle: the excessive use of fair value by credit institutions for the valuation of financial instruments and the excessive discretion left to financial statement preparers for the classification of financial assets and, lastly, the inability of IAS 39 to record losses on receivables in a timely manner. All these reasons prompted the IASB to question itself thoroughly and to mature a new accounting standard capable of regulating the regulations with the issuance in 2014 of the new accounting standard IFRS 9 concerning the classification, valuation of financial instruments and the calculation of expected losses.

2.5.1 IAS39: main limitations

Among the most critical aspects of the accounting principle, it is important to mention the difficulty in interpreting and applying the principle, which is most evident in the classification of financial instruments, leaving too much discretion in the initial recognition in which to include the financial instrument, causing a difficult comparison of the financial statements of different companies or even of the same company. In fact, IAS 39 provided for the possibility that the same financial instrument could be accounted for differently, taking into consideration only the management method and not the company's business model. In addition, many criticisms were made, especially with regard to the excessive use of fair value, since, on the one hand, the use of fair value makes it possible to draw up financial statements with values that are always up-to-date, but at the same time, it requires the presence of an active market capable of promptly providing the necessary data; the macro-economic context of crisis, characterized by a high level of market illiquidity and excessive volatility of values, made it possible to find a low level of reliability of fair value values, giving rise to the pro-cyclical effect. To conclude, it is also important to mention the criticism made regarding impairment based on the principle of incurred loss. In fact, applying IAS 39, the recording of losses is carried out ex post, that is, after the occurrence of the event and does not allow the timely recording of losses relating to receivables in the portfolio. Finally, IAS 39 does not envisage a precise definition of a trigger event on the occurrence of which it is necessary to write down receivables.

Consequently, it was necessary to use a new approach in the drafting of the new accounting standard aimed primarily at having a more detailed classification of financial assets and liabilities based on the entity's business model, to introduce a single impairment model, to carry out a reclassification based on the entity's business model and to record losses on receivables ex ante.

2.5.2 IFRS 9

The first change introduced by IFRS 9 concerns the classification of financial instruments. In fact, previously IAS 39 envisaged 4 categories of financial assets: held to maturity, available for sale, loans and receivables and held for trading; while IFRS 9 introduces the possibility of classifying financial instruments into two main categories and one residual category:

- financial assets valued at amortised cost: i.e. assets such that the instrument pays capital and interest at predefined maturities. This verification is carried out by carrying out the SPPI test, which must be carried out on each individual contract and not on each individual counterparty

or must be conducted on a pool of standardized contracts. Furthermore, it is a fundamental requirement that the instrument is managed in relation to the hold-to-collect (HTC) business model, which aims to hold it until maturity.

- Financial assets valued at fair value through other comprehensive income: assets are held as part of a business model, which pursues its objective both through the collection of cash flows, as provided for in the contract, and through the sale of the instrument. This business model, called Hold to Collect and Sell (HTCS), should logically be characterized by a more intense sales activity in terms of both frequency and volume.

- Financial assets valued at fair value through profit and loss (FVTPL): this category of financial assets is residual, in fact a financial asset is placed here if and only if it cannot be included in one of the two previous categories. Regardless of the entity's business model, when the cash flows do not pass the SPPI test, the financial assets must be accounted for at fair value. It is possible to use for this category of financial assets the fair value option with accounting through profit and loss, if and only if this choice makes it possible to reduce or eliminate the accounting mismatch that would occur if the financial asset were valued using different methodologies.

The rules relating to the valuation of financial liabilities held for trading, which provided for these types of financial instruments to be valued at fair value through profit and loss and others at amortised cost, have remained unchanged. In fact, changes in the value of these financial instruments, attributable to a reduction in the issuer's creditworthiness, in accordance with the provisions of the new accounting standard will be accounted for as Other Comprehensive Income (OCI) and therefore, changes in value will no longer impact the Income Statement. The objective of this change is to avoid that a deterioration of the issuer's creditworthiness may result in a gain in the Income Statement for these financial liabilities, thus eliminating this sometimes considerable volatility factor.

2.5.3 New impairment model

The objective is to provide more information on the expected loss which must be accounted for even when there is no trigger event and must be estimated not only on the basis of past data but also in relation to future data (forward looking). The objective of the new impairment model is to charge adjustments to the Income Statement, in advance and in proportion to the increase in credit risk. The regulations envisage that receivables be allocated to three stages, with the aim of identifying significant changes in credit risk in relation to three particular aspects:

1- The change in PD since the financial asset was first recognized.

2- The expected life of the financial asset

3- Forward-looking information that may impact on credit risk.

For each stage, there is a different method for calculating the expected loss:

- Stage 1: stage 1 will include all those instruments for which there has been no reduction in creditworthiness with respect to the origination date, or all those financial instruments which present a limited credit risk at the reporting date. For the financial instruments classified here, the expected loss is calculated using a time horizon of 12 months as a reference.

- Stage 2: this category includes all those financial instruments for which there has been a significant reduction in credit risk and which can be classified as "underperforming". The expected loss in this case is determined in relation to the entire duration of the financial instrument (Lifetime expected loss), furthermore, the new accounting standard envisages that the lifetime expected loss also takes into consideration forward-looking estimates, ergo it is necessary that forecasts relating to the trend of certain macroeconomic variables (GDP, inflation rate, employment, etc.) are also considered.

- Stage 3: this includes all financial instruments for which there has been a drastic reduction in credit risk compared with the date of origination, for this reason the instrument is classified as impaired, in which case the analytical expected loss is calculated and furthermore the interest recorded in the Income Statement is determined on the net exposure.

To facilitate the application of staging, two operational expedients are also envisaged:

1- A loan may not be subject to a stage 2 step, if at the reporting date the financial instrument has a low default risk, the debtor is able to meet its contractual obligations in the short term and finally any adverse macroeconomic scenarios, could but not necessarily, impact the debtor's ability to repay;

2- A receivable is subject to a move from stage 1 to stage 2 in the presence of more than 30 days' delay in payment. The limit of 30 days represents a final cap, ergo a significant deterioration in the debtor's creditworthiness can be detected even in the presence of a number of days overdue that is lower than the threshold established by international accounting standard 22. This presumption can be rebutted, in the sense that a bank can demonstrate, on the basis of its past experience, that, even if there is the presence of 30 days past due, there is no significant deterioration in the borrower's creditworthiness.

