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"THE EFFECT OF THE BANK RECOVERY AND RESOLUTION DIRECTIVE ON THE NON-PERFORMING LOANS: EVIDENCE FROM EUROPEAN BANKS"

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Firma dello studente

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Alla mia famiglia che mi ha sempre incoraggiata,
e al mio relatore per la disponibilità e il supporto.

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INTRODUCTION

The deterioration in the quality of the loan portfolio of banks was the main cause of problems in the banking system and in financial crisis in developed economies. Indeed, the increase in loan defaults underlines the links between macroeconomic and financial shocks and the relationship between the friction in the credit market and the risk of financial instability. Moreover, the fact that loan performance is tightly linked to the economic cycle is well known and not surprising: average bank assets quality deteriorated sharply due to the global economic recession of 2007-2008.

Therefore, addressing non-performing loans within the European banking system is one of the key priorities of the ECB's supervisory work. In particular, European supervisors generally consider a loan to be non-performing when there are indicators that the borrower is unlikely to repay the loan owing to financial difficulties or if more than 90 days have passed without the borrower paying the agreed instalments

For the European Commission, implementation and enforcement of a banking union within the eurozone is a key priority, with strong multinational teams concentrated at the European Central Bank (ECB). In this context, non-performing loans represent a real challenge for bank profitability and financial stability. NPLs also constrain credit expansion and delay economic recovery. A series of options have been suggested with a view to improving conditions in the European NPL market and reinforcing investor confidence respecting at the same time state aid rules. Public intervention measures, as it is reported in the first chapter, such as asset management companies and other co-investment strategies are considered necessary to increase the market efficiency and to create a virtuous cycle of reductions in the volume of NPLs.

After the financial crisis, bank supervision has mainly focused on large banks, as also remarked by the European Single Supervisory Mechanism (SSM) which involves only the 114 biggest banks operating in the Euro area. As I will better explain, patterns of non-performing loan developments have nonetheless varied significantly across member states, reflecting different problems and cycles in national banking systems (Schuler et al., 2015). Therefore the euro area countries that were relatively more hurt by the debt crisis (Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain) experienced substantial increases in the NPL ratios since 2010, lasting until recently, when the NPL trend started to decrease.

This study addresses a key policy relevant question: did the introduction of the BRRD have an effect on the stock of non-performing of the supervised entities by the ECB and so the SSM?

The remainder of this study is organized as follows.

Chapter 1 analyzes one of the most important directives introduced in 2014 in the euro zone but adopted by the member states in 2015, that is the Bank Recovery and Resolution Directive, and a shot description of other European supervisory directives introduced in the past decade with a brief overview of the related literature. The harmonized definitions of the European Banking Authority tried to give a supranational framework in the European Union, in order to get an easier picture and comparison of the state members.

Chapter 2 focuses on the econometric methodology that is applied for quantifying the relationship between the annual growth of non-performing loans and the macro and micro financial determinants. The most suitable approach is panel data model, with different estimations and specifications in order to capture all the relevant interactions between the variables.

Chapter 3 presents a comprehensive description of the dataset and gives a track of the relevant variables affecting the stock of NPLs and the role of the European Directive (BRRD). As independent variables, both bank-specific (gross loans, loan loss provisions, Tier 1 ratio and coverage ratio) and macro-economic (real GPD growth, inflation rate and judicial efficiency) factors are included in the analysis. Creating a panel of significant banks in the euro area according to the ECB, the observations starts in 2011 until 2017.

Chapter 4, the last part of the analysis, reports the empirical results of different econometric specifications, highlighting the statistically significance of the European directive and the relevance of the annual growth of real GDP as macro factor. In particular, the results will show that the introduction of the BRRD played a role in reducing the annual growth of the stock of non-performing loans, that is the dependent variable. Whereas between the bank-specific variables, only the annual growth of gross loans has a statistically significance and positive relation with the dependent variable.

