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TESI DI LAUREA

MORAL HAZARD AND NON-PERFORMING LOANS IN THE ITALIAN BANKING SYSTEM: A PANEL DATA ANALYSIS

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Firma dello studente

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A mamma e papà per aver reso possibile tutto ciò.

A Fabio perché tanto altro sarà possibile insieme.

A bank loan is considered non-performing when more than 90 days pass without the borrower paying the agreed installments or interest. Non-performing loans are also called "bad debt".

European Central Bank

Moral hazard is a situation in which one party gets involved in a risky event knowing that it is protected against the risk and the other party will incur the cost. It arises when both the parties have incomplete information about each other.

The Economic Times

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INTRODUCTION

The aim of this work is the analysis of the relationship between the stock of non-performing loans held by the Italian banks during the last decade and the lending banking strategy implemented by the banks' managers during the same period of time.

There are two theories that can be considered the main ones on this topic. On one hand, the literature supports the theory of credit crunch as a consequence of the financial crisis in 2008. Before the crisis, banks were more willing to offer credit. Since the crisis, they have started to reduce credits to retail clients as well as firms. We refer to this phenomenon as credit crunch, intended as an economic condition in which there are difficulties in obtaining investment capital. This usually involves direct negative consequences for borrowers, as the higher price and higher rates of debt products, and indirect negative consequences on the entire economic system.

However, although in Italy the empirical evidence shows a decreasing trend in the growth rate of credits granted after the crisis of 2008, it is becoming more widespread an economic banking theory which supports that, in the uncertain post-crisis environment in which Italian banks have found themselves to survive, managers often have proceeded to the creation of credit policies and strategies without regard to the amount of non-performing loans that were creating over the years within their balance sheets.

In other words, during the last decade, inappropriate and often excessive risk lending strategies has been taken by the managers without regard to the credit risk level inside the balance sheets of the Italian banks. This phenomenon could be interpreted as an evidence of moral hazard behaviour by managers.

The scope of this thesis is to identify, through the use of panel data regression model, the existence of opportunistic behaviour or moral hazard problem inside a panel of Italian banks during the last decade.

The European banking system was hit by a severe asset quality issues during the last years. The problem of non-performing loans has become the main threat for the European banks, and the main subject of several regulations by the European Supervisory Authorities.

The level of non-performing loans varies widely across the Euro area. The fact that the Italian banking system appears to be the one most affected by this phenomenon was the reason why we decided to select Italian banks as sample. According to the Bank of Italy, the share of gross

non-performing loans for the main Italian banking group was, according to the Bank of Italy, 16,8 % of total loan in 2015, compared with a European average of 5,8%. In particular more than 80% of banks' non-performing loans were in the corporate sector (SMEs).

From those facts came the idea to understand what are the connections between the threatening phenomenon of non-performing loans and the opportunistic behaviours and information asymmetry inside the banks, which could influence the lending strategy policy, already described and inherent to the corporate finance literature (Merton 1974).

The banking system can be affected during the lending decision process by the moral hazard, a form of asymmetric information problem implemented by the management of a bank.

A definition of the issues and its characteristic are presented afterwards in this thesis, since in the banking industry conflict of interests and moral hazard are serious threats to the stability of the overall economics system. An increase of non-performing loans in the portfolio of a bank is reflected in an increase the risk affecting both the liquidity and the profitability of the bank, entailing a deterioration of the balance sheet. Moreover, a deterioration of banks' assets quality reduces economic efficiency and causes a decline in economic activities, since a shock occurring in the banking system may have severe consequences for all the real economy.

The work is organized as follows.

Chapter I and II are dedicated to a literature review. In particular, in the first chapter is presented the phenomenon of non-performing loans, focusing on its determinants regulations. Causes, consequences, and measures taken by the Supervisory authorities are discussed.

In the second chapter the focus will be on the economic theory developed on the moral hazard

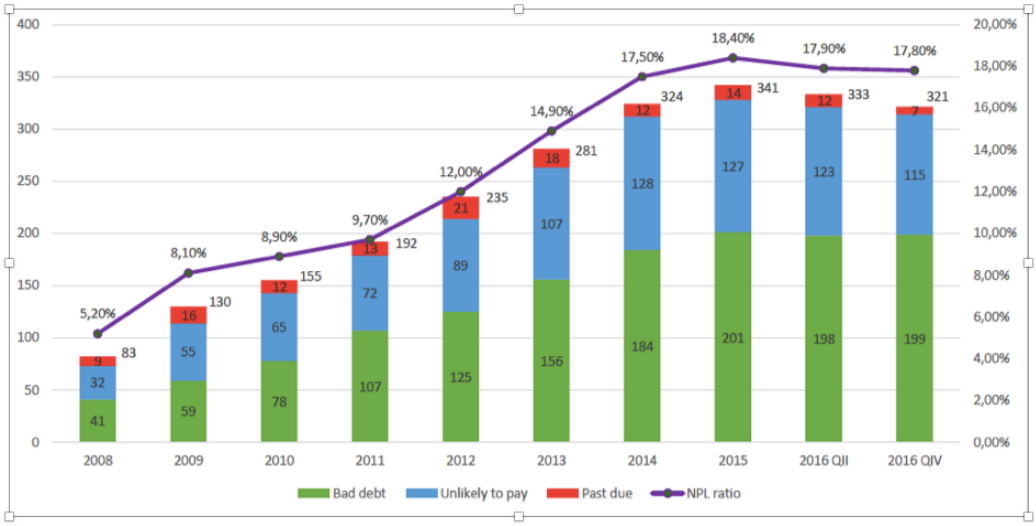

Figure 1- NPLs distribution in Italy, Statistical Bulletin, Bank of Italy - December 2016

problem and in general on the overall asymmetric information problem. However, the

intention will be to understand the phenomenon inside the banking system and how non-performing loans, lending strategy and moral hazard behaviour are connected.

Chapter III presents the contribution of literature and the main findings achieved by other authors who have made an empirical analysis on the relationship between non-performing loans and moral hazard aspects.

Chapter IV describes the models used for the empirical analysis, the data, the descriptive statistics and the expected results. A brief econometric introduction to panel data analysis is also displayed.

Country	**Tot. Gross Loan**	**NPL**	**NPL ratio**
All EU Banks	17.804.396,89	994.258,19	5,6%
Austria	304.994,63	24.311,75	8,0%
Belgium	408.344,11	17.756,08	4,3%
Cyprus	47.901,30	23.777,76	49,6%
Denmark	494.346,06	17.207,63	3,5%
Finland	77.898,97	1.332,76	1,7%
France	3.499.785,78	149.542,80	4,3%
Germany	2.256.303,71	76.262,25	3,4%
Hungary	28.011,28	5.286,67	18,9%
Ireland	206.480,50	44.311,41	21,5%
Italy	**1.653.665,38**	**276.382,20**	**16,7%**
Latvia	1.851,64	88,95	4,8%
Luxemburg	20.604,04	757,79	3,7%
Malta	4.285,17	400,26	9,3%
Netherlands	1.635.876,98	47.934,86	2,9%
Norway	203.995,69	2.943,12	1,4%
Poland	48.149,31	3.171,00	6,6%
Portugal	153.976,56	25.161,14	16,3%
Slovenia	12.423,37	3.523,45	28,4%
Spain	2.316.083,45	164.986,65	7,1%
Sweden	986.466,36	10.702,76	1,1%
United Kingdom	3.442.952,59	98.416,82	2,9%

Applying a panel analysis on a dataset composed by data collected from the 16[1] most capitalized Italian banks for the period from 2008 to 2016, we have decided to implement two different type of analysis using the same sample. We first investigated the relationship

[1] The ranking referred to 2017

between non-performing loans stock (that the banks of my sample have at time t) and the lending strategies implemented by the banks during the same years and some years before.

Later, we conducted a second analysis investigating the relationship between the new lending strategy of the banks implemented at time t and the stock of non-performing loans already existent inside the balance sheet at time t and some years before.

The intention was the creation of two models that were connected each other's. In other words, we wanted to use the models to analyze the same objects but with a different perspective, in order to arrive to a common economic conclusion for the sample.

A series of variable as control variables for the model are used, in such a way to differentiate the banks inside the panel dataset and to take into account both specific banking factors and macroeconomic variables that could influence the lending strategies of a bank and the amount of non-performing loans recorded.

The results of the empirical analysis are finally reported in the chapter V with the diagnostic test and robustness check.

CHAPTER I-The phenomenon of NPLs: determinants and regulation

1.1 – NPLs in Europe: an overall presentation of the fact focusing on the Italian scenario

In this section an overview of the situation about European non-performing loans during the last decade with a stronger focus on the Italian scenario is presented.

The credit business activity most represents the heart of a bank: the yields of the customer's loans have always been more significantly higher than those of other forms of bank's assets.

First, it provides liquidity to the firm, second the quality of bank's loans, and therefore the classification of credits, is important because it measures the strength of a bank: a bank is solid when its loans are solid.

After the financial crisis of 2008, a new classification of loans has begun to spread more in all the European banking scenario: the non-performing loans.

The definition provided from the European Central Bank is: "A bank loan is considered non-performing when more than 90 days pass without the borrower paying the agreed installments or interest." Moreover, according to subtitle 29, Annex V of Regulation (EU) No. 227/2015, an exposure shall be considered non-performing when:

- It is defaulted according to Basel framework or impaired in accordance with the specific accounting regulation;
- It is more than 90 days past due;
- There is evidence that the debtor is unlikely to pay in full the principal and the interest without realization of collateral, regardless of the existence of any past due amount or of the number of days past due.

In Italy, the definition of non-performing loans is provided by the Bank of Italy Circular no. 272 of 30 July 2008 concerning the banking and financial supervision legislation, but it was updated in 2015 and have been harmonized within the Single Supervisory Mechanism by applying the new definitions provided by EBA (European Banking Authority). Nevertheless, the Bank of Italy maintain a higher degree of detail dividing the Italian non-performing loans into categories on the basis of their quality and their probability of repayment:

- **Bad debts** (Sofferenze): exposure to any debtor that is defaulting or in an equivalent situation, regardless of the amount of loss estimated by the bank.
- **Unlikely to pay** (Inadempienze probabili): exposure to any debtor that the bank considers to be unlikely to repay the principle and/or interest charges in full, without taking actions like the realization of collateral, regardless of any past-due amounts.

- **Non-performing past due loans/exposures** (Esposizioni scadute e/o sconfinanti deteriorate): any exposure reported on the balance sheet presenting any past-due amounts or unauthorized overdrafts at the close of the balance sheet.

The exposures that do not fall into the first two categories must be classified as past due loans if at the end of the period are past due or overdue by more than 90 days.The exposure subject to forbearance measure, occurring when a debtor is experiencing financial difficulties in meeting its obligations and the bank grants a concession that it would not otherwise consider in normal circumstances, are not considered by the Bank of Italy as an independent class of non-performing loans since there exist also performing forbearance exposure. The non-performing loans exposure contains forbearance measure are already classified in one of the

Credit risk indicator and GDP growth

(quarterly data; per cent and growth rate)

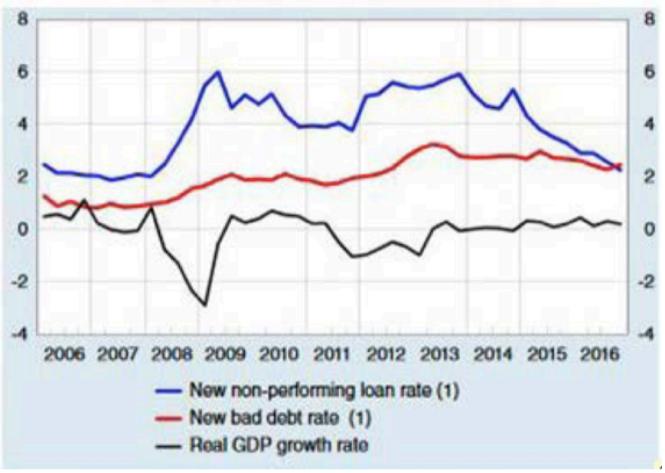

Figure 2 Source : Bank of Italy September 2016

previous subcategories.

Below is reported the upward trend of the phenomenon of the Italian non-performing loans divided in its categories recorded at the end of 2016 in which it is registered a total amount of non-performing loans of 321 billion of euro. The graph shows the gravity of the Italian situation given by the fact that more than the 50% are categorized as bad debt, in other words by not collectible debt and around 25% by unlikely to pay loans, whose probability of recovery was really insignificant.

The table below, instead, summarize the European credits situation at the middle of 2016. In the first column the European countries are reported, in the second one the total amount of

credits granted for each country, in third column the amount of non-performing loans in millions of euro for each country, while in the last column the non-performing loans ratio is reported, calculated as the ratio between non-performing loans over total gross loans. (column 3 over column 2)

Italy is part of those European states, between with Greece, Portugal, Slovenia, Ireland, Cyprus and Malta, which were affected more by non-performing loans phenomenon during the last decade.

As we can see Italy shows one of the higher level of gross non-performing loans over total loans ratio equal to 16,7 per cent in 2016. Actually, in proportion to total loans to customers, from a value of 5.8 per cent in 2007, in line with the current European average, the Italian non-performing loans ratio has tripled reaching the peak of 17.9 percent in September 2015 corresponding to a gross amount of 341 billion of euro of non-performing loans. (Figure 1)

It means that in Italy there is 1 euro of non-performing loans every 5,5 euro of loan granted and this is a value very far from the 17,8 euro of the European average. However, it must point out that a slow decrease of the ratio was registered in 2016, showing encouraging signals: bad debts and unlikely to pay recorded negative growth rates for the first time, decreasing respectively by 0,5% and 1,3%, representative of a trend reversal on which begin a recovery plan for the Italian credit system. Even that, Italy remain the country which has the highest non-performing loan ratio of the main developed countries (see France and Germany with a non-performing loans ratio equal to 4,3 % and 3,4 % respectively) with an average value over the period from 2011 to 2016 equal to 10,8 per cent.

The recession after the financial crisis of 2008, the sovereign debt crisis of 2011 and the slow recovery procedures of the last decade are identified as the main causes of the increasing stock of non-performing loans inside the Italian banks' balance sheets as well as of the European ones. In the turbulent worldwide scenario, the rapid rise of non-performing loans ratio during the last decade is due to the process of worsening of the creditworthiness of borrowers. In Italy the situation is aggravated by the inefficient Italian judicial process and the limited incentives to write-off loans, which helped to worsen the pace of eliminating of non-performing loans from Italian banks' balance sheets. In fact, in Italy the time to close a failure is double than the average of the other major European countries. If the times of Italian civil

justice would have been in line with the European averages, the Italian banks would have shown a ratio between non-performing loans and total gross loans between 7 and 8 percent, not far from the average of banks in the rest of Europe.
Nowadays, an intervention is required to avoid that non-performing loans will continue to remain high and a drag on bank profitability and market confidence. What has been done in the context of European regulation and what could be done in the future, it is treated in detail in the following paragraphs.

The most recent Italian data show that more than 75 per cent of the total amount of non-performing loans in Italians banks' balance sheets regards non-financial corporations.
In fact, the major part of the Italian non-performing loans refers to the indebtedness of Italian corporate sector especially to small-medium enterprises. During the last decade, Italian firms significantly increased their debt in relationship to equity and GDP, in other words, Italian non-financial corporate (NFCs) did not increase equity as much as their debt. As a consequence, there has been a notable change in their financial structure towards a more leveraged model. The lower level of capitalization helped firms to increase their financial fragility. During the crisis, this fragility of the financial structure of the SMEs, combined with the high level of indebtedness, have led quickly to severe difficulties in paying back debts and therefore to a high number of bankruptcies and difficulties in accessing to new finance.
Moreover, imprudent and sometimes excessive risky banking lending policies, practices of excessive tolerance towards defaulting debtors, conflict of interest such as moral hazard problem are part of the causes which have contributed to the increase of credit risk.
In the next chapter, the problem of moral hazard behavior and risky banking strategies, the theories about it and the consequences are presented and further explained in detail.
To summarize, focusing of the Italian scenario, the growth of non-performing loans during the last decade was driven first by the severe contraction of the Italian economy during the financial crisis, which led to a decrease of ten percentage points of GDP and around one fourth of industrial production. Moreover, the increase in non-performing loans was also driven by inadequate or sometimes too risky lending policies by bank's management. Finally, the Italian lengthy credit recovery procedures and the slow pace of civil justice has made things worse. Further details, especially about the impact of macroeconomic factor on the stock of non-performing loans, are discussed during the following paragraphs.

1.1.2 – The determinants of NPLs: macroeconomics factors and banking specific aspects

The role of the performance of the Italian economy as the main explanatory variable of the worsening of the creditworthiness of borrowers a thus, of the enhancement of the banking credit risk, is evident in the graph reported below. The graph refers to data at the end of 2016 taken from the Bank of Italy and reported in the blue line the rate of growth of Italian non-performing loans and in the black line the evolution of the gross Italian domestic product from 2006 to 2016. (Figure 2)

As the figure shows, the real GDP growth rate and the growth non-performing loans rate are moving together but in opposite directions. In other words, the existence of a clear inverse correlation between developments in GDP and increase of credit risk is highlighted.

In general, most of the studies done by the literature on the determinants of non-performing loans, agree to consider the link between risk credit and macroeconomics factors one of the main driver of the proliferation of the non-performing loans.

Louzis, Vouldis and Metaxas in their paper "Macroeconomics and bank specific determinants of non-performing loans in Greece: a comparative study of mortgage, business a consumer loans portfolio", 2010, have examined, using a dynamic panel data analysis, how the main determinants of non-performing loans are mainly of macroeconomic nature. The results show that non-performing loans in the Greek banking system can be explained mainly by macro fundamentals variables as GDP, unemployment, interest rates. In fact, if the unemployment rate increase, the consumer cash flow stream decrease and the debt burden

Author(s)	Country	Period	Main Findings
Louzis, Vouldis, Metaxas	Greece	2003-2009	Macroeconomic variables, especially real GDP growth, have a strong effect on the level of non-performing loans.
Saba et al. (2012)	U.S	1984- 2010	
Beck et al. (2013)	75 countries	2000-2010	
Salas and Saurina	U.S. Banks	1998-1999	
Marcucci and Quagliariello 2008	Italy		Macroeconomic variables have different effects on NPLs in different phases of the business cycle.
Messai and Jouini	Italy, Spain, Greece	2004-2008	Stock of non-performing loans is negatively related with the growth rate of GDP and the profitability of banks' assets and positively related with the unemployment rate, the loan loss reserves to total loans and the real interest rate.
Carlo Milani	Italy	2006-2015	Macroeconomics events have small impact of the NPLs, quality and risk attitude of management are more relevant factors.

increase, the production of the firms decreases which may lead to a contraction of the revenues and unstable debt condition. However, Louzis et al. were the first one introducing other key variables in determining non-performing loans amount as quality of management and bank specific determinants.

Saba et al. (2012) have analyzed, in US banking context, how macro indicators affect loans performance. Specifically, they use a 25-year time horizon (1984-2010) to analyze the existing relationship between non-performing loans ratio and two key macro variables, real GDP per capita and the interbank rate. The results show that, when banks define the conditions for granting loans, they should consider essentially the expected trend of GDP per capita.

The study conducted by **Beck et al.** (2013) focusing on panel of 75 countries over the period 2000-2010, analyzes the impact of a set of macroeconomic determinants as economic activity, interest rates on loans, possible existence of currency mismatch and stock market performance of that country, on the non-performing loans stock growth rate.

The results show that the growth rate of real GDP is the most important determinant for non-performing loans performance.

Another strand of the literature tends to base the relationship between non-performing loans and macroeconomic factors on the base of the link between business cycle and banking stability.

The idea is that an expansion phase of the economy is characterized by a relatively low number of non-performing loans, while high level of non-performing loans is connected with recession phases. In fact, during a period of expansion the consumers and firms face a sufficient stream of income and revenues to pay back their debts. Contrary, when credit is granted to lower-quality debtors, the period of recession lead to an increase of non-performing loans.

The study of **Marcucci and Quagliariello** (2008) published by the Bank of Italy, analyses whether the relationship between business cycle and Italian non-performing loans is characterized by regime switches and thus by asymmetries, i.e. the possibility that the impact of macroeconomic conditions on banks' portfolio riskiness change in different phases of the business cycle. The results are show that banking borrowers' default rates increase in downturns (the effects of the business cycle on credit risk are more evident during downturns) but also when there is unstable credit risk condition defined. An economic expansion phase is characterized by a relatively small number of bad loans, as consumers and companies have sufficient revenue to repay debts.

If the expansion phase continues to exist, then the credit is granted without considering the quality of the counterparts/receivables. However, in the recession phase, an increase in bad debts it has adverse consequence.

Considering a four-regime model, Marcucci and Quagliarello find that i) during economic slowdowns, the impact of the business cycle on portfolio riskiness for banks with lower asset quality is three times higher than that for sound banks. Also, ii) the impact of the business cycle on credit risk for banks with lower asset quality during recessions is almost five times higher than what we have during expansionary periods. In addition, iii) during recessions the impact of the business cycle on credit risk for banks with better asset quality is almost the double of that during expansions. Finally, iv) the impact of the business cycle on banks' riskiness during expansionary phases is substantially the same both for riskier and less risky banks. In sum, riskier banks' portfolios are more sensitive to the business cycle than less risky ones and cyclicality is more pronounced in bad economic period.

Also, the European Central Bank in "**Financial Stability Review of December 2011"** have highlighted that the real GDP growth results one of the main driver of non-performing loans.

In the publication is examined the trends of non-performing loan ratios over the decade 2000-2010, based on an econometric model for a panel of 80 countries. Results suggested that

there was a relatively close correlation between the decline in GDP and the rise in non-performing loan ratios across all selected economies.

Messai and Jouini, in their paper "Micro e Macro determinants of non-performing loans"[2], try to detect the determinants of non-performing loans for a sample of 85 banks in three countries (Italy, Greece and Spain) for the period of 2004-2008.

They introduce in the model macroeconomic variables as growth of GDP, unemployment rate and real interest rate and specific banking variables. They applied a panel data model and they found that the stock of non-performing loans is negatively related with the growth rate of GDP and the profitability of banks' assets (confirming the business cycle theory) and positively with the unemployment rate, the loan loss reserves to total loans and the real interest rate. Banks should give attention to many aspects when they offer loans in order to prevent and decrease the stock of non-performing loans. Such banks should also take into account the profitability of the real economy when extending loans. Impaired loans are expected to be important during the period of economic recession. Commercial banks should likewise extend its scope of macroeconomic surveillance to include prudential indicators such as GDP to assess the soundness and stability of the banking system.

Surprising results, are those from the recent work of **Carlo Milani** : "What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy", 2017.

The examination of the paper will be taken up in chapter III, dedicated to the presentation of the main findings by other authors who have done work similar to ours.

In his paper, Milani examines the macroeconomic and bank-specific variables that affect non-performing loans in Italy.

In contrast to the theory of Quagliarello and other authors, he found that macroeconomic changes have a limited effect on non-performing loans stock even during a period of extreme macroeconomic uncertainty and financial turbulence.

Milani affirms that quality and risk attitude of management are more relevant factors influencing the stock of non-performing loans. This last aspect will be further investigating in the next chapter, in which the moral hazard problem will be explained and the relationship with the non-performing loans will be investigated.