Therefore, the great innovation introduced by IFRS 9 was the passage from the concept of incurred loss to expected credit loss; in fact, through this change, the importance of promptly

verifying the presence of guarantees on the part of the counterparty before granting a loan is emphasized.

2.5.4 Hedging accounting

In addition, for better risk management, innovations have been introduced regarding hedge accounting operations, providing relevant information on risk management and reporting activities. The objective of hedge accounting is to provide greater clarity in the financial statements through evidence of the effects of risk management, therefore an increase in risks will be eligible as hedging items while an increase in the number of hedging strategies will be eligible as hedge accounting. This makes it much easier to identify the connection between hedging activities and their accounting effects when reading the financial statements. Hedging transactions require an effectiveness assessment that results in two different scenarios. In the first case, rebalancing, changes are made to the hedging relationship to modify the changes that have taken place between the hedge item and hedge instrument. Rembalacing is only relevant if there is a basis risk between the hedge item and the hedge instrument. The rebalancing can take place through an increase or decrease in the volume of the hedge item or hedge instrument. In the second case, i.e., if the risk management objective has changed since the drawing date, suspension of hedge accounting will occur. In addition, suspension will also occur if the economic relationship between the hedge item and hedge instrument is no longer valid, or in cases where the credit risk dominates the changes in fair value. There is also the possibility that suspensions are partial, therefore for some operations there is the possibility that the hedge can continue. The suspension is partial when there is a change in the risk management objective, in the case where the volume of the hedged item or the hedging instrument is reduced, in the case where the hedging instrument is wholly or partially sold, terminated or exercised and finally in the case where the hedged item or part of it no longer exists or is no longer expected to occur. On the other hand, the suspension is total in the event of substantial changes in the objective of risk management, in the absence of the economic relationship between the hedge item and hedge instrument, due to the effect of credit risk for changes in the value of the hedge relationship, in the event of expiry of the hedge instrument.

Chapter III: ROA and NPLs ratio relation: empirical evidence and possible solutions

3.1 Impact of NPLs on banking performance

The objective of this paper, however, is to determine the extent to which the level of NPLs affects bank performance and then to describe possible methodologies for managing NPLs in the banking book.

The objective of this paper, however, is to determine the extent to which the level of NPLs affects bank performance and then to describe possible methodologies to manage NPLs in the banking portfolio. Nevertheless, academic papers have shared the starting point that to explain performance it is necessary to include among the independent variables both internal and external factors to the bank. Therefore, this principle will be adhered to in the model and the paper "Bank Performance: Possible Internal and External Determinants" will be used as an academic theoretical basis.

3.1.1 Regression model explanation

The empirical analysis firstly explains the dependent variable of performance through independent variables internal and external to the bank to arrive at the objective of the study which is to determine the incidence of NPLs on the same.

The sample analysed averages the performance of several internal and external variables of 9 major banks belonging to the Eurozone. Specifically, the banks analysed include: Erste Bank, Deutsche Bank, Intesa Sanpaolo, KBC, Caixa, Santander, Bankinter, Sparebank.
The model analyses the time series expressed in quartiles with reference to the years 2007-2020. This timeframe was chosen to include the impact of the three major financial crises that have affected the European Union in the last two decades, namely the 2008 subprime mortgage crisis, the 2011 sovereign debt crisis and the 2019-2020 Covid19 crisis.

The dependent variable of the model is performance which is summarised by the sum of ROA and ROE as indicators of bank profitability. Performance is analysed through explanatory variables that include factors internal and factors external to the bank. With regard to internal factors, the following were analysed:

- Capitalisation using the capitalisation ratio capital/ tot assets as a proxy. The starting hypothesis for this variable is that it can have a positive impact on performance as it is an index of possible expansion, capable of guaranteeing the bank a higher profit.

- NPLs ratio given by the ratio of NPLs to total loans. This is the main variable in our analysis, given the objective set. In fact, we assume the presence of a significant negative relationship on the dependent variable.

Size given by ln(TA); where TA is total assets. In this case what is assumed is that bank size has a positive impact on bank performance.

- Loan/Asset ratio

- Price/Book ratio

- Financial margin

While between external variables:

- The crisis: expressed as a dummy, if the quartile falls within the crisis period it will take on a value of 1 while if it is in a state of equilibrium or expansion it will take on a value of 0. it is assumed that this variable has a negative impact on performance.

- Euribor rate: a positive impact is assumed;

- Inflation rate: according to economic theories, higher inflation rates tend to affect creditors and favour debtors; therefore, they should have a negative impact on bank profitability. As more sophisticated analyses point out [see, for example, Perry,1992], however, everything depends on the banks' ability to anticipate changes in inflation rates and to manage their assets and liabilities accordingly. Our expectation is that, in this respect, banks have an informational advantage over their contractors [households and firms]. Empirically, it should also be considered that, when inflation rates are rising, interest rates tend to rise; this provides banks with opportunities to widen interest margins and to increase service revenues. Finally, rising inflation rates are often accompanied by a macroeconomic expansion phase. For these reasons, in accordance with the findings of several studies [Bourke, 1989; Molyneux and Thorton 1992; Hassan and Bashir 2003; Kosmidou, 2006], our expectation is that the inflation rate will exert a positive impact on bank assets and profits.

- GDP growth rate: we expect GDP growth to exert a positive impact on the amount of assets and bank profits as it stimulates loan demand, facilitates funding, widens interest margins and creates opportunities to intermediate the allocation of private financial wealth.

The linear regression model will be based on the previous theorised structure.

The first function applied to the model represents the correlation matrix of the dataset both numerically and graphically. Once the correlation between the variables has been observed at an indicative level, it is possible to proceed with the estimation of a first regression model containing all the variables analysed through the application of the following formula

linear_model <- lm(formula = DATI$ROA + DATI$ROE ~ DATI$capitaliz + DATI$inflation + DATI$NPL + DATI$euribor + DATI$loantoass + DATI$gdpgrowth + DATI$size + DATI$crisis + DATI$ptobo + DATI$finmarg)

ottenendo i seguenti risultati:

```
Residuals:
    Min      1Q   Median      3Q      Max
-5.0998  -1.0541   0.2062   0.9911   3.9217
```

```
Coefficients:
                   Estimate Std. Error t value   Pr(>|t|)
(Intercept)     -238.04559   50.89731   -4.677   3.02e-05 ***
DATI$capitaliz   627.20507  171.85782    3.650   0.000721 ***
DATI$inflation    52.69785   48.95831    1.076   0.287901
DATI$NPL          -0.11949    0.03045   -3.924   0.000317 ***
DATI$euribor       2.60655    0.53711    4.853   1.71e-05 ***
DATI$loantoass    43.34448   13.25776    3.269   0.002155 **
DATI$gdpgrowth   118.47756   48.66791    2.434   0.019247 *
DATI$size         15.72780    4.44436    3.539   0.000997 ***
DATI$crisis       -3.08847    0.85514   -3.612   0.000806 ***
DATI$ptobo        66.76614   23.64226    2.824   0.007223 **
DATI$finmarg      -1.02427    0.18281   -5.603   1.48e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 2.011 on 42 degrees of freedom
Multiple R-squared:  0.8549,     Adjusted R-squared:  0.8203
```

```
F-statistic: 24.74 on 10 and 42 DF,  p-value: 1.735e-14
```

