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"NON-PERFORMING LOANS AND THE MORAL HAZARD, A STUDY OF THE ITALIAN BANKING SYSTEM"

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Firma (signature): 

This work is dedicated to you, my family and my love, for being the pillars of strength and the driving force behind my journey. Your support has made this achievement possible, and I am forever grateful.

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INTRODUCTION

The purpose of this study is to analyze the relationship between the stock of non-performing loans held by Italian banks from 2008 to 2022 and the lending banking strategy adapted by the banks' managers throughout the same period.

On this area of study, there are two basic theories that can be explored. On the one hand, the research supports the hypothesis of credit crunch as a result of the 2008 financial crisis. Prior to the crisis, banks were more willing to provide financing. Since the crisis, they have begun to reduce loans to both retail and business clients. This is referred to as a credit crunch, which is an economic condition in which it is difficult to gain access to funding for investments. This usually has immediate negative effects for borrowers, such as higher loan product prices and interest rates, as well as indirect negative consequences for the entire economic system.

However, while empirical evidence in Italy shows a decreasing trend in the growth rate of credits granted after the 2008 crisis, an economic banking theory suggests that in uncertain post-crisis environment, managers frequently have proceeded to the creation of credit policies and strategies. This without regard to the amount of non-performing loans that were created over the course of the crisis.
In brief, during the last decade, management have pursued improper and frequently risky lending practices without consideration for the credit risk level on the balance sheets of Italian banks. This phenomenon might be taken as proof of managers' moral hazard behaviour. The purpose of this thesis is to determine the presence of opportunistic behaviour or a moral hazard concern within a panel of Italian banks during the previous decade using a panel data regression model.

The European banking sector has faced formidable challenges in recent years, particularly concerning asset quality. Non-performing loans have emerged as a principal threat to European banks, prompting extensive regulations by the European Supervisory Authorities. The level of non-performing loans varies considerably across the Eurozone. Italy's banking system has notably been among the most affected, motivating our selection of Italian banks as our sample.
The central motivation behind this research is to understand what the connections between the threatening phenomenon of non-performing loans and the opportunistic behaviours are and

information asymmetry inside the banks. These factors can significantly influence the lending strategy policy, as previously described and discussed in the corporate finance literature, notably Merton (1974). Within the banking sector, conflicts of interest and moral hazard pose substantial threats to overall economic stability. An escalation in non-performing loans within a bank's portfolio translates into heightened risks affecting both liquidity and profitability. It also triggers a deterioration of the balance sheet and an erosion of asset quality, leading to a decline in economic activities. 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 has been divided into five chapters.
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 and 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 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 nonperforming 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 dataset used, descriptive statistics and the expected results. It also provides a brief introduction to panel data analysis. We have implemented two distinct types of analysis using the same dataset. Our dataset consists of the 12[1] most capitalized listed Italian banks, covering the period 2008-2022. First, we investigate the relationship between the stock of non-performing loans at a given time (t) and the lending strategies implemented by banks during the same period and preceding years. Subsequently, we conduct a second analysis exploring the relationship between the new lending strategies implemented by banks at time (t) and the stock of non-performing loans already present within their balance sheets at time (t) and prior years. The intention is to create two interconnected models that scrutinize the same objects from different perspectives, ultimately converging on a unified economic conclusion for the sample. We

[1] Borsa Italiana, listed companies capitalisation on February 2023

incorporate a range of variables as control measures in the model to differentiate banks within the panel dataset and account for both specific banking factors and macroeconomic variables that may influence a bank's lending strategies and the level of non-performing loans. This comprehensive examination aims to shed light on the relationship between non-performing loans and moral hazard behavior within Italian banks after the economic crisis of 2008.
The results of the empirical analysis, accompanied by diagnostic tests and robustness checks, are presented in the last chapter.

CHAPTER I -Explaining NPLs, Regulation and Determinants

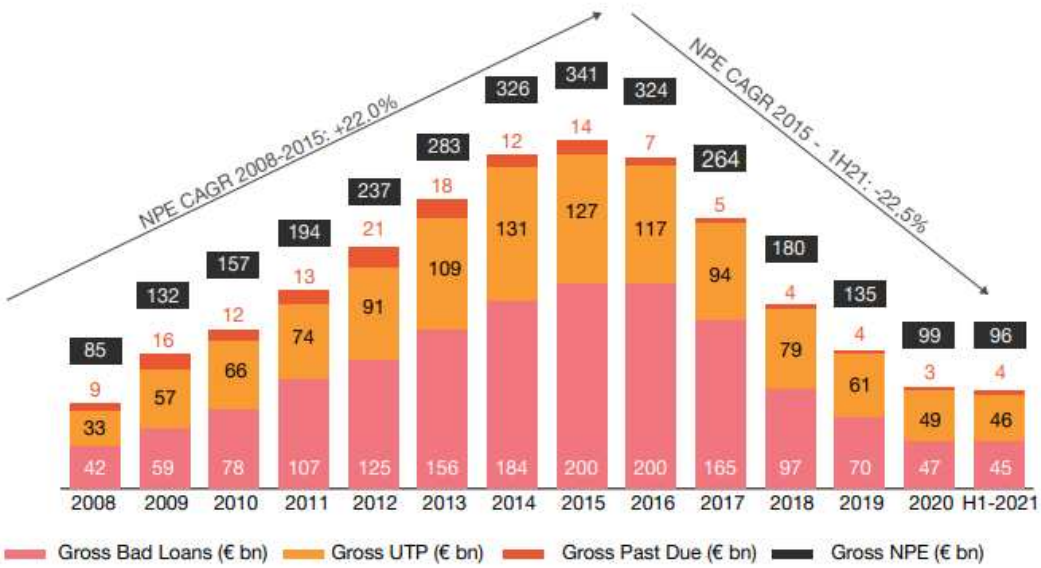
1.1– NPLs in the European banking system, with specific focus on Italian banking context

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 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 European Central bank has defined NPL as: "A bank loan is considered non-performing when more than 90 days pass without the borrower paying the agreed instalments 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 has been more than 90 days since the last payment
• 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 maintains a higher degree of detail dividing the Italian non-performing loans into categories based on their quality and their probability of repayment:
• **Bad debts**: 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:** 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:** any exposure reported on the balance sheet presenting any past-due amounts or unauthorized overdrafts at the close of the balance sheet. Whenever at the end of the term the exposures that do not fit into the first two categories are past due or overdue by more than 90 days, they must be categorized as past due loans. The Bank of Italy does not view the exposure subject to forbearance measures—which happen when a debtor is having trouble paying its debts and the bank makes a concession it would not ordinarily consider—as a separate class of non-performing loans because there is also performing forbearance exposure. Forbearance measures are included in the exposure to non-performing loans and are already categorized in one of the subcategories.

Below is reported the upward trend of the phenomenon of the Italian non-performing loans divided in its categories recorded from 2008 to H1-2021. The graph reflects the situation of the NPL in the Italian market. It can be noticed an upward curve from 2008 peaking in 2015 with 341 billion euro and after this there has been a continuous decrease in the total NPL. In H1-2021 the level of NPL was 96 billion, coming approximately at level of the year 2008, which was the moment when the financial crisis began.

Chart 23: Gross NPE trend

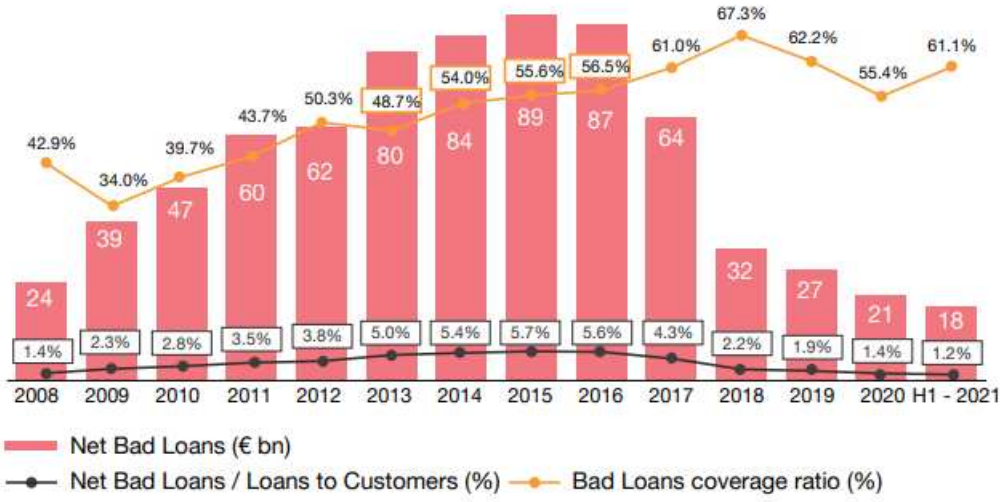


Source: PwC analysis on Banca d'Italia "Banche e istituzioni finanziarie: condizioni e rischiosità del credito per settori e territori", December 2021.

Figure 1

In fact, a 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. Therefore, 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, leading 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. As we seen at the chart below, after 2016 the trend of NPL is downward, this also because of the measure taken by the bank of Italy and the Italian government to address the NPL issue. The measures were regarding the GACS and the Atlante funds. Further details, especially about the impact of macroeconomic factor on the stock of non-performing loans, are discussed during the following paragraphs.

Chart 24: Net Bad Loans Trend



Source: PwC analysis on ABI Monthly Outlook and Bank of Italy data – October 2021.
Note: 2017 and 2018 data might include financial intermediaries.

Figure 2

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

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 drivers 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. Their 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 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 how macro indicators affect loans performance, taking into consideration the US banking system. 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. Their study suggests that banks should consider Real GDP per Capita when considering issuing new loans.

The study conducted by **Beck et al.** (2013) focusing on panel of 75 countries over the period 2000-2010, analyses 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.

As the economy enters an expansion period, it is characterized by a relatively low number of non-performing loans, while a high level of non-performing loans relates to recession phases. In fact, during a period of expansion the consumers and firms face a sufficient stream of income and revenue to pay back their debts. Whereas 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 procyclical behavior of the default rates of Italian bank borrowers.

If 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 changes in different phases of the business cycle. Their results 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 an 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 has an adverse consequence.

Marcucci and Quagliarello found that, when using a four-regime model, banks with lower asset quality see a three-fold increase in portfolio riskiness during economic downturns

compared to banks with greater asset quality. Additionally, during recessions, the effect of the business cycle on credit risk for banks with lower asset quality is about five times higher than it is during expansionary periods. Furthermore, the consequences of the business cycle on credit risk for banks with better asset quality is roughly two times greater during recessions than it is during expansions.

Finally, both riskier and less risky banks experience essentially the same effects of the business cycle on their riskiness during expansionary stages.

In conclusion, portfolios of riskier banks are more sensitive to the business cycle than portfolios of less risky institutions, and cyclicality is more noticeable during economic downturns.

Also, the European Central Bank in "**Financial Stability Review of December 2011"** highlighted that the real GDP growth results one of the main drivers 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.

In their work "**Micro e Macro determinants of non-performing loans**,"[2] **Messai** and **Jouini** aim to pinpoint the causes of non-performing loans for a sample of 85 banks across three nations (Italy, Greece, and Spain) between 2004 and 2008**.**

They introduce in the model macroeconomic variables such 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 to prevent and decrease the stock of non-performing loans. Such banks should also consider the profitability of the real economy when extending loans. Impaired loans are likely to be significant during the economic downturn. To assess the soundness and stability of the financial system, commercial banks should broaden their reach of macroeconomic surveillance to include prudential indicators such as GDP. Another paper with very interesting results is that of **Carlo Milani:** "What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy", 2017. **Milani affirms that**

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

quality and risk attitude of management are more relevant factors influencing the stock of non-performing loans.

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 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. Claims 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. Restricting the causes to the performance of the economy and the economic recession, it may be too simple. It must be pointed out that the source of the increase in non-performing loans is not the crisis as a concept in itself, but how the crisis impacts the economy as a whole. 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 leads to an inability to evaluate outstanding credits, collateral, and new consumers in a fast and effective manner. Increasing non-performing loans in the future are the result of poor management in the present.

• **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 result is an increase in the number of non-performing loans.

In summary, the findings confirm that an increase in non-performing loans is associated with a decrease in measured cost efficiency, implying that high levels of problem loans cause banks to increase spending on monitoring, resolving, and/or selling off these loans, as well as become more diligent in administering the amount of their existing loan portfolio that is currently performing.