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[2] International Journal of Economics and Finance issues , 2013

Moreover, although the economic growth remains, inside the literature, the primary risk for bank asset quality, there are additional macroeconomic factors which have been found to have

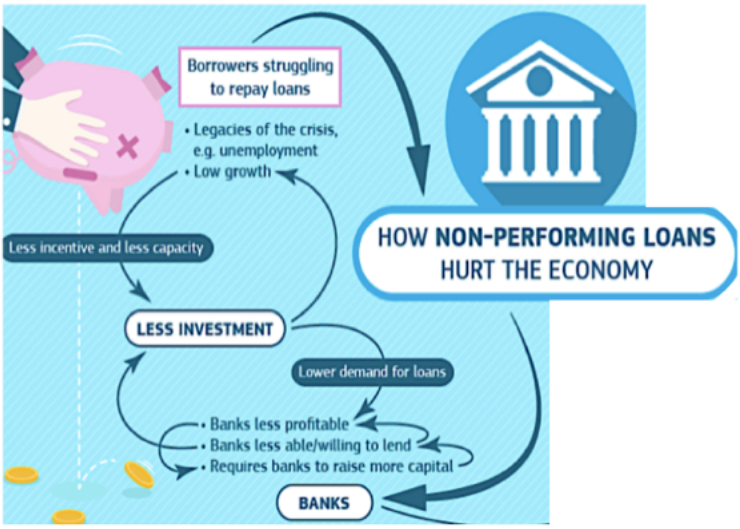


Figure3 - How NPLs hurt the economy - European Commission

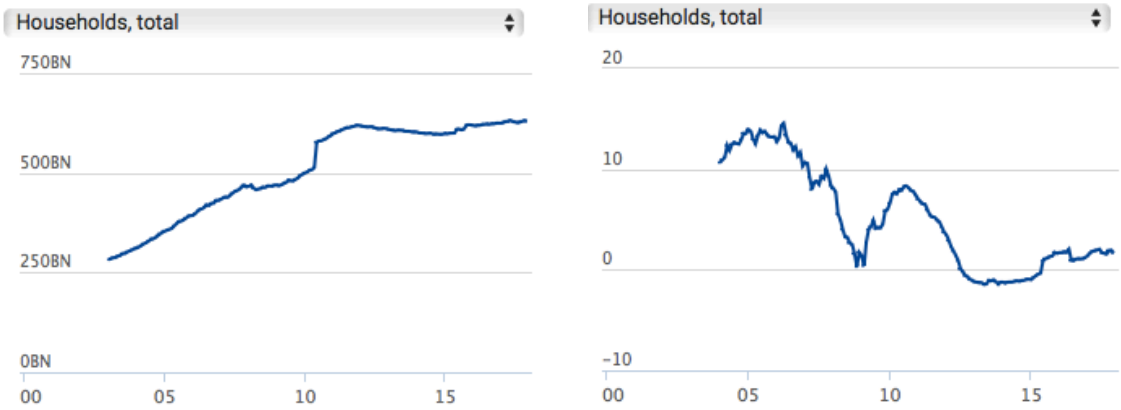
an impact on the level of non-performing loans such as the exchange rate, inflation rate, money supply, unemployment, stock prices, lending interest rates, but also quality of the behavior and risk attitude of the management.

The table below try to summarize the main findings by the authors which have tried to analyze the impact of macroeconomic factors on the non-performing loans stock level.

Claim that macroeconomic changes and therefore, inevitably the economic crisis, are exclusively the main causes of the accumulation of non-performing loans inside the Italian bank's balance sheets during the last decade is an understatement. Restrict the causes to the performance of the economy and the economic recession, it may be too simple. It must be specified that is not the crisis itself as an abstract concept the cause of the increase of non-performing loans but how the economic structure has been impacted by the crisis.

This is the reason why in addition to macroeconomic factors, empirical studies have suggested that bank-specific variables are also important determinants of non-performing loans stock.

Berger and DeYoung (1997), have studied bank specific determinants and focused on the



existing links between three variables: loan quality, efficiency in bank management costs and equity level. They analyzed a sample of US commercial banks over the period from 1985 to 1994, to test different hypothesis:

- **Bad luck**. Sudden macroeconomics changes may cause an increase in non-performing loans ratio.
- **Bad management.** Low cost efficiency is linked to low-profile managerial practices.This results in an inability to evaluate timely and effectively the outstanding credits, collaterals and potential customers. The future effect of a bad current management is an increase in the number of non-performing loans.
- **Skimping.** The hypothesis is based on the idea that there is a positive correlation between high cost efficiency and the level of non-performing loans.
- **Moral hazard.** Banks with a low level of capitalization are more willing to undertake risky investments driven by moral hazard incentives. The results is an increase of the number of non-performing loans.

In summary, the results confirm that an increase in non-performing loans tend to be followed by a decrease in measured cost efficiency, suggesting that high levels of problem loans cause banks to increase spending on monitoring, working out, and/or selling off these loans, and possibly become more diligent in administering the portion of their existing loan portfolio that is currently performing.

Moreover, the data confirm the bad management hypothesis: a decrease in measured cost efficiency are generally followed by an increase in non-performing loans. Finally, the decrease in bank capital ratios generally precedes increases in non-performing loans for banks with low capital ratios, evidencing that thinly capitalized banks may respond to moral hazard incentives by taking increased portfolio risks.

Other details will be further discussed in the chapter dedicated to the main finding by the authors that have already tried to investigate moral hazard behavior inside the banking system. In addition, the analysis of the literature, will show many other banking specific variables which are considered important to study the evolution of non-performing loans stock inside the banking system.

1.1.3 - NPLs and real economy: a vicious circle relationship

The non-performing loans problem is defined mostly as the result of the economic recession during the last decade started with the US subprime crisis in 2008. Even if at the beginning of the crisis, the Italian banking system reacted relatively well, a slowly deterioration of the quality of loans was increasing the burden of non-performing loans inside the balance sheets of the Italian banks, leading to a decrease of the credits growth and even banks failure.

The main channel through which the non-performing loans negatively affect the economic activities is represented by the credits supply channel. In the next paragraph the link between non-performing loans and supply of credits is better investigated.

When the recession phase began to spread, the ability of the customers to pay-back loans decrease leading to a rise of stock of non-performing loans.

A vicious circle was established in the real economy: the recession phase after the crisis led especially the small-medium enterprises to decrease their profitability and have difficulty to pay back their loans, leading to an increase in non-performing loans in the bank's balance sheet. Consequently the proliferation of non-performing loans inside the bank's balance sheet has led to an increase of banking credit risk forcing banks to reduce their credits, which means a contraction of the credit to the firms that led in turn to a slower economic growth.
On the other side, a slow economic growth forces the small medium enterprises to make less investments, lowering the demand for loans to the banks which ultimately led to a decrease of the bank's profitability, that means a need to more capital and consequently less willing to lend. Italy was the stage on which this vicious circle between non-performing loans and real economy worked perfectly.
As a consequence, the ratio of non-performing loans increased further in the balance sheet of the Italian banks, the bank' profitability decrease and they react reducing the credits granted, leading to a further low growth of the entire economy.
In other words, there is a strong relationship between high non-performing loans and weak economic performances especially financial instability. Real GDP slow growth rate and unemployment rate are two traditional drivers of non-performing loans. But conversely, non-performing loans also have a detrimental impact on economic growth: high non-performing loans reduce profitability, increase funding costs and tie up bank's capital, which negatively impact credit supply and ultimately growth.
The figure below (Figure 3) helps to summarize the concept and presents more connection related to the vicious circle between economic growth and non-performing loans.

1.1.4 - NPLs and the supply of credit: evidence from Italy

As already presented in the previous paragraphs, after the global financial crisis started in 2008 and the sequential recession period, we witnessed to a deterioration in banks' credit quality, which is then translated into a restriction in the supply of credits.
Banks begun to register low profitability due especially to the higher provisions required by the increasing value of non-performing loans and to the cost of human resources needed to manage the stock of non-performing loans. During the same period, the level of capital requirement inside the banks started to increase because of non-performing loans are more

risky assets than the performing loans and then the needs of more capital as a buffer for potential losses became necessary.

Moreover the cost of funding for the banks started to be really high. In fact, investors and other banks became less willing to lend to the banks with high level of stock of non-performing loans leading to higher funding costs for these banks and a negative impact on their capacity to generate profits.

All these factors lead the banks deciding to restrict their lending credit policies. Ultimately result in a dampening of the credit supply.

Focusing on the Italian scenario, the graph below (Figure 4) shows, on the left side the stock of loans to households granted from 2003 to 2017 and on the right side the banking growth rate of loans to households during the same period. What is important to underline is that even if the stock amount of loans granted have increased, starting from 414 billions of euro in 2016 and reaching 630 billions of euro at the end of 2017, the rate of growth of loans to households shows a decreasing trend and in some years even negative rate.

Figure 4- Italian Lending growth to households 2003 -2017 Source: Euro area statistic

Thus the main channel through the non-performing loans had a negative impact on the real economy was the credit supply. In the uncertain financial environmental of the last decade, the Italian banks became more risk averse and unwilling to grant new loans due to the fact that the rise of non-performing loans started to deteriorate their balance sheets. This phenomenon is named the “credit crunch” problem, characterized by a reduction in the supply and then an increase in lending interest rates, which consequently affects the profitability and growth of the SMEs (the most affected) and last the overall economy as a whole.

Moreover, we should underline, to better understand the assumption at the base of this work that, even if the rate of growth of loans to customers have decreased during the last decade, it doesn’t means that no loans were granted at all, but managers have continued always more often to grant loans even to individual with low creditworthiness.

As will be analyzed later, behind the negative trend of credit supply during the decade in which the non-performing loans recorded the highest levels, there is another branch of literature that is developing theories of moral hazard whereby the credit crunch have been followed by expansionary credit policies without considering the level of risk.

The effect of this mechanism was naturally an increase of the banking credit risk and consequently of the stock of non-performing loans itself.

The theme of the impact of non-performing loans on credit supply is treated in the recent paper by **Accornero, Alessandri, Carpinelli, Sorrentino "Non-performing loans and the supply of bank credit: evidence from Italy", published by the Bank of Italy in march 2017,** the influence of non-performing loans on the supply of bank credit to non-financial firms in Italy between 2008 and 2015 has been studied.

They used a Panel dataset composed by 500 Italian banks to examine the weight of the impact of non-performing loans on credits.

They find that the non-performing loans "per se" don't have an impact on the credit supply, but the negative correlation between non-performing loans ratio and credit growth of the Italian banks inside the sample, is due to changes in firms' conditions and decrease of their demand for credit.

In other words, they find out that the level of non-performing loans ratios does not influence bank lending growth rate directly. The negative correlation is driven by firm-related factors that once these are properly accounted for, the bank's lending behaviour appears to be unrelated to its non-performing loans ratio. The justification of this theory is given by the fact that, there is not a direct relationship between non-performing loans and credit supply, but a negative macroeconomic change, as the financial crisis, has an impact on both the aspects leading to a movement of it in opposite directions.

The problem will be resumed and analyzed in the later chapters, as the main purpose of our analysis is to study the relationship between non-performing loans and credit supply.

1.2 - Regulation of NPLs : What has been done and what could be done

In recent years the activity of the supervisory authorities, the European Central Bank and the Bank of Italy, to promote the solution of the problem of non-performing loans was particularly intense.

Reducing the non-performing loans ratio appears crucial in order to restore the economic growth in Europe:

- It is fundamental for the small medium enterprises that are more reliant on bank financing;
- It should encourage corporate restructuring and overall reduce the private sector debt overhang;
- It may enhances monetary policy transmission.

The emergency for the Italian banks to restore the quality of their balance sheet during the last years has led the Italian government to took inspiration from solutions used by other countries which have proven to be effective in the past.

In 2012, the Bank of Italy gave rise to an initiative, Asset Quality Review (AQR) that allowed to identify 20 banking groups whose provisions for substandard loans were impaired, or had recorded significant decreases. For these groups were organized ad hoc inspections to evaluate the adequacy of valuation adjustments and examining company policies and practices adopted. The inspection groups headed by approximately 40% of the total non-performing loans in the system.

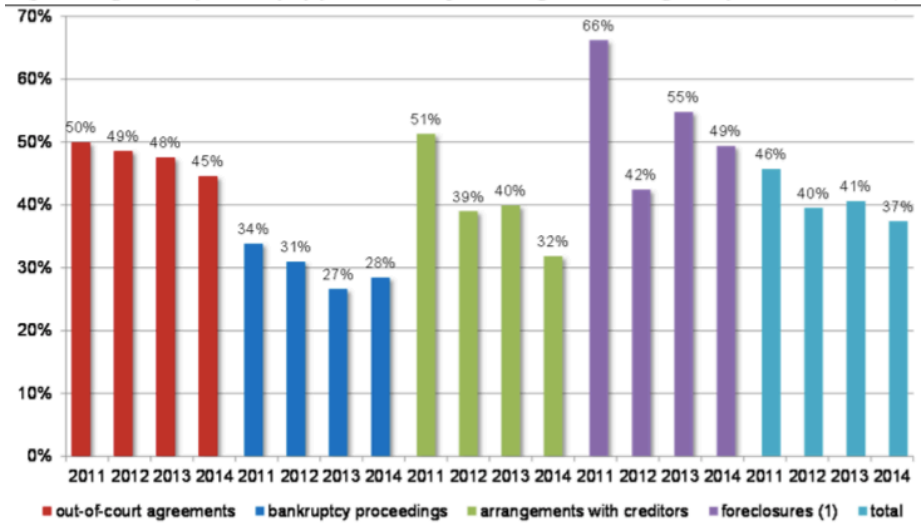
During the last years, the Italian authorities have introduced new measures aimed to reduce the amount of bad loans on bank balance sheets.

Among the initiatives:

- State-backed guarantee on senior tranches of securitized Bad Loans ("GACS");
- Two Atlante funds aimed at supporting capital raising and acquisitions of mezzanine and equity tranches in securitization of Bad Loans;
- Amendments on bankruptcy and foreclosure proceedings aimed at accelerating recovery of bad loans;
- Beneficial tax treatments of banks' loans provisions.
- Inclusion to the Single Supervisory Mechanism (SSM)

Overall recovery rate for loans under liquidation

(percentage rates of recovery by year in which proceedings closed, weighted by the loan amounts)



The Atlante fund is a private initiative backed by the Italian government in April 2016 aims to ensure success of banks recapitalization and to buy bad debts. In April 2016, the investor of a large number of financial institutions have agreed to participate in the launch of this alternative investment fund.

The fund's purposes were:

- To ensure the success of the capital increases required by the regulatory authority of banks that are currently facing objective market difficulties
- To contribute to the start-up of a market for non-performing bank loans. However, Atlante is concentrating its investment only on the junior and mezzanine tranches of securitization vehicles, whose market is particularly small.

The fund was able to collects 4,2 billions of euro, of which 2,5 billions were dedicated to support the capital increase of Banca Popolare di Vicenza and Veneto Banca and the remaining 1,7 billions were dedicated to the launch of the fund Atlante 2 in August 2016. The main scope of this second fund created is to invest in Junior and Mezzanine tranche of non-performing loans securitization.

A state guarantee scheme set up under Decree Law 18/2016 to securitize banks' non-performing loans (GACS, Garanzia sulla cartolarizzazione delle sofferenze) was published in the Official Gazette on 15 February 2016). The main purposes of the GACS is related with the process of securitization of non-performing loans. This is a guarantee that the Treasury provides to requesting intermediaries. The State guarantees only the senior tranches of securitization, namely, the more secure. The scope is to increase the creditworthiness of the senior asset back securities, increasing the investors' interests for such securities, and thus

reducing the funding costs of the SPV (special purpose vehicle), and ultimately, by encouraging banks to sale of non-performing receivables and improve their liquidity. In fact, the guarantee of the Italian treasure refer to the portion less risky and with minor return, the investments grade securities.

Securitization has been identified by the Italian Government as the financial structure for the disposal by Italian banks of the non-performing loans and the removal of such non-performing loans from the banks' balance sheets.

Private securitization vehicle ("SPV") are in charge to buy non-performing loans from the relevant banks. The SPV shall issue asset backed securities ("ABS"), that are financial instruments whose flows, interests and capital repayments, are guaranteed by those arising from underlying assets.

However, the sale of non-performing loans remains complicated in Italy.

As explained in the paper “Why exceptional NPLs sales should not affect the estimated LGDs of A-IRB banks”, published by the Bank of Italy in January 2017, non-performing loans sales tend to have a negative impact on banks’ capital ratios via direct losses, because the sale prices are typically lower than their book value. The discrepancy between sales price and book value represents the main disincentive for banks to sell. Banks using the advanced internal ratings-based method (A-IRB) face even stronger disincentives, as an additional impact on capital comes from the higher Loss Given Default (LGD) estimate induced by the non-performing loans sale.

Among the things which could be done in the future, it would be useful to try solutions in a way that the extraordinary transfer operations of non-performing loans do not reflect negatively on estimates the of the banks ' prudential parameters adopting advanced models for measuring of credit risk.

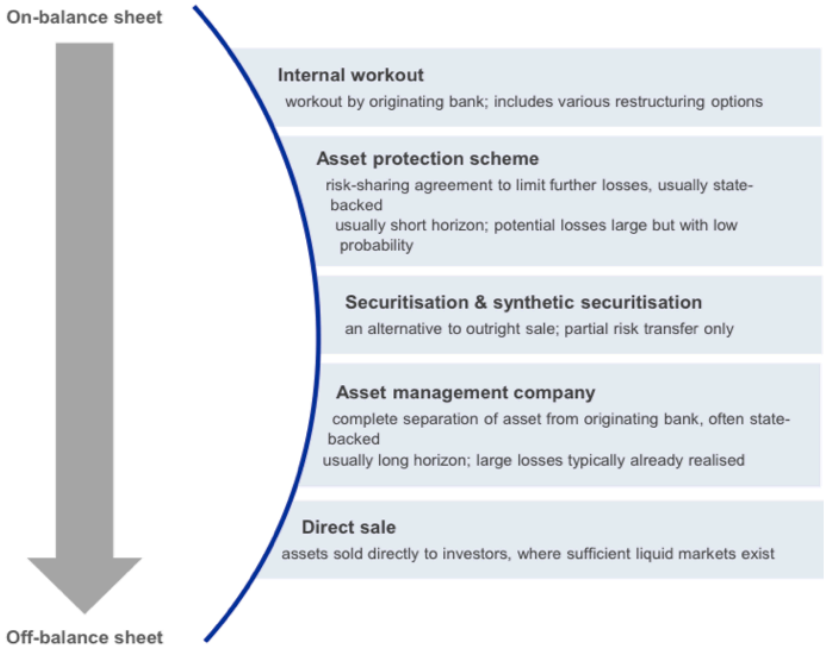
The turning point on the regulation of non-performing loans in Europe takes place in 2014, with the introduction by the European Central Bank of the Single Supervisory mechanism (SSM). The Single Supervisory Mechanism is an EU-level system for prudential supervision of credit institutions in the euro area and in those non-euro area EU member states that choose to join the mechanism. Its aim is to increase the supervision of the European banking sector through the integration of the supervisory activities of the European Central Bank and the activities of the national supervisory authorities in a way to create a common European guide for the management of banking non-performing loans.

The main task of the SSM are:

- Ensure the safety and soundness of the European banking system;
- Increase financial integration and stability;
- Ensure consistent supervision.

In the light of this structural change, European banks began to:

- Use quantitative data more massive and with increasing frequency;



- Structuring and standardizing the data requests to facilitate data collection by the Central regulator;
- Produce analysis reports, with public peer comparisons.

Moreover, the SSM has introduced for the first time a type of supervision which is risk-based. It takes into account both the degree of damage which the failure of an institution could cause to financial stability and the possibility or probability of such a failure occurring. Such a risk-based approach ensures that supervisory resources are always focused on the areas where they are likely to be most effective in enhancing financial stability.

The final aim is to improve the quality of credit to businesses, basing credit evaluation on methods that take into account objective and standardized information.

With the introduction of the SSM, the major 15 Italian banks have participated in the comprehensive assessment, which included an examination of the quality of their assets.

The exercise resulted in both an increase of non-performing loans and of value adjustments.

To better understand what has been done during the last years and how Italian banks have reacted to the problem of non-performing loans, we can refer to the occasional paper published by the **Bank of Italy on February 2016, " The management of non-performing loans, a survey on the major Italian banks**".

The paper shows the main results on the effectiveness of the procedures for debt recovery conducted during the last decade by the main 25 Italian banking group.

The most common methods to handle non-performing loans are: credit transfers to third parties, and the use of banking internal units specialized in credit management. Some banks have specialized organizational units, typically distinguished by handle settlements and restructuring; others present more fragmented structures. Other times, banks employ agencies of recovery credits for non-performing loans of small amount.

However, the procedure of debt recovery is costly. In 2014 the management of non-performing loans has absorbed the 2.8 percent of the banking operational costs.

During the period covered by the research, judicial restructuring tools provided by the Bankruptcy Act are: restructuring and recovery plans, agreements of restoration and arrangement with creditors. The chart below (Figure 5) shows the debt recovery rates over the time of the procedures taken. (2011-2014)

Figure 5 Overall rate of recovery for loans being settled. Source: Bank of Italy, 2016

The average rate of recovery for loans under liquidation for the period 2011-2014 is 41%. The crisis probably made difficult to increase the value for the activities of the firms on market and therefore the percentage recovered decreased for all procedures. This decrease was particularly noticeable for agreements with creditors and procedures of enforcement. The highest rate of recovery is real estate executions, probably due to the fact that typically these loans are covered by real guarantees.

The recovery procedures would have hindered mainly by the complexity and the duration of the procedures, the difficulty of delivering new finance, by the costs of the professionals and by the difficulty in coordination with non-financial creditors.The biggest obstacle to the

functioning of processes of debt recovery, is identified with the duration of the Italian procedures, especially with regard to the failure. In fact, from the information gathered about the time profile for the recovery, it is showed that all of the recovery occurs within the first five years. Increase the length of the procedure beyond a certain length doesn't increase the effectiveness of the procedure.

Italian bankruptcy procedures are complex, long, and costly. A first attempt to make the procedures more streamlined was made by Matteo Renzi's government which has worked to reform bankruptcy laws. In Italy the average duration of bankruptcy procedures is estimated at 7,5 years, which is much longer than in most other European countries.

In the light of these aspects, Law 119/2016 of 30 June 2016 extends the "Marcian Pact" to include corporate debt guaranteed by real-estate assets. Thank to this law, it is now possible to transfer the property used as a guarantee to the creditor, assuming the contract provides for it and up to the amount to be recovered, without a prior legal ruling. The new law simplify and accelerate bankruptcy and enforcement proceedings.

In summary, there is a need for measures to shorten the procedures and to make possible to close them once their substantial economic effects have been achieved.

1.2.1 - Impediments to NPL resolution in the EU and possible overcoming

Nowadays, in Europe a poorly developed secondary market for non-performing loans still persists. The main reason is that the majority of the European secondary markets for non-performing loans are still affected by a significant information asymmetries and uncertainty about the true values of the loans, transforming the market in a "market for lemons".

In fact, there exists a wide difference between the prices that investors are willing to pay for the non-performing loans and the net book values on banks' balance sheets. This pricing gap is mainly due to the presence of structural impediments to the resolution of non-performing loans and to the lack of transparency regarding the calculation of the non-performing loans' value. This main impediment can be grouped into three main areas: supply side, demand side, and structural issues.

From the supply side, the reason behind the resistance to sell the non-performing loans in the market, could be identified, not only to the loss given by the pricing gap between market value and book value recorded, but also by the opportunity cost of holding non-performing

loans. In fact, the IAS 39 permit banks to recognize interest income on non-performing loans. Moreover, tax disincentives can slow down the resolution of non-performing loans.

From the demand side, the main impediments are represented by the significant concentration of buyers, with barriers to entry for investors and servicers. This creates a type of oligopoly situation, with significant buyer power in the face of limited competition. Unavailability of sufficiently detailed, poor documentation represent further obstacles in the market.

Finally, the structural issues are given by the fact that forbearance measures and weak debt enforcement increases the cost of collection and banks are not willing to collect collateral in a timely manner, ultimately leading to a wider bid-ask spread.

Following is reported the available option suggested by the European Systemic Risk Board and presented by Víctor Constâncio, Vice-President of the ECB, at an event entitled "Tackling Europe's non-performing loans crisis: restructuring debt, reviving growth" organized in Bruegel, Brussels, on 3th February 2017 for the resolution of the non-performing loans problem.

The solutions are divided in on-balance sheet solutions where the stock of non-performing loans remaining on bank balance sheets, and off-balance sheet approaches, where it is pulled off, and approaches that fall between these two extremes. The figure reported below (Figure 6) helps to present the taxonomy of options that are considered as a tool to resolve the non-performing loans problem.

Figure 6 Taxonomy of options to resolve NPLs, European systemic risk board 2017

Internal workout represents the tool at the extreme of on-balance sheet solutions. Issues relating to the internal workout of non-performing loans are presented in detail in the “Guidance to Banks on Non-Performing Loans” issued by ECB Banking Supervision in March 2017

Direct sales of impaired assets to an outside investor is at the opposite side of the spectrum of resolution options and it’s an off-balance sheet tool. This kind of solution is strictly connected with the presence of a liquid market for non-performing loans.

Between the two-extreme solution presented, there are three other options such as asset protection schemes (APSs), securitization, and the creation of asset management companies (AMCs).