From an initial analysis, firstly by looking at the residuals we can deduce that not all the variables are significant, so in the next phase it might be appropriate to eliminate some of them. As far as the R^2 and Adjusted R-squared values are concerned, it is possible to validate the model as the variables taken into consideration explain at least 80% of the overall variability of Y. Now, by computing step()

function with direction "both", we apply the stepwise elimination, in order to have a confirmation of which variables we are going to exclude.

Trought this function, we eliminate the inflation variable due to its not significance in the model.

Once the variable has been eliminated it is possible to send again the model. In this way we obtain the model with all significant variables.

At this point, we have to test it in order to verify its consistency with the main assumptions of the linear model.

We check if there is any inclusion of irrelevant variables, which is considered a mis-specification problem, but it's fundamental for the validity of the analysis. In order to assess that, it is important to verify the absence of multicollinearity, that is the case in which one predictor can be linearly predicted by the others. This mis-specification does not imply any distorsion on the parameters estimation, but it causes an increase of its variability. This because the calculation of the variance of is based on R2j.

Since R2j is calculated on the regression of Xj on the other explanatory variables, if its value is high means that Xj can be expressed by the other variables and it increases the variance of the estimator. An useful tool for checking the presence of the multicollinearity is the VIF (Variance Inflation Factor), which is calculated for each variable "j" and the higher is R2j, the higher is the factor.

In the model under analysis the result is:

```
DATI$capitaliz :        9.852033

DATI$NPL                3.437769

DATI$euribor            5.787631

DATI$loantoass          1.288783
```

```
DATI$gdpgrowth        1.703572
DATI$size             6.631473
DATI$crisis            2.192473
DATI$ptobo             2.371575
DATI$finmarg           2.989165
```

Residual Analysis

Once estimating the model, the analysis has to take into consideration how residuals behave in order to test if there is presence of heteroscedasticity, autocorrelation and leverage points that can influence the OLS estimates. In the figure 3.1, we can observe the standardized residuals correspond to raw residuals divided by the standard deviation σ. They are used in order to check the normality assumption and to remove an inner heteroscedasticity in raw residuals by making them normally distributed with unit variance.
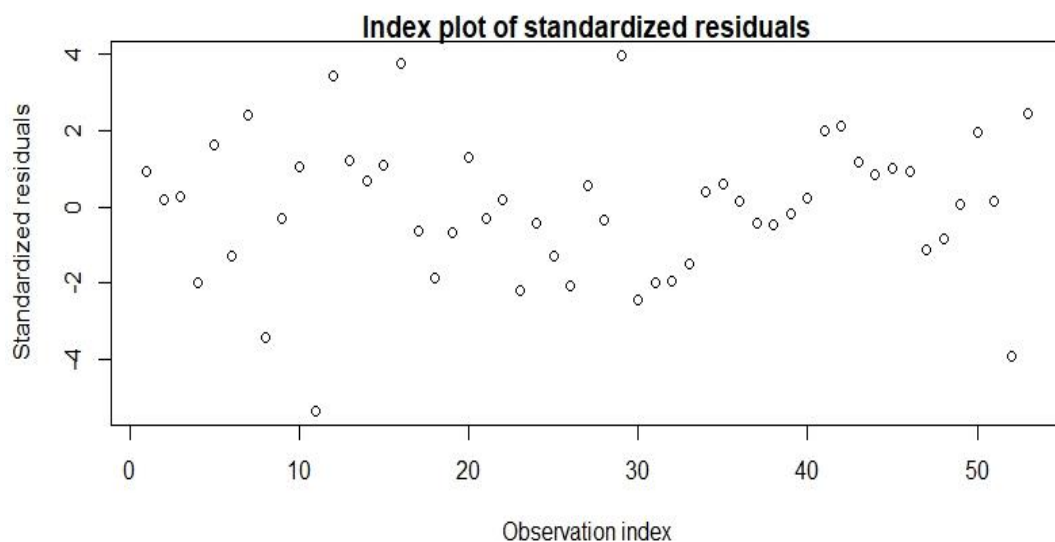

Figure 3.1: index plot of standardized residuals

Trought this chart it is possible to deduct the presence of heteroscedasticity. So, it will be important to better analyze it in the following tests.

The "residuals vs fitted plot" is a scattern plot that has the residuals on the y axis and he fitted values on the x axis. In order to have a good behavior of the residuals, they should bounce randomly around 0, not follow a regular pattern or stand out from the others.
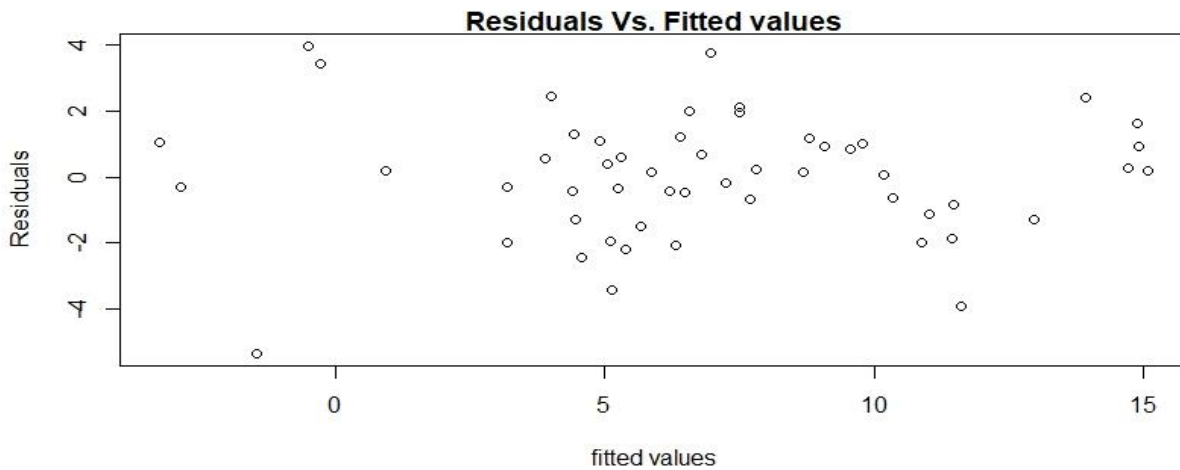

Figure 3.2: residual versus fitted values

The chart 3.2 suggests that the residuals are symmetric and that the Y variable is well expressed ad linear function of the other variable. Moreover, it is also possible to notice the presence of some outliers.