Moreover, the data confirm the bad management hypothesis: a decrease in measured cost efficiency is 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 – The relationship between NLP and the real economy

The non-performing loans problem is defined mostly as the result of the economic recession during the last decade, that 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 decreased leading to a rise in the 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.
Therefore, the ratio of non-performing loans increased further in the balance sheet of the Italian banks, the bank's profitability decreases, 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 performance, especially financial instability. Real GDP slow growth rate and unemployment rate are two traditional drivers of non-performing loans. But conversely, nonperforming 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.

1.1.4 – Non-performing loans in the Italian economy

After the global financial crisis started in 2008 and the sequential recession period, there has been a deterioration in banks' credit quality, which followed a restriction wave in the supply of credits. Banks started reporting low profitability, due to increasing provisions required by the rising value of non-performing loans, as well as the cost of human resources required 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. Furthermore, the cost of capital for banks began to surge. Investors and other banks became less willing to lend to banks with a significant stock of nonperforming loans, resulting in greater funding costs and a negative impact on these banks' ability to earn profits. All these variables influence banks' decisions to limit their lending credit rules. As a result, the credit supply will be reduced.
The primary channel through which non-performing loans had a detrimental effect on the real economy was the restriction of credit supply. In the uncertain financial climate of the past decade, Italian banks became more cautious and less willing to extend new loans due to the worsening condition of their balance sheets caused by the increase in non-performing loans. This situation is commonly referred to as the "credit crunch," characterized by a decrease in the availability of credit and a subsequent rise in lending interest rates. As a result, the profitability and growth of small and medium-sized enterprises (SMEs), which were particularly affected, were adversely impacted, ultimately affecting the overall economy. 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 has been followed by expansionary credit policies without considering the level of risk.
The effect of this mechanism was naturally an increase in the banking credit risk and consequently of the stock of non-performing loans itself.
In the paper titled "Non-performing loans and the supply of bank credit: evidence from Italy" by Accornero, Alessandri, Carpinelli, and Sorrentino, published by the Bank of Italy in March 2017, is addressed the impact of non-performing loans on credit supply. The study focuses on the relationship between non-performing loans and the provision of bank credit to non-financial firms in Italy from 2008 to 2015. To investigate this relationship, the authors utilized a Panel dataset consisting of 500 Italian banks. The findings indicate that non-performing loans, by themselves, do not have a direct impact on credit supply. Instead, the negative correlation observed between the non-performing loans ratio and credit growth in the sampled Italian banks can be attributed to changes in firms' conditions and a decrease in their demand for credit.
In essence, the study reveals that the level of non-performing loan ratios does not directly influence the growth rate of bank lending. The negative correlation observed is driven by firm-related factors. Once these factors are properly considered, it appears that the lending behavior of banks becomes unrelated to their non-performing loan ratios. This finding is supported by the fact that there is no direct causal relationship between non-performing loans and credit supply.
Rather, a negative macroeconomic change, such as the financial crisis, impacts both variables, leading to opposing movements. The subsequent chapters of the paper will delve deeper into this problem and analyze it further. The primary objective of the analysis is to examine the relationship between non-performing loans and credit supply.

1.2 – The regulation process of NPL

In terms of regulation of NPL, it has been seen an intense collaboration between European Central Bank and the Bank of Italy, to promote solutions in terms of non-performing loans. Italy is not the only country impacted by a high number of NLP; this issue affects other EU

countries as well, and actions to address these difficulties are required to resume strong economic growth.

• It is essential for small and medium-sized businesses that rely heavily on bank financing.

• It should incentivize corporate restructuring and reduce the total private sector debt overhang.

• It could improve monetary policy transmission.

The importance for the Italian banks to restore the quality of their balance sheet during the last years has involved also the Italian government to take measures, often implementing solutions that have proven to be effective in other countries.

In 2012, the Bank of Italy introduced a new measure, 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)

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.

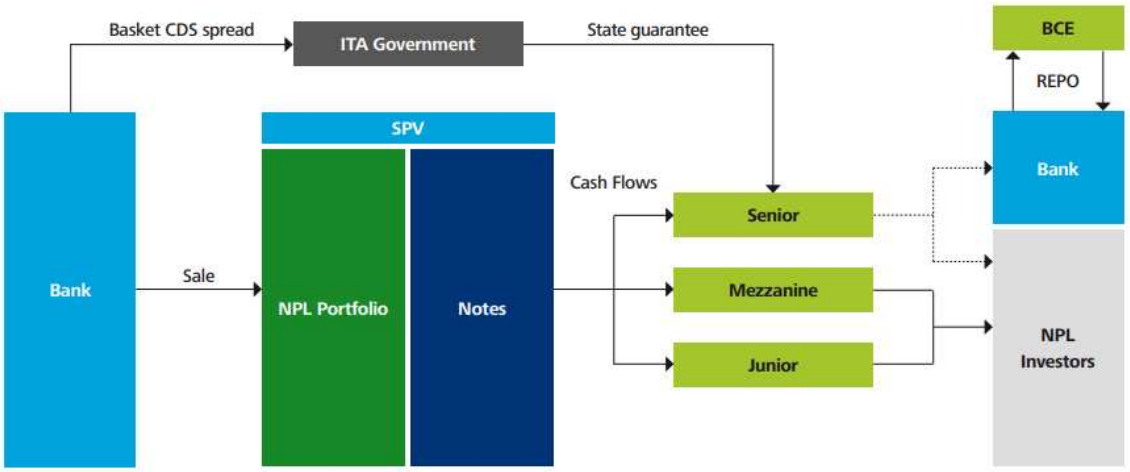
The fund's purposes were:

• 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, the Atlante fund 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 billion euro, of which 2,5 billion were dedicated to support the capital increase of Banca Popolare di Vicenza and Veneto Banca and the remaining 1,7 billion were dedicated to the launch of the fund Atlante two in August 2016. The main scope of this second fund created is to invest in Junior and Mezzanine tranche of nonperforming 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 purpose of GACS is related with the process of securitization of non-performing loans.



Source: Deloitte, February 2016 “Italian non-performing loans, State guarantee and securitisation scheme”

Figure 3

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 refers 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 nonperforming loans from the banks' balance sheets.

Private securitization vehicles ("SPV") are in charge of buying 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 tasks 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 massively 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 considers 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 the non-performing loans and of value adjustments.

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

For many years, Europe has had a poorly developed secondary market for non-performing loans. There have been many efforts to create a functioning secondary market, especially after the 2008 financial crisis. Recently a strategic plan has been approved about the way to tackle the problem of NPL in the European union. The European commission came up with an action plan with the aim to prevent a future build-up of nonperforming loans. This action plan creates the mechanisms to facilitate the access in funds in times of crisis. The target goals of this plan are four:

- Further develop secondary markets for distressed assets, allowing banks to shift NPLs off their balance sheet while providing debtors with additional protection
- Reforming the EU's corporate bankruptcy and debt recovery legislation would bring the various insolvency regimes across the EU closer together while preserving high consumer protection requirements.
- Encourage the establishment and the collaboration of national asset management firms at EU level
- Implement precautionary public support measures, where needed, to ensure the continued funding of the real economy under the EU’s Bank Recovery and Resolution Directive and State aid frameworks

Below there is an illustrative timeline, through which the regulatory process has gone. The directive for the secondary market of NPL entered into force in

Source: PwC: The Italian NPL Market, transformation at Work

Figure 4

December 2021 and the adaptation in national level with be 24 months after this date.

The directive aims to promote the efficient and transparent sale of NPLs by providing a set of guidelines and principles for the conduct of these transactions. It sets out requirements for the assessment, valuation, and disclosure of NPLs, as well as for the protection of borrowers and investors.

By establishing a standardized framework for the sale of NPLs, the directive seeks to enhance market liquidity.

CHAPTER II– Moral Hazard in the Banking System, Theories and Implications

2.1– Overview of Moral Hazard and asymmetric information

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 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 behavior and thus moral hazard. In general, the problem of asymmetric information, one manifestation of which is moral hazard, is already embedded in the Italian banking sector and poses a potential threat to the overall stability of the financial system. The next paragraphs give a more in-depth examination of this topic as well as the economic theories that have been evolved in.
Following a general introduction to the problem of asymmetric information is reported. Asymmetric information refers to the situation in which one agent in an economic activity has more information than others. The person who is better informed may benefit from this element when making decisions or acting.
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 parts, 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 behavior of one part takes place after that the contract is stipulated.
The purpose of this discussion will be focused on the study of the behavior of moral hazard since it is the manifestation more evident of asymmetric information and since, as we will discuss later, moral hazard behavior by banking management during the last decade has become 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. Frequently, even the agent hides an action from the main. The term "hidden action" is derived from this moral hazard. In the insurance industry, a common case of moral hazard occurs when a person purchases insurance and is covered against monetary damages, causing him to engage in more risky behavior than if he had to bear the risk himself without insurance protection.
However, moral hazard behavior within a firm appears to be strongly connected to the problem of separation of 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 agent-principal 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 behavior 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 associated with the general problem of an agency. One of the main sources of the divergence in the process of maximization of the utility comes from the impossibility by the principal to monitor the behavior 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 behavior by the agent. Normally the problem of asymmetric information concerns the principal who cannot be fully assured about the agent's acts and behavior. 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 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 includes 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. A second possibility is an outcome-based instrument, such as incentives. The agent's output can be rewarded by the principal. When output is measurable, incentives or output control are more appealing since they are a less expensive technique than monitoring.

Monetary bonus and monetary incentive given to the agent when some results are achieved. Focusing on personal interest, economic reward and monetary bonus sometimes the goal of the agent is completely altered. This focus brings us 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 behavior 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 behavior holding by the agent during the process of achievement.

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

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 agents 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 behavior 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 (behavior-based contract).
The following equation describes the expected utility of the principal:

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

While that of the agent:

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

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, indicates 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:

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

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

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 of attracting and retaining 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 principal's struggle to comprehend how incentives work.

• The risk of a poor link between the quality of managerial behavior and the compensation provided. The stock option compensation plan must establish a stock link between remuneration and firm performance. Otherwise, the upshot could be to unjustifiably reward managers who have achieved insufficient company results during a period of favorable stock market development, while failing to recognize managers who have made an active contribution to business performance.

• The bond's potential value loss due to the sale of shares obtained by managers across the floor

• The danger of underestimating the expense of issuing a high number of options.

• The risk that management would pursue aggressive and hazardous actions in order to meet the targets associated with the advantages of a stock option plan.

The problem of excessive risk that managers occasionally take will be a theme that we will consider throughout the examination of this book.

A non-option stock plan is also utilized as a compensation mechanism with the same scope. In the article: Stocks or Options? Ohad Kadan and M. Swinkels examined the differences between stock and option compensations in their paper "Moral Hazard, Firm Viability, and the Design of Compensation Contracts."[4] They analyze a principal-agent relationship between risk neutral investors and risk averse and effort averse managers to accomplish this. According to their findings, start-ups should give stock to CEOs in the early stages, but after an IPO, they should switch to option-based remuneration because the risk of non-viability is considerably lower. Similarly, they recommend that distressed enterprises use stock plan compensation first, and subsequently transition to options plans once they emerge from bankruptcy. To put it simply, the authors argue that stock plans are better as a motivator only when the danger of non-viability is high, such as in financially challenged enterprises or start-ups. This suggests that increased bankruptcy risk is associated with more use of simple stock.

2.2– 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.

[4] Washington University, March 2006

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 investigated 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 resulting is one of the main causes that reduce the value of a firm.
The most obvious conflicts inside a financial institution happen 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 a debt contract has been stipulated, the shareholders could have more incentives to invest in risky projects that are aligned with their interests but not with those of the debt holders. Undertaking 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 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

[5] Journal of Financial Economics 2009

problem inside a financial system. Moreover, they further expand their research analyzing the impact that national bank regulation, aimed to minimize problem of moral hazard, has on the banking system.