The creation of asset management companies (AMC) represent a useful tool to deal with property-related assets and some corporate exposures, while the creation of asset protection

schemes (APS) have proven to be useful in situations where potential losses are large in case of default but this probability is low.

Direct sale of non-performing loans, securitization and creation of asset management companies are solution referring to the same concept: the creation of an efficient and regulated secondary market for non-performing loans. The main challenge will be reducing information asymmetry through provision of harmonized non-performing loans data in a common data template.

In details:

I. Given the number of impediments to create a secondary market for non-performing loans, especially due to the lack of harmonization, a possible solution to implement a direct sale of non-performing loans in Europe could be the creation of a platform. The advantages of this solution are:

- Possibility of use standard data template for non-performing loans enhancing data comparability and increasing data quality
- The possibility of storing data in a central warehouse, will give the possibility to easily access to the data
- The platform can be the single point of contact for potential investors, enabling them to package assets originated from multiple banks without having to approach them individually.
- Ownership and risk transfer of assets contained in the NPL platform would only take place at the point of sale from banks to investors, thereby avoiding any State aid.

II. For what concern the securitization solution, aside from the explanation of the process in detail, the main concept to point out is that this probable form of resolution is characterized by a phenomenon of risk transfer, but partial because there is not a complete separation of the assets concerned. However, the main advantage is that the non-performing loans can be derecognized quickly form the bank balance sheet but conversely, force banks to sell their non-performing loans can result only to a transfer of value from banks to the investor community putting further pressure on bank profitability, instead of relieving it.

III. Asset management companies (AMC), acquire non-performing loans directly from banks and resolve them over a longer horizon, using government capital or funding support, but remaining independent from the government. This kind of solution can bring economies of scale and professional recovery management because banks often lack specific skills required for large scale asset recovery. A bank can also establish a AMC as its own subsidiary, reducing

the cost compared to an internal workout. However, the main drawback of a single-bank AMC subsidiary is that it does not fully remove the risk related to non-performing loans from the bank balance sheet.

To conclude, the resolution of European non-performing loans should involve various measures in different areas and it is essential that governments take a range of actions related to debt enforcement and reduction of information asymmetries.

Some of the measures may show clear results in the short term, other measures require more time to be implemented and to be effective.

What it is necessary is that, the quality, the scope and accessibility of financial information should be improved to decrease the level of asymmetric information. For these reasons, it is necessary to develop a unique, orderly and complete legislation on non-performing loans that will enable to precisely identify the role of individual operators in the market and the tools thanks to which the problem might be solved in the medium term.

On the supervisory side, non-performing loans resolution has been designated as one of the top priorities of the Single Supervisory Mechanism and the guide published in March 2017 represent a common guidance to the management of non-performing loans and express the supervisory expectations with regard to governance, management, recognition and valuation.

In fact, the guide is a supervisory tool requiring banks with high non-performing loans ratios to reduce them within a time horizon to a level to be defined by the regulator. It is focused on the following core aspects regarding non-performing loans management:

- **Strategy:** Development of stocks of non-performing loans reduction strategies by implementing dynamic plans with multi-year horizon
- **Governance**: Definition of both a Governance model and non-core asset management with the aim to reducing stocks and flows of non-performing loans.
- **Operations**: Development of policy and standard processes, based on the characteristics of the portfolio, to identify and develop optimal strategies for reducing non-performing loans.

All of these reforms are essential not only for the resolution of Europe's non-performing loans burden, but also as prevention for future downturn. However, a great hard work in many fronts is needed for resolving the problem in Europe. Neither a partial solution, nor further waiting is an option anymore.

CHAPTER II-Aspects and theories of the Moral Hazard in the Banking system

2.1-Moral Hazard and asymmetric information problems: an overview

The purpose of this chapter is to explain the main aspects of the moral hazard problem and to contextualize it within the Italian banking system. Many authors have, in fact, already discussed about this topic, recognizing how the evolution of the stock of non-performing loans inside the bank balance sheet is often the consequences of bad management behaviour and thus moral hazard. In general, the problem of asymmetric information, whose moral hazard is one of its manifestation, is actually already rooted in the Italian banking scenario and represents a potential threat for the stability of the all financial system as a whole. A further investigation of this aspect and the economic theories that have been developed, are presented during the next paragraphs.
Following a general introduction to the problem of asymmetric information is reported.

The term asymmetric information refers to the case in which a person in an economic process has better information than other persons. The person better informed could take advantages of this aspect during the process of taking decisions or acts.
In other words, the information is asymmetric when the persons participating in the contract don't have the same set of information: one of the part hold information that the other part doesn't have. If one of the part, the agent, has more information than the other one, the principal, before the start of a contractual relationship, we refer to a typical form of asymmetric information called **adverse selection**. If instead, the information advantage is on the actions that will happen after the stipulation of the contract, we are in presence of a **moral hazard problem**. Consequently, we refer to ex-ante asymmetric information when we deal with adverse selection and ex-post asymmetric information when we deal whit moral hazard, because the opportunist behaviour of one part takes place after that the contract is stipulated.
The purpose of this discussion will be focused on the study of the behaviour of moral hazard since it is the manifestation more evident of asymmetric information and since, as we will

discuss later, moral hazard behaviour by banking management during the last decade has became strictly connected with the economic performance of the Italian banking system.

Even if the term moral hazard comes from the insurance world, it is widely used in many other economics fields. In the context of financial institutions, the term moral hazard consists in a situation in which one agent decides on how much risk to take, in an opportunistic manner, without taking account of the likely negative consequences of risky choices for the principal. Often, even the agent makes an action non-observable from the principal.
From this moral hazard is also identified with the term hidden action.
In the insurance specific field, a typical case of moral hazard happens when a person who buys an insurance is protected against monetary damages and then he may engage in more risky behaviours than if he has to bear the risk himself without the insurance protection.
However, in general, the moral hazard behaviour inside a corporation appears strictly linked to the problem of separation between ownership and control.

2.1.1- The principal-agent theory at the base of moral hazard behaviour

To investigate the aspect of the separation between ownership and control, a definition of the principal-agent relationship is necessary. The agency relationship is a contract under which one or more persons, named the principal, delegates another person, the agent, to perform some actions and decision on their behalf.
Since, in general the behaviour of an economic "character" is aimed to maximize their own utility, there exists a good reason to believe that the agent will not always act in the best interests of the principal.
If a wholly-owned firm is managed by the owner, he will make operating decisions that maximize his utility. If the owner delegates managers to act on his behalf, the maximization of the utility function is more difficult to achieve. This is a simple manifestation of the separation between ownership and control and of risk shifting problem.
The relationship between shareholders and managers of a corporation, the separation of ownership and control typical of any corporation in which the owners do not have control, can be definitely associated with the general problem of agency.

One of the main source of the divergence in the process of maximization of the utility come from the impossibility by the principal to monitor the behaviour of the agent, after that the contract has been stipulated.

An efficient activity of **monitoring** can help to reduce the information gap between principal and agent. However, the monitoring activity could result difficult to implement because it entails pecuniary and not pecuniary cost. The principal owns complete information when is able to know whether or not the agent is behaving as the contract plan and for the optimal situation for the principal.

Full information is very unlikely to be achieved and the principal agent relationship entails in general some degree of information asymmetry. This creates the ground for moral hazard behaviour by the agent. Normally the problem of asymmetric information is concerning the principal who cannot be fully assured about the agent's acts and behaviour. If the agent has some information hidden to the principal the agent can take an action unobserved by the principal, which purpose does not always coincide with the utility maximization of the principal (the case of moral hazard or hidden action).

There are measures within in the principal agent theory that seeks to reduce or prevent these agent problems. In general, two options are available to the principal; **monitoring or incentives**.

Monitoring the agent's act can be necessary for the principal in order to achieve the desirable goal set up by the principal. Monitoring involves a degree of control that is imposed on the agent and it is costly and time-consuming from a principal perspective.

The monitoring process include auditing, formal control systems, budget restrictions, the establishment of incentive compensation systems which serve to identify the manager's interests more closely with those of the outside equity holders or shareholders.

In many situations a monitoring approach would lead to added layers of management to perform surveillance activities. Of course, this has very high costs.

The second option is an outcome related tool, incentives. The principal can reward the outcomes produced by the agent. Incentives or output control are more attractive when output is measurable because they are less costly tool compared to monitoring.

Monetary bonus and monetary incentive given to the agent when some results are achieved. Focusing of personal interest, economic reward, monetary bonus sometimes the goal of the agent is completely translated. This focus brings to forget other important aspects that can have a negative impact on the principal side and on the economic situation of the corporation.

To minimize the cost or in general to mitigate the moral hazard problem, a contractual formulation based on the behaviour of the agent instead of outcome-based contract, is necessary.

Nicita and Scoppa (2005) [3] formulated a model in which the compensation of the agent is not more related to the achievement of the results but to the behaviour holding by the agent during the process of achievement.

The model is based on the idea that the agent acts on the behalf of the principal to achieve an outcome y, producing an effort e that is cost for the principal c.

Assuming perfect information by the agent, in order to achieve the maximization of the utility of the principal, the equation that quantifies the surplus produced is:

$$S = y(e) - c(e)$$

The contract for the first best that ensure the maximum surplus for the principal is obtained by the equality between marginal product (first derivative of y(e)) and marginal cost (first derivative of c(e)).

However, because of the problem of asymmetric information that arise between principal and agents, the agent will be intended to maximize his utility that result different from the principal's utility. A moral hazard problem arises when it is not possible to verify the agent's effort (e).

To control the behaviour of the agent, Nicita and Scoppa, affirm the necessity to introduce a remuneration for the agent. This remuneration can be seen as a double aspect: cost of monitoring and remuneration for the agent's effort.

The new idea of the authors is that this remuneration will have to be connected directly to the level of effort applied by the agent (behaviour-based contract).

The expected utility of the principal is described through the equation:

$$Up = E\,[y(e, X) - w(y(e, X))]$$

While that of the agent:

$$Ua = E\,[u(w(y(e, X))) - c(e)]$$

[3] [3] Economia dei contratti, Antonio Nicita Vincenzo Scoppa, Carocci 2005

The utility of the principal is dependent on the results achieved (y), on the remuneration given to the agent (w) and X that is a random variable indicate a set of possible outcomes.
The optimal remuneration to the agent is given by the maximization of the principal's benefit subject to the agent participation constraint. The participation constraint says that the remuneration should be at least equal to the utility derived from the best alternative available to the agent.
In other words, the remuneration must be at least equal to the utility that the agent can achieve outside the relationship /contract with the principal.

$$E[u(w(y)) - c(e^*)] \geq U \text{ (Best alternative possible)}$$

With e* indicate the optimal effort of the agent, giving the remuneration w.
A second constraint is necessary to ensure that the agent will choice the action that bring major utility to the principal:

$$E\{u[w(y(e^*)] - c(e^*)\} \geq E\{u[w(y(e))] - c(e)\}$$

Under asymmetric information assumption and moral hazard, the effort is observable, and the agent can choose the effort that is best for him, given the contract without regard to the utility function of the principal. If the agent receives a fixe wage, there will be not a link between the effort he decides to put to pursue the object and the remuneration. Thus, he will choose the effort that is least costly for him, that is, the lowest possible level of effort.
The solution is that in presence of moral hazard, the principal to make the agent participant to the effect of his own effort and behavior in doing actions, make the remuneration of the agent on the outcome and as a result dependent of the agent's effort—> w(y(e))
This model makes the agent participant final outcome of the contract, as if the utility of the principal became in part also the utility of the agent.
The optimal contract under moral hazard is the solution to the maximization problem

$$\text{Max} \quad [E\,[(y(e) - w(y)|e))]$$

$$\text{s.t} \qquad E[u(w(y)|e) - c(e)] \geq U \text{ (Best alternative possible)}$$

$$\text{and } E\{u[w(y)|e^*] - c(e^*)\} \geq E\{u[w(y(e))] - c(e)\}$$

The problem now is shifted to the decision of the amount of agent's effort results optimal for both the principal and agent.

Sometimes another constraint should be added to the model if the principal cannot pay the agent more than a threshold value imposed by the law.

An example of upper bounds is the European Union regulatory cap on bankers' bonus payments such that the maximum ratio between the variable and the fixed part of the total remuneration is limited to 100%.

2.1.2 - A Modern solution to the principal-agent problem: Stock option as an incentive plan

Performance-based compensation produces managerial behavior that is closer to that observed in companies with owner control.

The model of Nicita and Scoppa described above can have a modern application in the use of stock option as a form of remuneration to the managers, in a way to make the managers participant of the final results of the corporation.

Measure and evaluate the activity of the managers in doing their action on behalf of the stockholders of a company is difficult to implement.

In fact, inside corporations which have the problem of the separation between ownership and control, in other words corporation where someone different from the owner is delegated to act on behalf of the owner, is difficult to directly monitor the actions and behaviors of the agent.

Given the difficulty of the cost of monitoring, in recent years, in the wake of the theory of Nicita and Scoppa, corporations tried to create incentive plans to at least reduce the possibility of moral hazard, i.e. of behaviors on the part of managers that don't have as a final scope the maximization of the utility of the corporation.

Stock based compensation has steadily increased over the last decade. Typically, stock-based compensation is implemented by one of two methods: granting the manager restricted stock or granting stock options. Incentive plans aimed at top management tend to be characterized by the following elements:

- A significant part of the remuneration is linked to the overall business performance, often through the assignment of shares or options on purchasing and subscription of shares;
- The performances are measured, at least in part, on medium and long-term horizons, in other words the lapse of time between the allocation of targets and the measurement of performance is greater than the length of a calendar year.

These two issues are linked. In fact, fees related to the holding of shares or options are characterized by being compared to other forms of incentives, more oriented towards the long term.Stock options are incentive contracts that are usually granted to senior management and members of the Board of Directors of a company.Those plans give managers the option to buy, if you use the previously issued shares, or sign up for, if you are using newly issued shares, securities representing risk capital in the company.

The options granted are technically similar to American call options since they grant (but not the obligation) the right to acquire the titles within a specified interval of time and at a given price. The manager who receives the offer of options, usually at a strike price equal to or lower than the market rate, has the opportunity to make a significant capital gain if at a time following the assignment of options the price of title exceeds the amount of exercise.

If you assume that the managers' decisions and actions can affect corporate performance, and therefore on the market value of the stock, in the presence of a stock option plan the managers are encouraged to contribute to maximize the value created for shareholders and, consequently, their own personal gain.

Stock based compensations represent the modern solution to the theory of Nicita and Scoppa: the principal to make the agent participant to the effect of his own effort and behavior in doing actions, make the remuneration of the agent depend on the outcome and as a result dependent of the agent's effort —> w(y(e)) —> behavioral contract.

The logic in this instrument is based on the assumption that if the introduction of the incentive plan allows the company to create greater shareholder value, a distribution of this increased value between shareholders and especially between managers can only satisfy both parties involved in the relationship.

At the end, the effectiveness of a stock option plan should then be evaluated by comparing the amount of financial resources that the shareholder must grant to managers with the greatest economic value that these can achieve for effect of the scheme of incentives.

Moreover, stock options are compensation tool that companies use with the intention of obtaining advantages such as:

- Alignment of interests of shareholders and managers. Stock option plans are most often used because they allow the company to align the retribution of top managers to corporate performance, and therefore the economic interest of the shareholders.
- Promoting entrepreneurial behavior. A well-defined stock option plan allows to stimulate the managers to a greater propensity towards risk, entrepreneurial attitude and innovation rather than the exploitation of competitive advantages acquired up to a certain point in time. Because of this, stock options plans are a very widespread even in venture capital transactions because the investment banks and investment funds that finance these operations want to stimulate the entrepreneurial spirit of management by connecting the remuneration to the value created for shareholders.
- Attraction and retention of high level management. Stock options can be created with the aim to attract and retain top managers with major skills. If one considers the people as risk adverse, stock option plans, which presuppose the acceptance of a variable remuneration, allow to select the top management.
- Creating a participatory business climate. The share incentive plans allow companies to create a participatory and collaborative business climate, thanks to the increased perception of the consequences of its activity on the results in total the company by the managers.

On the other side, the major limits of stock options plan as a tool for compensation are:

- The difficulty for the principal to understand the functioning of incentive.
- The risk of a weak relationship between the quality of managerial behavior and the compensation paid. The stock option compensation plan must create a stock link between remuneration and company performance. Otherwise the consequence could be to reward unjustifiably managers who have produced business results unsatisfactory in a period characterized by favorable development of the stock market and on the opposite side to don’t reward managers who have actively contributed to business performance.
- The possible loss of value of the bond on the disposal of shares purchased by managers across the floor
- The risk of underestimating the cost implicit in the issuance of a large amount of options.

- The risk that management adopt aggressive and risky policies in order to achieve the targets which are related the benefits of stock option plan.

The problem of excessive risk that sometimes is undertaken by the managers will be a theme that we will take into account throughout the all the discussion of this work.

There is also non-option stock plan used as compensation method with the same scope.

In the paper: Stocks or Options? Moral Hazard, Firm Viability, and the Design of Compensation Contracts", Ohad Kadan and M. Swinkels[4], analyzed the differences between stocks and options compensations. To do this, they study a principal-agent relationship between risk neutral investors and a risk averse and effort averse managers. According with their results, start-ups should use stock to executives in early stages, while they should migrate to option-based compensation after undergoing and IPO, since the non-viability risk is then much smaller.

Similarly, they suggest that distressed firms should use stock plan compensation, and then move toward options plan when the firm emerge from bankruptcy. In other words, the authors provide that stocks plans as a means of motivation are better only if non-viability risk is substantial like in financially distressed firms or start-ups. This means that higher bankruptcy risk is correlated with more use of simple stock

[4] Washington University, March 2006

2.3 - Risk taking, ownership structure and moral hazard inside the Banking system

Underlying the debate on the problem of moral hazard within the banking system, the differences between ownership structure and management must be analyzed, as well as the risk- shifting practice. Although all the literature produced to discuss the problem of moral hazard and in general asymmetric information, has been referred to the corporate sector, recently, after the financial crisis of 2008, the same observations are being extended to the banking system.

The problem of moral hazard behavior inside a financial institution is linked with the relationship between the concept of risk taking, ownership structure and management.

It's from a misalignment between ownership, control, risk taking and risk bearing that moral hazard behavior has its roots.

In the "**Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure", Jensen and Meckling (1976)**, have focused their attention on the explanation of why a manager in a firm will choose a set of activities for the firm such that the total value of the firm is less than it would be if he were the sole owner. Studying the relationship between the agency cost and the separation of control, they further investigated the nature of them demonstrating who bears costs and why and investigate the Pareto optimality.

They argue that in a principal agent relation, the agent can have incentive to take riskier activities above the optimal level.

Agency theory proposes that a utility-maximizing economic agent may take actions that are inconsistent with the interests of the principal. This happens because the agent is not perfectly monitored, or because the actions are not observable or because the principal does not have the incentive to monitor. The separation between ownership and control and the conflicts resulted is one of the main cause that reduce the value of a firm.

The most obvious conflicts inside a financial institution happens between equity holders and debt holders. These conflicts can arise because of the opportunity that shareholders have to exploit debt holders by substituting safer assets with riskier ones. The reason behind this behavior is that, in a positive scenario the shareholders keep the profits of the risky investments, due to limited liability, but in a negative scenario the debt holders bear most of

the losses. This is the reason why the shareholders have more incentives to invest in risky projects. In other words, after that a debt contract has been stipulated, the shareholders could have more incentives to invest in risky project that are aligned with their interests but not with those of the debt holders. Undertake risky projects with negative net present value can result profitable for shareholders because in the negative state of nature they will leave bondholders to face the losses. Risk shifting can be particularly severe in the banking sector because leverage in this sector is systematically higher than that of any other (Berger et al., 1995). In addition, most of the liabilities of banks are in the form of deposits, whose owners mostly have only limited ability to monitor banks (Caprio and Summers, 1993).

The capital structure irrelevant theory developed by Modigliani and Miller in the presence of agency cost can collapse.

Many authors have tried over the years to study the relationship between ownership and control as well as between people risk taking and people bearing the risk inside a financial system or in general inside one corporation.

Laeven and Levine in their paper "Bank governance, regulation and risk taking"[5] , are among the first authors investigating the relationship between the ownership structure and risk-taking problem inside a financial system. Moreover, they further enlarge their research analyzing the impact that national bank regulation, aimed to minimize problem of moral hazard, have on the banking system.

The use of national regulation, requirement of capital and limits on interest's rate as a tool to mitigate bad management will be discussed better later in this chapter. However, Laeven and Levine, using a dataset of 270 banks across 48 countries, they analyzed how potential conflict of interests between managers and owners can arise during the decision process about the level of risk taken by the bank. They found that banks with larger owners tend to adopt a riskier strategy. In other words, their analysis is the proof of how ownership structure mainly influences the level of bank risk.

Assuming that managers have not shares, equity holders tend to have stronger incentives to increase risk than managers and debt holders. Moreover, the authors have highlighted how the same banking regulations has a different impact on bank risk taking depending on the ownership structure of the bank. The sign of the effect of a national bank regulation on capital

[5] Journal of Financial Economics 2009

regulation or activity restriction, aimed to mitigate the conflict of interests between the owners and the managers, can be negative or positive depending on the magnitude of the shareholders' power.

Finally, according to Laeven and Levine not consider the ownership structure could be a big mistake in analyzing the risk taking by a bank.

Saunders et al. in their paper "Ownership Structure, Deregulation, and Bank Risk Taking"[6], have investigated the relationship between banking ownership structure and risk taking.

They analyzed the potential conflict of interests that differentiate managerially controlled banks and stockholders-controlled banks. It is hypothesized that stockholders-controlled banks have incentives to take riskier investments than managerially controlled banks and that in period of deregulation this difference became more pronounced. In other words, bank controlled by stockholders tend to take riskier activities especially during period of deregulation and financial instability.

Here again ownership matter in the process of decision about bank risk and it is more relevant during the period of uncertainty and financial turbulence.

Amihuid and Lev in their work "Does corporate ownership structure affect its strategy towards diversification?" proposed that, if the managers are fully controlling a firm, they will tend to apply strategies of diversification with the scope of reduce the risk. The level of risk of the institution is controlled and higher risky investments are avoiding. On the opposite side, if a firm is fully controlled by stockholders, it's likely that they try to reduce their risk using the capital markets instead of diversifying the investments of the firm. In other words, thanks to the access to capital market, shareholders are able to better diversify their risk by their own and thus are more willing to undertake riskier investment inside the corporation. Manager-controlled firms, have instead incentive to undertake actions that result in the reduction of diversified risk without using the capital markets.

From all the theories presented, became evident to arrive to the conclusion that stockholders are more incentive to undertake riskier activities inside a bank (in general inside any corporation).

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[6] Journal of Finance 1990

Shareholders, although they want to engage in more risky assets, it should be emphasized that they want to do it at the expense of others.

Risk appetite at the expense of others is called moral hazard.

The link between non-performing loans and moral hazard will be further investigated in the next paragraph.

Contrary to theories that argue that shareholders, investing in risky actions, tend to increase the probability of default of the bank , **Assaf Eidorfer in "risk shifting and investment asymmetry" 2009,** analyzed the possibility that in order to shift risk to the bondholders, the shareholders must increase the risk of the firm's total assets, and thereby the risk of the equity and the probability of bankruptcy.

However, in his study, Eidorfer has arrived at the conclusion that risk-shifting problem should not necessarily be associated with an increase in firm risk, equity risk, and default risk. When shareholders can change not only the variance of the future firm value, but also its asymmetry, they enjoy the benefits of the wealth transfer by imposing more risk on bondholders, and at the same time reduce the firm risk, and more importantly, the equity risk and the probability of bankruptcy.

2.4 - The link between moral hazard behaviour and non-performing loans

As pointed out so far, within the banking system there are inconsistencies and conflicts of interests that may lead to moral hazard behaviour and risk shifting problem.

Jensen and Meckling refer to two different type of moral hazard inside the bank: managerial rent-seeking and conflict of interests between shareholders and creditors.

The first one is manifested when the managers instead of the maximization of the utility of the institution, they are interested to maximize their own utility reaching pecuniary compensations or personal rewards. The second type of moral hazard refer to the evidence that shareholders tend to stimulate the managers to undertake more risky actions, or better to grant risky loans and shift the risk to the depositors.

The author moreover argue that managers are likely to undertake riskier activities above the optimal level for the institution.