CHAPTER 1 – THE ROLE OF BRRD IN THE NPL RESOLUTION

1.1 The Bank Recovery and Resolution Directive (BBRD)

The global financial crisis, starting in 2007-2009, is still being processed by many economies. It was not clear how to react to a distressed banking sector and serious weaknesses in the tools available to deal with failing banks without interrupting the provision or systematically critical functions to customers and to the whole economy. In other words, the financial crisis has brought to light many weaknesses in global financial systems, including the threat to financial stability posed by banks that were too big, interconnected and complex to be closed or go bankrupt. As a result, many banks have been rescued with public support but basically shifting their losses to taxpayers of bank owners or investors. Together with higher capital and liquidity requirements, the enhancement of resolution regimes was a central element of the international regulatory response to increase bank resilience. The Key Attributes of the Effective Resolution Regimes for Financial Institutions by the Financial Stability Board (endorsed by the G20 in 2011) gave the new harmonized international standard for resolution regimes for financial institutions: the KA serve as guidance for jurisdictions that are adopting national resolution regimes.

Within the European Union, more than 40 legislative and non-legislative measures were adopted after the financial crisis: the EU was a forerunner in implementing the KA especially in terms of bail-in tool. A new framework for dealing with failing banks, the Bank Recovery and Resolution Directive (BRRD), was agreed in 2014 for national implementation as of January 2015. It translates the KA in the EU context and provides for a harmonized framework and enhanced cooperation for bank resolution in the EU, building on other EU legislations, such as the capital adequacy requirements for banks, the European Market Infrastructure Regulation (EMIR), the Deposit Guarantee Scheme Directive (DGSD), and EU state aid rules, as a basis and potential game-changer in creating a more stable and fairer banking system. The objective of the new post-crisis resolution framework is essentially regulating how banks should be organized. Moreover it provides the instruments that should be in place to preserve overall financial stability while reducing the costs of a failed systematically important bank for sovereigns and tax-payers.

The BRRD regulates the several stages and elements of a problem bank recovery and resolution process, including advanced planning and restructuring (World Bank, 2017). The key elements of the BRRD are the following:

- Recovery and resolution planning including the removal of obstacles to resolvability;
- A stronger set of early intervention measures to foster forward looking supervision and crisis prevention;
- A harmonized set of resolution tools and powers to manage bank failure, aiming to ensure that losses are absorbed by shareholders and creditors while allowing the continuity of critical functions.

In particular, according to Article 37-44 of the BRRD, the four main resolution tools are:

1) bail-in tool, ensuring that losses are absorbed by shareholders and creditors, allows the resolution authority to allocate incurred losses to the owners and debt holders of the institution;
2) sale of business tool, allowing the resolution authority to sell all or part of the failing bank to a private acquirer, allows for a swift transfer of shares, assets, rights and liabilities of the institution under resolution to a purchaser "on commercial terms";
3) bridge institution tool: transferring the good assets and essential functions of the problem bank into a new temporary institution (bridge bank) with the aim of selling it;
4) the asset separation tool[1]: isolating the "bad" assets of the bank into an asset management vehicle (also known as a "bad bank") for orderly wind down, if immediate liquidation is not justified in current market conditions and so it allows for a value improving workout of assets and avoids possible value destruction caused by the liquidation.

In addition, government stabilization tools (which are technically defined as resolution tools) may be used as a last resort in the extraordinary situation of systemic crisis and after having exploited all resolution tools. The resolution authority may seek funding from the government either by way of temporary public ownership or public equity support.

[1] Article 42(5) of the BRRD limits the use of the asset separation tool: it might be only used if, under normal insolvency proceedings, the liquidation of the assets could have an adverse effect on one or more financial markets.

The BRRD is adopted in spring 2014 to provide authorities with:

- comprehensive and effective arrangements to deal with failing banks at national level;
- cooperation arrangements to manage cross-border banking failures.

The directive requires banks to prepare recovery plans against financial distress. It also grants national authorities' powers to ensure an orderly resolution of failing banks with minimal costs for taxpayers.