The use of national regulation, requirement of capital and limits on interest 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, 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 have 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 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 structures and risk taking. They analyzed the potential conflict of interests that differentiate managerially controlled banks and stockholders-controlled banks. It is hypothesized that stockholder-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, banks 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 reducing the risk. The level of risk of the institution is controlled and higher risky investments are avoided. On the opposite

[6] Journal of Finance 1990

side, if a firm is fully controlled by stockholders, it's likely that they will try to reduce their risk using the capital markets instead of diversifying the investments of the firm. In other words, thanks to the access in 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 an 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). 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 who engage in risky activities tend to increase the likelihood of the bank's default, Assaf Eidorfer examined the possibility that in order to shift risk to bondholders, shareholders must increase the risk of the firm's total assets, and thus the risk of equity and the probability of bankruptcy, in "risk shifting and investment asymmetry" 2009. However, Eidorfer's research discovered that the risk-shifting problem is not always connected with an increase in company risk, equity risk, and default risk.

When shareholders have the ability to change not only the variance of future firm value, but also its asymmetry, they benefit from wealth transfer by imposing more risk on bondholders while reducing firm risk, and more importantly, equity risk and the probability of bankruptcy.

2.3 – 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 behavior and risk shifting problem. Jensen and Meckling refer to two different types 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 in maximizing their own utility reaching pecuniary compensations or personal rewards. The second type of moral hazard refers 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 argues 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 analyse the relationship between moral hazard behavior, credit growth and non-performing loans. Even this work is based on the same intention: spotting moral hazard behavior 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) analyses 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) studies data on individual Texas banks from 1976 to 1990 and finds a negative impact of loan growth on non-performing loans and the loan charge-off rate in the first year after a bank's credit expansion, but a partial positive relationship in subsequent years.
Salas and Saurina (2002) examined a large set of data from Spanish commercial and savings banks from 1985 to 1997. They noticed that savings bank loan growth is considerably positively associated with loan losses three years in the future.
Hess et al. (2009) study the causes of credit losses at 32 Australasian banks from 1980 to 2005. It was noticed that strong loan growth leads to 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 taking more risk the result can be worse.
Considering 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

[7] Journal of Banking and Finance 2010

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.

2.4 – The impact of Banking regulation on moral hazard behaviours

The problem of moral hazard inside the banking system, as discussed before, leads to excessive risky lending strategies and to the rise of non-performing loans stock. This process has been considered one of the main aspects to 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 giving 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.

Establishing minimum capital requirements can help banks to reduce their probability of default and limit the excessive risk actions taking. In fact, major capital requirements mean putting 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 happens 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 refers 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 of aggressive lending strategy increasing their amount of nonperforming 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 arises because the government deposit-guarantee allows banks to make riskier loans without having to pay higher interest rates on deposits.

The findings of the analysis demonstrate a U-shaped link between capital and risk-taking: as capital requirements grow, the bank initially takes less risk, but in the long run, it takes more risk. Milne and Whaley's approach shares the concept of a U-shaped link between capital and risk taking. They expect that banks will first increase capital and lower risk following an increase in minimum capital requirements, and then increase both capital and risk after a period of adjustment. 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 analyse 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.

[8] Journal of Financial Intermediation, 8, 1999

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

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.

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.
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 [10] 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

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

decrease risk. Instead, the capital buffer theory adds an inter-temporal aspect: as long as bank 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 more than 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 in capital requirements. In contrast, banks with high capital buffers tend to choose the lowest risk investment possible.

To summarize, various studies have attempted to investigate the disciplinary function of on-site audits in the reduction of excessive risk carried by banks as a result of the discussion on the efficiency of regulatory operations on banking risk taking.

The following are the objectives of the on-site audit:

• 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.

CHAPTER III- Literature overview

3.1– Main theories and findings by other authors

Many other authors have already tried to analyze the relationship between non-performing loans and the lending behavior of the banking system during the recent years, identifying in moral hazard phenomenon the predominant link.
Two streams of research in the subject of financial institutions have gained a lot of attention over the last decade. One strand looks into the problem of non-performing loans. The other stream of inquiry looks into the productive efficiency of financial institutions. These research examined merger diagnosis, corporate governance features, as well as agency costs, poor management, and moral hazard behavior: Following we tried to summarize some of the main theories and findings by other authors that are in line with this 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 focused largely on how current credit policies influence an upsurge of non-performing loans, while others have focused on how the rate of growth of gross loans may be influenced by the amount of non-performing loans acquired in the past. In truth, it is merely examining the same idea from two different angles. As a result, we attempted to carry out both of them in our analysis.

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 behavior of the banks belonging to each

part separately. Specifically, they have focused their attention on the behavior of banks with a level of nonperforming 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 the result is 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.

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

The authors were expecting a negative and significant relationship between banks' loans growth rate and the level of non-performing loans in their dataset.
They first 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 in 2008. Moreover, since the deterioration in quality loans occur with some delay, the model (with no threshold value) results in inappropriate to spot moral hazard due to the dilution effect.
Even if banks suffer from 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-performing loans since the denominator will increase. Though, this impact fades over time.
The findings are consistent with the findings of my analysis reported in the following chapter.

In contrast, the results of the model that takes into account the threshold value demonstrate and confirm the presence of bad management in the financial system over the last decade. After the dilution effect is eliminated (taking into account at least two lags of the GLGR variable), the banks above the threshold have a positive relationship between non-performing loans ratio and gross loans growth rate, which is consistent with what the authors suspected: banks may be affected by moral hazard problems. (For the outcome, see the appendix).
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 behavior. 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 nonperforming loans ratio leaves space for further investigations.
Carlo Milani's paper "What Factors Influence Non-Performing Loans During Macroeconomic and Financial Turmoil?" Evidence from Italy" (October 2017) analyses the macroeconomic and bank-specific variables influencing 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.

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 million 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 nonperforming loans, the ratio between public debt and nominal GDP, expecting instead a positive relationship with nonperforming 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.

Milani in his paper tested the following hypotheses:

- H1. Sovereign debt hypothesis: an increase in the debt to GDP ratio implies higher nonperforming loans ratio. H1 is not rejected if the Δdebt coefficient is positive.
- 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.
- H3. Too-big-to-fail (TBTF) hypothesis: large banks have an implicit guarantee from governments under the presumption that they are too big to be left to fail. H3 is not rejected if the derivative of ΔNpl with respect to lr is positive for high levels of size;

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

- H4. 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. This hypothesis is not rejected if the SOLVENCY coefficient is negative.
- H5. Procyclical credit policy hypothesis: to reach higher performance in the short run, bank managers have incentives to extend credit also to borrowers with lower standards. H5 is not rejected if the roe or $loan$ coefficients are positive.

The results of the analysis show robust evidence in favor of 'moral hazard' and '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 researchers but many other authors, after the global crisis of 2007-2008, have performed a similar analysis outside Europe. One of the most important works conducted by **Dayong Zhang, Jing Cai, David G. Dickinson b, Ali M. Kutan, in their paper "Nonperforming loans, moral hazard and regulation of the Chinese commercial banking system", in 2015.**

The paper examines the impact of non-performing loans on banks behavior 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 behavior 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:

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

The first explanatory variable is the loans growth rate. The non-performing loans ratio level is used as the threshold variable. X is a vector including explanatory variables such as macroeconomic factors and bank-specific variables such as size, deposit growth rate, and

capitalization indices. 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 led 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 percentage points in the non-performing loans ratio. To also conclude, 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 behavior. Finally, one of the main aspects 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 behavior. 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 hypotheses that describe the inter-temporal relationship among problem loans, cost efficiency, and financial capital. They refer to these hypotheses with the mnemonics “bad luck”, “bad management”, “skimping” and “moral hazard”. Under all these assumptions, the authors were expecting that an increase in nonperforming 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 suggested that low levels of cost efficiency Granger-cause increase 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:

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

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 types 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" 2015, 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:

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

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. Regarding 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 highlighted and nor moral hazard behavior 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 nonfinancial firms in Italy between 2008-2015.
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 number 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.

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

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 γ < 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 estimation led the authors to arrive at the conclusion that the level of non-performing loans ratios "per se" has no effect on bank lending decisions. The authors discovered that other bank-related criteria, such as capital ratios and size, actively influence credit supply during the study period rather than the non-performing loans ratio and hence a bank's credit risk.

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 nonperforming 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.

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

An empirical analysis is required to determine the fundamental relationship between the number of gross non-performing loans on a bank's balance sheet and other factors that could influence the decisions during the loan granting process. Many other authors have undertaken similar analyses, but in each case, adjustments must be made. In order to construct an analysis that is appropriate for the purpose of this work, we decided to examine the behavior of twelve of the biggest Italian banks by capitalization in 2023.

The data needed to generate the dataset was collected via the Eikon database as well as direct consultation of each bank's consolidated balance sheets and consolidated income statements. The observations cover a fifteen-year span from 2008 to 2022, with an annual frequency of 180 observations. We opted to construct a panel data estimation after researching which type of statistical analysis would be the greatest fit. Most multiple regression applications are performed on datasets that contain only cross-sectional or time series data.

Despite the fact that these two instances are widespread, the use of cross-sectional dimension and time series combined in empirical research is becoming more common. There are two approaches to create this type of dataset. On the one hand, a set of pooled cross sections is obtained by randomly selecting a large population at various time intervals. The independence of observations, which excludes any correlation in the error terms of many observations, is an important element of subsequent analysis. A panel data set, on the other hand, observes the same people across time.

As such, panel data is made up of researchers' observations of various cases collected across time for the same group of units or things. More information necessitates more work, and more effort necessitates more effort costs. When working with panel data, you can deal with more information than with a single dataset, including more variability and, as a result, less collinearity between variables. Furthermore, because panel data "follow" the data across time, they allow for the study of the dynamics of data volatility. Panel data are frequently organized and used to test the hypothesis of the presence of a linear connection between the dependent variable and k independent variables.

The analysis's goal is to identify evidence of moral hazard behaviour among the Italian banks employed in the study.

Because the sample includes the 12 most capitalized Italian banks, it might be used to determine a general trend in the banking sector. Of course, as will be demonstrated later, such claim is pretentious.

On the same dataset, the analysis is carried out by estimating two different types of Panel data regression. The purpose is to draw broad generalizations about the lending strategy of the sample and its relationship to the stock of nonperforming loans. We intended to look at the elements that influence the nonperforming loans ratio on the bank's balance sheet over time in the first analysis (Equation 1), with a particular emphasis on the impact of lending strategy decisions made by management. The second analysis (Equation 2) aimed to better understand the factors that influence Italian banks' lending strategy policies, including the already accumulated non-performing loans. Each of the two equations can be thought of as an analysis of the same phenomenon from two different points of view. To summarize, we developed two models that communicate with one another in order to get a unified economic meaning.

4.1 – Model 1: Explanation of the tested hypothesis

The first model that we took into consideration, has as dependent variable GNPL, which is the ratio of non-performing loans to the total outstanding loans for bank i at time t. Below is an outlook of the equation.

$$\begin{aligned} \boldsymbol{GNPL_{i,t}} = {} & \boldsymbol{\beta_1 GLGR_{i,t} + \beta_2 GLGR_{i,t-1} + \beta_3 GLGR_{i,t-2} + \beta_4 GLGR_{i,t-3}} \\ & \boldsymbol{+ \beta_5 \log (Solvency)_{i,t} + \beta_6 \log (Solvency)_{i,t-1}} \\ & \boldsymbol{+ \beta_7 \log (Solvency)_{i,t-2} + \beta_8 \log (Solvency)_{i,t-3} + \beta_9 ROE_{i,t}} \\ & \boldsymbol{+ \beta_{10} Margin_{i,t} + \beta_{11} DEP_{i,t} + \beta_{12} CAR_{i,t} + \beta_{13} Tier1_{i,t}} \\ & \boldsymbol{+ \beta_{14} SIZE_{i,t} + \beta_{15} RGDP_{i,t} + u_{i,t}} \end{aligned}$$

The error term can be decomposed in two parts:

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

Both the parties are unobservable called a fixed effect and an idiosyncratic error, respectively. Two are the observations that must be done:
-Adding lags to the GLGR and SOLVENCY variables improves the model since the amount of non-performing loans on a bank's balance sheet today is primarily due to prior credit policies and, more broadly, past bank factors, decisions, and results. Although we decided to execute the delays over three years, the limited time laps could indicate a drawback of the model's importance.
The transformation of the variable SOLVENCY in LOG (SOLVENCY). There are several reasons for calculating the log of a variable. A log transformation may be useful in linearization and series stabilization. A logarithmic transformation variable is commonly used to bring outlying data from a positively skewed distribution closer to most of the data in order to make the variable regularly distributed. Furthermore, the transformation to log form is useful for data comprehension. Assuming all predictors are held constant, a one-unit change in the independent variable results in a one-unit change in the respective regression coefficient in the expected value of the dependent variable. It is possible to interpret a log converted variable in this manner. Such coefficients, however, are commonly understood in terms of percentage change. In this scenario, the transformation of the variable **SOLVENCY** will be important to detect the sign of the variable's change on the total quantity of non-performing loans. The **GLGR** variable, which is lagged up to three periods, expresses the loan gross growth rate for bank i at time t. The other variables included in the model as control variables and held constant during the estimation of the coefficient between GNPL and GLGR are specific banking and macroeconomic variables that will be discussed in detail in the following paragraph with their main descriptive statistics and the expected sign of their coefficients.