The key aspect of their theory and also of this work, is the suggestion that both this kind of moral hazard problems inside the banks lead to an excessive and increase of the loans growth rate to customers and consequently to a large number of non-performing loans and losses.

Jensen and Meckling are only the first, but many authors have tried later to analyze the relationship between moral hazard behaviour, credit growth and non-performing loans.

Even this work is based on the same intention: spotting moral hazard behaviour inside the Italian banking system that could lead to an increase of loans growth, so an excessive risk taking by the banks, resulting to an increase of losses and non-performing loans itself.

Sinkey and Greenawalt (1991) analyze large US banks during the period 1984–1987 and find that the average past loan growth is significantly positively related to the contemporaneous loan loss rate.

Clair (1992) analyzes data on individual banks from Texas during the period 1976–1990 and detects a negative impact of loan growth on non-performing loans and the loan charge-off rate for the first year after a bank's credit expansion, whereas for subsequent years, a positive relationship is partly found.

Salas and Saurina (2002) analyze a large data set from Spanish commercial and savings banks from the period 1985–1997. They find that loan growth of savings banks is significantly positively associated with loan losses three years ahead.

Hess et al. (2009) analyze determinants of credit losses at 32 Australasian banks during the period 1980–2005. It turns out that strong loan growth translates into higher credit losses with a lag of two to four years.

More recently, **Foos, Norden and Weber in the paper "Loan growth and riskiness of banks"[7],** investigate the inter-temporal relationship between loan growth and the riskiness of individual banks. When banks decide to take more risk and grant new loans to borrowers that were previously rejected or conceding too low rates or accepting too little collateral relative to customer's credit quality, adverse effects on bank risk could be the main consequence of this excessive credit growth. In other words, when the bank accepts to take more risk the result can be worse.

[7] Journal of Banking and Finance 2010

Taking into account data from more than 16,000 individual banks in 16 major countries during the period 1997–2007, the Foos and al, analyzed the relationship between abnormal loan growth and riskiness of the banks.

Abnormal loan growth is defined as the difference between an individual bank's loan growth and the median loan growth of banks from the same country and year.

First, they investigated if and how past abnormal loan growth affects loan losses of individual banks. They expected, given that borrowers do not immediately default, that the loan growth rate translates into an increase of loan loss provisions with a time lag of several years. Second, they analyzed how abnormal loan growth influences the overall profitability of individual banks. In fact, for example the concession of new loans at low interest rate, even if the total number of loans increase, will bring a lower relative interest income. Third, they analyzed the impact of abnormal loan growth on bank solvency. Assuming that the banks fund their new loans with new debt and not with new equity, loan growth will lead to a decrease of the equity-to-total assets ratio. Since the equity-to-asset ratio determine what percentage of a company's assets are owned by investors and not leveraged and therefore the part that could come under the control of debt holders in the event of bankruptcy, the lower the equity-to-asset ratio is the less the bank is able in case of bankruptcy to meet its obligations.

The results found thanks to the empirical analysis proved that excessive loans growth can lead to increase the loans losses and negatively affect the bank profitability and solvency.

2.5 -The impact of Banking regulation on moral hazard behaviours

Capital regulation in the form of minimum capital requirements is the most popular instrument in current banking regulation.

The problem of moral hazard inside the banking system, as discussed before, lead to excessive risky lending strategies and to the rise of non-performing loans stock. This process has been considered one of the main aspect on which the banking regulation and supervisory authorities have devoted attention during the last decade.

The European supervisory regulation of the bank's capital born also with this scope: create risk-based capital requirement that help to eliminate bad management activities and the moral hazard problem and consequently the probability of default of a financial institution. In other words, in order to limit the probability of default, the European authorities continued to require banks to hold a certain amount of capital measured as a percentage of total assets.

Internationally, the Bank for International Settlements' Basel Committee on Banking Supervision influences each country's capital requirements with the scope of give to the banks a common framework to handle their capital.

The European capital adequacy framework known as Basel framework from 1988 represent the most important system of rules for European banking world designed to stabilize the financial world and impose it correct practices in terms of capitalization, liquidity and risk management.

The thing to point out is that Basel frameworks does not arise with the specific aim to eliminate the moral hazard of the management inside the European banks, but Basel framework placing minimal capital requirements and limits on the interest rates, indirectly help reduce bad management inside the banks and reduce the excessive risky policies undertaken.

Basil II framework contains 146 of the 251 pages of the document devoted solely to the calculation of minimum capital requirements.

The use of minimum capital requirements as a tool is based mainly on the assumption

that banks engage in moral hazard behavior. To discuss the fact that the capital requirement is objectively a good tool to reduce situations of bad management and moral hazard behavior, I must specify that two opposing theories has been developed in the economic literature during the recent years.

Establish minimum capital requirements can help bank to reduce their probability of default and limit the excessive risk actions taking. In fact, major capital requirements mean put more of the "skin" of the shareholder in the bank, thus they will be more risk adverse and more prudent in taking decisions. However, as discussed in the previous paragraphs, the banking system is characterized by a disregard between ownership and control, in simpler words, the decisions are not taken by the shareholders but from the management side.

What happen inside the board of a bank, the decision of the managers and their strategies are unknown to the depositor and even to the shareholders.

Inside the banks are the managers that take decisions, and the management doesn't have in major case the "skin in the game". This refer to the simple problem of principal-agent problem, asymmetric information and bad management presented in the previous paragraphs.

The efficiency of an increase of banking capital requirement to mitigate bad management is very discussed and some authors have showed, contrarily that capital regulation may in the opposite increase the probability of default of the bank. In other words, banks more capitalized are better in favor to aggressive lending strategy increasing their amount of non-performing loans and ultimately their probability of default.

Kashan (1977) and Koehn and Santomero (1980) demonstrate that higher capital requirements may induce a bank to increase its asset portfolio risk, thereby partially defeating the purpose of capital controls.

Paul Calem and Rafael Rob in their work "The Impact of Capital-Based Regulation on Bank Risk-Taking"[8], they analyze the impact of regulation in US bank capital on the risk-taking behavior of banks, using empirical data from the banking industry from 1984 to 1993.

The capital regulation imposed to the US banks in the years taken into account in the analysis, had as aim the discouragement of excessive bank risk taking in a way to reduce the probability of default and financial uncertainty. The source of the excessive risk-taking and moral hazard problem for the authors arise because the government deposit-guarantee allows banks to make riskier loans without having to pay higher interest rates on deposits.

[8] Journal of Financial Intermediation, 8, 1999

The analysis' results show a U-shaped relationship between capital and risk-taking: in the short term when capital requirements increase, the bank first takes less risk, but in the long run it will undertake more risk. The idea of U-shape of the relationship between capital and risk taking is also shared by Hence Milne and Whaley model. They predict that banks after an increase of the minimum capital requirements, first increase capital and decrease risk and after a period of adjustment increase both capital and risk.

However, the greatness of the Paul Calem and Rafael Rob' work is given by taking into consideration the different level of capital of each bank before the capital regulation was established. The idea was to study how different capitalized banks react differently to new capital regulations. The result highlights an important distinction between the moral hazard problem, in particular, and bank risk-taking, in general. If bank undercapitalized increase their risk after the capital regulation could be seen as a reflection of the moral hazard problem. On the opposite side, incremental risk-taking at higher capital levels, however, occurs when the bank is sufficiently remote from insolvency and its portfolio choice ensures very low probability of insolvency, in other words the hypothesis of moral hazard behavior cannot be detective.

Gerard Genotte and David Pyle in their study "Capital controls and bank risk"[9], they analyze the relationship between the ownership structure of the bank and the bank willingness to take risk. In particular, their study focuses on the impact that a new capital regulation could have on the risk-taking decision and lately on the overall probability of default of a bank.

This kind of analysis was made on the base of two main assumptions: the presence of deposit guarantees and imperfect regulatory control of the risk of the bank' assets.

Using a model that takes into account the loans cost function (loans evaluation costs and loans monitoring costs), they have shown that deposit guarantees have a negative impact on the banking decision process about investments and further, that there exists high probability that an increase in capital requirements will result in a decrease in the level of investment undertaken and an offsetting increase of the asset risk. As a consequence of the increase level of asset risk, the overall probability of default of the bank will increase.

Summarizing, for the authors, the expected effects of an increase of capital requirements is offset by an increase of asset risk.

[9] Journal of Banking and Finance, 15, 1991

The positive effect of a capital increase in reducing the probability of default of the bank is completely eliminated by the increase of the risk added to the balance sheet of the bank.

In other words, the increase of capital requirement of a bank doesn't represent a way to monitoring the risk of the bank and to control its investments and the eventual bad management behavior, but oppositely, can represent an incentive, for the management side, to undertaken riskier investments, as excessive and riskier lending strategy, having lately as a consequence an increase of the probability of default of the bank and financial instability.

This result appears in contrast to what normally we could expect: the increase in capital reduces the probability of bankruptcy, make the bank lending more efficient, and reduces the government subsidy.

For example, **Keeley and Furlong (1990)** after having proved that the return of a bank in case of insolvency are not more normally distributed and thus that the mean-variance framework employed in the earlier studies is inappropriate, they analyze the effect of imposing leverage limits for the bank that in other words means increase capital requirements.

Their study results show that limit on leverage for a bank lead to a decrease in total bank risk and no increase in asset risk. An increase in capital constraint reduces leverage and bank risk but the optimal asset composition is unchanged.

$$\begin{aligned} NPL_{i,t} = \alpha_i &+ \beta_1 GLGR_{i,t} I(NPL_{i,t-1} \le \gamma) + \beta_2 GLGR_{i,t} I(\mathrm{NPL}_{i,t-1} > \gamma) + \\ &+ \beta_3 GLGR_{i,t-1} I(NPL_{i,t-1} \le \gamma) + \beta_4 GLGR_{i,t-1} I(NPL_{i,t-1} > \gamma) + \\ &+ \beta_5 GLGR_{i,t-2} I(NPL_{i,t-1} \le \gamma) + \beta_6 GLGR_{i,t-2} I(NPL_{i,t-1} > \gamma) + \\ &+ \beta_7 X_{i,t} + \varepsilon_{i,t} \end{aligned}$$

As discussed so far, many theories have been developed to study the relationship between capital requirements and optimal banking risk level, producing mixed results and often opposite. However, the workhorse of the traditional banking literature is the model of moral hazard[10]: the moral hazard theory and the capital buffer theory have different implication for how bank adjust capital and risk after an increase in the regulatory capital requirements.

The moral hazard theory shows opposite results about the effect of increase capital requirement on the level of banking risk. In fact, as a consequence bank can either increase or decrease risk. Instead, the capital buffer theory adds an inter-temporal aspect: as long as bank

[10] Stephanie M. Stolz, Bank Capital and Risk-Taking: The Impact of Capital Regulation, 2007

capital buffer remain positive after the increase of minimum requirement, the banks continue to choose the lowest risk investments possible. If capital buffer became negative, bank increase capital and because the bank risk aversion decreases, an increase of the risk undertaken will be recorded.

Stolz in "Bank Capital and Risk-Taking: The Impact of Capital Regulation", has tried in his study to verify the buffer theory. Based on the assumption that banks hold a capital buffer that is substantially in excess of the regulatory minimum capital requirements, he made an empirical analysis on the German banking system to understand whiter banks increase or decrease risk when capital requirements force them to hold higher capital levels. The results found are in line with the capital buffer theory. Banks with low capital buffers tend to increase the risk after an increase on capital requirements. In contrast, banks with high capital buffers, tend to choose the lowest risk investment possible.

To conclude, because of the debate on the efficiency of the regulation activities on the banking risk taking, other studies have tried to examine the disciplinary role of on-site audits on the reduction of excessive risk undertaken by banks.

The on-site audit objectives are:

- Verification of legislative and regulatory compliance
- Assessment of internal policy and procedural conformance
- Establishment of current practice status
- Identification of improvement opportunities

The results of empirical studies argue that on-site audits enhance banking discipline and impose remedial measures on imprudent banks, reduce the excessive risk-taking problem and thus can be seen as a possible tool, instead of capital regulation, to decrease bad management probability.

In the next Chapters the empirical analysis of my work is presented. The intention is to study the behavior of the specific Italian banking system during the last decade.

In fact, the Italian banking system is not excluded from the issues related the problem of ownership, control and risk taking discussed so far. The analysis presented will help to detect and understand the effect of excessive risk taking by Italian management and thus moral hazard problem.

$$\Delta NPL,it = kt + \alpha \cdot \Delta NPL,t-1 + \delta(L) \cdot Xt + \beta(L) \cdot Zi,t + \varepsilon i,t$$

CHAPTER III- Main theories and findings by other authors

Many other authors have already tried to analyze the relationship between non-performing loans and the lending behaviour of the banking system during the recent years, identifying in moral hazard phenomenon the predominant link.

During the last decade, two strands of research in the field of financial institutions have received great amounts of attention. One strand investigates the issue of non-performing loans. The other strand of research investigates the productive efficiency of financial institutions. These studies included the diagnosis of mergers, corporate governance aspects but also agency costs, bad management and moral hazard behaviour.

Following we tried to summarize some of the main theories and findings by other authors that most are in line with our research. The purpose is to compare the different results and assumptions underlying the works. The limits of my analysis, as well as the limits emerged in other studies, emphasize how this phenomenon is the basis of an open debate and the results come from the literature are sometimes completely opposite but still consistent and they finally lay the foundations for further and future discussions.

Some authors have placed their attention primarily on how the growth of non-performing loans is influenced by recent credit policies and other authors on how the rate of growth of gross loans could be the consequence of the past level of non-performing loans accumulated. In fact, it is only studying the same concept but with two different perspectives. For this reason, in our analysis we tried to carry out both of them.

In the study **"Non-performing loan, moral hazard and supervisory authority: the Italian Banking system", (2017), of Cincinelli and Piatti, they** have tried to show how banks with higher non-performing loans ratio tend to adopt more aggressive and riskier lending strategies. Specifically, using a panel threshold regression analysis on a dataset of 298 Italian banks from 2006 to 2014, the authors have tried to analyze the relationship between banks' lending behavior and the level of non-performing loans to prove what they were suspecting: banks with a higher level (over the intrinsic threshold) of non-performing loans ratio tend to adopt riskier investments. The particularity of their work is that, using a panel threshold regression they were able to divide the dataset into two parts (above the threshold value of non-performing loans and below it) and analyze the behaviour of the banks belonging to each part separately.

Specifically, they have focused the attention on the behaviour of banks with a level of non-performing loans bigger than the intrinsic threshold value found. They have shown how this kind of banks are, opposite to what we reasonably could have expected, willing to undertake riskier investments, increasing further the level of risk inside the banks and finally the probability of default. This mechanism is identified inside the paper as a result of moral hazard behavior by banking managers or more simple by bad management.

In other words, banks which have experienced large gross non-performing loans ratio in the past may be more willing to grant credits today even to creditors with low creditworthiness.

The estimated equation of the analysis is reported below and result quite similar to my EQUATION 1.

The dependent variable is the ratio between gross non-performing loans and total gross outstanding loans at time t. The independent variable is the loans growth rate at time t and two lags backward, while the vector X contain a series of explanatory variables as banking specific factors and macroeconomics aspects.

The authors were expecting a negative and significant relationship between banks' loans growth rate and the level of non-performing loans in their dataset.

$$NPL_{i,t} = c_i + \sum_{j=0}^{m} \beta_{1,j} LGR_{i,t-j}(NPL_{i,t-1} \leqslant \gamma) + \sum_{j=0}^{m} \beta_{2,j} LGR_{i,t-j}(NPL_{i,t-1} > \gamma) + \theta' X_{i,t} + \varepsilon_{i,t}$$

They first have estimated the model with no threshold effect at all. The results are reported in the appendix. If the threshold effect is not taken into account the model doesn't show a significant impact of the gross loans growth rate on the stock of non-performing loans at time t, justified by the small increase of lending after the financial crisis on 2008. Moreover, since the deterioration in quality loans occur with some delay, the model (with no threshold value) results inappropriate to spot moral hazard due to the dilution effect.

Even if banks suffer for bad management, the lags included in the model are not enough to let an increase of loans granted to be transformed in non-performing loans. If banks, with previous significant losses, grant additional loans they temporarily reduce the ratio of non-preforming loans since the denominator will increase. However, this effect disappears in the long run. The results are in line with the results of my analysis presented in the next chapter.

Contrarily, the results of the model that takes into account the threshold value show and confirm the presence of bad management in the banking system during the last decade.

The banks above the threshold (with a level of non-performing loans ratio bigger than 15,66%) , after that the dilution effect is eliminated (taken into consideration at least two lags of the GLGR variable), have a positive relationship between non-performing loans ratio and gross loans growth rate and this is consistent to what the authors were suspected: banks may be affected by moral hazard problems.(see the appendix for the result)

To summarize, from the theory of Cincinelli and Piatti, banks with significant previous losses (significant levels of gross non-performing loans ratio) can reduce the non-performing loans ratio temporarily by making additional loans due to the dilution effect. However, banks managers may have to accept riskier positions to get additional loans potentially generating higher future losses. In other words, they support the hypothesis that bank managers behave badly when they face pressure due to the previous losses moral hazard behaviour. However, the analysis conducted from the authors entails limits that we can't leave out. First at all, as we will further explain during our empirical analysis, the absence of past lags of the gross loans growth rate variable makes the model inappropriate in spotting moral hazard behavior. Moreover, the endogeneity issue between the loans growth rate and the current non-performing loans ratio leaves space for further investigations.

Carlo Milani in his paper "What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy", (October 2017), examines the

macroeconomic and bank-specific variables that affect non-performing loans in Italy from 2006 to 2015.

The analysis developed in the paper is different from the analysis conducted by Cincinelli and Piatti, but the results are in line with the theory about moral hazard and bad management presence inside the Italian banking system.

$$NPL_{i,t} = f_1\big(NPL_{i,\text{lag}}, X\text{-}EFF_{i,\text{lag}}, CAP_{i,\text{lag}}, RWA_{i,\text{lag}}, YEAR_t, REGION_i, YEAR_t \cdot REGION_i\big) + \epsilon_{1i,t}.$$

The aim of the analysis was to study the impact of macroeconomics factors on the accumulation of non-performing loans inside the bank's balance sheets during the last decade. In other words, Milani evaluates the effect of macroeconomic but also bank-specific determinants on non-performing loans to understand the relationship between them. Using a dataset of 482 banks operating in Italy over the period 2006-2015 with at least 50 millions of total assets, the power of the analysis is the greatness of the dataset and time laps that include extreme turbulent macroeconomic and financial conditions.

The model estimated is a dynamic panel model:

where ΔNPL is the first difference in net non-performing loans ratio defined as the ratio between net non-performing loans over net total loans, $\delta(L)$ and $\beta(L)$ are two lag polynomial vectors, X is a vector of macroeconomic explanatory variables, Z is a vector of time-varying bank-specific explanatory variables, kt is the time fixed-effect.

Among the vector X of Italian macroeconomic variables, the author included the annual growth of real GDP, expecting a negative relationship with non-performing loans, the ratio between public debt and nominal GDP, expecting instead a positive relationship with non-performing loans ratio.

Contrary, the vector Z include a series of time varying bank-specific explanatory variables as ROE, equal to the ratio between profits and equity, SOLVENCY, equal to the ratio between equity and total assets, SIZE, equal to the ratio between the bank's total assets and the cumulative total assets for all the banks considered in the dataset and the INEFFICIENCY RATIO, equal to the ratio between operating expenses over operating income, which taken as a measure of management inefficiency.

The main hypothesis tested by Milani are:

- H1. Sovereign debt hypothesis: an increase in the debt to GDP ratio implies higher non-performing loans ratio.
- H2. Bad management hypothesis: low cost efficiency and profitability are two signals of poor management skills.H2 is not rejected if the INEFFICIENCY coefficient is positive or ROE coefficient is negative

$$BB_{i,t} = \alpha + \beta_1 CR_{i,t-1} + \beta_2 TIER1_{i,t-1} + \beta_3 LTC_{i,t-1} + \beta_4 E\_TA_{i,t-1} + \beta_5 DEP_{i,t-1} + \beta_6 UNEMP_t + \beta_7 GDP_t + \beta_8 INF_t + \varepsilon_{it}$$

- H3. Moral hazard hypothesis: banks with thin capitalization have moral hazard incentives to increase their riskiness attitude with the consequence of higher non-performing loans ratio. The last hypothesis is not rejected if the SOLVENCY coefficient is negative.

The results of the analysis show robust evidence in favor of the 'moral hazard' and the 'bad management' hypotheses. In other words, Milani supports the theory that bank's managers have a relevant role increasing in non-performing loans ratio after the international financial crisis due to their risk-loving approach.

The conclusion of the research is that during the last decade the macroeconomic explanatory variables do not seem to have a significant impact on the stock level of non-performing loans accumulated inside the Italian banking system. Oppositely, quality and risk attitude of management are more relevant factors. Milani also found evidence in favor of the presence of a too-big-too-fail problem, which increases moral hazard attitude.

Not only Italian researches but many other authors, after the global crisis of 2007-2008, have performed a similar analysis outside Europe. One of the most important work conducted by **Dayong Zhang, Jing Cai, David G. Dickinson b, Ali M. Kutan, in their paper "Non-performing loans, moral hazard and regulation of the Chinese commercial banking system", in 2015.**

The paper examines the impact of non-performing loans on banks behaviour in China. Based on the theory of Jensen and Meckling's (1976), the authors suspect that managers of financial institutions have clear incentives to deviate from the interests of both investors and international regulators. Using a threshold panel regression model and a dataset covering 60 city commercial banks, 16 state-owned banks and joint-stock banks, and 11 rural commercial banks, the authors' aim was to test whether the lending behaviour of Chinese banks exhibit

moral hazard and mainly the relationship between lending decision and non-performing loans ratio exists.

The method used by the authors to find such moral hazard behavior results similar to the method used by Cincinelli and Piatti in their paper presented above. The author used a panel threshold regression model on a dataset of 87 commercial banks for the period from 2006 to 2012 with a total number of 609 observations, to find whether there is a particular threshold value of non-performing loans ratio, such that above that, the risk taken by banks increases and consequently also the probability of a rise in the non-performing loans level.

In other words, previous losses can generate incentives for bank managers to take an excessive risk today. The model used result a follow:

The first explanatory variable is the loans growth rate. The threshold variable is set to be the non-performing loans ratio level. X is a vector that contains other explanatory variables, in particular macroeconomic factors and bank specific variable as size, deposit growth rate and capitalization indexes.

The threshold value estimated of the non-performing loans ratio results equal to 4,81%.

The results of the estimation shown that an increase of the loans growth ratio lead to an increase of non-performing loans when banks have previous significant non-performing loans (bank over the threshold value).

An increase of 15% of the loan growth rate for those banks above the threshold 0.9 - 1.05

$$\Delta Loans_{ijt} = \alpha_{jt} + \alpha_i + \gamma NPL_{i\,t-1} + \sum_k \beta_k X_{ki\,t-1} \quad + \varepsilon_{ijt}.$$

percentage points in the non-performing loans ratio. To conclude also the study of the Chinese financial system supports the hypothesis that bank managers behave badly when they face pressure due to previous losses, leading to further losses as a consequence of moral hazard behaviour. Finally, one of the main aspect to be considered in this model, which will be also present in our empirical analysis, is that the contemporaneous effect of loans growth rate on non-performing loans ratio for banks (over the threshold) is negative while the lagged effect remains positive and higher in value. In fact, the so-called dilution effect is designed to disappear in the short term, underling a positive relationship between non-performing loans and loans growth rate and thus moral hazard behaviour.

However, the limited data available for certain bank groups and the continuously changing of the regulatory environment in China, could make the threshold value changes over time and should therefore be interpreted with caution.

Berger and De Young in the paper " Problem loans and cost efficiency in commercial banks", 1996, by using the Granger-causality analysis on a dataset of US commercial banks from 1985 -1994, they have tried to test a set of hypothesis that describe the inter-temporal relationship among problem loans, cost efficiency, and financial capital. They refer to these hypothesis with the mnemonics "bad luck", " bad management" ,"skimping" and "moral hazard". Under all these assumptions, the authors were expecting that an increase in non-performing loans grander- cause decrease in measure cost efficiency, consistent with the hypothesis that the extra costs of administering these loans reduces measured cost efficiency or in other words that non-performing loans will be negatively associated with cost efficiency. The data also suggest that low levels of cost efficiency Granger-cause increases in non-performing loans, consistent with the hypothesis that cost-inefficient managers are also poor loan portfolio managers ('bad management').