Another important aspect of the analysis is verifying the linearity hypothesis of the model. This can be achieved by observing the partial residuals plot of the dependent variable Y respect to each single explanatory variable taken separately. If the point cloud approximates a straight line then the linear hypothesis is confirmed, otherwise the independent variable X influences Y in a non-linear way.

The crPlots function returns the functional relation between Y and X (which is denoted in violet) while the dashed line represents a perfect linear dependency between the two variables.
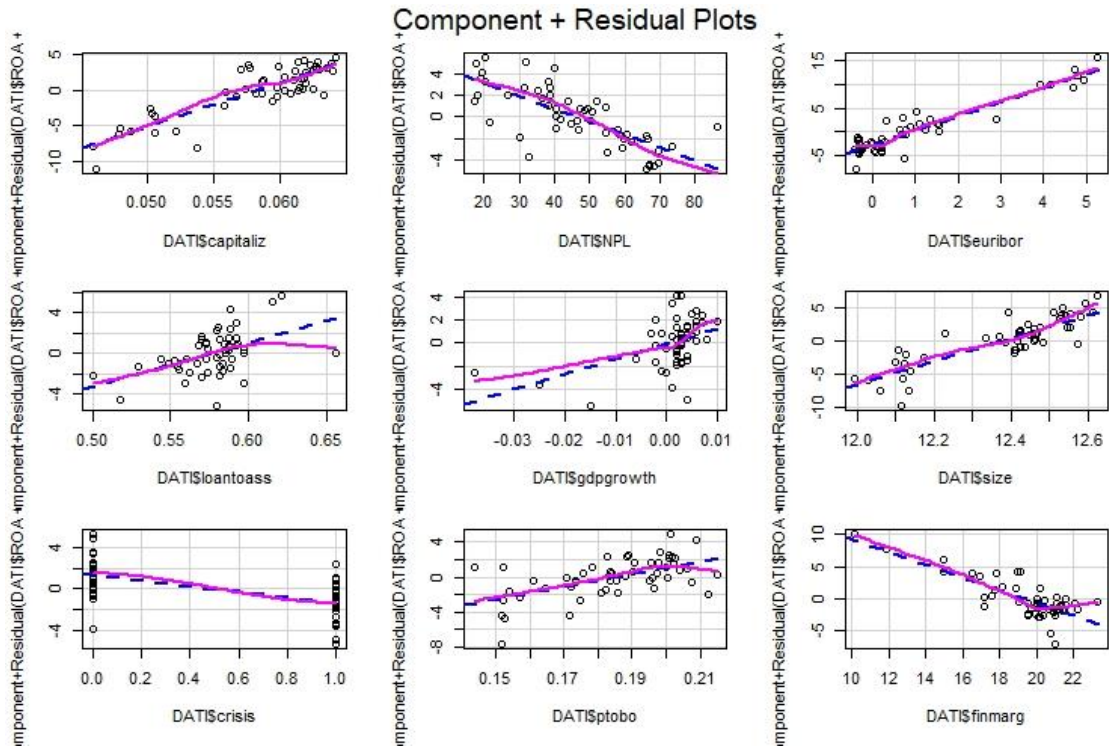
Figure 3.3: plot partial residuals

As shown in the figure 3.3, all the plots show a relation that is really similar to linearity.

Normality of residuals

The normality assumption is important for the validity of inferential procedures and, for this purpose, it is useful to firstly analyze the Normal QQ-plot of the standardized residuals. As the plot QQ-plot shows, the standardized residuals approximate quite well the straight Normal QQ-plot line even though there is not evidence of points that are significantly far from the others.
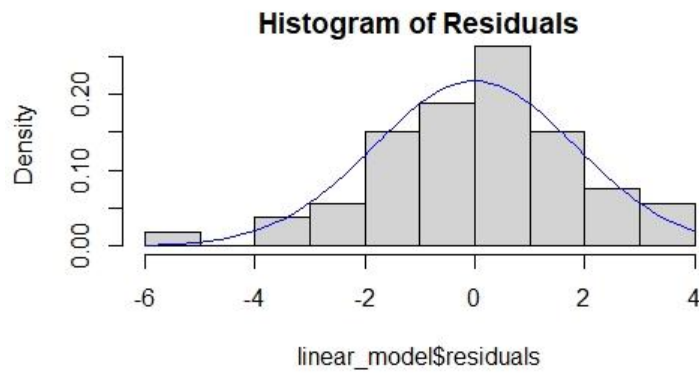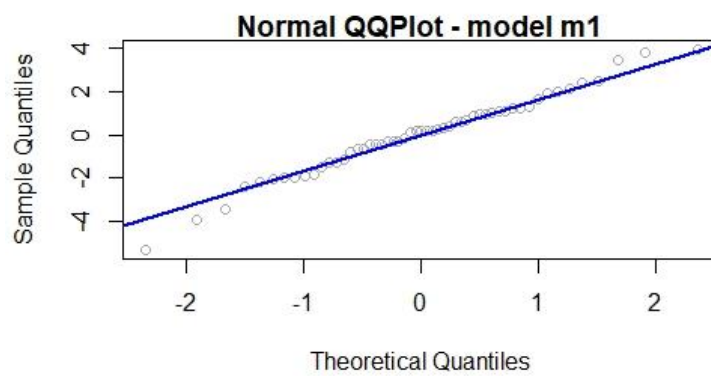
Figure 3.4: histogram of residuals
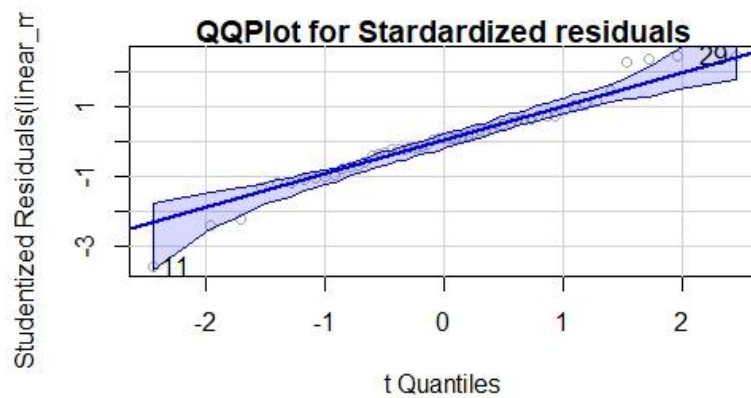