The study of **EQUATION 1** aims to determine if banking lending behaviour has any influence on the deterioration of banking loans in recent years. If we consider the collected data to be a suitable proxy for analysing the Italian banking scenario, we can reasonably predict a negative association between the stock of non-performing loans at time t and the trend of loan growth in the recent past. The presence of moral hazard would be indicated by opposite findings.
If the stock of non-performing loans has increased at time t, it might be due to the management's overly aggressive and expansive lending strategy at time t and some periods lagged, and moral hazard behaviour could be identified.

4.1.1– Data and expected results for Equation 1

The analysis performed on the Equation 1 to analyse the evolution of non-performing loans inside the Italian bank's balance sheet and mainly to spot moral hazard behaviour, 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.

$$\boldsymbol{GNPL} = \frac{NPL(t)}{Total\ Gross\ Loans(t)}$$

The surge in non-performing loans (NPLs) in Italy following the 2008 financial crisis can be primarily attributed to loans extended to customers and small and medium-sized enterprises (SMEs) that proved unable to repay their debts.

To gauge the dynamics of this issue, one effective metric involves calculating the annual accumulation of NPLs on the balance sheets in relation to the loans granted to customers. This ratio signifies the percentage of bad loans relative to the total loans disbursed. Naturally, the trend in this ratio is quite straightforward to discern—it exhibited an exponential increase in the aftermath of the crisis. Over the last decade, the trajectory of Italian non-performing loans as a proportion of total loans has consistently shown an upward trend.

Below, we present the evolution of the Gross Non-Performing Loans (GNPLs) variable for the 12 banks included in our dataset from 2008 to 2022. It is evident how the ratio of non-performing loans over the past decade experienced a significant uptick, primarily after 2011 until 2016 when we can notice a downward trend for all the banks. This goes in line with the economic crisis in Italy during that period. As the economy started to stabilize, also the GNPL in the bank balance sheets started to go toward a normalisation.

As Figure 5 and Figure 6 below show that there is a similar trend for the Italian banking system, with the data of our dataset for the GNPL variable. Of course, the data in our sample are not enough to reveal a precise image of the reality, but it is significant that they have the same trendline.

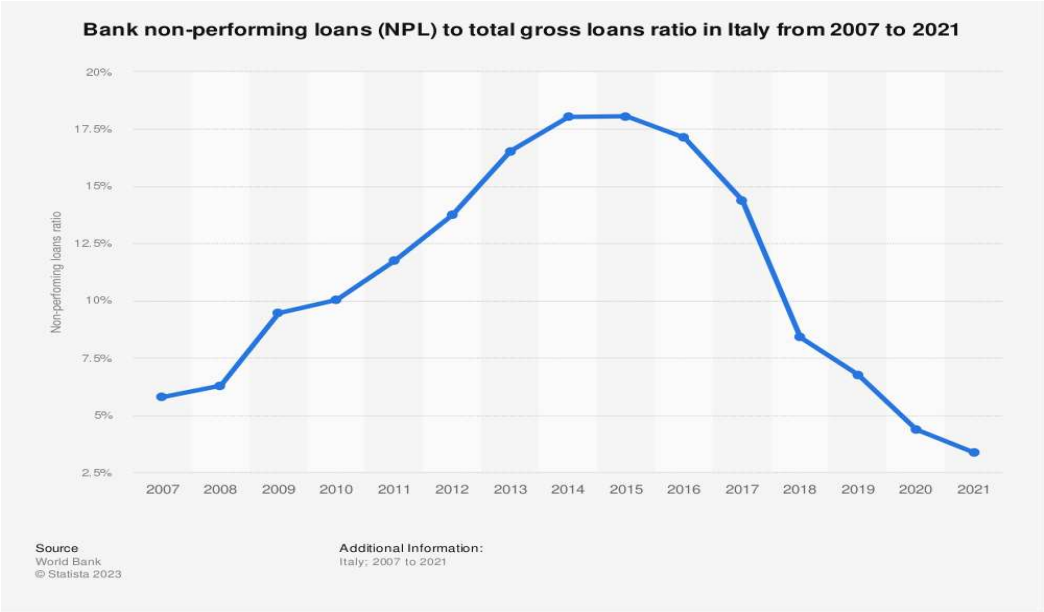


Figure 5

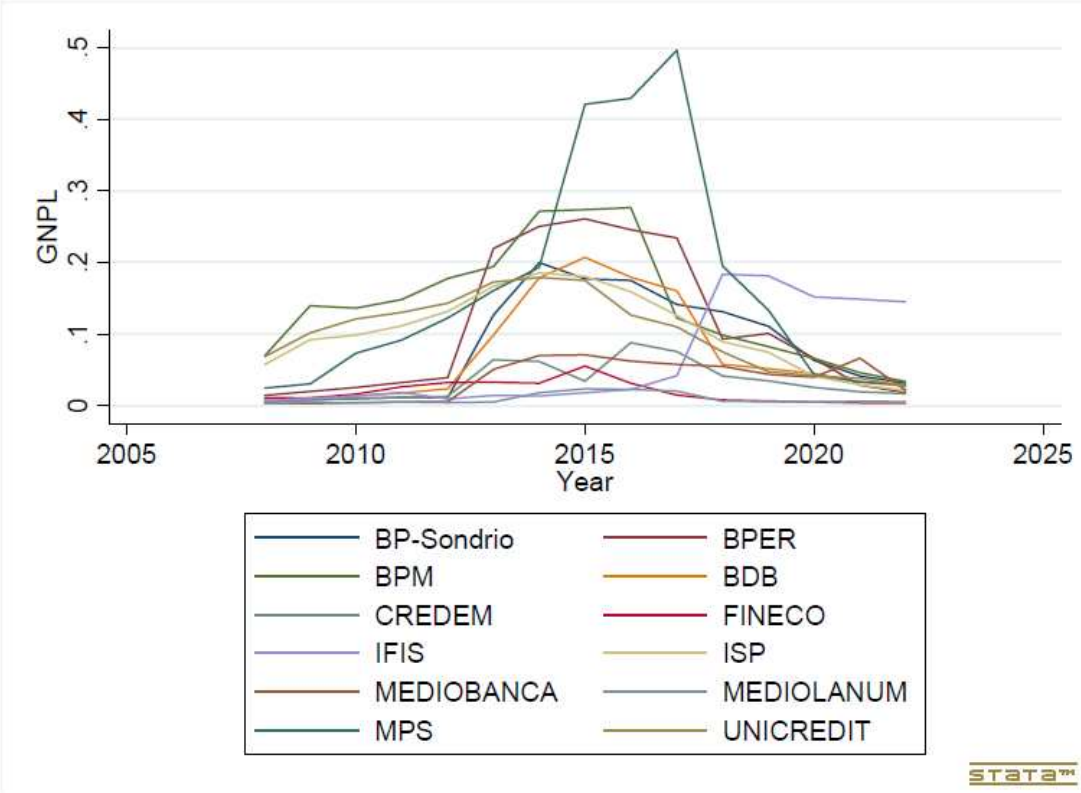


Figure 6

This delayed effect of deteriorating loans becoming non-performing can be attributed to the time required for loans to transition into the non-performing category. 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 nonperforming loans in the bank balance sheet and consequently understand the banks choice in term of lending behaviour. Following are reported all the explanatory variables used for the specification of the models. The choice of the introduction of this variable is a consequence of a reflection about the aspects that in our opinion influence the bank behaviour 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.

$$\boldsymbol{GLGR} = \frac{Total\ loans_{(t)} - Total\ loans_{(t-1)}}{Total\ loans_{(t-1)}}$$

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 nonperforming loans ratio. However, an abnormal loans growth rate would indicate a moral hazard behaviour, causing subsequent further losses and an increase of GNPL itself.
The second explanatory variables used is:

$$\boldsymbol{Margin} = \frac{Intermediation\ margin(t)}{Total\ Asset(t)}$$

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 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:

$$\boldsymbol{Solvency} = \frac{Equity(t)}{Total\ Asset(t)}$$

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 $t-1$, $t-2$ and $t-3$, 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 $t-1$, $t-2$ and $t-3$. This stems from the fact that the latter three variables have a relationship with the non-performing loans ambiguous or even insignificant.

ROE is another variable used in my study:

$$\boldsymbol{ROE} = \frac{Net\ profit(t)}{Equity(t)}$$

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. 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 nonperforming
loans can be detective.
The fifth explanatory variable is:

$$\boldsymbol{DEP} = \frac{Deposit_t - Deposit_{(t-1)}}{Deposit_{(t-1)}}$$

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 considered. 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:

$$\boldsymbol{CAR} = \frac{Tier_1 + Tier_2}{TRWA_t}$$

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 behaviour 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 behaviour. 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:

$$\boldsymbol{TIER1} = \frac{Tier1\ Capital}{TRWA_t}$$

It's the main important variable to consider the capitalization of a bank. It is expressed as the ratio between the Tier1 capital, and the total risk weighed assets. The Tier1 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:

$$\mathbf{SIZE} = \mathrm{LN}(\mathrm{Asset})_{\boldsymbol{t}}$$

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. 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. 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.

$$\boldsymbol{RGDP} = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$$

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 2008 to 2022. It's an important variable because using 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 serves as an initial insight into a bank's lending strategy and its correlation with the stock of non-performing loans, which will be further explored in the second analysis (Equation 2). As elucidated in the literature review section, poor management decisions may lead to an anticipation of a surge in the non-performing loans inventory, prompting a risky approach aimed at curtailing short-term losses through heightened lending levels. This mechanism can engender a dilution effect, causing the percentage of non-performing loans to temporarily decrease. Nonetheless, it's important to note that this effect is transient, and over time, a risky lending strategy can exacerbate the non-performing loans stock, creating what I will refer to as a "vicious circle." The outcomes and limitations of the initial model will be presented in the forthcoming chapter.

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

4.2 – Model 2: Specification and hypothesis tested

The objective was to implement a secondary model aimed at exploring the potential correlation between the annual growth rate of banking gross loans at time t and the presence of non-performing loans within the bank's balance sheet at time t, along with several lags of this variable (which serves as a proxy for assessing the bank's credit risk). The overarching goal was to construct a model to substantiate our earlier suspicion from the initial analysis: that an aggressive lending strategy by a bank's management, without due consideration for the high levels of existing non-performing loans on the bank's balance sheet, could encourage moral hazard behaviour.

We chose to estimate a credit supply equation in which the annual stock of non-performing loans played a pivotal role in influencing the strategies adopted by banks. Recognizing that it typically takes more than two years on average for a credit to transition from performing to non-performing (as Equation 1 inadequately specifies), we decided to conduct an analysis that gives more weight to recent factors. This decision stemmed from the belief that the decisions made by a bank's management at time t are primarily influenced by more recent factors, rather than considering the organization's distant past performance.

To summarize, while it generally takes over two years for a credit to become non-performing (as Equation 1 suggests), our model assumes that the factors impacting a bank's lending strategy at the present time primarily stem from more recent influences.

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

Equation 2 it is structured in the following way:

$$\begin{aligned}\mathbf{GLGR_{i,t}} = {} & \boldsymbol{\beta_1}\,\mathbf{LOG(GNPL)_{i,t}} + \boldsymbol{\beta_2}\,\mathbf{LOG(GNPL)_{i,t-1}} + \boldsymbol{\beta_3}\,\mathbf{DEP_{i,t}} \\ & + \boldsymbol{\beta_4}\,\mathbf{ROE_{i,t}} + \boldsymbol{\beta_5}\mathbf{Margin_{i,t}} + \boldsymbol{\beta_6}\,\mathbf{CAR_{i,t}} + \boldsymbol{\beta_7}\,\mathbf{RDGP_{i,t}} \\ & + \mathbf{u_{i,t}}\end{aligned}$$

The error term can be decomposed in two parts:

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

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 used 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 euros. 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, signalling therefore the presence of a moral hazard behaviour.