Focusing on the moral hazard hypothesis, the authors referred to the classical problem of excessive risk-taking and they were expecting that low financial capital will Granger-cause high non- performing loans. To test this aspect they used the granger-causality model :

Where NPL is the ratio between the non-performing loan and total loans, X-EFF is the short term cost efficiency, CAP is the equity capital ratio calculated by total equity capital divided by gross total assets, RWA is the ratio between total risk-weights assets and gross total assets, and the other variables account for change in regional economic condition over time.

The results of the estimation support the moral hazard hypothesis and have shown evidence that banks with relatively low capital (with CAP(- 1) less than sample median in individual) years respond to moral hazard incentives by increasing the riskiness of their loans portfolios, which results in higher non-performing loans on average in the future. For the typical low-capital bank, a one standard deviation reduction in CAP (from 0.0712 to 0.0578) predicts a cumulative increase in the non-performing loans of 3.8 percent. Again, this result likely understates the reduction in loan quality for individual banks that are subject to significant moral hazard incentives.

As mentioned at the beginning of this paragraph, the argument has no shortage of debate and opposing hypothesis are tested and proved. This is why we will proceed with two different

AUTHOR	SCOPE	METHODOLOGY	FINDINGS
Cincinelli and Piatti 2017	Identify the existence of opportunistic behavior in the Italian banking system	Using a panel regression analysis on a dataset of 298 Italian banks from 2006 to 2014.	Banks with previous high level of losses are willing to take riskier investment generating an even further high level of NPLs. The cause is detective in moral hazard and band management.
Carlo Milani 2017	Identify macroeconomic impact on NPLs during the last decade.	The dataset consists of all banks operating in Italy with at least €50 millions of total assets over the period 2006-2015 for a total of 482 banks.	Macroeconomics event have small impact of the NPLs, quality and risk attitude of management are more relevant factors. Bad management suspects are found.
Zhang et al. 2015	Examine the impact of NPLs on bank behavior in China especially on lending strategies.	The sample consists of 87 Chinese banks during 2006-2012.Using a threshold panel regression the model tests whether lending decisions of Chinese banks exhibit moral hazard.	The results support the moral hazard hypothesis, suggesting that an increase in the NPLs ratio raises riskier lending, potentially causing further deterioration of the loans quality and financial system instability.
Berger and De Young 1996	Test the hypotheses regarding the relationships among loan quality, cost efficiency, and bank capital.	Granger-causality techniques on a dataset of US commercial banks from 1985 to 1994.	Data support the moral hazard hypothesis, and suggest that, on average, thinly capitalized banks take increased portfolio risk, which results in higher levels of problem loans in the future.
Cuccinelli 2015	The Impact of NPLs on Italian Bank Lending Behavior during the last decade	The sample consists of 488 listed and unlisted Italian banks observed 2007-2013. Panel data estimation and Fixed effect regression is used	Findings show a negative impact of credit risk (NPLs) on bank lending behavior. After the crisis, banks, have reduced credit to retail clients as well as firms. (Credit Crunch)
Accornero, Alessandri, Carpinelli, Sorrentino. 2017	Study the influence of NPLs on the supply of bank credit to non-financial firms in Italy between 2008 and 2015.	Using a large panel of 500 Italian Banks from 2008 to 2015 and a non-financial frim dataset for a total of 4 million of bank-firm relationship.	Banks' lending behavior is negatively affected by the level of NPL ratios. This relationship is not due to NPLs but mostly generated by changes in firm's firm-related factors as capital ratio and size and turbulent economic conditions.

type of analysis. (EQUATION 1 , EQUATION 2)

Doriana Cuccinelli, in her paper "The Impact of Non-performing Loans on Bank Lending Behavior: Evidence from the Italian Banking Sector" 2105, analyses the Italian

banking lending behavior during the financial crisis to understand if an increase of credit risk during this period could influence, increasing or decreasing, the lending activity.

Reasonably a positive result would have been the evidence of the moral hazard or bad management behavior inside the Italian banking system. However, findings show a negative impact of credit risk on bank lending behavior.

The research hypothesis of the paper is the following: **an increase in bank credit risk in period t-1 leads banks to supply less credit in period t.**

The sample used consists of 488 Italian banks listed and unlisted, 412 cooperative and 76 commercial banks (in term of total assets, sample represents 75% of total Italian banking system). Data are based on annual frequency for 2007-2013 for a total of 2928 observations.

The fixed effect regression presents the following form:

The dependent variable, bank behavior (BB), is measured by the growth of gross loans rate at time t. The independent variables are macroeconomics variable as the unemployment growth rate at time t (UNEMP), the inflation growth rate at time t (INF) and the GDP growth rate at time t and banks' specific variables as the non-performing loans over gross loans (NPL) and the loan loss provision ratio (LLP) as measures of the credit portfolio quality (CR), the loans to deposit ratio at time t-1 (LTD) and the growth of total customer deposits at time t-1 (DEP) which are measures of banks' funding activity, for which, the author expects a negative and a positive sign, respectively. Moreover, is taken into consideration the equity-to-total assets ratio at time t-1 (ETA) which represents the key measure of bank solvency indicating that banks with a higher solvency are more willing to lend, so we expect a positive sign. Finally, the Tier 1 ratio (TIER1) as measure of a bank's capitalization. The increase in ratio is achieved by increasing capital or reducing lending therefore, a negative sign is justified.The results from the estimation of the model show if the credit risk is an important determinant of the bank lending behavior impacting negatively and significantly.

In other word, an increase of non-performing loans leads banks in a decrease of the propensity to grant new loans.

With regard to the other variables, as expected, GDP growth rate shows a positive impact on the bank lending behavior, while unemployment rate displays a negative impact. An increase of customer deposits influences positively the bank lending activity. If banks have high deposits, they are more willing to grant more loans.

The analysis of Cuccinelli represents a different stream other than the works presented previously. In fact, in contrast to the theories previously presented this analysis confirms that,

since the financial crisis, banks have started to take less risk as a result of the past increase in credit risk. Taking less risk leads banks to reduce their credit lines and thus shows a slower growth rate in gross loans. The phenomenon is often referred to the term credit crunch.

In other words, for the author, a reasonable negative relationship between non-performing loans ratio and loans grow rate is highlights and nor moral hazard behaviour and neither bad management is detective inside the Italian banking system during the last decade.

Accornero, Alessandri, Carpinelli, Sorrentino, in their paper "Non-performing loans and the supply of bank credit: evidence from Italy", (2017), have performed an analysis to understand the influence of non-performing loans on the supply of bank credit to non-financial firms in Italy between 2008-2015. The aim of their work is really similar to ours and represents the fundamental concept that is at the base of this discussion.

To examine the impact of the level of non-performing loans ratios, the authors used a large panel of over 500 banks with the aim of assessing how non-performing loans weighs on credit supply and a non-financial firm level dataset for a total of more than 4 million bank-firm relationships. For every firm the information on the amount of credits obtained by any bank operating in Italy and for every bank are collected together with a large set of balance sheet indicators, including the non-performing loans ratio.

They estimated a credit supply equation where non-performing loans ratio is one of the potential driver of banks' lending strategies.

The dependent variable is the yearly (log) growth in credit granted by bank i to firm j at time t, while ai is the fixed effect that let the equation be interpreted as a supply of credit equation.

The most important explanatory variable is the bank-specific non-performing loans ratio. **The hypothesis tested is**: **banks with high non-performing loans ratio should have lent less to firm j for any given level of borrower characteristics. In other words, the hypothesis been tested is that $\gamma < 0$.** The equation also includes bank fixed effects (α) and various bank-level variables controls (X).

A negative correlation between non-performing loans ratio and loans gross rate is found in line with the results of the study of Cincinelli just presented above.

However, the negative correlation found between non-performing loans ratios and credit growth over the 8 years of analysis is almost entirely driven by firm-related factors. In fact, once these are properly accounted for, a bank's lending behavior appears to be unrelated to its

non-performing loans ratio. The results of the estimation let the authors to conclude that the level of non-performing loans ratios "per se" does not influence bank lending decisions.
The authors found that other bank-related factors such as capital ratios and size actively influence credit supply during the period under consideration rather than the non-performing loans ratio and thus the credit risk of a bank.
The negative correlation found in the data is mainly due to turbulent economic condition that cause negative effect on both the level on non-performing loans ratio (increasing it) and on the credit demand by the non-financial firms (decreasing it). Naturally, the model presented is not exempt from limits. The results might be biased by the period taken into account, a period of extreme macroeconomic weakness. Probably, in stronger economic conditions an increase of the credit demand is likely as well as the possibility that high non-performing loans ratios might directly influence the credit supply.

The literature about this topic is really wide. However, the most authors have focused on the study of the factors influencing the non-performing loans with greater attention to macroeconomic variables and specific banking factors as the lending growth rate.
Other authors, separately, have studied the factors affecting the lending policies of the banks focusing on a series of macroeconomics factors and banking specific variables.
Our work stands somewhere between these two strands. The main idea was to study from two different perspectives the same phenomenon: the relationship between the stock of non-performing loans accumulated inside the banks and the banking lending policies chosen by the Italian managers during the last decade. From this idea, the two different models were constructed.
The assumption at the base of our study was the idea that managers of the Italian banks during the last decade have taken decisions without considering the level of investment risk but other factors, as well as private awards and monetary compensations.

All the relevant studies presented in this chapter are briefly reported and summarized in the table below.

INTO THE EMPIRICAL ANALYSIS

CHAPTER IV-Model, Data, Descriptive Statistics and Expected results

Analyzing the lending strategy behavior of a sample of banks, it's a complex procedure to be implemented. A lot of literature has already tried to understand the intrinsic relationship between the amount of gross non-performing loans inside the bank's balance and other factors that could influence the annual decision of the banking managers to grant loans. In this work, we decided to conduct a particular and customized type of analysis. The intention was to take into account only some of the possible aspects than in our opinion could influence the implementation of a particular banking lending strategy. Moreover, we further decided to consider only a finite number of banks which became the "characters" of the dataset. To make this analysis possible, we proceed following a series of steps:

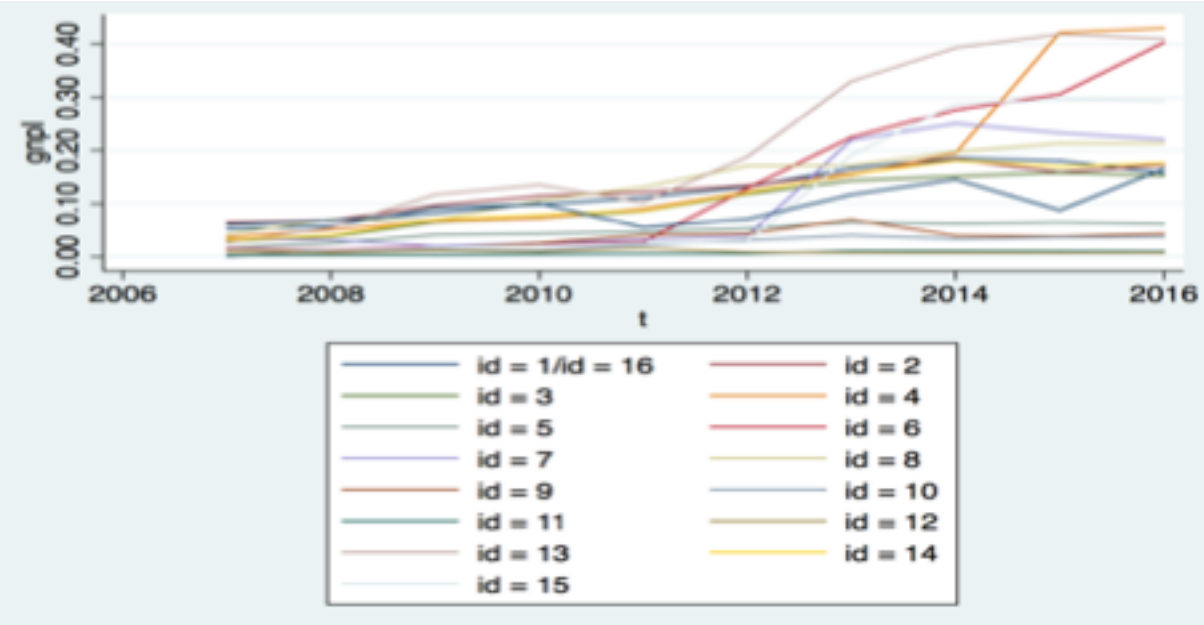
1. Decide a rule to choose which kind of banks transform in the "character" of our study
2. Decide the aspects and variable to use, in other words construct the models
3. Collect from the balance sheet and income statement all the data required from the analysis and properly analyze them calculating the ratio useful for make the model possible
4. Construct the dataset, which was one of the part that required major effort
5. Conduct a Panel Data regression model analysis using the statistic software Stata 13
6. Discuss about the results and the efficiency of the models and expand it to investigate further aspects
7. Make the appropriate conclusions.

The rule that we decided to establish was to focus the study and to analyze only the behaviour of the main banks of an European country. Then, we restricted the circle only on the Italian scenario and after we picked up the first 16 main banks for capitalization recorded in 2017.
The collection of the data used to construct the dataset has been implemented both with the use of Eikon database and with the direct consultation of the aggregated balance sheets and aggregated income statements of each banks. The observations concern the periods of nine years from 2008 to 2016 with an annual frequency for a total of 144 observations.
A panel data estimation is the best statistical analysis for this work. Generally, most applications of multiple regression are performed on datasets with purely cross-sectional or purely data of time series.
Despite these two cases are very frequent, a joint use of cross-sectional dimension and time series is increasingly used in empirical research. Datasets of this type can be construct in two ways. On the one hand, a set of pooled cross sections is obtained by sampling randomly from large population at different time points. Key aspects of subsequent analysis are independence between observations in that it excludes any correlation in the error terms of the various observations. A panel data set instead follow the same individuals over time. As such, panel data consists of researcher's observations of numerous phenomena that were collected over several time periods for the same group of units or entities. Panel data means more information, and more information means more costs in term of effort. Using panel data allows to work with more information than simple dataset, including more variability and thus reducing collinearity between the variables. In addition, panel data allow to study the dynamics of variation of the data because “follow” it over time. Normally the panel data are structured and used to verify if the hypothesis of the existence of a linear function between the dependent variable and a k number of independent variables is checked.
The collection of data, their cleaning and the preparation of the dataset are the most important stage of the whole study. In fact, solid models can be constructed from solid datasets. Otherwise if the dataset lacks consistency or precision the whole study could be consider biased.

After we have stablished the “terrain and the boundaries” of the analysis, which kind of banks analyze and after that the data have been collected from the aggregated balance sheet and income statement and the dataset has been constructed, we proceed with the fifth step of the process: conduct the panel regression model analysis using the statistic software Stata.

The scope of the analysis is to find evidence of moral hazard behaviour inside the Italian banks of the sample during the last decade.

Because of the sample encompasses the 16 most capitalized Italian banks, it could be regarded



as a proxy to identify a general trend of the banking sector. Of course, as will be pointed out later, that claim suffers from pretentiousness.

The analysis is based on the estimation of two different type of Panel data regression that will be performed on the same dataset. The intention is to find general conclusions upon the lending strategy behaviour of the sample and the relationship of it with the stock of non-performing loans.

The first analysis (**EQUATION 1)** wanted to study the factors that influence the non-performing loans ratio inside the bank's balance sheet at time t focusing on the impact of the lending strategy decisions implemented by the management.

The second analysis **(EQUATION 2)**, wanted, inversely, to study the factors that influence the lending strategy policies of the Italian banks, including the non-performing loans already accumulated. The two analyses can be defined as the study of the same phenomenon but analyzed from two different perspective.

In other words, we have built two models which talk each other with the aim of reaching a common economic meaning.

4.1 – Model 1: Specification and hypothesis tested

The first model which I have decided to study is defined as :

$$\begin{aligned} GNPL_{i,t} = {} & \beta_1 GLGR_{i,t} + \beta_2 GLGR_{i,t\text{-}1} + \beta_3 GLGR_{i,t\text{-}2} + \beta_4 MARGIN_{i,t} \\ & + \beta_5 \log (SOLVENCY)_{i,t} + \beta_6 \log (SOLVENCY)_{i,t\text{-}1} \\ & + \beta_7 \log (SOLVENCY)_{i,t\text{-}2} + \beta_8 ROE_{i,t} + \beta_9 DEP_{i,t} + \beta_{10} CAR_{i,t} \\ & + \beta_{11} TIER1_{i,t} + \beta_{120} SIZE_{i,t} + \beta_{13} RGDP_{i,t} + u_{i,t} \end{aligned}$$

The error term can be decomposed in two parts:

$$u_{i,t} = a_i + \varepsilon_{it}$$

Both the parties are unobservable called a fixed effect and an idiosyncratic error, respectively. Two are the observations that must be done:

- Adding lags of the GLGR and SOLVENCY variables makes the model well defined because the amount of non-performing loans present today in a bank's balance sheet is mainly due to past credit policies and in general to past bank' factors, decisions and results. The presence is nothing but a collection of past mistakes. However, the lags are limited on two years and, as we will discuss further later, the limited time laps could represent a downside of the significance of my model.
- The transformation of the variable SOLVENCY in LOG (SOLVENCY). There are different reasons for taking the log of a variable. A log transformation can help to linearize and stabilize the series. A typical use of a logarithmic transformation variable is to pull outlying data from a positively skewed distribution closer to the bulk of the data in a quest to have the variable be normally distributed. Moreover, the transformation on log form is useful for the interpretation of the data. The standard interpretation of coefficients in a regression analysis is that a one-unit change in the independent variable results in the respective regression coefficient change in the expected value of the dependent variable while all the predictors are held constant. Interpreting a log transformed variable can be done in such a manner. However, such coefficients are routinely interpreted in terms of percent change. In this specific case, the transformation of the variable SOLVENCY will be useful to identify the with and the sign of the change of the variable on the amount of total non-performing loans.

The **GNPL** variable, the dependent variable, is the ratio between non-performing loans and total outstanding loans for bank i at time t.

The **GLGR** variable, expresses the loan gross growth rate for bank i at time t and it is lagged one and two periods backwards.

The other variables included in the model as control variables and keeping constant during the estimation of the coefficient between GNPL and GLGR, are specific banking and macroeconomic variables that will be explained in detail in the next paragraph between with their main descriptive statistics and the expectation of the sign of their coefficients.

The study of the EQUATION 1 is aimed to understand whether the banking lending behavior has any effect on the deterioration of banking loans during the recent years.

If we consider the sample a good proxy to analyze the Italian banking scenario, we reasonably expected a negative relationship between the stock of non-performing loans at time t and the recent past banks' loans growth rate. Opposite results would indicate the moral hazard presence.

If at time t the stock of non-performing loans has increased, it could be due to an extreme aggressive and expansive lending strategy by the management a time t and some periods lagged, and moral hazard behavior could be detective.-

Research hypotheses is the following: 1) An increase in the stock of bank deteriorated loans in period t could be the consequences of contemporaneous and recent past bad lending strategy by the banking managers

4.1.1 Data and expected results for EQ1

The analysis performed on the EQUATION 1 to analyze the evolution of non-performing loans inside the Italian bank's balance sheet and mainly to spot moral hazard behavior, uses as a dependent variable the ratio between gross non-performing loans at time t and the contemporaneous total gross loans to customers.

The GNPL variable is defined as the ratio of bank non-performing loans to total gross loans at time t. The information relative to the bank's total gross loans are contained in the asset side of the aggregate balance sheet and are reported, as all the data in the dataset in Billions of euro.

$$\textbf{GNPLt} = \frac{NPL(t)}{TotalGrossLoans(t)}$$

The evolution of the non-performing loans in Italy after the financial crisis of 2008 is mainly due to the concession of loans to customers and small medium enterprises (SMEs) that were not able to pay-back the credits.

Calculating every year the **stock** accumulated in the balance sheet of non-performing loans over the loans granted to customer, it's a good ratio to understand the dynamics of this aspect. The ratio represents the percentage of bad loans respect to total loans been granted.

Naturally, the dynamics of the ratio it's simply to spot, it increased exponentially after the crisis. The Italian non-performing loans over total loans' evolution is represented by an increasing curve over the last decade which shows how the total non-performing loans ratio has risen consistently over time.

Only during the 2016 a slight decrease is recorded due to the slowly economy recovery.

Here below the evolution of the GNPLs variable for the 16 banks collected in our dataset from 2007 to 2016 is reported. We can notice how the non-performing loans ratio over the last decade has followed an increasing evolution starting mainly after 2011. In fact, the effect of deteriorated loans start to be evident some year after of 2008, due to the period necessary for the loans to be converting in non-performing loans.

Figure 7- The Evolution of GNPL ratio from our dataset

In the EQUATION 1 the dependent variable, the GNPL is regressed on a set of explanatory variables with the aim of explaining which factors actually affect the amount of non-performing loans in the bank balance sheet and consequently understand the banks choice in term of lending behavior.

Following are reported all the explanatory variables used for the specification of the models. The choice of the introduction of these variable is a consequence of a reflection about the aspects that in our opinion influence the bank behavior and loans quality.

First, the variables that represent specific bank factors are considered and subsequently the macroeconomic variable used to better contextualize the analysis.

The most determinant explanatory variable used is the annual gross total loan growth rate.

$$\textbf{GLGR} = \frac{TotalLoans(t) - TotalLoans(t-1)}{TotalLoans(t-1)}$$

The rate represents the percent change of loans to costumers granted from one year to another and it is a key variable to spot moral hazard behaviour. Despite the banking management have expected to register high level of non-performing loans, in the recent past they were inclined to take more aggressive lending strategies.

However, the time laps taken into account in the first model is too short to make evidence of the existence of a relationship between GNPL and GLGR. (The time laps too small to convert new loans grated in non-performing).

Normal loans growth rate associated with standard banking operations may reduce the non-performing loans ratio. However, an abnormal loans growth rate would indicate a moral hazard behavior, causing subsequent further losses and an increase of GNPL itself.

The second explanatory variables used is:

$$\textbf{MARGIN} = \frac{IntermediationMargin(t)}{TotalAsset(t)}$$

Intermediation margin over total asset at time t is the subsequent explanatory variable we have considered.

The intermediation margin is defined as the sum of net fee and commission income and income from financial service activities.

It represents a good indicator of the profitability of the lending activity of a bank.

The intermediation margin over asset, called also unit interest margin, expresses the contribution of credit intermediation activities to the overall profitability of the bank.

The intermediation margin of a bank is influenced by the rates charged on loans, which are higher on risky loans (loans that are likely to became non-performing loans).

In the long term, banks with higher intermediation margin are more profitable and thus are more willing to take riskier investments. Therefore, we were expecting a positive relationship between the banking intermediation margin and the stock of non-performing loans. If the banks have profitable margin, it assumes more risk and the likelihood that new loans become non-performing loans will increases.

The third explanatory variable used is:

$$\textbf{SOLVENCY} = \frac{Equity(t)}{Totalasset(t)}$$

Solvency is equal to the ratio between equity and total assets (solvency ratio).

This variable expresses the ability of a bank to pay its long-term debt.

Solvency directly relates to the ability of an individual or business to pay their long-term debts including any associated interest. To be considered solvent, the value of an entity's assets, must be greater than the sum of its debt obligations. Various mathematical calculations can be performed to help to determine the solvency of an institution.

While solvency represents a company's ability to meet long-term obligations, we refer to liquidity as a company's ability to meet its short-term obligations.

If a time t the bank shows an high level of non-performing loans given by an expansive lending strategy during the past recent years t-1 and t-2 and thus there is a suspect moral hazard behaviour by management, It should be noted that this kind of moral hazard is partially compensated/justified by an higher profitability (MARGIN) and by high solvency ratio during the time t-1 and t-2. This stems from the fact that the latter two variables have a relationship with the non-performing loans ambiguous or even insignificant.

Roe is another variable used in my study:

$$\textbf{ROE} = \frac{NetProfit(t)}{Equity(t)}$$

Return on equity (ROE) is the amount of net income returned as a percentage of shareholders' equity. It measures the banking profitability by revealing how much profits an institution generates with the money that shareholders have previously invested. ROE is expressed as a percentage and is expected to be negative related with the stock of gross non-performing loans inside the balance sheet of a bank.

Actually, it is not easy to make predictions about the sign on the relationship between the annual ROE of a bank and the stock of non-performing loans recorded. In general, low levels of Return on Equity, stimulates the managers to take more investments, which if in the long run they turn out to be non-performing, then a positive relationship with the stock of non-performing loans can be detective.