Figure 3.5: Normal QQ

Figure 3.6: QQ plot for standardized residuals

However, a useful test to assess the normality of residuals is the Shapiro and Wilk Test, In case of Normality the test statistic has to be close to 1 and the p-value should be higher than

0.05. As we can see from the test results we conclude that the residuals are characterized by a Normal distribution since

```
data:  resid(linear_model)
W = 0.98237, p-value = 0.6191
```

Leverage points and outliers

In this section it is relevant to analyze if there are some variables that during the observed period doesn't comply with the model. The point that can ben determinant are:

1) Leverage points, that either may or may not have a great influence on the estimates;
2) Influence points, if removed they produce a great influence on the linear regression model (they have high value of pii and residuals);
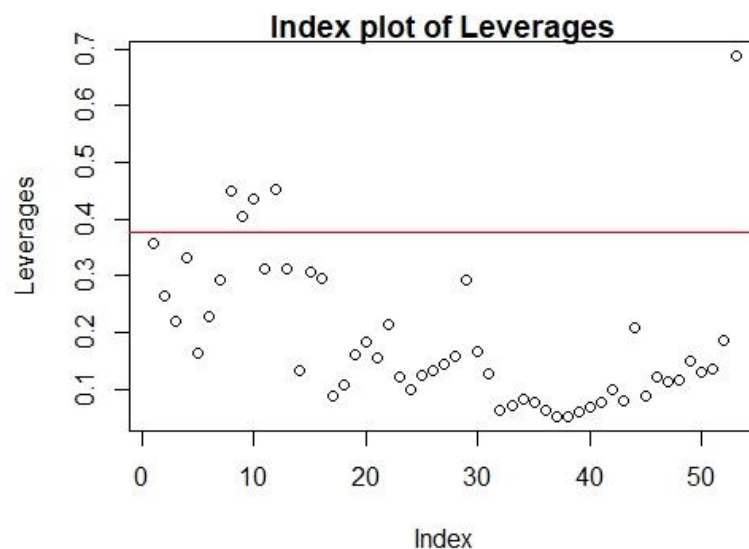3) Outliers, points that are far away from the others.

Figure 3.7: plot of leverage

Starting from the figure, we can notice the presence of some outliers that is confirmed by the results obatained with the following function:

```
LEV = hat(model.matrix(linear_model))
plot(LEV, ylab = "Leverages", main = "Index plot of Leverages")
LEVM=2*ncol(model.matrix(linear_model))/nrow(model.matrix(linear
_model))
```

```
abline(h = LEVM, col = "red")
```

```
        [,1]        [,2]
[1,]  8       0.4489571
[2,]  9       0.4052927
[3,] 10       0.4348077
[4,] 12       0.4521141
[5,  53       0.6863623
```

This numbers corresponds to the quartiles: 31-12-2008, 31-03-2009, 30-06-2009, 31-03-2010,31-03-2020. Anyway, it does not strengthen the probability that these are also influential points for the model. In fact, for evaluating the influence of each single point it is used the Cook's distance, which is computed as:

$$D_i = \frac{e_i^2}{ks^2} \frac{p_{ii}}{1 - p_{ii}}$$

where e_i^2, is the squared error term, p_{ii} is the leverage, k is the number of coefficients in the regression model and s is the mean squared error. The Cook'sdistance is considered high if D_i is major than 4/n, with n the number of observations, and so their possible removal has to be considered.
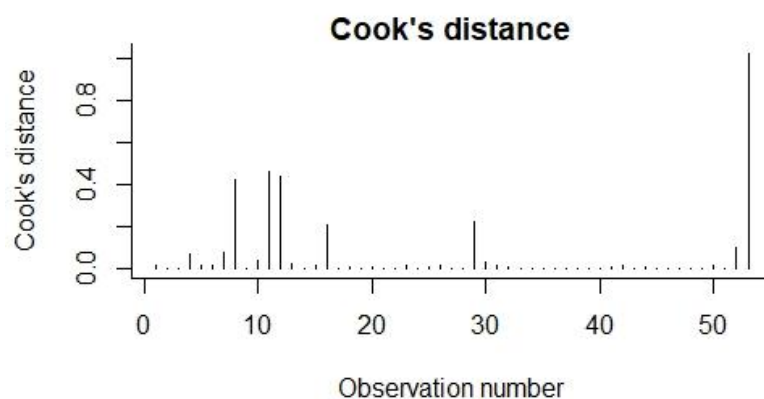

Figure 3.8: cook's distance

As we can see from the figure 3.8, we hypothesize the presence of an outlier: the observation 53. But applying the following test we arrive to an unexpected results:

```
outlierTest(linear_model, cutoff = 0.05, n.max = 56)
 rstudent unadjusted    p-value       Bonferroni p
11 -3.609284          0.0008113      0.042999
```

So, after the test, the outlier is the observation n.11.