4.2.1– Data and expected results for Equation 2

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 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 fear bankruptcies or defaults. Therefore, the price of debt products for borrowers increases 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 analyse 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. 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. 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 nonperforming 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.

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 analyses 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.

4.3 – Descriptive statistics

In the scope of this study, a sample of twelve prominent Italian banks was selected for comprehensive analysis. The dataset employed in this research encompasses a panel of observations spanning a fifteen-year period, ranging from 2008 to 2022, resulting in a total of 180 complete observations. It is important to note that data collection for this study occurred on an annual basis, with information primarily drawn from the consolidated balance sheets of each bank, supplemented in certain instances by data sourced from the EIKON dataset.

A brief overview of the key descriptive statistics for both the dependent and independent variables utilized in our econometric models is presented below. Given the panel dataset's structure, with each of the twelve banks contributing 15 annual observations, the total number of observations amounts to 180.

Variable		Mean	Std. dev.	Min	Max	Observations	
GNPL	overall	.0776261	.0839568	0	.4963	N =	180
	between		.0467423	.0095467	.1652667	n =	12
	within		.0709562	-.0627406	.4086594	T =	15
GLGR	overall	.0793228	.1973146	-.7979	1.2973	N =	180
	between		.0788221	-.0154333	.2638067	n =	12
	within		.1822252	-.8222439	1.112816	T =	15
MARGIN	overall	.133535	1.439218	-.8816	19.3132	N =	180
	between		.3557275	.02016	1.262833	n =	12
	within		1.398107	-2.010898	18.1839	T =	15
SOLVENCY	overall	.0676544	.0256883	.0218	.155	N =	180
	between		.0212491	.0354267	.1111933	n =	12
	within		.0156103	.0027144	.1242144	T =	15
ROE	overall	.038655	.1419434	-.9358	.3111	N =	180
	between		.1006746	-.2025267	.2283733	n =	12
	within		.1039484	-.6946183	.3051817	T =	15
DEP	overall	.0899133	.2207594	-.4653	1.9111	N =	180
	between		.0596137	.00086	.2351667	n =	12
	within		.2132109	-.6105533	1.765847	T =	15
CAR	overall	.1558117	.0485989	.0858	.4168	N =	180
	between		.0296397	.12862	.22176	n =	12
	within		.0393961	.0263517	.3508517	T =	15
TIER1	overall	.13403	.051988	.0513	.4168	N =	180
	between		.0357347	.1102067	.2216533	n =	12
	within		.0390597	.0046767	.3291767	T =	15
SIZE	overall	11.11629	1.469308	7.2145	13.8822	N =	180
	between		1.495978	8.815007	13.69819	n =	12
	within		.309759	9.515787	11.86021	T =	15
RGDP	overall	-.121192	3.600731	-8.979126	6.986766	N =	180
	between		0	-.121192	-.121192	n =	12
	within		3.600731	-8.979126	6.986766	T =	15

The overall sample exhibits an average Gross Nonperforming Loan (GNPL) ratio of 7.76%, reflecting the average proportion of nonperforming loans relative to total loans, as reported in the banks' balance sheets over the preceding decade. Furthermore, in terms of GLGR, the sample displays an average rate of 7.93%, indicating an average increase in credit extended to consumers over the same period.

Assessing the capital adequacy of the sampled banks, we find a notable average Common Equity Tier 1 (CET1) capital adequacy ratio (CAR) of 15.58%, with a Tier 1 capital ratio (TIER1) averaging at 13.4%. While the specific CAR levels vary among individual banks, it is pertinent to note that a common regulatory threshold, in line with Basel Accords standards, is established at 10%, a benchmark adhered to by national banking regulatory authorities.

The high levels of capitalization observed in this study are inherent, given the inclusion of the top 12 capitalized Italian banks in the sample. Additional metrics pertaining to profitability reveal an average Return on Equity (ROE) of 3.86% and an intermediation margin over asset ratio of 13.35%.

Correlation analysis indicates a negative correlation of -0.2667 between GNPL and GLGR, aligning with our initial expectations.

	GNPL	GLGR	DEP	SOLVENCY	MARGIN	CAR	ROE
GNPL	1.0000						
GLGR	-0.2667	1.0000					
DEP	-0.1250	0.1593	1.0000				
SOLVENCY	0.1274	-0.0074	-0.1003	1.0000			
MARGIN	-0.0503	-0.0184	-0.0289	-0.0434	1.0000		
CAR	-0.1907	0.1880	0.0368	-0.1617	0.0967	1.0000	
ROE	-0.4580	0.2544	0.1347	-0.0308	0.0719	0.3186	1.0000

Moving forward, the ensuing section shall provide an introduction to the fundamental principles underpinning panel data analysis, while also introducing the primary models that will be employed for panel data regression estimation in subsequent chapters. Finally, the concluding chapter will present the findings stemming from the estimation procedure.

4.4 – Brief econometric introduction to Panel Data analysis

In the following section, we embark on a concise introduction to the econometric models employed for estimating the equations within our study. Three primary models have been developed for the analysis of panel data:

1. **Pooled OLS Model or First-Differenced Estimator**
2. **Fixed Effects Model**
3. **Random Effects Model**

Subsequently, we delve into a discussion of the core aspects of these models, which will be utilized in our empirical investigation in the ensuing chapters. The Pooled OLS estimator, which relies on the Ordinary Least Squares (OLS) technique, represents the most straightforward approach to estimating panel data. While this model serves as a foundational point of reference for comparison with more intricate models, it is crucial to acknowledge its limited applicability. As we will elaborate later, the Pooled OLS model rests upon a set of assumptions that are seldom met in practice.

Specifically, the Pooled OLS estimation hinges on several key assumptions:

1. **Linearity**: The dependent variable (y) is a linear function of the independent variables and the error term ($u_{i,t}$).
2. **Exogeneity**: The expected value of the error term (E($u_{i,t}$))equals zero, and the covariance between the error term and the independent variables $Cov(u_{i,t}; x_{i,t})$ equals zero.
3. **Homoscedasticity and No Autocorrelation:** The variance of the error term $Var\ (u_{i,t})$ is constant, and the covariance between error terms for different observations ($Cov\ (u_{11};\ u_{12})$) =0
4. **Non-Stochastic Independent Variables**: The independent variables are not stochastic but remain fixed within the sample, free from measurement error.
5. **Full Rank**: There is no multicollinearity, implying that there are no perfect linear relationships between the explanatory variables. In essence, one independent variable should not predict another, avoiding redundant information. However, the Pooled OLS estimator often fails due to its usual correlation with x_{it} (i.e., Cov (u_{it}, x_{it}) ≠ 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 uit can be decomposed in two parts:

The Fixed Effects model relies on several assumptions:

1. **Conditional Mean Independence**: E(u_{it}| x_{it})=0.
2. **Correlation Between Fixed Effects and Explanatory Variables**: Cov(a_i,x_{it})≠0
3. **Temporal Variation of Explanatory Variables**: Every explanatory variable varies over time, and there is no linear relationship among them.
4. **Conditional Mean Independence (Extended):** E(εit|X,ai) equals zero.
5. **Homoscedasticity:** Var(εit|X1, ai) = Var(εit) = σε² for each t.
6. **Uncorrelated Error Terms:** For t ≠ s, idiosyncratic errors are uncorrelated (Cov(εit,εis|Xi,ai) = 0).
7. **Normal Distribution of Error Terms:** The error terms follow a normal distribution with a mean of zero and a variance of σε².

The estimator derived from this model is commonly referred to as the Within Estimator, owing to its reliance on the time variation in y and x within each cross-sectional observation. This procedure leads to a reduction in degrees of freedom.

The two models introduced thus far provide means to eliminate unobserved heterogeneity within the model. However, a crucial question arises: which model should be employed to estimate our model—Pooled OLS or Fixed Effects? When T (the number of time periods) is equal to 2, both the Fixed Effects model and the Pooled OLS estimator yield identical results, along with equivalent statistical tests. The situation differs for T > 2, where the Fixed Effects estimator is necessary when idiosyncratic errors exhibit serial uncorrelation. Nonetheless, the unobserved factors are likely to exhibit serial correlation. If idiosyncratic errors follow a

random walk, signifying positive serial correlation, then the difference is serially uncorrelated, allowing the use of the First-Differenced (FD) estimator. However, if the correlation pattern does not follow a random walk but remains positive, it becomes challenging to determine whether to use the FD or Fixed Effects estimator. Conversely, if there is significant negative serial correlation, the Fixed Effects estimator tends to yield more reliable results. Generally, when faced with substantively different outcomes, it is prudent to report both sets of results and investigate the underlying reasons for discrepancies.

In the Fixed Effects model, the primary objective is to mitigate the potential influence of unobserved heterogeneity by eliminating ai, as its correlation with one or more explanatory variables can introduce estimator bias

$$(\text{Cov}(a_i, x_{it}) \neq 0).$$

In contrast, the Random Effects model operates under the assumption that the error term is not a fixed term but a realization of a random variable uncorrelated with the explanatory variables:

$$(\text{Cov}(a_i, x_{it}) = 0)$$

While one might argue that due to this assumption, ai does not need to be eliminated, and the Pooled OLS estimator can be employed, practicality dictates otherwise. The presence of serial correlation within the error components renders any inference based on the Pooled OLS estimator unreliable. Thus, the utilization of Generalized Least Squares is imperative to mitigate this issue. The Random Effects estimator represents a hybrid of the Pooled OLS and Fixed Effects estimators.

The critical assumptions underpinning the Random Effects model encompass:

-There is no linear relation between the explanatory variables

- **Absence of Linear Relationships**: There is no linear relationship between the explanatory variables.
- **Conditional Mean Independence:** E(ε_{it}|X,ai) equals zero, and E(ai|Xi) equals β_0.
- **Homoscedasticity:** Var(ε_{it}|X,ai) = Var(ε_{it}) = $\sigma\varepsilon^2$ for each t, and Var(ai,Xi) = σa^2.
- **Uncorrelated Error Terms**: For t ≠ s, idiosyncratic errors are uncorrelated (Cov(ε_{it}, ε_{is}|Xi, a_i) = 0).
- **Normal Distribution of Error Terms:** The error terms ε_{it} follow a normal distribution.

Finally, to determine the appropriate model choice between Pooled OLS and Random Effects, it is essential to test whether Cov(a_i, x_{it}) = 0 or not.

The Hausman test be the best approach to so it.

The Hausman test, introduced by Hausman in 1978, represents a potent statistical tool employed in panel data analysis to determine the model that best fits the data. This test serves as a pivotal diagnostic for choosing between the Fixed Effects (FE) and Random Effects (RE) models, aiming to ascertain which model aligns more closely with the data. The fundamental premise of the Hausman test is straightforward, encompassing two hypotheses:

Null Hypothesis (Ho): Covariance between individual effects (a_i) and the explanatory variables (X_{it}) is equal to zero, implying that the Random Effect model is consistent.

Alternative Hypothesis (H1): Covariance between individual effects (a_i) and the explanatory variables (X_{it}) is not equal to zero, signifying that the Fixed Effect model is consistent.

The core notion underlying the Hausman test is that under the null hypothesis (Ho), both the Fixed Effects (FE) and Random Effects (RE) estimators are consistent. However, under the alternative hypothesis (H1), only the Fixed Effect estimators are consistent.

In practice, if the null hypothesis is rejected, it implies that the fixed or individual effect is significantly associated with at least one of the regressors in the model. Consequently, the Random Effect model is considered inconsistent, and the Fixed Effect model is the more appropriate choice for modelling the data. Conversely, if the null hypothesis is accepted, it suggests that the Random Effect model offers the best goodness of fit for the data. To operationalize the Hausman test, Hausman proposed comparing two sets of estimations:

1. $\beta_{\mathbf{gls}}$: The estimate from the Random Effect model, which is BLUE (Best Linear Unbiased Estimator) and consistent only when Ho is true.
2. $\beta_{\mathbf{within}}$: The estimation coefficients from the Fixed Effect model.