The directive includes rules to set up a national resolution fund that must be established by each EU country and all financial institutions have to contribute to these funds: contributions are calculated on the basis of the institution's size and risk profile. Moreover, the European Union bank resolution rules ensure that the shareholders of the bank and creditors pay their share of the costs through a "bail-in" mechanism. If that is still not enough, the national resolution funds can provide the resources needed to ensure that a bank operating while it is being restructured.

A bank resolution takes place when authorities determine that a failing bank cannot go through normal insolvency proceedings without harming public interest and causing financial instability. To manage the bank failure in an orderly manner, authorities use resolution tools that ensure continuity of the bank critical functions, maintain financial stability and restore the viability of parts of all the bank.

As it will be specified in the next part, after the financial crisis, the European Union adopted many measures to harmonize and improve the tools for dealing with bank crisis in its member countries.

Especially, the BRRD resolution toolkit is applied only if justified by public interest, that is to systematically importan. The BRRD does not regulate bankruptcy or insolvency law which remain in the national competence as an alternative to resolution. This directive is the outcome of a long negotiation process: the new bank recovery and resolution framework has several far reaching implications, both within the EU but also for countries having relations with the EU.

The directive promotes a forward-looking approach to supervision, with early and timely intervention measures, the removal of impediments to resolution under going concern ensuring that an entity is actually "resolvable", when circumstances require. By making failure possible, directive aims at reducing the need for public support, boosting sustainable market economies and creating positive effects for civil society. Furthermore, by removing the implicit government guarantee, it also helps to increase banks accountability towards their costumers, clients and investors encouraging better risk management and financial strength.

As such, the BRRD serves as a robust benchmark for cohesion among countries and the wider Europe and Central Asia (ECA) region.

The SSM and the supervised entities

Before formally taking on its responsibilities in November 2014, the ECB conducted a "comprehensive assessment". The assessment includes two main pillars for banks falling under its mandate, in preparation of the launch of the Single Supervisory Mechanism (SSM):

1) an asset quality review (AQR) held between 2013 and 2014: to improve the transparency of bank exposures including the adequacy of asset and collateral valuation and related provisions (the accuracy of loan classification in the performing and non-performing);
2) a stress-test: to test the resilience of bank balance sheet (in cooperation with the European Banking Authority), it was conducted with reference to a baseline and an adverse macroeconomic scenario.

Of the 130 largest banks, 25 banks were found to have capital shortfall.

The SSM delivers prudential supervision led by the EBC as the supervisor of financial institutions in the euro area, together with the national supervisory authorities of the participating member states. As of July 2019, 114 "significant" banks (or SI, significant institutions) are under the ECB's direct supervision, representing approximately 82% of euro area bank assets[2].

In 2015, the ECB decided to take a further step in the management of bad loans with the publication of the "Guidance to banks on non-performing loans" in March 2017. The document established several measures to deal with this issue, and to clarify the supervisory expectations regarding the identification, management, measurement and write-off of NPLs in the context of existing regulations, directives and guidelines. The Guidance stressed the importance of timely provisioning and write-off practices related to NPLs in order to strengthen bank balance sheets.

In October 2017, the Guidance was complemented by a draft "Addendum to the ECB Guidance", in order to reinforce the practices. This Addendum specifies the supervisory expectations of the ECB when assessing the level of prudential provisions for NPLs of banks.

In the SSM Framework Regulation, the types of supervised banks are referred to as:

[2] According to Article 49(1) of Regulation (EU) No 468/2014 of the ECB (ECB/2014/17).

- credit institutions established in participating Member States;
- financial holding companies established in participating Member States;
- mixed financial holding companies established in participating Member States;
- branches established in participating Member States by credit institutions established in non-participating Member States.

De Nederlandsche Bank and the Bank of England have the responsibility for other European banks, because they are defined as National Resolution Authorities (NRAs) by the BRRD. Moreover, a close collaboration between the Single Resolution Mechanism (SRM) and the NRAs is required and will be based on a cooperation framework[3], with the SRM's own Internal Resolution[4].

What makes a bank significant?