Mis specification test

The first aspect important to check is the ability of the model to capture the autocorrelation. Often in the time series it persists, as in our case. The test for the first order autocorrelation is performed through the Durbin-Watson test, which for our model, guarantee the absence of autocorrelation.

```
> durbinWatsonTest(linear_model)
 lag     Autocorrelation D-W Statistic  p-value
   1       -0.1626704        2.285928      0.846
 Alternative hypothesis: rho != 0
```


Another important analysis is related to the linearity of residuals. Infact, applying the following function, it is possible to verify the model is correct linear specified.

```
RESET test


data:  linear_model
RESET = 0.76502, df1 = 2, df2 = 41,
p-value = 0.4719
```

Finally, it's quite relevant to verify the presence of eteroscedasticity already theorized at the beginning of the analysis. In fact, applying the BP test we can confirm the theory:

```
bptest(linear_model)


    studentized Breusch-Pagan test
```

```
data:  linear_model
BP = 18.228, df = 9, p-value = 0.03262
```

To solve this problem, it is possible to use a tool able to use the robust estimations of the standard errors. This because the autocorrelation causes problems on the efficiency of the OLS estimators and on the reliability of the inferential procedures, because they are based on an erroneous estimation of the standard errors. The variance of the β estimators is based on the variance of the errors. If the OLS estimator is unbiased and asymptotically normal, the covariance matrix ψ is equal to:

$$\psi = \text{VAR}\hat{\beta} = (X^T X)^{-1} X^T \Omega\, X (X^T X)^{-1} = (\frac{1}{n} X^T X)^{-1} \frac{1}{n} \Phi\, (\frac{1}{n} X^T X)^{-1}$$

Where X is the regressors matrix, Ω is the variance of the errors and Φ is $n^{-1} X^T \Omega\, X$ the covariance matrix of the scores. When homoscedasticity and independence assumptions are violated, the inferential procedures become biased. Since in our case we lack of the independence assumption, we need Φ which is consistent to use for calculating covariance matrix ˆ ψ. For doing that we can use the HAC estimators.

We calculate the HAC covariance matrix and through that we test coefficients calculated with this matrix.

```
> vcovHAC(linear_model)
                   (Intercept)  DATI$capitaliz
(Intercept)      2809.7554692     2138.263601
DATI$capitaliz   2138.2636013    42590.046540
DATI$NPL           -0.4961306       -2.839384
DATI$euribor      -13.4052328       40.413801
DATI$loantoass    -73.4395993     -731.149035
DATI$gdpgrowth    -26.8741152    -6143.288064
DATI$size        -240.3458584     -305.845408
DATI$crisis         2.4620488       48.443839
DATI$ptobo         85.1481893     -637.791066
DATI$finmarg        5.3898376      -11.724324
```

	DATI$NPL	DATI$euribor
(Intercept)	-0.496130597	-13.405232759
DATI$capitaliz	-2.839383721	40.413800545
DATI$NPL	0.001811006	0.005263868
DATI$euribor	0.005263868	0.235836374
DATI$loantoass	0.176054420	-1.879533474
DATI$gdpgrowth	0.308598171	-12.635533217
DATI$size	0.036085379	0.986553706
DATI$crisis	0.012371695	-0.000372107
DATI$ptobo	0.488087379	-1.032186079
DATI$finmarg	-0.003705440	-0.018196046

	DATI$loantoass	DATI$gdpgrowth
(Intercept)	-73.4395993	-26.8741152
DATI$capitaliz	-731.1490350	-6143.2880644
DATI$NPL	0.1760544	0.3085982
DATI$euribor	-1.8795335	-12.6355332
DATI$loantoass	330.9893004	301.7505092
DATI$gdpgrowth	301.7505092	3188.5025811
DATI$size	-6.4929442	15.8986701
DATI$crisis	6.6655563	9.7321213
DATI$ptobo	132.4210012	-30.5594410
DATI$finmarg	-1.4369128	0.4783758

	DATI$size	DATI$crisis
(Intercept)	-240.34585842	2.462048829
DATI$capitaliz	-305.84540801	48.443838530
DATI$NPL	0.03608538	0.012371695
DATI$euribor	0.98655371	-0.000372107
DATI$loantoass	-6.49294420	6.665556260
DATI$gdpgrowth	15.89867014	9.732121338
DATI$size	21.74450280	-0.715228296
DATI$crisis	-0.71522830	0.587791549

```
DATI$ptobo        -17.36323568   4.315323634

DATI$finmarg       -0.33791170  -0.100487128

                  DATI$ptobo  DATI$finmarg

(Intercept)        85.1481893    5.38983761

DATI$capitaliz   -637.7910656  -11.72432438

DATI$NPL            0.4880874   -0.00370544

DATI$euribor       -1.0321861   -0.01819605

DATI$loantoass    132.4210012   -1.43691278

DATI$gdpgrowth    -30.5594410    0.47837576

DATI$size         -17.3632357   -0.33791170

DATI$crisis         4.3153236   -0.10048713

DATI$ptobo        606.5739364   -2.36094752

DATI$finmarg       -2.3609475    0.05152034
```