The fifth explanatory variable is:

$$\textbf{DEP} = \frac{Deposit(t) - Deposit(t-1)}{Deposit(t-1)}$$

It's the variable indicating the annual growth of deposits from customers collected by a bank. In other words, it's a liquidity indicator because it represents the direct deposit or the direct collection that a bank is able to perform during a year respect to the previous one. The direct banking collection is the set of transactions carried out by the bank to secure its financial resources. Here, we take into account only the retail banking operations. These are banking operations between the bank and the private individuals. Within it are instruments such as bank deposits and bank accounts. Conversely the collection by securities is not taken into account.

Determine the sign of the relationship between deposit growth rate DEP at time t and the stock of non-performing loans it's difficult because deposits are an important part of bank balance sheet, influencing the loan quality. In fact, more liquid bank willing to undertake riskier investments, leading to a positive influence of the stock of non-performing loans recorded by the bank.

Also some capitalization indexes are included in the model:

$$\textbf{CAR} = \frac{Tier1 + Tier2}{TRWAt}$$

The capital adequacy ratio (CAR) is a measure of a bank's capital. It is expressed as a percentage of a bank's risk weighted credit exposures. This variable it is used to protect depositors and promote the stability and efficiency of financial systems around the world.

If bad management behaviour is presented in the model an ambiguous relationship between CAR and non-performing loans is expected. In other words, more capitalized banks are justified to take riskier activity but if the risky investments are taken by less capitalized banks, a suspect of moral hazard behavior can be found**. Banks with a low level of capitalization are driven by moral hazard incentives to increase the risk of their loans portfolio. This increased risk translates into an increasing number of non-performing loans, even if with some time lags.** However, the positive relationship between CAR and GNPL could be also justified by the fact that risky investments are taken by more capitalized banks and not

necessarily by the presence of moral behavior. Being my dataset consisting of the most capitalized banks, we were expecting a positive relationship between the two variables also in the absence of moral hazard behaviour. **For this reason, the capitalization variables introduced are important to well specify the model but are ambiguous in determining the presence of moral hazard.**

The second capitalization index used is:

$$\textbf{TIER1} = \frac{Tier1capital}{TRWAt}$$

It's the main important variable to take into account the capitalization of a bank. It is expressed as the ratio between the tier1 capital and the total risk weighed assets.

The TIER 1 Capital is a size defined by the Basel Committee, which identifies the main components of a bank's own capital. It represents the amount of capital that allows to absorb losses without affecting the interests of depositors. It is given by the share capital, the unavailable budgetary reserves and the profits not distributed to the shareholders and accrued during the life of the bank. Equity capital is inclusive of instruments that cannot be redeemed at the option of the holder.

The risk weighted assets, represent the main risk factors attributable to a given financial asset. Measuring Risk-Weighted Assets is of great importance, especially in the banking sector. Indeed, the Basel Committee, in the process of defining international capital requirements rules, calls for and regulates risk-weighted assets for the purposes of calculating the banks' capital adequacy ratios.

An optimal level of Tier 1 Capital ratio should be 8%, and for Basel II should be at least 6%. Banks that do not meet this level of the index are often called by the market to capital increase efforts to restore a balance between financial sources and loans that will ensure the bank's persistent stability over time.

The relationship expected between TIER1 and GNPL is similar to the relationship expected for the CAR variable. A positive relationship between GNPL and TIER 1 could be due to the fact that risky investments are taken by more capitalized banks but also by the fact that a low level of capitalization could stimulate the management to increase the risk of their loans portfolio giving rise to moral hazard phenomenon. Therefore, the positive relationship between CAR and GNPL is not necessarily the proof of the presence of moral behaviour.

A variable useful to distinguish the small banks from the bigger one is introduced:

$$\textbf{SIZE} = \text{LN}(\text{Asset}_t)$$

The size variable it's simply the natural logarithm of the total asset of a bank at time t. The **SIZE** variable, is introduced in the model to differentiate the bank inside my sample based on the total assets owned.

It represents a standard unit of measurement to differentiate the banks in my dataset. The size variable is expressed as a number between 1 and 10. It's simply a scale, where a number near to one represent the smaller banks of our dataset in term of total asset owned, while a number near to 10 represent the bigger one.

In some research conducted, the size of the bank was used as a proxy of bank diversification level. Greater diversification should correspond to a smaller number of non-performing loans, because diversification is the most effective tool to decrease credit risk. In particular, Salas and Saurina (2002) found statistical significance that larger banks correspond, in proportion, to a smaller number of non-performing loans, confirming the hypothesis that **the bigger is the size of the bank the greater is the diversification opportunities and the smaller the amount of non-performing loans**.

Moreover, large banks should be more able to assess the creditworthiness of the counterparts and thus at the end a negative relationship between bank size and GNPL is expected. **Contrarily, a positive relationship between SIZE and stock of non-performing loans could signal the presence of too big to fall problem which increase moral hazard attitude. Large banks have an implicit guarantee from governments under the presumption that they are too big to be left to fail.** Thus, this bank has moral hazard incentives to take excessive risks by increasing their leverage, with the consequence of having more non-performing loans.

Finally, a macroeconomics variable, the annual gross growth rate of Italian domestic product is introduced to understand if macroeconomics conditions and mainly changes of the economic environment can be considered factors that have contribute to the increase of the stock of non-performing loans.

$$\textbf{RGDP} = \frac{GDPt - GDPt - 1}{GDPt - 1}$$

This is a macroeconomics variable useful to contextualize the analysis. The real gross domestic production rate represents the annual increase or decrease of the Italian GDP from the 2007 to 2016. It's an important variable because through the use of it we can spot if there exists a relationship between the growth of the non-performing loans inside the bank's balance sheet and macroeconomics event as a financial crisis which probably affects the GDP growth rate. We were expecting a negative relationship between GDP growth and GNPL. Period of recession during the last decade had a negative impact on the economy as a whole and on the banking system, deteriorating the quality of the credits. Vice versa, many authors support that macroeconomic variables have a limited impact on the dynamics of the bank's balance sheet even during a period of extreme macroeconomic and financial conditions. Quality and risk attitude of management are more relevant factors. [11]

Finally, the sign of this relationship is uncertain, and many authors have already tried in their studies to explain the impact of macroeconomics changes on the bank losses.

Carlo Milani, in his paper "What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy*",* has studied the factors that could explain the dynamics of non-performing loans. In particular, he has introduced in the model macroeconomic variables and he has noticed that macroeconomic event has a limited effect on non-performing loans stock. Milani instead, affirms that quality and risk attitude of management are more relevant factors than extreme macroeconomic and bad financial conditions in the determination of non-performing loans. Conversely, Carey in his study "Credit risk in private debt portfolio", 1998, has argued that a change in the economic condition is the most important systematic factor affecting bank losses.

The analysis of EQUATION 1 is useful to create a first idea about the lending strategy of a bank and its relationship between the non-performing loans stock, which will be further investigated in the second analysis (EQUATION 2).

As we discussed in the chapter dedicated to the literature review, bad management can induce, by expecting a rise in the non-performing loans stock, to take additional risk in a way to reduce the losses in the short term through higher level of lending. This mechanism can give rise to a dilution effect and the non-performing loans in percentage can decrease. However,

[11] Carlo Milani, What factors affect non-performing loans during macroeconomic and financial turbulence? October 2017

the duration of this effect is temporary and the consequences of too risky lending strategy in the long run could be the increase of non-performing loans stock itself, creating what I will define as vicious circle.

The results and the limits of the first model will be presented in the next chapter.

4.2 – Model 2 : Specification and hypothesis tested

The intention was to run a second model with the aims of investigate whether there exists a relationship between the annual banking gross loans growth rate a time t and the stock on non-performing loans inside the bank balance sheet at time t and some lags of it (that became my proxy for considering the credit risk of the bank). The idea is to construct a model to find the proof of what we suspected earlier during the first analysis: an aggressive lending strategy by the management of a bank without taking into account high level of non-performing loans already existing in the bank's balance sheets, could give rise to moral hazard behaviour.

We decided to estimate a credit supply equation where annual non-performing loans stock became a potential drive of banks' lending strategies.

Since a credit, to be transformed in performing or non-performing, needs some time (the time of realization of the obligation) which is on average bigger than two years, we decided to make an analysis that could be significant taking instead into consideration more recent factors. In fact, the lending strategies decided by a bank, or better by the management of the bank at time t, are influenced by multiple "recent past" factors.

It id important to specify that, this is an assumption of the model and it is simply based on the idea that managers use to look only to the recent past when are calling to take decisions today, ignoring the more past performance of the organization.

To summarize, while for a credit to became non-performing it is necessary on average more than two years (EQUATION 1 is not well specified), the factors that influence the lending strategy of the bank today are assumed to be more recent factors.

We have assumed that actual funding decisions are influenced by the recent level of non-performing loans stock recorded in the bank' balance sheet by other banking factors, economic conditions the behaviour of the economic system.

The **EQUATION 2** is defined as:

$$GLGR_{i,t} = \beta_1 LOG(GNPL)_{i,t} + \beta_2 LOG(GNPL)_{i,t-1} + \beta_3 DEP_{i,t} + \beta_4 ROE_{i,t} + \beta_5 \mathbf{MARGIN}_{,t} + \beta_6 \mathbf{CAR}_{i,t} + \beta_7 RGDP_{i,t} + u_{i,t}$$

The error term can be decomposed in two parts:

$$u_{i,t} = a_i + \varepsilon_{it}$$

The dependent variable is the rate of growth of loans to customer from time t-1 and t and can identify better with GLGR.

The GLGR variable together with the GNPL are the key variables of my study.

While during the first analysis, the GLGR is only uses as one of the independent variables and in absence of moral hazard it's expected to be negative related with the amount of GNPL, in the second model it represents the object of our study. Here again the relationship between gross growth loans rate and the stock amount of non-performing loans is expected to be negative in the absence of moral hazard.

The information relative to the loans growth rates are contained in the asset side of the consolidated balance sheet and is reported in the dataset in Billions of euro.

The annual growth loans rate is the key element that summarize the lending strategy of a bank. An increase of the annual loans growth rate represents the implementation of an expansive lending strategy by the managers. On the opposite side, the reduction of the ratio represents a restrictive lending policy by the bank. This is the reason why this variable could be important to determine if a bank implements an aggressive lending strategy even if the bank recorded past high stock on non-performing loans in the balance sheet, signaling therefore the presence of a moral hazard behaviour.

4.2.1. Data and expected results for EQ2

It's reasonable to expect a negative and significant relationship between bank's loans growth rate and level of non-performing loans ratio in the Italian Banking system.

In my opinion, banks with recent past high stock of non-performing loans tend to restrict the credit lending because of the increase of the probability of default (PD), the probability that

Variable name	Description	Use	Expected Sign in EQ1	Expected Sign in EQ2
GNPL	Is the ratio between the amount of gross non-performing loan at time t and the amount of total gross loan to customers at time t.	It's the dependent variable in EQ1 and the Object Independent variable in EQ2	-	Positive relationship with GLGR in presence of moral hazard behaviour
GLGR	Is the annual growth ratio of total gross loans to customer	Analyze the impact of the growth loan over the non-performing loan	Negative if no moral hazard is present or if the dilution effect prevails	-
MARGIN	Is the ratio between the intermediation margin at time t and the total asset at time t.	It's a profitability index of the bank.	Positive with GNPL	Positive relationship with GLGR
SOLVENCY	Is the ratio between total equity at time t and total asset at time t. (solvency ratio)	Express the ability of the bank to pay its long-term debt. Moreover, it's useful to spot the presence of moral hazard problem	Positive with GNPL	-
ROE	Is the ratio between net profit at time t and total equity at time t	Profitability index	Negative relationship with GNPL	Positive relationship with GLGR
DEP	It's the annual growth rate of direct deposit	Liquidity index Indicator of a good or bad implementation of the core business of the banks = bank fund-raising	Ambiguous relationship with GNPL	Positive relationship with GLGR
CAR	Is the capital adequacy ratio	Capitalization and banks' risk index	Positive relationship with GNPL	Positive relationship with GLGR
TIER1	Is the ratio between tier1 capital and total average weighed asset	Capitalization index	Positive relationship with GNPL	-
SIZE	Is the natural log of total asset at time t	Is an index useful to indicate the size of the bank and distinguish one bank from another one	Positive relationship if the problem of too big to fail is detective	-
RGDP	Is the annual Italian growth rate of gross domestic product from 2007 to 2016	Is a macroeconomic variable to contextualize the growth of NPLs	Limited and negative relationship with NPLs	To be defined

new loans can became bad loans and in the long run increase the amount of non-performing

itself.

The credit crunch phenomenon is in fact an economic condition in which investment capital is difficult to obtain. Banks and investors become wary of lending funds to corporations, because lenders are scared of bankruptcies or defaults. As a consequence, the price of debt products for borrowers increase and the rates became higher. In extreme cases, such as the 2008 financial crisis, the rate of bad debt becomes so high that many banks become insolvent and must shut their doors or rely on help in the form of a government bailout to continue as a going concern.

Because of our intention was mainly to analyze the relationship between GLGR and GNPL under the assumption that the lending strategy of the bank is influenced by the "recent" past, we added to the model a lag for the GNPL variable. **In other words, we were interesting to investigate if the lending strategy of a bank at time t is influenced by the non-performing loans ratio at time t-1**.

Variable name		Obs.	Mean	Stv.Dev	Min	Max
GNPL	Overall	144	0.1061736	0.100157	0.0033333	0.4296435
	Between			0.0649378	0.0070985	0.2388755
	Within			0.0777844	-0.0779373	0.357718
GLGR	Overall	144	0.0691328	0.2180065	-0.2821888	1.467391
	Between			0.1010664	-0.0385236	0.2504936
	Within			0.1946377	-0.3185207	1.328836
MARGIN	Overall	144	0.0304015	0.0100297	0.0079365	0.0759804
	Between			0.0078178	0.023589	0.0571579
	Within			0.0065495	0.0051165	0.0546512
SOLVENCY	Overall	144	0.0918274	0.0839454	0.0287803	0.4757967
	Between			0.0830992	0.0509779	0.4009022
	Within			0.0229713	-0.0525748	0.1667219
ROE	Overall	144	0.0335373	0.1976065	-1.069182	0.5655738
	Between			0.135047	-0.2549501	0.2508141
	Within			0.1477528	-0.8968372	0.3718099
DEP	Overall	144	0.1054555	0.5688705	-0.8854368	1.00000
	Between			0.321434	-0.1167394	1.286763
	Within			0.4754724	-1.672166	3.818692
CAR	Overall	144	0.1311734	0.0404361	0.0198058	0.3618
	Between			0.0170243	0.1095007	0.1642463
	Within			0.0369006	0.0310212	0.3287271
TIER1	Overall	144	0.1060604	0.0334602	0.01171	0.2051
	Between			0.0256122	0.07526	0.1810567
	Within			0.0223673	0.0425104	0.1707604
SIZE	Overall	144	3.907827	1.457813	0.3074847	6.952346
	Between			1.477482	1.569008	6.804318
	Within			0.2537499	2.646304	4.82149
RGDP	Overall	9	-0.777777	2.153691	-5.5	1.7

The transformation of the variable GNPL in log-term can help to linearize and stabilize the series to pull outlying data from a positively skewed distribution closer to the bulk of the data in a quest to have the variable be normally distributed. Moreover, the transformation on log form is useful for the interpretation of the data in percent change.

In this specific case, the transformation of the variable GNPL will be useful to identify the with and the sign of a percent change of the gross non-performing loans ratio to the gross loans growth rate.

The other variables introduced in the model and used as control variables are specific factors that can influence the lending strategy decision of a bank and macroeconomics variable.

The way in which the variables are calculated, their significance and the explanation during the presentation of the data for EQUATION 1. In fact, the variables used in the second equation are the same used before, given the intention to realize two model that were linked each other.

Following are presented only the expectations about the relationship between the GLGR at time t and the variables taken into account. For details please refer to the previous paragraph.[12]

	GNPL	GLGR	DEP	SOLVENCY	MARGIN	CAR	ROE
GNPL	1						
GLGR	-0,3585	1					
DEP	-0,2141	0,2602	1				
SOLVENCY	0,3393	-0,00657	-0,00268	1			
MARGIN	-0,2038	0,2055	0,1824	0,0308	1		
CAR	-0,1151	0,2219	-0,0255	-0,0246	0,1468	1	
ROE	0,4024	0,2196	0,1523	0,0018	0,3871	0,0701	1

When banking managers are called to take lending decisions, they used to look at the “recent” past aspects of the bank and they are more influenced by it than by what happened with more lags. In particular is simpler to define whether the amount of the stock of non-performing loans of recent years has influenced, positively or not, the current lending policies of banks. The change on the annual lending strategy of a bank is in fact influenced by a time frame shorter than the time of realization of loans in performing or not.

Reasonably, we could have expected that if the stock of GNPL is high the lending strategy implemented by the bank will be a restrictive strategy, in other words a negative relationship between GLGR and GNPL. A positive relationship could signal, instead, a moral hazard problem. Expansive lending strategy without regard to the stock already accumulated of non-performing loans in the bank’s balance sheets is a threat for the shareholders of the bank and signal that managers are following interests different from shareholders ‘interests.

[12] Data and expected results for EQ1

Reasonable speaking, we could also expect a negative relationship between GLGR at time t and GNPL at time t-1 because banks suffering during the last year of an increase of the amount of gross non-performing loans over total loans, are more likely to adopt restrictive lending strategies. Positive relationship will be the sign of too aggressive lending strategies or better don't thoughtful strategies implemented without regard of the stock of non-performing loans already accumulated inside the bank's balance sheet therefore revealing moral hazard problem.

The choice of the introduction of the other specific banking variables is a consequence of a reflection about the aspects that in our opinion influence the bank behaviour and loans strategy.

Moreover, the **MARGIN** variable indicates the ratio between the intermediation margin and total asset. We expect that banks with higher intermediation margin over asset ratio are conducting a profitable lending strategy that in other words means we expect positive relationship with the loans growth rate.

Bank more profitable tend to grant more loans, leading to an increase of GLGR. However too excessive risky investments can increase the probability of default of the loans been granted, leading in the long term to an increase of the amount of non-performing loans inside the bank's balance sheet (refer to EQUATION 1).

CAR, is a good measure for the bank's risk and if positive related with GLGR could signal lack of prudence by the management side.

But on the other side it's justified that more capitalized banks are willing to increase their investments and thus the loans granted to customers. Also, the level of risk taken sometimes results higher than that one of the less capitalized banks. As we already have underlined in the first analysis, banks with high level of capital adequacy ratio are more willing to grant loans to customers which sometimes involve also an increase of non-performing loans. The level of risk taken by these banks is higher, justified by the fact that more capital can work as a buffer in case of default.

On the other side, if banks less capitalized tend to increase the loans granted, increasing their risky investments without regard of the probability of default, a moral hazard behaviour can be detective.

Moreover, the relationship between the deposits growth rate, **DEP,** at time t and new lending strategy implemented is reasonably expected to be positive. Banks able to perform a good

collection strategy represent banks with more liquidity and they have also the possibility to perform a good and why not expansive lending.

The **ROE** variable is considered in the model an indicator of performance of the bank.

There is no rule that force the banks with higher return on equity to grant more loans. Anyway, a positive relationship is expected.

Finally, the introduction of the macroeconomic variable real gross domestic products growth is important to contextualize the analysis. However, the expected relationship of RGDP with the GLGR is difficult to establish.

Quagliarello in his article published in 2008 from the Bank of Italy "Macroeconomic uncertainty and banks' lending decisions: The case of Italy", he analyzes a sample of more than 900 Italian banks during the period 1990-2004, confirming that the uncertainty about the prospects for the economy (measured by conditioning variance of the inflation rate and the rate of growth of industrial production) plays an important role in the investment decisions of banks. In periods of macroeconomic changes, banks receive noisier signals on the expected returns of loans in the future and, therefore, tend to behave more homogeneously (herding behaviour).

"*Macroeconomic uncertainty is therefore an important determinant of banks' lending decisions and a cause of potential disturbances in financial resource allocation. Since bank loans are a relevant source of financing for the non-financial sector, central banks and supervisory authorities should monitor the degree of uncertainty on the evolution of the main economic aggregates in order to strengthen macroeconomic and financial stability*.[13]"

Following, in the table below we try to summarize all the variables used in my analysis and the expected results.

4.3 – Descriptive statistics

The sample considered for the analysis includes sixteen Italian banks. The panel dataset has a time dimension of nine years, from 2008 to 2016, for a total of 144 complete observations.

The data used are collected at annual frequency. The information are collected from the consolidated balance sheet of each banks and sometimes also with the help of the EIKON

[13]Quagliarello "Macroeconomic uncertainty and banks' lending decisions: The case of Italy", Bank of Italy 2008

dataset. Following we report the summary main statistics relative to both dependent and independent variables used in our models. For each of them, the number of observations is equal to 144, as long as the panel dataset includes 9 yearly observations for each of the sixteen banks composing the sample.

In term of GNPL, the full sample average is 10,61 % indicating the average stock of non-performing loan over total loans recorded in the bank's balance sheet during the last decade.
In term of GLGR, the full sample average rate is 6,9 % indicating the average growth of credit to customers over the last decade.
The level of capital adequacy requirements is reasonably high with CAR average equal to 13,11 % and TIER1 equal to 10,6 %. The CAR percent threshold varies from bank to bank but a common requirement for regulators conforming to the Basel Accords is 10 % and is set by the national banking regulator of different countries.
But on the other hand, it was normal to expected on average high value of capitalization because my dataset is composed by the most 16 capitalized Italian banks.
The indexes of profitability report an average of 3,33 % ROE and 3 % for the intermediation margin over asset ratio.
In the table below are reported the correlations between the main variables of the model. As I reasonably could have expected the correlation between GNPL e GLGR is negative and equal to - 0,3585.

Following is presented an econometric introduction of the general aspects of Panel data analysis and the main models used for Panel data regression estimation performed in the next chapter.
Last, but not least, we will proceed in the last chapter with the presentation of the results obtained from the estimation process.

4.4 – Brief econometric introduction to Panel Data analysis

Following we proceed with a brief econometric introduction to panel data model used for the estimation of our equations.

Three are the main model that have been developed to analyze panel data:

1. Pooled OLS model or First differentiate estimator
2. Fixed effects model
3. Random effect model

Following, we introduce the main aspect of the models that we will use to implement in the next chapter our empirical analysis.

The simpler method of estimation of panel data is the pooled OLS estimator, using, as the name report, the Ordinary Least Square estimator. It's really unlikely that this model is appropriate because as we will see later, is based on assumption that rarely hold, but it represent a guideline for a comparison with more complex model.

More precisely, the pooled OLS estimation is based on a series of assumptions as:

1. **Linearity** = y is a linear function of the independent variables and the error term u_{it}.

2. **Exogeneity** = $E(u_{it}) = 0$ and Cov $(u_{it};x_{it}) = 0$

3. **Homoscedasticity and not autocorrelation** = Var $(u_{it}) =$ and Cov $(u_{11}; u_{12}) = 0$

4. The observation of the independent variables is **not stochastic** but fixed in sample repeated without error of measurement.

5. **The rank is full**, that means no multicollinearity. Multicollinearity occurs when there are correlations between the explanatory variables. In other words, one independent variable can be used to predict another one. This creates redundant information. The absence of multicollinearity ensures that there is no presence of perfect linear relationship between the explanatory variables.

The pooled OLS does not work well since is usually correlated with x_{it} , i.e. Cov$(u_{it}; x_{it}) \neq 0$.

The main alternative to the Pooled OLS are the Fixed Effect and Random Effect model presented below.

Even the fixed effect model is concentrated on the elimination of the fixed effect constant over time but its elimination requires a more complicated procedure than that used in Pooled

OLS and a basic use of linear algebra. The need of eliminate come from the fact that it contains non-observable errors which could be correlated with the explanatory variables x_{it}, returning then a biased estimation.

The elimination of the fixed effect is based on a data-demeaning proceed. It consists on the deduction of the average of the sample from each variable and then conduct the estimation using a Pooled OLS technique.