The test statistic is then calculated as q = $\beta_{\mathbf{gls}}$- $\beta_{\mathbf{within}}$. If the difference between gls and within is sufficiently significant, the null hypothesis (Ho) is rejected, and the Fixed Effect model is deemed the more appropriate choice. In summary, the Hausman test serves as a pivotal instrument for model selection in panel data analysis, helping researchers determine whether individual effects are correlated with the explanatory variables and thereby guiding the choice between the Fixed Effects and Random Effects models.

CHAPTER V-Results

5.1– Results of model 1

In our initial study, our primary objective was to investigate the relationship between the stock of non-performing loans at a given time t and the lending strategies employed by the banks in our sample at that time, as well as at various time lags leading up to it. To achieve this, we employed various econometric models, including Pooled OLS, Fixed Effects, and Random Effects models. The estimated coefficients and their corresponding significance levels for Equation 1 are presented in the table below.

Equation 1 : GNPL as Dependent variable

	Pooled OLS	Fixed Effect	Random Effect
GLGR	-0.063407	-0.0708478	-0.063407
GLGR1	-0.0255043	-0.0189574	-0.0255043
GLGR2	-0.0103757	0.0056951	-0.0103757
GLGR3	0.0226503	0.0450023	0.0226503
MARGIN	-0.0005708	-0.0008798	-0.0005708
logSolvency	0.0555299	0.1082222	0.0555299
logSolvency1	-0.0186268	-0.0206276	-0.0186268
logSolvency2	0.0227947	0.0198516	0.0227947
logSolvency3	-0.0288163	-0.0053762	-0.0288163
ROE	-0.2523826	-0.2351964	-0.2523826
DEP	-0.0045652	-0.0028354	-0.0045652
CAR	-0.9592239	-1.157206	-0.9592239
TIER1	0.9646677	1.006806	0.9646677
SIZE	0.0133828	0.024784	0.0133828
RGDP	0.0025461	0.0021795	0.0025461
Constant	0.0526563	0.1438251	0.0526563
Observation	177	177	177
R-squared within		0.1994	0.1638
R-squared overall		0.2763	0.3261
Breusch-Pagan test	0		
Hausman Test		0.0402	
F-Test		0	
Wooldridge test		0	

Having been established a significant level of 5%, the estimation of GLGR coefficient, using the Pooled OLS method results negative and significant. Despite this significance, our analysis encountered a significant challenge: the Breusch-Pagan test for heteroscedasticity rejected the null hypothesis, indicating a presence of correlation between the unobserved error factors and the explanatory variables. This finding rendered the Pooled OLS model unsuitable for our analysis, as it violated a key assumption of this model.

To address this issue and determine the most appropriate model for our analysis, we conducted the Hausman test. The Hausman test serves as a critical diagnostic tool in panel data analysis to choose between the Fixed Effects and Random Effects models. By comparing the consistency of these models under different assumptions, we could determine which model was more suitable for our data.

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 a predictor variable and the error term. Instrumental variables estimators can be used as an alternative in this case. However, before deciding on the best regression method, first we have to figure out if the 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 Consistent efficient is Random effect

H1 = Cov (a_i; x_{it};) ≠ 0 Consistent efficient is Fixed effect

Essentially, the tests checks 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 better fit 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:

Hausman Fixed Random Equation 1

	Fixed	Random	Difference
GLGR	-0.0708478	-0.063407	-0.0074408
GLGR1	-0.0189574	-0.0255043	0.0065468
GLGR2	0.0056951	-0.0103757	0.0160708
GLGR3	0.0450023	0.0226503	0.0223519
MARGIN	-0.0008798	-0.0005708	-0.000309
logSolvency	0.1082222	0.0555299	0.0526923
logSolvency1	-0.0206276	-0.0186268	-0.0020008
logSolvency2	0.0198516	0.0227947	-0.0029431
logSolvency3	-0.0053762	-0.0288163	0.0234401
ROE	-0.2351964	-0.2523826	0.0171862
DEP	-0.0028354	-0.0045652	0.0017298
CAR	-1.157206	-0.9592239	-0.1979824
TIER1	1.006806	0.9646677	0.042138
SIZE	0.024784	0.0133828	0.0114012
RGDP	0.0021795	0.0025461	-0.0003666

Test of H0: Difference in coefficients not systematic

chi2(15)=25.80
Prob > chi2 = 0.0402

The obtained p-value of 0.0402 from the Hausman test provides statistical evidence to reject the null hypothesis and favor the Fixed Effects estimator as the most appropriate model for our analysis. The choice of the Fixed Effects model stems from the necessity to address unobservable errors encapsulated within the Fixed Effect, which have the potential to be correlated with the explanatory variables, thereby biasing the estimation.

To mitigate this concern, the Fixed Effects model employs a data-demeaning procedure. This process entails deducting the sample average from each variable before conducting the estimation using the Pooled OLS technique. The results of this estimation are presented in the second column of the table above.

Our analysis shows that the relationship between the stock of non-performing loans (GNPLs) at time t and the contemporaneous GLGR2 and GLGR3 is positive for the lagged variables. Although the values are very small, this may be a sign of moral hazard evidence. Since the relationship is positive only in the lagged variables, this is in line with the hypothesis that the deterioration in the quality of loans occurs with some delay, on average more than two years. For this reason, a positive connection between GNPL and of the lagged variables of GLGR can be considered as evidence of moral hazard.

But, it is noteworthy that the analysis does not reveal a strong evidence of moral hazard. Further investigation and refinement of the model may be required to explore this aspect comprehensively.

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 analyse 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.
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 behaviour inside the banking system.

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 favour 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.
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.

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 an F-test that determines if all coefficients in the model are greater than or less than 0. In this situation, the p-value is quite low, suggesting that all of the coefficients deviate from 0.

```
F(15, 150)        =      2.49
Prob > F          =    0.0027
```

Test for autocorrelation: Wooldridge test.

Since serial correlation biases the standard errors and makes the outcomes less efficient in linear panel data models, researchers need to identify serial correlation in the idiosyncratic error component in a panel data model. Wooldridge (2002) developed a new test for serial correlation in random- or fixed-effects one-way models.

H0: no first order autocorrelation

F(1, 15) = 97.86

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 autocorrelation between the idiosyncratic error terms.

5.2– Results of model 2

The objective of our second analysis was to investigate the relationship between the lending strategies employed by the banks in our sample at time t and the stock of non-performing loans (NPLs) that had already accumulated in their balance sheets. In essence, we aimed to discern whether the trend of credit risk had any discernible impact on the lending behaviour of these banks. The research hypothesis guiding this investigation was as follows:

- **An increase in bank credit risk in period t-1 leads to banks supplying more credit, potentially indicating the presence of moral hazard behaviour.**

	Pooled OLS	Fixed Effect	GLS Random Effect
logGNPL	-0.0267546	-0.0155483	-0.0267546
logGNPL1	-0.0160721	-0.0184974	-0.0160721
DEP	0.0941369	0.0457134	0.0941369
ROE	0.1358296	0.1836224	0.1358296
MARGIN	-0.0067198	-0.0122716	-0.0067198
CAR	0.3350746	0.4037105	0.3350746
RDGP	0.0007256	-0.0002802	0.0007256
Constant	-0.1208104	-0.1003731	-0.1208104
Observation	177	177	177
R-squared within		0.0740	0.0682
R-squared overall		0.1391	0.1461
Breusch-Pagan test	0		
Hausman Test			0.0558

The table presented above displays the estimated coefficients and the significance levels obtained from panel data regression models, encompassing Pooled OLS, Fixed Effects, and Random Effects models.

Initially, employing the Pooled OLS method and establishing a significance level of 5%, we identified several significant variables: logNPL, logNPL1, DEP, and CAR. Of particular note was the coefficient between Gross Loans to Gross Retail Loans (GLGR) and the lagged variable logNPL1, which was observed to be negative to -1.6%

However, a significant challenge arose as the Breusch-Pagan test for heteroscedasticity, employed in the context of the Pooled OLS method, rejected the null hypothesis of no correlation between the unobserved error factors and the explanatory variables. This finding rendered the Pooled OLS model unsuitable for our analysis, highlighting the presence of heteroscedasticity in the data.

To determine the most appropriate model for our analysis and to mitigate the issues associated with heteroscedasticity, we conducted the Hausman test. The result of the Hausman test is reported below:

Hausman Test for Equation 2

	Fixed Effect	Random Effect	Difference
logGNPL	-0.0155483	-0.0267546	0.0112064
logGNPL1	-0.0184974	-0.0160721	-0.0024253
DEP	0.0457134	0.0941369	-0.0484235
ROE	0.1836224	0.1358296	0.0477928
MARGIN	-0.0122716	-0.0067198	-0.0055518
CAR	0.4037105	0.3350746	0.0686359
RDGP	-0.0002802	0.0007256	-0.0010058

Test of H0: Difference in coefficients not systematic

chi2(7)=13.75
Prob > chi2 = 0.0558

The computed p-value for the Hausman test is equal to 0.0558, which indicates that we cannot reject the null hypothesis (Ho = Cov(ai, xit) = 0). Consequently, the Random Effects Model is deemed the most suitable for our analysis. This decision aligns with the broader understanding that Random Effects models are efficient and should be preferred over Fixed Effects models if the underlying assumptions are met.

Additionally, the Random Effects Generalized Least Squares (GLS) regression used in our analysis serves the purpose of overcoming issues related to heteroscedasticity and autocorrelation, which are typically associated with the Fixed Effects model. This further substantiates the suitability of the Random Effects approach for our research.

5.2.1– The diagnostic test for model 2

The Random Effects model operates under the fundamental assumption that the error term is not a fixed entity but rather a realization of a random variable with no correlation to the explanatory variables:

$$(\text{Cov}(ai, xit) = 0)$$

However, the presence of a serial correlation issue prohibits the use of the Ordinary Least Squares (OLS) estimator in this context. To overcome this challenge, the Random Effects model employs Generalized Least Squares (GLS) regression, resulting in superior model performance compared to the Fixed Effects model used previously. Additionally, this model assumes no correlation (i.e., no heteroscedasticity) between the fixed part of the error term and the explanatory variables.

The results derived from the GLS Random Effects estimation in the second model, as presented in the table above, represent a pivotal aspect of our entire thesis. Notably, several variables were found to be statistically significant at a 5% significance level, including GNPL, GNPL1, DEP, and CAR.
Our primary focus has been on the estimation of the coefficients for GLGR and GNPL1, while holding the other variables constant. The coefficient for GNPL1 is found to be negative –0.0160721 This implies that a one percent increase in the non-performing loans ratio at time t-1 has a negative impact on the gross loan growth rate at time t, amounting to a substantial decrease of 1.6%. In simpler terms, the lending strategy of a bank at time t appears to be negatively influenced by the stock of non-performing loans present in the bank's balance sheet at time t-1.

This finding suggests that bank managers at time t are more inclined to adopt a more cautionary lending strategy, if they had experienced an increase in the non-performing loans ratio in the previous year.
Furthermore, concerning the other significant variables, the coefficients for **DEP** and **CAR** are positive. It is reasonable to expect that as bank profitability increases, other factors held constant, the bank becomes more inclined to extend new loans. An increase in profitability can serve as a motivator for implementing an expansionary strategy. Similarly, the positive coefficient for the capitalization index (CAR) can be justified by the notion that well-capitalized banks are more willing to engage in riskier activities, consequently increasing the loan growth rate.

In conclusion, the macroeconomic variable **GDP** does not appear to exert a substantial impact, reaffirming the notion that, within this model, the macroeconomic environment does not significantly influence the internal decision-making of bank management.

Finally, based on the results obtained from Equation 2, we can deduce that the banks in our dataset, despite having a high level of non-performing loans ratio in certain periods of the timespan of the study, they are very cautious when deciding whether to expand credit to customers or not.
In the forthcoming conclusion section, we will delve deeper into these results and reflect upon their economic significance within the context of the overall analysis conducted.

Conclusion and Limitations

After describing the phenomenon of moral hazard and its manifestations in the Italian banking system, as well as the aspects of non-performing loans focusing on the Italian scenario, we moved on to conduct an empirical analysis of 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 into two separate analyses, both based on the same panel dataset obtained from the 12 most capitalized Italian banks during the period from 2008 to 2022 for a total of 180 observations, and both following the stream of the literature:

- **Equation 1 (Eq1)** investigates 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) investigates 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.