And then we apply the test coefficient and trough that we notice that all the estimates of the coefficients can be considered significant and so we can use the coefficients estimated in our linear regression model.

```
> coeftest ( linear_model, sandwich :: vcovHAC (linear_model , lag
= Inf ))


t test of coefficients:


                  Estimate   Std. Error    tvalue

(Intercept)     -262.916648   53.007127   -4.9600

DATI$capitaliz   622.881908  206.373561    3.0182

DATI$NPL          -0.120839    0.042556   -2.8395

DATI$euribor       2.980308    0.485630    6.1370

DATI$loantoass    43.492701   18.193111    2.3906

DATI$gdpgrowth   129.389290   56.466827    2.2914

DATI$size         17.669143    4.663100    3.7891

DATI$crisis       -2.820449    0.766676   -3.6788
```

```
DATI$ptobo          70.928516    24.628722  2.8799
DATI$finmarg        -0.993237     0.226981 -4.3759
                    Pr(>|t|)
(Intercept)     1.154e-05 ***
DATI$capitaliz  0.0042624 **
DATI$NPL        0.0068734 **
DATI$euribor    2.311e-07 ***
DATI$loantoass  0.0212706 *
DATI$gdpgrowth  0.0268995 *
DATI$size       0.0004656 ***
DATI$crisis     0.0006478 ***
DATI$ptobo      0.0061781 **
DATI$finmarg    7.580e-05 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Comments:

From the computed analysis, we can say that the estimated model can adequately explain the the banking performance during the period analyzed. Since the R2 coefficient presents very high value, the model has a good fit. Through the performed tests, the fundamental assumptions have been verified.

Moreover, the majority of the results reflect the projections done at the beginning of our analysis. Infact, we can sustain, without doubts, that the banking performance is in a significant way affected by internal and external variables.

In line with the main goal of this paper, we can conclude confirming that the NPLs ratio affect in a negative and significant way the banking performance.

Considerations:

As a result of this empirical demonstration, the attention paid by the economic and supervisory system to NPLs is amply justified. Indeed, this correlation further confirms that banks need to maintain an adequate level of this indicator in order to avoid non-performing conditions and substantial losses.

However, after having extensively dealt with the possible ex ante solutions, i.e. those to be adopted when assessing the granting of credit, it is necessary to dwell also on the possible ex post solutions. In fact, how can a bank behave when faced with a loan portfolio that is already or close to deterioration?

3.2. Strategic solution to reduce the amount of NPLs

The strategic solutions that can be adopted for the efficient management of impaired loans can be distinguished on the basis of their effects on the bank's balance sheet.

1- On-balance solutions: aimed at managing and containing the stock of impaired loans that remain on the bank's balance sheet and will continue to weigh on the bank's capital. This category includes the following options

- Maintenance of the on-balance sheet position and management through restructuring activities and granting measures, known as internal workout solution with dedicated NPLs unit)

- Maintenance of the on-balance sheet position and management by a specialised credit recovery company (outsourcing of NPLs to a servicing company)

- Transfer to a captive company wholly owned by the transferor bank, represented by reserved credit funds or real estate owned companies (REOC).

2- Mixed on-balance solutions: disposal to companies not wholly owned by the bank by setting up a joint venture with other industrial partners.

3- Off-balance solutions: these are aimed at the disposal of positions and their derecognition from the transferor's balance sheet. In this case we can have options such as

- Definitive sale of the receivable on the primary NPLs market

- Securitisation of loans with complete derecognition through sale to a special purpose entity with simultaneous issuance of government guaranteed and non-guaranteed asset-backed securities.

The different strategies present a trade-off between the use of time and resources on the one hand, and the final amount recovered on the other. In-house management certainly presents a

greater use of resources than bulk portfolio sales, but it also presents a higher degree of recovery of non-performing loans. Usually, banks that want to initiate an internal workout process either set up a servicing company to recover the impaired loan or hire an external servicing company that is accountable to the servicing company.

The management solutions through internal workout are the options that allow a higher recovery rate but at the same time require for their implementation a dedicated organisational structure and longer recovery times. In fact, it is necessary to consider that the immobilisation of an impaired loan for a prolonged period of time does not allow for a correct rotation of the portfolio and for several years there could be negative economic effects linked to provisions and capital absorption with a one-off positive effect in the year in which the position is definitively closed. Therefore, it is convenient to use this solution when the prospects for recovery of the position are good and the average pricing offered by the market (estimated Market value - EMV) is lower than the economic value of the credit obtainable through the normal process of long-term recovery (real underlying long-term economic value - REV).

If a legal debt recovery process is undertaken, the relationship with the customer is terminated and a smaller percentage of the money is recovered than if the debt is recovered out-of-court, e.g. by restructuring the loan or by granting a further loan to repay the old, non-performing loan. The bank, in general, always prefers to proceed out of court as it maintains the relationship with the customer and could recover as much money as possible. In this way it is possible to obtain better recovery conditions since the servicing company is specialized in this specific activity, but it is still up to the bank to monitor the performance of the management of defaulted positions through KPIs (Key Indicator Performance). Therefore, recovery through an internal platform is not always taken into consideration by banks because of the high fixed costs that could be generated in the profit and loss account. In this case, the intermediary could outsource the management of debt recovery to a specialized platform that will depend exclusively on the bank itself.

The most popular tool currently used to tackle the NPL problem is the sale of part or all of the impaired loan portfolio. In this way, it is possible to reduce the non-performing items on the balance sheets of Italian banks in order to better tackle the provisioning problem. Banks, in return for the sale of portfolios, require a substantial sum because of the entry in the profit and loss account under "capital losses" (which could lead to a loss in the profit and loss account), while investors require too high a rate of return to acquire the defaulted loans. It is therefore very difficult to find the right balance between supply and demand in the secondary NPL market.

in the secondary NPL market. However, the latest document published by Banca Ifis "Market Watch NPL "14 shows the growth of the average price of loan portfolios (secured and unsecured) from 19% in 2017 to 28% in 201815 . This process of price growth is caused by the desire of servicing companies to grow quickly in the Italian market through the purchase of new portfolios. This phenomenon causes an increase in the level of competition among these companies and consequently also the price at which banks sell their defaulted loans. The benefits of such a sale are manifold. First of all, banks are not forced to invest in the reorganisation of internal processes, such as document management or the process of retrofitting technology platforms. The securitisation of anomalous credits is one of the tools in the hands of banks to manage the stock on their balance sheets. In particular, it is very useful because it eliminates on-balance sheet items and therefore NPLs do not weigh on the economic, financial and balance sheet situation. With the assignment, the bank transfers the credit risk completely to the specialised company and can use the new revenues and savings from internal recovery management for new targeted investments. However, this operation is very costly as the banks would have to set up, if not already present in the group, a special purpose vehicle which finances the purchase of the pool of credits set up by issuing ABS (asset backed securities) on the capital market. Investors buying these fixed income instruments on the market will only be remunerated once the write-off has been completed, which can be either by selling them or by recovering the entire abnormal flow. The Government Guarantee Scheme on the Securitisation of Non-performing Loans (GACS) has brought enormous benefits to the securitisation process because, as its name implies, it provides a guarantee by the government (granted by the Minister of Economy and Finance) on NPLs that meet the requirement of belonging to the "senior" tranche with at least an "investment grade" rating assigned by an agency appointed by the ECB.

Strategies determinants

An effective strategy for the management of impaired loans must be implemented by a careful mix of choices suitable for achieving, in a short time, predefined objectives, evaluating each time the most advantageous option for each specific case.

Among the main variables influencing the optimal management choice are:

1- Current organisational set-up of the workout units;

2- Quality of the information system;

3- Size of impaired loans to be managed

4- Presence of underlying guarantees;

5- Provisioning policies;

6- Size of the institution and level of capitalisation;

7- Sentiment in the secondary market for NPLs.