Remembering that the error term u_{it} can be decomposed in two parts: $\boldsymbol{u_{i,t} = a_i + \varepsilon_{it}}$

The Fixed effect model is based on the assumption that:

1. $E(u_{it} \mid x_{it}) = 0$
2. $Cov(ai; x_{it}) \neq 0$
3. Every explanatory variable change over time and there is no linear relation between the explanatory variables
4. $E(\varepsilon_{it}|X,a_i) = 0$
5. $Var(\varepsilon_{it}|X1,ai) = Var(\varepsilon_{it}) = \sigma_\varepsilon^2$ for each t
6. For each $t \neq s$, the idiosyncratic errors are uncorrelated. $Cov(\varepsilon_{it},\varepsilon_{is}|Xi,a_i) = 0$
7. The error term are iid and distributed as a normal $(0, \sigma_\varepsilon^2)$.

The estimator resulted is called Within Estimator. We refer to the same estimation procedure if we use within estimator or fixed effect estimator indifferently. The name of within estimator came from the fact that the procedure uses the time variation in y and x within each cross-sectional observation. Because of this procedure the within estimator will lose a degree of freedom.

The two models presented at this point give the possibility to eliminate the unobserved heterogeneity in the model. Nevertheless, a question is inevitable: which one we should use to estimate our model, Pooled OLS or Fixed effect?

When T = 2, the answer is simple because the fixed effect model and the Pooled OLS estimator are identical. Also, the same test statistical are identical.

The situation is different for T > 2, in this case the FE e FD estimator are not the same.

If the idiosyncratic errors are serially uncorrelated, the FE estimator must be used.

Nevertheless, the unobserved factors are likely to be serially correlated. If the idiosyncratic errors follow a random walk, that means a positive serial correlation, then the difference is serially uncorrelated and FD estimator ca be used. If the correlation doesn't follow a random

walk but is still positive, it's difficult to establish which one between FD e FE estimator use. If instead there is a substantial negative serial correlation in , again the FE estimator result the best one.

Generally, it is difficult to choose between FE and FD when they give substantively different results. It makes sense to report both sets of results and to try to determine why they differ.

Last, in the Fixed Effect model the intention is to eliminate the possible unobserved heterogeneity of the model eliminating **ai** since it is correlated with one or more explanatory variables can produce biased estimator. **Cov (ai;** x_{it}**)** $\neq$ **0**

In the Random Effect model, the assumption of correlation between the fixed effect and the explanatory variables doesn't hold anymore. At the base of the Random Effect model there is the assumption that the error term is not a fixed term, but a realization of a random variable not correlated with the explanatory variables **Cov (ai;** x_{it}**) = 0**

Given this assumption we might think that, since is uncorrelated with we don't need to cancel out and proceed the estimation using the Pooled OLS estimator.

But it's not possible due to the presence in the model of a serial correlation problem.

Any inference using Pooled OLS estimator will result biased due to the presence of a serial correlation of the error terms. To bypass this problem the used of Generalized Least square is required.

The Random Effect estimator is something between the Pooled OLS and the FE estimator.

The assumption required from the Random Effect model are:

- There is no linear relation between the explanatory variables
- E ($\varepsilon_{it}|X,ai$) = 0 and E ($ai|Xi$) = β_0
- Var ($\varepsilon_{it}|X,ai$)= Var = (ε_{it}) = σ_ε^2 for each t and Var (ai,Xi) = σ_a^2
- For each $t \neq s$, the idiosyncratic errors are uncorrelated. Cov($\varepsilon_{it},\varepsilon_{is}|Xi,a_i$) = 0
- The error term ε_{it} are iid and distributed as a normal

Finally, since the Random Effect model is not more consistent if Cov ($ai; x_{it}$) $\neq$ 0 to be sure about which model use , we need to test whether Cov ($ai; x_{it}$) = 0 or not. The Hausman test will be the best approach to so it.

The Hausman test (1978) represents the most powerful tools to spot which one of the model implemented in our analysis is the one with the greatest goodness of the fit.

The idea of the Hausman test is simple:

$$Ho = Cov\ (ai;\ x_{it}) = 0 \quad \text{Radom effect model consistent}$$

$$H1 = Cov\ (ai;\ x_{it}) \neq 0 \quad \text{Fixed effect model consistent}$$

	Poleed OLS	Fixed Effect	Random Effect
GLGR	-.1065935	-.950576	-.1065935
	***	***	***
GLGR1	-.1014591	-.8022229	-.1014591
	***	***	***
GLGR2	-.1188663	-.882165	-.1188663
	***	***	***
MARGIN	.1127125	.8632657	.1127125
SOLVENCY	.995962	-.0118003	.0995962
	***		***
SOLVENCY1	-.003636	.017871	-.003636
SOLVENCY2	-.0549694	.078126	-.0549694
		***	**
ROE	-.1704792	-.0600074	-.1704792
	***		***
DEP	-.0076094	-.0066175	-.0076094
CAR	.0055526	.0042553	-.0055526
TIER1	.1099637	1.223.691	-.0024127
		***	
SIZE	-.0024127	-.538363	-0.0024127
GDP	.0045218	.0038587	.0045218
Constant	0.2414957	0.0013582	0.2414956
Observation	144	144	144
R-squared within		0.4848	0.3706
R-squared overall		0.0004	0.4800
Breusch-Pagan test	0.00000		
Ramsey test	0.00000		
Hausman test		0.0266	
F-test		0.0000	
Wooldrigde test		0.00000	
Wald test		0.00000	

The Hausman test is based on the null hypothesis that the fixed effect is not correlated with any regress or in the model. Under Ho both the FE and RE estimator are consistent. However, under H1 only FE estimators are consistent. If the null hypothesis is rejected, we can conclude that the fixed effect or individual effect are significantly correlated with at least one of the regressors in the model. It follows, therefore, that the random effect model is inconsistent, and the use of Fixed Effect model is required. On the other hand, if the null hypothesis is accepted, the Random Effect will result the model with the best goodness of the fit.

What in other words suggests Hausman, is to compare β_{gls} , the estimation obtained from the Random effect model, and β_{within} the estimation coefficients obtained from the Fixed effect model. The estimation β_{gls} will be BLUE and consistent only under Ho and inconsistent when Ho is false. The test statistic will be based on $q = \beta_{gls} - \beta_{within}$.

If the different between β_{gls} and β_{within} is large enough, we reject Ho and we adopt a Fixed Effect model.

Hausman Fixed Random EQUATION 1			
	Fixed	**Random**	**Difference**
GLGR	-.950576	-.1065935	.0115359
GLGR1	-.0802229	-.1014591	.0212363
GLGR2	-.0882165	-.1188663	.0306498
MARGIN	.08632657	.1127125	.7505532
SOLVENCY	-.0118003	.0995962	-.1113965
SOLVENCY 1	.17871	-.003636	.021507
SOLVENCY 2	-.078126	-.0549694	-.0231566
ROE	-.0600074	-.1704792	.1104718
DEP	-.0066175	-.0076094	.0009919
CAR	.0042553	.0055526	-.0012973
TIER1	1.223691	.1099637	1.113727
SIZE	-.0538363	-.0024127	-.0514237
GDP	-.0038587	.0045218	-.0006632
Test: Ho = difference in coefficients not systematic			
chi2(13) = 24.52	**Prob>chi2 = 0.0266**		

The directors of such [joint-stock] companies, however, being the managers rather of other people's money than of their own, it cannot well be expected, that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own. Like the stewards of a rich man, they are apt to consider attention to small matters as not for their master's honour, and very easily give themselves a dispensation from having it.

Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company.

— Adam Smith (1776)

CHAPTER V-Results

5.1- Results of model 1

EQ1 Dependent variable : GNPL

The aim of our first analysis was to investigate inside the relationship between the stock of non-performing loans at time t and the lending strategy of the banks of the sample that has been implemented at time t and some lags before.

In the table above the estimated coefficients and the significant level of EQUATION 1 using Pooled OLS, Fixed effect and Random effect model are reported.

Having been established a significant level of 5%, the estimation of GLGR coefficient, using the Pooled OLS method, result negative and significant but the Breusch Pagan test for heteroscedasticity reject the hypothesis of no correlation between the unobserved error factors and the explanatory variables, making the Pooled OLS model not appropriate for my analysis.

In order to run a Fixed or Random effect model, I performed the Hausman test.

The Hausman test (1978) represents the most powerful tool to identify which one of the models implemented in our analysis (Fixed effect or Random effect) is the one with the greatest goodness of the fit. Moreover, the Hausman Test (also called the Hausman specification test) detects endogenous regressors in a regression model. Endogenous variables have values that are determined by other variables in the system. Having endogenous regressors in a model will cause ordinary least squares estimators to fail, as one of the assumptions of OLS is that there is no correlation between an predictor variable and the error term. Instrumental variables estimators can be used as an alternative in this case. However, before you can decide on the best regression method, you first have to figure out if your predictor variables are endogenous. This is what the Hausman test will do.

The idea of the Hausman test is simple:

$$Ho = Cov\ (a_i;x_{it}) = 0 \quad \text{Consistent efficient is Radom effect}$$

$$H1 = Cov\ (a_i;x_{it}) \neq 0 \quad \text{Consistent efficient is Fixed effect}$$

Essentially, the tests looks to see if there is a correlation between the unique errors and the regressors in the model. If the test cannot reject the null hypothesis, the model with greater goodness will be the Random model.

The Random effect estimation is based on the assumption that the correlation between the fixed error term and the explanatory variables is equal to zero.

The result of the test is reported below:

The p-value equal to 0,0266 leads to reject the null hypothesis and to accept as best model the Fixed Effect estimator.

The Fixed effect model is used with the intention of eliminate the fixed error term**.**

In fact, the Fixed effect contains not observable errors which could be correlated with the explanatory variables, returning then a biased estimation. The elimination of the fixed effect is based on a data-demeaning proceed. It consists on the deduction of the average of the sample from each variable and then conduct the estimation using a Pooled OLS technique.

	GLS Fixed Effect
GLGR	-.1065935
	***
GLGR1	-.1014591
	***
GLGR2	-.1188663
	***
MARGIN	.1127125
SOLVENCY	.0995962
	***
SOLVENCY1	-.003636
SOLVENCY2	-.0549694
	***
ROE	-.1704792
	***
DEP	-.0076094
CAR	.0055526
TIER1	.1099637
SIZE	-.0024127
GDP	.0045218
constant	0.2414956
Observation	144

The results of the estimation are reported in the second columns of the table above. The reasonably expectation about the sign of the relationship between GNPLs at time t and the

contemporaneous GLGR and some lags before are confirmed. This relationship results negative and significant, using a 5 % of significant level, and it is justified by the contained growth and credits after the crisis of 2008. No traces of moral hazard are found.

However, in our opinion, the EQUATION 1 doesn't exclude the presence of moral hazard, but, because of it's not well specified, it's not able to identify it.

In fact, the negative relationship between GNPL and GLGR could be given by:

- **The decreasing trend of gross loans growth rate after the financial crisis of 2008 and the relative credit crunch in the economy**
- **Since the deterioration in quality loans occurs with some delay, on average more than two years, it's reasonable, also in presence of moral hazard to expect that the contemporaneous relationship between GLGR and GNPL is negative.**
- **The lags of GLGR introduced in the model are not enough and the dilution effect can prevail and make the results biased. This effect, however, disappear in the short run.**

In other words, traces of moral hazard in this model are difficult to spot because if I take into account only the lending strategy of the bank of the last year and the previous year, the dilution effect on the credit lets the amount of non-performing loans to decrease. In fact, the GNPL variable is calculated as the ratio between gross non-performing loans and total gross loans granted at time t. If the amount of loans granted increase at time t and the amount of non-performing loans doesn't change (the time laps considered is too small to transform a part of the new credit in non-performing) the denominator of the ratio will increase and the total ratio will decrease . The negative coefficients are justified.

Finally, the negative relationship between the non-performing loans ratio at time t and the gross loans growth rate of the bank at time t and some lags ago, is reasonable and doesn't exclude the moral hazard suspect. Or better, the model doesn't show evident moral hazard behavior because the time laps considered is too small.

Enlarge the period of observations to have a more significant investigation, was resulted quite impossible because of the limited tools and the missing observation we had available.

Therefore, we have decided to implement another type of analysis, that strictly is related with the first one proposed and that let us to take into consideration more recent factors.

To conclude, the analysis performed is carried out in line of that one already made by Cincinelli and Piatti and explained in detail in the previous chapter. The authors, using a model similar to ours, wanted to analyze the relationship between the stock of non-performing loans in year t e and the loans growth rate of the last years. A positive relationship between

these two factors would be proof of the existence of moral hazard among the managers. However, since the deterioration of quality of loans occur with some delay, the

	Poleed OLS	Fixed Effect	GLS Random Effect
GNPL	-.1909508	-.2230405	-.1984982
	***	***	***
GNPL1	.1559392	.1592363	.1589282
	***	***	***
DEP	.0735623	.0570143	.0691841
	***		***
ROE	.0794958	.0663874	.0781042
MARGIN	.4634187	.2643738	.353348
CAR	.0373825	.0386125	.0369506
	***	***	***
GDP	-.0099486	-.0083845	-.0099373
constant	-.0514376	-.1215583	-0.595547
Observation	143	143	143
R-squared within		0.2685	0.2618
R-squared overall		0.3089	0.3215
Breusch-Pagan test	0.00000		
Ramsey test	0.0056		
Hausman test			0.7765
F-test		0.00000	
Wooldrigde test		0.00000	
Wald test		0.00000	

contemporaneous relationship between the loans growth rate and the non-performing loans ratio is found to be negative and not significant, thus the model doesn't show evidence of moral hazard. The results are quite close to ours, except that Cincinelli end Piatti have used non-performing loans ratio as a threshold value and they were able to divide the dataset into two parts. The results have shown that only the banks above the threshold, or those that have a

greater amount of non-performing loans, are more willing to undertake risky investments that may in turn result in an increase of non-performing loans themselves. This mechanism could be the consequences of moral hazard behavior inside the banking system.

5.1.2 The diagnostic test for model 1

Decided that the Fixed effect model could be the better model to estimate my coefficients, we then went further into the analysis performing the main diagnostic test to better understand the significance of the model.

Joint test on regressors

The joint test on regressors is a F-test that assesses whether all coefficients in the model are different from 0. In this case provides a value of the p-value is very low, indicating that all the coefficients are different from 0.

$$F(13,115) = 8.32$$

$$Prob > F = 0.0000$$

Test for autocorrelation: Wooldridge test.

Because serial correlation in linear panel data models biases the standard errors and causes the results to be less efficient, researchers need to identify serial correlation in the idiosyncratic error term in a panel data model. A new test for serial correlation in random- or fixed-effects one-way models derived by Wooldridge (2002).

Hausman fixed random EQUATION 2			
	Fixed	**Random**	**Difference**
GNPL	-.2230405	-.1984982	-.0245423
GNPL1	.1592363	.1589202	.0003161
DEP	.0570143	.0691841	-.0121698
ROE	.0663874	.0781042	-.0117168
MARGIN	.2643738	.353348	-.0889742
CAR	.0386125	.0369506	.0016619
GDP	-.0083845	-.0099374	-.0015529
Test: Ho = difference in coefficients not systematic			
chi2(13) =4.83		**Prob>chi2 = 0.7765**	

H0: no first order autocorrelation

$$F(1, 15) = 54.007$$

$$Prob > F = 0.0000$$

The test provides a value of the p-value very low, indicating to reject the null hypothesis of non first order auto-correlation between the idiosyncratic error terms.

Modified Wald test for group-wise heteroscedasticity in fixed effect regression model

H0: = $\sigma_i^2 = \sigma^{2.}$ For all i = No Heteroscedasticity

$$chi2\ (16) = 2277.78$$

$$Prob>chi2 = 0.0000$$

The test provides a value of the p-value very low, indicating to reject the null hypothesis of absence of heteroscedasticity.

To summarize, the fixed effect model presents some downwards that could transform my coefficient in biased coefficients as the autocorrelation problem and the presence of heteroscedasticity.

Even if the Hausman test recognize that between random effect model and fixed effect model the last one is the more appropriate one, after we have performed the appropriate test, we have discovered that we cannot use that model because of two problems: heteroscedasticity and first order auto-correlation.

The perfect tool to bypass the problem of auto-correlation and heteroscedasticity is the Generalized Least Square method for Fixed Effect.

The results obtained through the use of GLS method are reported in the table below.

In the presence of heteroskedastic errors, regression using Feasible Generalized Least Squares (FGLS) offers potential efficiency gains over Ordinary Least Squares (OLS). Taking into consideration the heteroscedasticity and assuming the autocorrelation equal to zero, these estimators hold the promise of greater efficiency. Moreover, the GLS method allows estimation in the presence of AR (1) autocorrelation within panels and cross-sectional correlation and heteroscedasticity across panels.

The results obtained from the GLS fixed effect are not far from the results discussed before. The coefficient of the GLGR is still negative and significant.
Considering other factors than the loan's growth rate, the negative coefficient of the ROE variable is reasonable and confirm my expectations.
Moreover, as already discussed in the previous chapter, the expectation of the impact of macroeconomics variables on the amount of non-performing loans inside the bank's balance sheet is uncertain. The results of our model is in favor of the theory that support a limited impact of macroeconomics events on the banking sector dynamics. In fact, in the model the GDP variable, which indicate the annual Italian gross domestic product growth rate is not significant with a p-value bigger the 5%.

At the end, for what concern the solvency ratio, the results are ambiguous but it's reasonable to expect that an increase of the capability of the bank to pay its long-term debt during the recent year can have a negative impact to the stock of non-performing loans. However,
the positive coefficient of SOLVENCY at time t, means that a percent change of the solvency of the bank increase the non-performing loans ratio at time t.
Since we reasonably expected the opposite, a further study is required to better understand what's going on in the Italian baking system and to overpass some limits of the model just presented.
We then, have decided to make another type of analysis: investigating the relationship between the rate of growth of loans to customers and some factors that in our opinion could influence the lending strategy policy of a bank, among these also the stock of non-performing loans itself.
The results of EQUATION 2 are reported in the next paragraph.

5.2 Results of model 2

The aim of our second analysis was to investigate the relationship between the lending strategy implemented by the banks of the sample at time t and the stock of non-performing

loans already accumulated in their balance sheets. In other words, identifying whether the trend of credit risk has any impact on bank lending behaviour.

Research hypothesis is the following:

- **An increase in bank credit risk in period t-1 leads banks to supply more credit underlying moral hazard behaviour.**

In the table above the estimated coefficients and the significant level of Panel data regression using Pooled OLS, Fixed effect and Random effect model are reported.

Using the Pooled OLS method and establishing a significant level of 5 %, the significant variables are: LOGNPL, LOGNPL1, DEP, CAR.

What immediately we have noticed is that the coefficient between GLGR and LOGNPL1 is positive and equal to +15,59 %.

However, the Breusch Pagan test for heteroscedasticity of the Pooled OLS method reject the hypothesis of no correlation between the unobserved error factors and the explanatory variables, making the Pooled OLS model not appropriate for my analysis.

In order to run a Fixed or Random effect model, we performed the Hausman test.

The result of the Hausman test is reported:

The p-value is equal to 0.7765, then, we cannot reject the null hypothesis

Ho = Cov (; ,) = 0. This means that the most appropriate model for our analysis is the Random Effect Model.

In general, Random effects are efficient, and should be used (over fixed effects) if the assumptions underlying them are believed to be satisfied or by running Fixed effects, then Random effects, and doing a Hausman specification test. If the test accepted the null hypothesis, then Random effects is the correct estimation procedure.

Moreover, the Random effect GLS regression used, is useful to by-pass problems of heteroscedasticity and autocorrelation typical of the Fixed effect model.

5.2.1 The diagnostic test for model 2

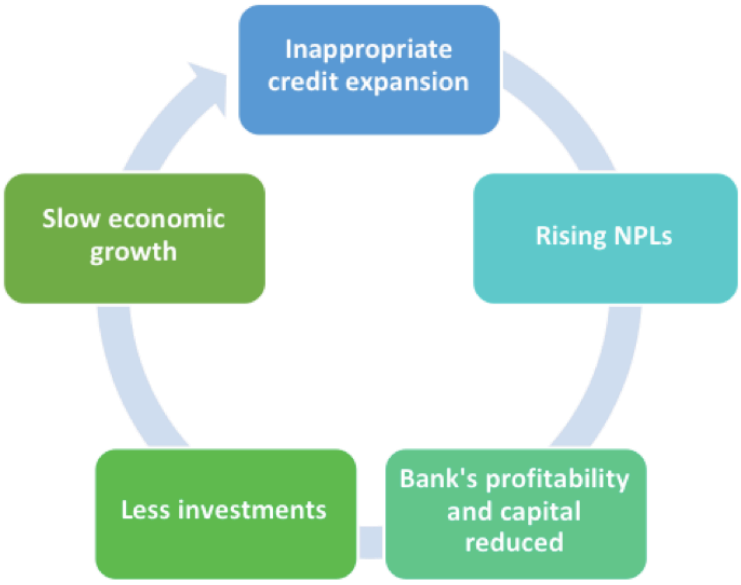
At the base of the Random Effect model there is the assumption that the error term is not a fixed term, but a realization of a random variable not correlated with the explanatory variables **Cov (ai;** x_{it}**) = 0**

However, because of to the presence of a serial correlation problem, we cannot use the OLS estimator. The random effect model uses the Generalized least square regression. In other words, the goodness of the model is bigger than the Fixed effect model used before. The correlation of the fixed part of the error term with the explanatory variables is assumed to be zero (no heteroscedasticity).

The results from the GLS Random Effect estimation of the second model, reported in the table above, are the key aspect of our entire thesis. The significant variables, having been established a significant level of 5 %, are: GNPL, GNPL1, DEP, CAR.

We mainly have focused our attention on the results obtained from the estimation of the coefficient GLGR and GNPL1, holding the other variables constants. It results positive and equal to 0.1589202. This means that a positive increase of one percent of the non-performing loans ratio at time t-1, have a positive impact on the gross loan growth rate of time t equals to 15,8 %. Better, in other words, the lending strategy policy of a bank at time t is positive influenced by the stock of non-performing loans presented inside the bank balance sheet at time t-1.

It means that managers at time t are much more likely to choose an expansive lending strategy even if the last year they have recorded an increase in the gross non-performing loans ratio.



The key point of the analysis is that moral hazard suspect rises when an aggressive and risky lending strategy (+15,8 %) at time t is implemented without regard to the "recent past" evolution of the non-performing loans.

Banks' managers may have to accept riskier position to obtain additional loans potentially generating higher future losses. The empirical analysis identifies the existence of an opportunistic behaviour from the managers side of a bank, typical of the moral hazard problem, already discussed in the chapter dedicated to the literature review.

Finally, for what concern the other significant variables, the coefficient of DEP and CAR result positive. It's reasonable to expect that if the profitability of the bank is increasing, holding constant the other variable, the bank will be more favor in granted new loans. The increase of the profitability could be considering a good reason to implement a new expanding strategy. The positive coefficient of the capitalization index CAR could be justified by the fact that well capitalized banks are more willing to take riskier activity and thus increasing the loans growth rate. Contrarily, the problem of moral hazard would arise for banks with less capitalization. However, taking into account the sample we were analyzing, since there are the most 16 capitalized Italian banks, was reasonable to expect that this kind of banks are more justified in taking riskier activities. Banks better capitalized could in fact take advantage of the good level of capitalization they possess, in other words of the good "visiting card" to pursue expansionary credit policies.

To conclude, the impact of the macroeconomic variable, GDP is not relevant, underling once again that in my model the macroeconomic environment has not impact on the internal decision of bank's management.

Finally, reading the result of the EQUATION 2 we can conclude that the bank in our dataset, despite they have high level of non-performing loans ratio, they continue to expand the credit to costumers.

Following in the conclusions, we will investigate further the results and we will reflect on the economic meaning of the overall analysis performed.

Conclusion and Limitations

After having described the phenomenon of moral hazard and its manifestations in the Italian banking system, the aspects of the non-performing loans focusing on the Italian scenario, we have proceeded our work making the empirical analysis to analyze the relationship between the stock of non-performing loans retained by the banking system and the rate of growth of credits to the private sector. The study is divided in two different analyses, (following the stream of the literature) both based on the same panel dataset collected from the 16 most capitalized Italian banks during the period from 2008 to 2016 for a total of 144 observations:

- EQUATION 1 (EQ1) to investigate the behaviour of the stock of non-performing loans inside the bank's balance sheet, mainly focusing on the impact that recent past lending strategy of the managers has on it.
- EQUATION 2 (EQ2) to investigate the relationship between the gross loans growth rate to customers of the banks at time t and the "recent" past amount of non-performing loans recorded.