In essence, these two distinct analyses serve the same purpose: they were used to validate a single basic hypothesis, that of the existence of an opportunistic behaviour or so-called moral hazard problem within the Italian banking sector. To minimize potential financial instability, the regulator believes it is critical to recognize the presence of moral hazard behaviour in the commercial banking system. Following the 2007-2008 financial crisis, there was a clear decrease in the rate of growth of loans granted by banks to private counterparts; at the same time, non-performing loans increased sharply, surpassing pre-crisis levels more than three times.

The empirical literature supports the presence of a relationship between these two trends, highlighting how an increase in the portfolio of non-performing loans is one of the causes driving poor credit growth. This statement may appear to contradict the notions discussed in our work.
However, even if the growth rate of loans to the private sector has slowed since the financial crisis, this does not imply that no loans were granted at all. Managers have persisted, in some cases and for some years, to pursue an excessive and too risky lending strategy in relation to the quantity of non-performing loans already accrued on the bank's balance sheets, or in general, in relation to the credit risk level of the bank.

In other words, while loan growth has slowed over the last decade, it should have been substantially lower if bank executives had not made overly risky loans.
The granting of such unlikely-to-be-repaid loans has resulted in a growth in the stock of non-performing loans rather than a resumption of lending.
This type of issue has already been addressed in the Chinese banking system by Zhang et al. in their work "Non-performing loans, moral hazard, and regulation of the Chinese commercial banking system," published in 2006.
The paper studies the impact of non-performing loans on banking behaviour in the Chinese banking system, concluding that an increase in the non-performing loans ratio induces bank management to engage in inappropriate credit expansion, which could lead to further deterioration of loan quality and financial instability. Finally, the authors recommend that Chinese authorities regard the non-performing loans ratio as a good indication for spotting potential bank moral hazard problems, as well as set transparent policy goals and actively supervise institutions.
Our objective was to repeat Zhang's analysis to see if Italian bank management had a predisposition to engage in excessive credit expansions, resulting in the formation of a vicious circle:

In our view, an overly broad and hence risky lending strategy (given the previous losses reported) is likely to increase the number of deteriorating loans on the bank's balance sheet. The bank's profitability looks to rise, but it actually falls, and less investments are made. As a result, economic growth is slowing, which can be exacerbated by further unsuitable lending methods by management, restarting the vicious spiral. Of course, not all new loans made to the private sector will become nonperforming.
However, the bank should consider the probability of default (PD) of the new commitments, which will determine the portion of the loans that are likely to become nonperforming. Banks that can accurately assess the creditworthiness of their rivals are less likely to suffer unexpected losses.
The goal of the analysis on Equation 1 was to determine the sign of the link between the non-performing loans ratio at time t and the bank's lending strategy behaviour, as indicated by its gross loans growth rate at time t and some delays previously. The inclusion of GLGR delays in the model is critical and determinant in order to eliminate or at least mitigate the endogeneity problem.

The estimates show that increasing the loan growth rate has a positive impact on the amount of non-performing loans on the bank's balance sheet, but only with some lags, whereas the contemporaneous relationship between GLGR and GNPL is negative due to the dilution effect. Cincinelli and Piatti discovered the same conclusion in their study, which has been thoroughly explored in previous chapters.

In our analysis, the substantial and negative coefficient between GNPL and GLGR at time t, as well as the positive association at times t-2 and t-3, can be interpreted as a moral hazard issue inside Italian banks from 2008 to 2022.

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.*

Something similar happened in our model: the association is negative during time t, while the lagged variables GLGR2 and GLGR3 have a positive relationship with GNPL. The relation is greater in the lagged variable GLGR 3, but we can't be certain that this is a trend because more lagged variables are required. This conclusion is consistent with the findings of the other authors stated above.

In other words, because we only considered the lending strategy policy of banks with three-time lags in Model 1, and the model results revealed the presence of moral hazard

It cannot be considered completely acceptable because three years is not enough time for the credit to be realized or better to succeed or fail in performing.

In their paper "Macroeconomic Determinants of Bad Loans: Evidence from Italian Banks" (2006), Bofondi and Gobbi confirm the idea that riskier banks increase their loans in order to minimize their risk level by relaxing their screening and monitoring policy.

However, the analysis performed on Equation 1 reveals constraints that must be considered. First and foremost, the dataset contains only 180 observations, not enough to draw quick judgments. The limited number of observations clearly limits the ability to draw significant conclusions about the behaviour of the entire Italian banking sector, limiting exclusively to the sample.

It should also be noted that at the heart of the model are assumptions that, if not met, can jeopardize the model's validity. Furthermore, because it is measured as the ratio of non-performing loans over total gross loans, there is a risk of endogeneity between the loans growth rate and the gross non-performing loans ratio. Despite these constraints, the estimation of the first equation has raised concerns about moral hazard. This is why we decided to make two models that were related to each other like a litmus test.

Rather than including more lags in Equation 1 of the GLGR to increase the model's significance, the analysis performed on Equation 2 examines the factors that influence the bank's lending strategy as bank-specific factors and macroeconomic variables.
Because we need a longer time span to analyse the stock of non-performing loans, we believe that the banks' lending strategies are influenced by more recent variables.
The analysis is based, in particular on the relationship between the growth rate of loans to the private sector at time t and the non-performing loans ratio reflected in the bank's balance sheet at time t -1.
The aim is to discover evidence of what Cincinelli and Piatti assert in their paper: "Bank 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, number of observations, and the time period are all the same as in the previous analysis.
The above-mentioned estimation results are important for this study.
Indeed, we discovered evidence that bank management tend to reduce lending activity as the pool of non-performing loans rises.
Taking all other variables into account, the estimated coefficient reflecting the association between the lending strategy today and the stock of non-performing loans yesterday is -0.0160721. A one percent increase in the non-performing loans ratio at time t-1 has a -1.6% negative impact on the gross loans growth rate at time t. The second model demonstrates that banks limited their lending approach to the private sector as the quantity of non-performing loans on their balance sheets increased.
These results may be influenced by a general rise of responsibility after the frequent crisis that have hit the Italian banking system and the whole Italian economy after 2008. As we showed earlier in Figure 6, there was a connection between the trend of GNPL with the economic event during the same period.
Although the model considers a time span of fifteen years, we hypothesized that bank credit policies are influenced by current variables, and so the model results are relevant even when only one lag of non-performing loans ratio is examined.
To conclude, it is necessary to state that the analysis on Equation 2 is also an empirical analysis performed on a small dataset, and while sometimes less is more, in order to draw definitive conclusions about the lending policies developed in the Italian banking system over the last fifteen years, a larger sample size is required.

These models have limitations, mostly because to a lack of access to larger databases and the ability to observe longer time periods. Not for this, the analysis can be viewed as an exercise. The findings are substantial and can be used to generate hypotheses regarding the overall behaviour of the Italian banking sector. However, more extensive research might be performed to distinguish the banks into popular banks, stock banks, cooperative banks, and so on in order to obtain more particular results and to identify various managers' behaviour in different banking sectors.
Another avenue for growth may be the addition of a threshold value, like in Cincinelli's investigation, to evaluate how banks with varying amounts of non-performing loans react differently in the lending selection process.

In summary, while our models provide valuable insights, it's important to recognize their limitations, primarily stemming from the small dataset and the relatively short time frame. Nevertheless, these findings can serve as a foundation for generating hypotheses regarding the broader behavior of the Italian banking sector. Further research could explore differences in managerial behavior across various banking sectors and consider the inclusion of threshold values to assess lending practices under varying levels of non-performing loans.

APPENDIX

The list of the Banks used in the panel data model

Intesa San Paolo	Mediobanca	Banco di Desio e della Brianza
Unicredit	IFIS	CREDEM
Monte dei Paschi di Siena	Banca Popolare di Sondrio	BPM
Mediolanum	BPER	FINECO

Pooled OLS for Equation 1

Source	SS	df	MS	Number of obs	=	177
				F(15, 161)	=	5.19
Model	.409747879	15	.027316525	Prob > F	=	0.0000
Residual	.846579624	161	.005258259	R-squared	=	0.3261
				Adj R-squared	=	0.2634
Total	1.2563275	176	.007138224	Root MSE	=	.07251

GNPL	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
GLGR	-.063407	.0307666	-2.06	0.041	-.1241651	-.0026488
glgr1	-.0255043	.0394235	-0.65	0.519	-.103358	.0523495
glgr2	-.0103757	.034799	-0.30	0.766	-.079097	.0583456
glgr3	.0226503	.0358311	0.63	0.528	-.0481093	.0934099
MARGIN	-.0005708	.0044514	-0.13	0.898	-.0093615	.0082199
logSolvency	.0555299	.0274196	2.03	0.045	.0013814	.1096784
logSolvency1	-.0186268	.0359892	-0.52	0.605	-.0896985	.0524449
logSolvency2	.0227947	.0371325	0.61	0.540	-.0505349	.0961244
logSolvency3	-.0288163	.0285716	-1.01	0.315	-.0852397	.0276071
ROE	-.2523826	.0461323	-5.47	0.000	-.343485	-.1612801
DEP	-.0045652	.027055	-0.17	0.866	-.0579935	.0488632
CAR	-.9592239	.5045851	-1.90	0.059	-1.955683	.0372348
TIER1	.9646677	.494876	1.95	0.053	-.0126175	1.941953
SIZE	.0133828	.0045838	2.92	0.004	.0043306	.022435
RGDP	.0025461	.0016669	1.53	0.129	-.0007458	.005838
_cons	.0526563	.0668787	0.79	0.432	-.0794162	.1847289

Fixed effect for Equation 1

Fixed-effects (within) regression — Number of obs = 177
Group variable: Bank_Id_nu~c — Number of groups = 12

R-squared:
Within = 0.1994
Between = 0.5331
Overall = 0.2763

Obs per group:
min = 12
avg = 14.8
max = 15

F(15, 150) = 2.49
corr(u_i, Xb) = -0.5485 — Prob > F = 0.0027

GNPL	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
GLGR	-.0708478	.0303415	-2.34	0.021	-.1307997	-.0108958
glgr1	-.0189574	.0379425	-0.50	0.618	-.0939282	.0560133
glgr2	.0056951	.0337382	0.17	0.866	-.0609683	.0723585
glgr3	.0450023	.0346281	1.30	0.196	-.0234196	.1134241
MARGIN	-.0008798	.004348	-0.20	0.840	-.0094711	.0077114
logSolvency	.1082222	.0340621	3.18	0.002	.0409188	.1755256
logSolvency1	-.0206276	.0343979	-0.60	0.550	-.0885945	.0473393
logSolvency2	.0198516	.0353315	0.56	0.575	-.0499602	.0896634
logSolvency3	-.0053762	.0288527	-0.19	0.852	-.0623864	.051634
ROE	-.2351964	.0557956	-4.22	0.000	-.3454431	-.1249496
DEP	-.0028354	.0269047	-0.11	0.916	-.0559965	.0503257
CAR	-1.157206	.518715	-2.23	0.027	-2.182138	-.1322746
TIER1	1.006806	.5113762	1.97	0.051	-.0036252	2.017237
SIZE	.024784	.0209863	1.18	0.239	-.0166829	.0662509
RGDP	.0021795	.0016148	1.35	0.179	-.0010112	.0053703
_cons	.1438251	.2446354	0.59	0.557	-.3395512	.6272015
sigma_u	.0420639					
sigma_e	.06867819					
rho	.27279587	(fraction of variance due to u_i)				

F test that all u_i=0: F(11, 150) = 2.68 — Prob > F = 0.0036

Random effect Equation 1

Random-effects GLS regression — Number of obs = 177
Group variable: Bank_Id_nu~c — Number of groups = 12

R-squared:
Within = 0.1638
Between = 0.7166
Overall = 0.3261

Obs per group:
min = 12
avg = 14.8
max = 15

Wald chi2(15) = 77.92
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

GNPL	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
GLGR	-.063407	.0307666	-2.06	0.039	-.1237084	-.0031055
glgr1	-.0255043	.0394235	-0.65	0.518	-.1027728	.0517643
glgr2	-.0103757	.034799	-0.30	0.766	-.0785805	.0578291
glgr3	.0226503	.0358311	0.63	0.527	-.0475774	.092878
MARGIN	-.0005708	.0044514	-0.13	0.898	-.0092955	.0081538
logSolvency	.0555299	.0274196	2.03	0.043	.0017884	.1092714
logSolvency1	-.0186268	.0359892	-0.52	0.605	-.0891643	.0519107
logSolvency2	.0227947	.0371325	0.61	0.539	-.0499837	.0955732
logSolvency3	-.0288163	.0285716	-1.01	0.313	-.0848155	.027183
ROE	-.2523826	.0461323	-5.47	0.000	-.3428002	-.1619649
DEP	-.0045652	.027055	-0.17	0.866	-.0575919	.0484616
CAR	-.9592239	.5045851	-1.90	0.057	-1.948192	.0297447
TIER1	.9646677	.494876	1.95	0.051	-.0052715	1.934607
SIZE	.0133828	.0045838	2.92	0.004	.0043986	.0223669
RGDP	.0025461	.0016669	1.53	0.127	-.000721	.0058132
_cons	.0526563	.0668787	0.79	0.431	-.0784234	.1837361
sigma_u	0					
sigma_e	.06867819					
rho	0	(fraction of variance due to u_i)				