3.2.1 Organisational Structure

With regard to the organisational aspect of workout units, it is important to consider that the banking system, mainly in Italy, has several groups of banks whose organisational structure dates back to the 1970s. In fact, older organisational structures are often characterised by non-formalised processes, a non-systemic use of IT tools and management software, long execution times, lack of reporting and performance analysis of average times and recovery rates. As a result, all this leads to ineffective management of impaired loans due to a lack of organizational efficiency. After 2010 and with the advent of the digital transformation, several banks have found it necessary to reorganize their recovery units. In particular, dedicated NPLs units have been introduced, characterised by an explicit recovery strategy formalised in a business plan that captures the performance of the recovery activity and the related turnaround time. Consequently, the incentive systems are also suitably revised according to the achievement of a defined target. Given the gap within the system, it is advisable for structures lacking in organizational terms to develop an appropriate management strategy and to use highly qualified external servicers as much as possible in order to maximize recovery rates and bring the activity down to physiological levels of NPLs.

3.2.2 quality of the information system

The quality of the information system influences a number of internal and external management processes. For a fast and cost-effective direct sale, it is essential to have implemented an up-to-date and high-quality database. In fact, elements such as: IT infrastructure, skills and strategy. In fact, especially in banks that are the result of repeated M&A transactions, the lack of data and sufficient documentation is often a constant and consequently the lack of information in many cases makes it impossible to withstand litigation. In order to incentivize banks to improve the data quality of their loan portfolios and enable a uniform data collection at European level, Regulation ECB/2016/13 on granular data collection on credit risk was adopted on 18 May 2016. And the resulting Bank of Italy Circular No. 297 of 16 May 2017 " Collection of granular data on credit: instructions for reported intermediaries" represents an excellent starting point for structuring an effective database to census, monitor and evaluate portfolio performance.

3.2.3 size of impaired loans to be managed

The size of the portfolio is essential to distinguish between a pathological situation, which is difficult to manage through an internal workout structure, and a physiological situation. In fact, an excessive accumulation of NPLs produces inefficiencies and a lack of focus on practices that are still recoverable. In addition, there is an inverse relationship between the length of time that NPLs are held and the recovery rate. The pathological situations in terms of volume must necessarily be resolved with the help of external servicers and through targeted disposals capable of encouraging the destocking of NPLs to physiological levels. The size of the bank's capital is essential, since the sale of loans almost always involves significant loss-making transactions, and market conditions or governance of the ownership structure do not always allow for recapitalization. The size of the institution is also important in order to verify the adequacy of the work unit's workforce, the presence of economies of scale, and the possibility of spreading structured finance transaction costs.

A correct NPLs management strategy should be oriented towards the outsourcing of time-consuming and low-value-added activities, while it should focus the bank's efforts (through management with restructuring units) on activities that allow a significant level of recovery rates and with the possibility of bringing a portion of the credit back into bonis. For this reason, the presence of guarantees and the type of counterparty decisively determine the optimal choice.

Conclusions

The management of NPLs has always been a crucial point in the conduct of banking business, as NPLs are a significant risk indicator. Over the years, especially in times of crisis, European banks have recorded very high levels of impaired loans in their portfolios, causing various problems for the banking system. Indeed, an increase in their value on the balance sheet has led to a reduction in revenues. This happens by means of the inverse relationship present between bank performance and NPL ratio demonstrated within the discussion. In fact, the NPLs ratio is one of the most significant explanatory variables of banking performance. The empirical demonstration of this phenomenon makes it even more necessary for banks to pay attention to this indicator.

When assessing creditworthiness, it is already possible to carry out certain analyses capable of reducing the risk of credit deterioration. However, as the course of historical events has shown, these assessments have often not been sufficient because the growth of impaired loans does not depend solely on the debtor but also on macroeconomic factors.

For this reason, the ECB has over the years prepared and renewed its supervisory and risk management activities in order to reduce the amount of NPLs on bank balance sheets. Indeed, since 2016 there has been a steady reduction in their value in all banks supervised by the ECB. However, due to the pandemic crisis, these values have increased considerably since 2020 and banks are now faced with the need to reduce their present value either through efficient internal management or by using external factors.

In conclusion, given the extreme importance of impaired loans in a bank, it is necessary to have adequate means of managing and forecasting the evolution of the NPL ratio.

Abstract

The purpose of the following paper is to demonstrate the relationship between bank performance and the level of NPLs on their balance sheets.

The credit supply has always been a key activity of the banking sector and over the centuries it has been fundamental to the development of the economic system and to the achievement of a better standard of living for the population. In addition, in times of crisis, the lending activities of credit institutions have enabled them to survive and brought the economic system back into balance. This is why it is possible to state with great certainty the key role played by banks in the specific function of lending.

However, lending also generates exposure to numerous risks. In fact, it is extremely linked to the risk that the counterparty will not be able to repay the capital received as a loan, due to situations linked to its exposures or to adverse economic conditions. For this reason, it is extremely important for banks to constantly monitor the credit risk to which they are exposed.

When managing credit risk, it is important to analyse and keep under observation an important indicator: non-performing loans. Non-performing loans are types of loans that are highly unlikely to be recovered.

This category of loans has been the subject of banking supervision for years as it has been found that if they reach high levels in the bank balance sheet, they can affect the smooth running of the banking business.

Moreover, as the trend in non-performing loans is also related to macroeconomic conditions in recessionary periods, their amount has increased considerably, causing

serious damage to several banking institutions. Indeed, the major financial crises of the last two decades have witnessed this phenomenon.

In fact, analysing the development of the banking system, it is possible to observe how the substantial increase in NPLs in bank balance sheets has had an impact on the performance and solidity of the bank itself. Therefore, it would seem logical to hypothesise a theoretical correlation between the two phenomena. But does this correlation really exist?

Before demonstrating the evidence for this observation, it is necessary to elaborate on key aspects concerning the banking system and NPLs.

For this reason, the first chapter presents the need to use an appropriate level of credit risk measurement through an in-depth study of the subject by analyzing its fundamental components and appropriate valuation methods. At the end of the first chapter, it will be possible to focus on the importance of impaired loans in risk assessment.

The second chapter, on the other hand, aims to illustrate the regulation of non-performing loans where it will also be possible to fully understand the main determinants and highlight what leads to the condition of credit deterioration. Secondly, the chapter focuses on the importance of determining adequate provisions and other hedging instruments in order to avoid situations of high non-performing loans that could burden the credit institution.

 The third chapter, instead, is focused on the quantitative analysis aimed at demonstrating the impact of Non-Performing Loans on bank performance. This analysis was carried out by means of a linear regression model using a sample of 9 of

the main European banks over a period of time ranging from 2007 to 2020. The dependent variable Y, identified as performance, will be explained by dependent variables internal and external to the banking business. Subsequently, in the light of the results obtained, focus on possible strategies to alleviate the problem of non-performing loans.

At the end of the analysis developed, it was possible to state that the management of NPLs is quite complex and at the same time crucial for the banking sector. Indeed, the proven relationship between performance and the level of NPLs in the banking book cannot absolve banks from their responsibility towards this indicator. For this reason, it is necessary to have adequate means of managing and forecasting the evolution of the NPL ratio.

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