More simply, these two different analyses are part of the same purpose: they became the tool to verify one general hypothesis, the suspect of the existence of an opportunistic behaviour or so-called moral hazard problem inside the Italian banking system. From the regulator's point of view, it is important to identify the existence of a moral hazard behaviour in the commercial banking system in order to avoid potential financial instability.

After the 2007-2008 financial crisis, it can be observed a clear decrease in the rate of growth of loans granted by banks to private counterparts; at the same time, non-performing loans have increased sharply, reaching levels even more than three times higher compared to the ones reported in the pre-crisis period. The empirical literature confirms the existence of a link between these two trends, underling how an increase in the stock of non-performing loans is one of the factors driving the low credits growth. This statement might seem in contrast with the theories explained in our work.

However, even if after the financial crisis the loans growth rate of loans to the private sector have decreased compared to the years before, it doesn't means that no loans were

granted at all. Managers have continued in some case and in some years to pursue an excessive and too risky lending strategy regarding the amount of non-performing loans already accumulated inside the bank's balance sheets, or in general regarding the level of the credit risk level of the bank.

In other words, during the past decade, although the growth rate of loans has decreased, it should have been even lower, if the banking managers would have not granted too risky loans. The grant of those unlikely-to-be repaid loans, has had as result not a resumption of credit, but an increase in non-performing loans stock.

This kind of problem has been already discussed in the Chinese banking system by Zhang et al., inside the paper "Non-performing loans, moral hazard and regulation of the Chinese commercial banking system", 2006.

The paper examines the impact of non-performing loans on the banking behaviour in the Chinese banking system confirming that an increase in the non-performing loans ratio induces bank management to engage in inappropriate credit expansion that potentially may result in further deterioration of loans quality and financial instability. The authors finally suggest that Chinese regulators should consider non-performing loans ratio as a useful indicator for detecting potential bank moral hazard problem and design transparent policy goals and monitor banks closely.

Our intention was to repeat the Zhang's analysis to check if in the Italian bank management has the propensity to engage in inappropriate credit expansions that have as result the creation of a vicious circle:

In our opinion, too expansive and thus too risky (given the previous losses recorded) lending strategy are likely to increase the amount of deteriorated loans inside the bank's balance sheet. The bank's profitability appears to increase but instead it is reduced and fewer investment are made. The consequence is a slow economic growth that can be aggravated by further inappropriate lending strategies by the managers, which give the start again to the vicious circle. Of course, not all the new loans granted to the private sector are likely to become non-performing. The bank should however, takes into account the probability of default (PD) of the new obligations, which will determine the part of the loans are likely to became non-performing. Banks able to perform a good evaluation of the creditworthiness of the counterparts are less likely to incur in unexpected losses.

The analysis performed on EQUATION 1, had the aim to investigate the sign of the relationship between the non-performing loans ratio at time t and the lending strategy behaviour of the bank, represented by its gross loans growth rate at time t and some lags before. The inclusion in the model of lags of GLGR, is important and determinant and helpful in order to eliminate or at least mitigate endogeneity problem.

The results of the estimates have shown that an increase of the loans growth rate of loans could impact positively the amount of non-performing loans in the bank's balance sheet only with some delay or lags, whereas the contemporaneous relationship between GLGR and GNPL is negative due to the dilution effect. The same conclusion were already found by Cincinelli and Piatti in their study that has been discussed properly in the previous chapters.

The significant and negative result of the coefficient between GNPL and GLGR at time t, doesn't show moral hazard problem inside the Italian banks from 2008 to 2016.

Clair (1992) argues that the impact of a higher GLGR is a deterioration in the quality of loans, but only with some lags: *since the deterioration in quality loans occurs with the same delay, instead the contemporaneous relationship between the GLGR and GNPL ratio should be negative.*

It happens in our model.

In fact, if banks make additional loans (i.e. higher loan growth rate of loans), they may potentially reduce the GNPL ratio due to the dilution effect, but this effect disappears in the short run.

In other words, because in the Model 1 we have taken in account only the lending strategy policy of the banks with two times lags, the model is not appropriate to test the presence of moral hazard, since on average two years are not enough for the credit to be realized or better to succeed in performing or not. Hence, we expect a positive relationship between more lagged GLGR and non-performing loans ratio at time t.

Bofondi and Gobbi in their study "Macroeconomic Determinants of Bad Loans: Evidence from Italian Banks" (2006), they confirm the hypothesis that riskier banks, in attempting to reduce their risk level, they increase their loans by relaxing their screening and monitoring policy.

The results will be the generation of something worse.

However, the analysis conduct on EQUATION 1 presents limits that should be taken into account. First at all, the dataset counts only 144 observations, too few to make hasty conclusions. The small number of observations obviously limits the possibility to make

meaningful conclusions on the behaviour of the entire Italian banking system, limiting only to limited conclusion to the sample.

It should also be recalled that at the base of the model there are assumptions, which if they are not satisfied, they can undermine the validity of the model. Moreover, a problem of endogeneity can arise between the loans growth rate and the gross non-performing loans

Sampling Banks			
Intesa San Paolo	Credem	Banca IFIS	Unipol
Unicredit	Carige	Banca Generali	BPM
Ubi	Bper	Mediobanca	Credito Valtellinese
Monte dei Paschi di Siena	BNL	Banca Mediolanum	Banca Popolare di Sondrio

ratio, since it is calculated as the ratio between non-performing loans over total gross loans itself. Despite these limitations, the estimation of the first equation has given birth to suspicion of moral hazard, even still no evidence.

This is the reason why we have decided to create two models that were connected each other's like a litmus test.

Instead of adding lags in the EQUATION 1 of the GLGR to make the model more significant, the analysis performed on EQUATION 2, analyzes the factors that influence the lending

Source	SS	df	MS
Model	.688590876	13	.052968529
Residual	.74590265	130	.005737713
Total	1.43449353	143	.010031423

Number of obs	144
F(13, 130)	9.23
Prob > F	0.0000
R-squared	0.4800
Adj R-squared	0.4280
Root MSE	.07575

gnpl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
glgr	-.1065935	.0332344	-3.21	0.002	-.1723438	-.0408431
glgr1	-.1014591	.0314678	-3.22	0.002	-.1637144	-.0392038
glgr2	-.1188663	.0272921	-4.36	0.000	-.1728604	-.0648722
margin	.1127125	.8194011	0.14	0.891	-1.508375	1.7338
logsolvency	.0995962	.0351607	2.83	0.005	.0300349	.1691575
logsolvency1	-.003636	.0431084	-0.08	0.933	-.0889208	.0816488
logsolvency2	-.0549694	.0292231	-1.88	0.062	-.1127838	.002845
roe	-.1704792	.0378308	-4.51	0.000	-.2453229	-.0956355
dep	-.0076094	.012427	-0.61	0.541	-.0321946	.0169759
car	.0055526	.0069732	0.80	0.427	-.0082431	.0193482
tier1	.1099637	.2227914	0.49	0.622	-.3308024	.5507299
size	-.0024127	.0057382	-0.42	0.675	-.0137651	.0089398
gdp	.0045218	.0032288	1.40	0.164	-.0018659	.0109096
_cons	.2414956	.0475805	5.08	0.000	.1473632	.335628

strategy of the bank as bank-specific factors and macroeconomics variables.

The choice is due to the fact that, while to analyze the stock of non-performing loans we need

```
Fixed-effects (within) regression               Number of obs      =       144
Group variable: id                              Number of groups   =        16

R-sq:  within  = 0.4848                         Obs per group: min =         9
       between = 0.3632                                        avg =       9.0
       overall = 0.0004                                        max =         9

                                                F(13,115)          =      8.32
corr(u_i, Xb)  = -0.7282                        Prob > F           =    0.0000
```

gnpl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
glgr	-.0950576	.0296607	-3.20	0.002	-.1538097	-.0363055
glgr1	-.0802229	.0277165	-2.89	0.005	-.1351239	-.0253219
glgr2	-.0882165	.0241554	-3.65	0.000	-.1360636	-.0403694
margin	.8632657	1.012624	0.85	0.396	-1.142547	2.869078
logsolvency	-.0118003	.0397688	-0.30	0.767	-.0905747	.066974
logsolvency1	.017871	.0366769	0.49	0.627	-.0547789	.0905209
logsolvency2	-.078126	.0272803	-2.86	0.005	-.1321631	-.0240889
roe	-.0600074	.043441	-1.38	0.170	-.1460556	.0260408
dep	-.0066175	.0127934	-0.52	0.606	-.0319587	.0187237
car	.0042553	.0063376	0.67	0.503	-.0082982	.0168088
tier1	1.223691	.2687503	4.55	0.000	.691348	1.756033
size	-.0538363	.026247	-2.05	0.043	-.1058266	-.001846
gdp	.0038587	.0026828	1.44	0.153	-.0014554	.0091727
_cons	.0013582	.1353505	0.01	0.992	-.2667451	.2694616
sigma_u	.12482754					
sigma_e	.06225806					
rho	.80079813	(fraction of variance due to u_i)				

a broader time period, we assume that the banks 's lending policies are influenced by more recent factors.

```
Random-effects GLS regression                   Number of obs      =       143
Group variable: id                              Number of groups   =        16

R-sq:  within  = 0.2618                         Obs per group: min =         8
       between = 0.5759                                        avg =       8.9
       overall = 0.3215                                        max =         9

                                                Wald chi2(7)       =     58.56
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

glgr	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lognpl	-.1984982	.0422085	-4.70	0.000	-.2812254	-.1157709
lognpl1	.1589202	.0431612	3.68	0.000	.0743259	.2435145
dep	.0691841	.0265905	2.60	0.009	.0170676	.1213006
roe	.0781042	.0829463	0.94	0.346	-.0844677	.240676
margin	.353348	1.649662	0.21	0.830	-2.87993	3.586626
car	.0369506	.0139662	2.65	0.008	.0095774	.0643239
gdp	-.0099374	.0067826	-1.47	0.143	-.0232309	.0033562
_cons	-.0595547	.0643474	-0.93	0.355	-.1856732	.0665638
sigma_u	.04074892					
sigma_e	.16239456					
rho	.05923397	(fraction of variance due to u_i)				

In particular the study is based on the relationship between the growth rate of loans to the

Source	SS	df	MS		
Model	1.74798497	7	.249712139	Number of obs =	143
Residual	3.67890954	135	.027251182	F(7, 135) =	9.16
				Prob > F =	0.0000
Total	5.42689451	142	.038217567	R-squared =	0.3221
				Adj R-squared =	0.2869
				Root MSE =	.16508

glgr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lognpl	-.1909508	.0425944	-4.48	0.000	-.2751894	-.1067123
lognpl1	.1559392	.0436074	3.58	0.000	.0696972	.2421812
dep	.0735623	.0256925	2.86	0.005	.0227505	.1243741
roe	.0794948	.0798071	1.00	0.321	-.078339	.2373286
margin	.4634187	1.530736	0.30	0.763	-2.563907	3.490744
car	.0373825	.0136757	2.73	0.007	.0103362	.0644289
gdp	-.0099486	.0068928	-1.44	0.151	-.0235805	.0036833
_cons	-.0514376	.0582666	-0.88	0.379	-.166671	.0637958

private sector a time t, and non-performing loans ratio recorded in the bank's balance sheet at time t -1.

Fixed-effects (within) regression — Number of obs = 143
Group variable: id — Number of groups = 16

R-sq: within = 0.2685 — Obs per group: min = 8
between = 0.5301 — avg = 8.9
overall = 0.3089 — max = 9

F(7,120) = 6.29
corr(u_i, Xb) = -0.3361 — Prob > F = 0.0000

glgr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lognpl	-.2230405	.0447688	-4.98	0.000	-.3116795	-.1344014
lognpl1	.1592363	.0449353	3.54	0.001	.0702675	.2482051
dep	.0570143	.0307101	1.86	0.066	-.0037895	.1178181
roe	.0663874	.0972555	0.68	0.496	-.1261717	.2589465
margin	.2643738	2.265201	0.12	0.907	-4.220567	4.749315
car	.0386125	.0156399	2.47	0.015	.0076466	.0695785
gdp	-.0083845	.0070826	-1.18	0.239	-.0224074	.0056385
_cons	-.1215583	.093827	-1.30	0.198	-.3073292	.0642127
sigma_u	.06996426					
sigma_e	.16239456					
rho	.15655481	(fraction of variance due to u_i)				

F test that all u_i=0: F(15, 120) = 1.30 Prob > F = 0.2126

The scope is to find the proof of what Cincinelli and Piatti affirm in their paper: "*Bank*

```
Random-effects GLS regression                   Number of obs      =       143
Group variable: id                              Number of groups   =        16

R-sq:  within  = 0.2618                         Obs per group: min =         8
       between = 0.5759                                        avg =       8.9
       overall = 0.3215                                        max =         9

                                                Wald chi2(7)       =     58.56
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

glgr	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lognpl	-.1984982	.0422085	-4.70	0.000	-.2812254	-.1157709
lognpl1	.1589202	.0431612	3.68	0.000	.0743259	.2435145
dep	.0691841	.0265905	2.60	0.009	.0170676	.1213006
roe	.0781042	.0829463	0.94	0.346	-.0844677	.240676
margin	.353348	1.649662	0.21	0.830	-2.87993	3.586626
car	.0369506	.0139662	2.65	0.008	.0095774	.0643239
gdp	-.0099374	.0067826	-1.47	0.143	-.0232309	.0033562
_cons	-.0595547	.0643474	-0.93	0.355	-.1856732	.0665638
sigma_u	.04074892					
sigma_e	.16239456					
rho	.05923397	(fraction of variance due to u_i)				

managers behave badly when they face pressure due to previous losses, and this is consistent with what we expected: banks may be affected by moral hazard problems."

The panel dataset, the number of observations and the time period are the same used during the first analysis.

The results of the estimation, reported above, are determinant for this work.

In fact, we found the proof that bank managers tend to increase their lending activity even in already negative scenario.

The estimation of the coefficient indicating that the relationship between the lending strategy today and the stock of non-performing loans yesterday, taking constant the other variables, is equal to 0.1589282. An increase of 1 % of the non-performing loans ratio at time t-1 have a positive impact on the gross loans growth rate at time t equal to 15,89 %.

The second model shows that the banks execute a very expansive lending strategy to the private sector, even if the stock of non-performing loans inside the bank's balance sheet is increased during the last years.

In other words, banks that have already a high stock of non-performing loans inside the balance sheet, tend to be affected by moral hazard behaviour by the managers of the banks

Source	SS	df	MS	Number of obs =	144
				F(13, 130) =	9.23
Model	.688590876	13	.052968529	Prob > F =	0.0000
Residual	.74590265	130	.005737713	R-squared =	0.4800
				Adj R-squared =	0.4280
Total	1.43449353	143	.010031423	Root MSE =	.07575

gnpl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
glgr	-.1065935	.0332344	-3.21	0.002	-.1723438	-.0408431
glgr1	-.1014591	.0314678	-3.22	0.002	-.1637144	-.0392038
glgr2	-.1188663	.0272921	-4.36	0.000	-.1728604	-.0648722
margin	.1127125	.8194011	0.14	0.891	-1.508375	1.7338
logsolvency	.0995962	.0351607	2.83	0.005	.0300349	.1691575
logsolvency1	-.003636	.0431084	-0.08	0.933	-.0889208	.0816488
logsolvency2	-.0549694	.0292231	-1.88	0.062	-.1127838	.002845
roe	-.1704792	.0378308	-4.51	0.000	-.2453229	-.0956355
dep	-.0076094	.012427	-0.61	0.541	-.0321946	.0169759
car	.0055526	.0069732	0.80	0.427	-.0082431	.0193482
tier1	.1099637	.2227914	0.49	0.622	-.3308024	.5507299
size	-.0024127	.0057382	-0.42	0.675	-.0137651	.0089398
gdp	.0045218	.0032288	1.40	0.164	-.0018659	.0109096
_cons	.2414956	.0475805	5.08	0.000	.1473632	.335628

with the probability of enter inside the vicious circle we were speaking before and at the and

Source	SS	df	MS	Number of obs =	144
				F(8, 135) =	8.14
Model	2.2112348	8	.27640435	Prob > F =	0.0000
Residual	4.58510193	135	.033963718	R-squared =	0.3254
				Adj R-squared =	0.2854
Total	6.79633673	143	.04752683	Root MSE =	.18429

glgr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gnpl	-2.245958	.5143752	-4.37	0.000	-3.263234	-1.228682
gnpl1	.620007	.5059696	1.23	0.223	-.3806451	1.620659
dep	.0447372	.0289666	1.54	0.125	-.0125498	.1020242
roe	-.1795176	.1032292	-1.74	0.084	-.3836732	.024638
margin	1.485632	1.700246	0.87	0.384	-1.87693	4.848195
car	.0300254	.0152004	1.98	0.050	-.0000364	.0600872
gdp	.0059741	.0080352	0.74	0.458	-.009917	.0218653
gnpl_res	1.74953	.3731361	4.69	0.000	1.011581	2.487478
_cons	.2041086	.0652615	3.13	0.002	.0750414	.3331759

```
. test gnpl_res

 ( 1)  gnpl_res = 0

       F(  1,   135) =   21.98
            Prob > F =    0.0000
```

have as a result a bigger amount of non-performing loans itself.

Although the model takes into account a limited period of time, we have assumed that bank's credit policies are influenced by recent factors and thus, the model results significant even if we have considered only one lag of non-performing loans ratio.

```
Instrumental variables (2SLS) regression
```

Source	SS	df	MS		
Model	1.2818713	6	.213645217	Number of obs	= 144
Residual	5.51446542	137	.040251572	F(6, 137)	= 4.95
				Prob > F	= 0.0001
				R-squared	= 0.1886
				Adj R-squared	= 0.1531
Total	6.79633673	143	.04752683	Root MSE	= .20063

glgr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gnpl	-.9245093	.5079683	-1.82	0.071	-1.928982	.0799631
dep	.0634631	.0325898	1.95	0.054	-.0009809	.1279071
roe	-.0177346	.1338287	-0.13	0.895	-.2823717	.2469025
margin	1.545716	1.851216	0.83	0.405	-2.114935	5.206368
car	.0354062	.0167593	2.11	0.036	.0022659	.0685465
gdp	.0014173	.0090925	0.16	0.876	-.0165624	.0193971
_cons	.1044221	.0861355	1.21	0.227	-.0659049	.2747491

```
Instrumented:  gnpl
Instruments:   dep roe margin car gdp logsolvency logsolvency1 logsolvency2
               tier1 size
```

To conclude, it's necessary to affirm that also the analysis on the EQUATION 2 is an empirical analysis carried out on a small dataset and, although sometimes you have to settle for less, to make definitive conclusions about the lending policies which have been developed in the Italian banking system during the last decade, a further analysis on a larger sample is absolutely necessary.

That's why our models have limitations, due mainly to the lack of access to larger databases and to analyze more long-time periods. Not for this, the analysis can be seen as an exercise as an end in itself. The results are significant and useful to create hypothesis about the general behaviour of the Italian banking system. However, a more detailed analysis could be done differentiating the banks in popular banks, stock banks, cooperative banks, etc. to get more specific result and to spot different managers' behaviour in different banking sector.

Another possibility of expansion could be the introduction of a threshold value, as in Cincinelli' s analysis, to test how banks with different levels of non-performing loans react differently in the lending decision process.

Nevertheless, the conclusion that banking managers during the last decade were affected by moral hazard behaviour to pursue their own benefits and rewards, not considering the level of credit risk, needs some specifications.

In fact, most strongly-capitalized banks may have more risky investments undertaken and be justified for this. This kind of banks can be affected by a weak form of moral hazard or not at all. On the other hand, banks with previous losses and with minor level of capitalization, are less justified in taking too risky investments and can be consider victims of a stronger form of moral hazard by the management side.

Definitely, after watching the general trend of Italian banks in the last decade, the studies of the other authors, and the results of our analysis a suspect of a bad management behaviour can be confirmed. Managers' decisions are often disconnected from the major variables that should be taken into account in the process of implementation of a new lending strategy.

In general, we would have expected a more cautious or rather more rational and therefore more predictable behaviour by the managers of the Italian banks in the current and recent past economic scenario.

However, often the banking decisions (but in general in every organization) are driven by other factors such as economic interests and personal awards.

Many economic theories have been developed to create solutions to overcome the problem of moral hazard in an organization system in general, such as economic bonus or stock options solutions, in a way that the interest of managers can converge with that one of the shareholders.

But, as already Adam Smith has taught us in the middle of 1700, the directors of a stock company, being the managers, and not people investing money, they will not watch over the company with the same anxious vigilance with which the partners in a private company could do.

The true is that the problem of moral hazard is more complex and very rooted in the behaviour of Italian managers than we can imagine.

APPENDIX

- The table lists the 16 most capitalized Italian banks using for the construction of the dataset used for the analysis

- Results from empirical analysis

OLS reg EQ1

Fixed effect model for EQ1

Random Effect Model EQ1

```
Random-effects GLS regression                   Number of obs      =       144
Group variable: id                              Number of groups   =        16

R-sq:  within  = 0.3706                         Obs per group: min =         9
       between = 0.6615                                        avg =       9.0
       overall = 0.4800                                        max =         9

                                                Wald chi2(13)      =    120.01
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

gnpl	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
glgr	-.1065935	.0332344	-3.21	0.001	-.1717317	-.0414552
glgr1	-.1014591	.0314678	-3.22	0.001	-.1631349	-.0397833
glgr2	-.1188663	.0272921	-4.36	0.000	-.1723578	-.0653748
margin	.1127125	.8194011	0.14	0.891	-1.493284	1.718709
logsolvency	.0995962	.0351607	2.83	0.005	.0306824	.1685099
logsolvency1	-.003636	.0431084	-0.08	0.933	-.0881269	.0808549
logsolvency2	-.0549694	.0292231	-1.88	0.060	-.1122456	.0023069
roe	-.1704792	.0378308	-4.51	0.000	-.2446262	-.0963322
dep	-.0076094	.012427	-0.61	0.540	-.0319657	.016747
car	.0055526	.0069732	0.80	0.426	-.0081147	.0192198
tier1	.1099637	.2227914	0.49	0.622	-.3266994	.5466268
size	-.0024127	.0057382	-0.42	0.674	-.0136594	.0088341
gdp	.0045218	.0032288	1.40	0.161	-.0018064	.0108501
_cons	.2414956	.0475805	5.08	0.000	.1482395	.3347517
sigma_u	0					
sigma_e	.06225806					
rho	0	(fraction of variance due to u_i)				

OLS reg EQ2

Fixed Effect model EQ2

Random Effect model EQ2

- **Test for endogeneity and estimation through IV**

The models of our analysis exhibit some type of simultaneity or "back and forth" causation between the X and Y variables. Since the variable GNPL is calculated as the ratio between non performing loans over gross loans growth rate, a possible form of autocorrelation could exists between GNPL and GLGR. Following is reported the study made to check the endogeneity of the GNPL variables, considering the models as simultaneous equations. This expansion is aimed to check the consistency of the OLS estimator and, in negative case, the introduction of the instrumental variable method.

After Having estimate the residual of the first model we have performed the model 2 introducing the residuals as independent variable. Since the coefficient of the residuals is different from zero the OLS is not consistent. An IV model is used.

- Cincinelli and Piatti, 2007. “Non-performing loans, Moral hazard and supervisory authority: The Italian banking system”, Journal of financial management markets and institutions.

Results from the model without threshold value and from model with threshold value

Dependent variable GNPL		No Threshold	Threshold
GLGRt		-0.0147	
GLGRt-1		-0.0177	
GLGRt-2		-0.0172	
LGRit (NPLit-1 < y)			0.0117
LGRit (NPLit-1 > y)			-0.0795***
LGRit-1 (NPLit-1 < y)			-0.0305***
LGRit-1 (NPLit-1 < y)			0.0296
LGRit-2(NPLit-1 < y)			-0.0385***
LGRit-2 (NPLit-1 < y)			0.0866***
DGR		0.0057	0.0071
C_I		-0.0407***	-0.0447***
CAR		-0.1527***	-0.1564***
ROA		-1.3572***	-1.3758***
SIZE		-0.0265***	-0.0315***
cons		0.5394***	0.6137

N.Obse		1788	1788
Rsquared		0,7288	0.7411
Rsquared adj		0,7265	0.7388
Threshold y			15,66%
P-value			0.00

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