Hausman Test

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
GLGR	-.0708478	-.063407	-.0074408	.
glgr1	-.0189574	-.0255043	.0065468	.
glgr2	.0056951	-.0103757	.0160708	.
glgr3	.0450023	.0226503	.0223519	.
MARGIN	-.0008798	-.0005708	-.000309	.
logSolvency	.1082222	.0555299	.0526923	.0202086
logSolvency1	-.0206276	-.0186268	-.0020008	.
logSolvency2	.0198516	.0227947	-.0029431	.
logSolvency3	-.0053762	-.0288163	.0234401	.0040179
ROE	-.2351964	-.2523826	.0171862	.031384
DEP	-.0028354	-.0045652	.0017298	.
CAR	-1.157206	-.9592239	-.1979824	.1202461
TIER1	1.006806	.9646677	.042138	.1288539
SIZE	.024784	.0133828	.0114012	.0204795
RGDP	.0021795	.0025461	-.0003666	.

b = Consistent under H0 and Ha; obtained from **xtreg**.
B = Inconsistent under Ha, efficient under H0; obtained from **xtreg**.

Test of H0: Difference in coefficients not systematic

chi2(**15**) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= **25.80**
Prob > chi2 = **0.0402**
(V_b-V_B is not positive definite)

Pooled OLS for Equation 2

Source	SS	df	MS		
Model	1.01356771	7	.144795386	Number of obs	177
Residual	5.92472656	169	.035057554	F(7, 169)	4.13
				Prob > F	0.0003
Total	6.93829427	176	.039422127	R-squared	0.1461
				Adj R-squared	0.1107
				Root MSE	.18724

GLGR	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
logGNPL	-.0267546	.0236857	-1.13	0.260	-.0735126	.0200033
logGNPL1	-.0160721	.0245787	-0.65	0.514	-.0645929	.0324487
DEP	.0941369	.0654767	1.44	0.152	-.0351206	.2233944
ROE	.1358296	.1159896	1.17	0.243	-.0931456	.3648048
MARGIN	-.0067198	.0098827	-0.68	0.497	-.0262291	.0127896
CAR	.3350746	.3148617	1.06	0.289	-.2864941	.9566432
RGDP	.0007256	.0040777	0.18	0.859	-.0073241	.0087754
_cons	-.1208104	.0582098	-2.08	0.039	-.2357224	-.0058983

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of **GLGR**

H0: Constant variance

chi2(**1**) = **97.86**
Prob > chi2 = **0.0000**

Fixed effect model for Equation 2

Fixed-effects (within) regression — Number of obs = 177
Group variable: Bank_Id_nu~c — Number of groups = 12

R-squared:
Within = 0.0740
Between = 0.5294
Overall = 0.1391

Obs per group:
min = 13
avg = 14.8
max = 15

F(7, 158) = 1.80
corr(u_i, Xb) = 0.0765 — Prob > F = 0.0901

GLGR	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
logGNPL	-.0155483	.0257864	-0.60	0.547	-.0664788	.0353823
logGNPL1	-.0184974	.0248273	-0.75	0.457	-.0675335	.0305388
DEP	.0457134	.0672363	0.68	0.498	-.0870845	.1785114
ROE	.1836224	.1438325	1.28	0.204	-.1004601	.4677049
MARGIN	-.0122716	.0101354	-1.21	0.228	-.0322899	.0077467
CAR	.4037105	.3689166	1.09	0.275	-.3249337	1.132355
RGDP	-.0002802	.004092	-0.07	0.945	-.0083622	.0078019
_cons	-.1003731	.075177	-1.34	0.184	-.2488546	.0481084
sigma_u	.05423553					
sigma_e	.18645532					
rho	.07800904	(fraction of variance due to u_i)				

F test that all u_i=0: F(11, 158) = 1.13 — Prob > F = 0.3421

Random effect model for Equation 2

```
Random-effects GLS regression                   Number of obs     =       177
Group variable: Bank_Id_nu~c                    Number of groups  =        12

R-squared:                                      Obs per group:
     Within  = 0.0682                                         min =        13
     Between = 0.6232                                         avg =      14.8
     Overall = 0.1461                                         max =        15

                                                Wald chi2(7)      =     28.91
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =    0.0002
```

GLGR	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
logGNPL	-.0267546	.0236857	-1.13	0.259	-.0731778	.0196685
logGNPL1	-.0160721	.0245787	-0.65	0.513	-.0642454	.0321012
DEP	.0941369	.0654767	1.44	0.151	-.034195	.2224688
ROE	.1358296	.1159896	1.17	0.242	-.0915059	.3631651
MARGIN	-.0067198	.0098827	-0.68	0.497	-.0260894	.0126499
CAR	.3350746	.3148617	1.06	0.287	-.2820431	.9521922
RGDP	.0007256	.0040777	0.18	0.859	-.0072664	.0087177
_cons	-.1208104	.0582098	-2.08	0.038	-.2348995	-.0067212
sigma_u	0					
sigma_e	.18645532					
rho	0	(fraction of variance due to u_i)				

Hausman test for Equation 2

	Coefficients (b) fe	Coefficients (B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
logGNPL	-.0155483	-.0267546	.0112064	.0101945
logGNPL1	-.0184974	-.0160721	-.0024253	.0035045
DEP	.0457134	.0941369	-.0484235	.0152818
ROE	.1836224	.1358296	.0477928	.0850541
MARGIN	-.0122716	-.0067198	-.0055518	.0022491
CAR	.4037105	.3350746	.0686359	.1922538
RGDP	-.0002802	.0007256	-.0010058	.0003419

b = Consistent under H0 and Ha; obtained from **xtreg**.
B = Inconsistent under Ha, efficient under H0; obtained from **xtreg**.

```
Test of H0: Difference in coefficients not systematic

    chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  13.75
Prob > chi2 = 0.0558
(V_b-V_B is not positive definite)
```

REFERENCES

Accornero, M., P. Alessandri, L. Carpinelli and A.M. Sorrentino (2017), "Non-performing loans and the supply of bank credit: evidence from Italy", Occasional Papers, Banca d'Italia, No 374

Aiyar, S., W. Bergthaler, J. M. Garrido, A. Ilyina, A. Jobst, K. Kang, D. Kovtun, Y. Liu, D. Monaghan and M. Moretti, 2015, "A Strategy for Resolving Europe's Problem Loans", IMF staff Discussion Note, September.

Amihud and Lev, 1999. "Does corporate ownership structure affect its strategy towards diversification", Strategic management Journal.

Assaf Eidorfer,2008. "Empirical Evidence of Risk Shifting in Financially Distressed Firms",The journal of Finance.

Assaf Eidorfer,2010. "Risk-shifting and investment asymmetry", Finance Research Letters 7 (2010) 232–237

Baltagi, 2005 "Econometric analysis of Panel data analysis".

Bank of Italy, 2012. "La recente analisi dei prestiti deteriorati condotta dalla Banca d'Italia: principali caratteristiche e risultati".

Bank of Italy, 2018, "The Euro are bank lending survey: main results for Italian banks".

Bank of Italy, April 2017. Financial Stability Report.

Bank of Italy, February 2016, " The management of non-performing loans, a survey on the major Italian banks.

Berger and DeYoung ,1997. "Problem loans and cost efficiency in commercial banks", Board of Governors of the Federal Reserve System (U.S.) in its series Finance and Economics Discussion Series with number 1997-8.

Bofondi, Ropele, March 2011. “Macroeconomic determinants of bad loans: evidence from Italian banks”.Technical Report 89, Bank of Italy.

Calem Paul, Rob Rafael ,1999. “The Impact of Capital-Based Regulation”

Carpinelli, Cascarino, Giacomelli, Vacca, 2016. “The management of non-performing loans: a survey at the major Italian banks, Bank of Italy.

Cincinelli and Piatti, 2017. “Non-performing loans, Moral hazard and supervisory authority: The Italian banking system”, Journal of financial management markets and institutions.

Cuccinelli Doriana, 2015. “The Impact of Non-performing Loans on Bank Lending Behaviour: Evidence from the Italian Banking Sector”, Eurasian Journal of Business and Economics.

Dayong Zhang, Jing Cai, David G. Dickinson, Ali M. Kutan,2015. “Non-performing loans, moral hazard and regulation of the Chinese commercial banking system”, Journal of banking and Finance.

Duran, Lozano-Vivas, 2014. “Moral hazard and the financial structure of banks”, Journal of International Financial Markets, Institutions & Money

European Central Bank , Banking Supervision, 2017, “Guidance to banks on non-performing loans”, March.

European Central Bank, “Guide to banking supervision”, November 2014

European Central Bank, 2016. "Draft ECB Guidance to Banks on Non-Performing Loans." European Central Bank.

European systemic risk Board, ESRB, July 2017. “Resolving Non-performing loans in Europe”

Foos, Norden, Weber, 2009. “Loan growth and riskiness of banks”, Journal of Banking and

Finance.

Foglia, Matteo. 2022. Non-Performing Loans and Macroeconomics Factor: The Italian Case

Gangeri, Lanotte, Della Corte, Rinna, 2017. “Why exceptional NPLs sales should not affect the estimated LGDs of A-IRB banks”, Bank of Italy.

Gennotte and Pyle, 1991. “Capital controls and bank risk”, Journal of Banking & Finance

Gjeçi, Marinč, Rant, 2023. "Non-performing loans and bank lending behaviour," Risk Management

Humblot Thomas, 2017. “Non-performing loans in Italy: An Overview”, economic research bnpparibas

Jassaud, Kang, 2015. “A Strategy for Developing a Market for Non-performing Loans in Italy”, Working paper, International Monetary Fund (IMF).

Jensen, Meckling, 1976. “Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure”, Journal of Financial Economics.

Kadan and M. Swinkels, 2016. “Stocks or Options? Moral Hazard, Firm Viability, and the Design of Compensation Contracts”, Washington University on Bank Risk-Taking, Journal of financial Intermediation.

Laeven and Levine,2009. “Bank governance, regulation and risk taking”, Journal of financial economics

Louzis, Vouldis, Metaxas, 2010. “Macroeconomics and bank specific determinants of nonperforming loans in Greece: a comparative study of mortgage, business a consumer loans portfolio”, Bank of Greece Working Paper 118.

Marcucci, Quagliariello, 2008. “Credit risk and business cycle over different regimes”, Bank of Italy.

Messai, Jouini, 2013. “ Micro e Macro determinants of non-performing loans”, International Journal of Economics and Finance issues.

Milani Carlo, 2017. “What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy”.

Nicita Antonio, Scoppa Vincenzo, 2005. “Economia dei contratti”, Carocci editore
Pannetta Fabio, 2017. “Seminario istituzionale sulle tematiche legate ai non-performing loans”, Bank of Italy

Pwc, December 2021 “The Italian NPL market: Transformation at Work”

Quagliarello, 2006. “Banks' riskiness over the business cycle: a panel analysis on Italian intermediaries”, Bank of Italy

Sales and Saurina, 2002. “Credit risk in two Institutional regimes: Spanish commercial and saving banks”, Journal of Financial Services Research

Saunders, Strock and Travlos, 1990. “Ownership Structure, Deregulation, and Bank Risk Taking”, The Journal of Finance

Stolz Stephanie ,2007. “Bank Capital and Risk-Taking: The Impact of Capital Regulation, Springer.

Wooldridge, 2013. “Introductory Econometrics: A Modern Approach, Fifth Edition.

World Bank, 1996, “Bank Insolvency: Bad Luck, Bad Policy, or Bad Banking?”, Annual

World Bank Conference on Development Economics.