The criteria for determining whether banks are considered significant, and therefore under the ECB's direct supervision, are set out in the SSM Regulation and the SSM Framework Regulation. The ECB can decide at any time to classify a bank as significant to ensure that high supervisory standards are applied consistently. To qualify as significant, banks must fulfill at least one of the folllowing criteria.

Figure 1.1: Significance criteria.

Significance criteria	
Size	the total value of its assets exceeds €30 billion
Economic importance	for the specific country or the EU economy as a whole
Cross-border activities	the total value of its assets exceeds €5 billion and the ratio of its cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities is above 20%
Direct public financial assistance	it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility
A supervised bank can also be considered significant if it is one of the three most significant banks established in a particular country.	

Source: ECB Banking Supervision.

[3] To be approved under Article 31(1) of the SRM regulation.
[4] Any Single Resolution Board (SRB) decision will be implemented by the NRAs.

Nowadays, with the establishment of the SSM, the ECB and the national supervisors have developed a common approach for collecting data from the European banking sector: the framework for reporting have been developed by the European Banking Authority (EBA).
The status of banks may change: either through normal business activity or due to one-off events such as merges or acquisitions. In these cases, the ECB and the national supervisors involved coordinate the transfer of supervisory responsibilities[5].

Other activities at European level addressing the problem of NPLs

In addition to the ECB and the related SSM, other European institutions took a step forward the resolution and the management of these bad loans. First, the European Parliament in the Annual Report on the Banking Union 2016, published in 2017, was worried about the high level of NPLs and suggested to reduce it in some European members. The European Parliament also indicated the Commission as assistant in the establishment of dedicated asset management companies ("bad banks"). They requested that European economies revised their legislation, with particular attention to the length of recovery procedures, the functioning of judicial system and the legal framework concerning the restructuring of debt.

In 2016, the European Parliament has claimed that the high level of NPLs on bank balance sheets in the Banking Union weighs on their ability to lend to the real economy because of their impact on profitability, funding costs, and bank capital (European Parliament, 2016).
In fact, banks having weaker balance sheets tend to lend less, because they are less profitable and so weaker capital buffers, facing higher funding costs. This phenomenon has implication also on the monetary transmission, as credit supply remains heavily influenced by the lending behavior of banks, due to the dominance of bank lending in the corporate sector finance in Europe.

In the meanwhile, in July 2017, the Council decided to make an action plan[6] to manage the problem of NPLs in the banking sector explaining a set of policy actions in order to reduce the level of non-performing loans[7]. The document established the reciprocal actions of the banks, member states and the whole European Union, encouraging the Commission to deal with NPLs and the relative risks (European Commission, 2018).

[5] The ECB conducts regular reviews of all banks authorized within the participating countries.
[6] The so called "Action plan to tackle non-performing loans in Europe" of 11 July 2017.
[7] Based on the recommendations in its Financial Services Committee report.

Also, the European Commission with the Commission reflection paper of 31 May 2017 suggested a strategy for the non-performing loans in the European Union, defining NPLs "one of the most damaging legacies of the crisis", which would not stop weigh on the performance of the banking sector and a source of potential fragility. In October 2017, the European Commission announced that a comprehensive package of measures would be established by spring 2018 (European Parliament, 2018):

1) a blueprint for how national AMC can be built up;
2) measures to expand the secondary markets for NPLs;
3) measures to improve the protection of the creditors;
4) a benchmarking exercise of loan enforcement regimes to better display the delays and value-recovery banks experience when borrowers default;
5) a report on the possible introduction of minimum levels of provisioning for future NPLs;
6) a proposal to promote the transparency on NPLs by improving the data availability.

Then, in March 2018, the European Commission presented the set of measures to deal with the high stock of NPLs, proposing a regulation on a minimum loss coverage for new non-performing exposures: first, a requirement for institutions to cover up to common minimum levels the expected losses on new loans when they turn non-performing and second, when this minimum coverage requirement is not satisfied, a deduction of the difference between the level of actual coverage and the minimum coverage from CET1[8] items is applied.

Overall, ECB has maintained the credit risk area among the SSM priorities for 2019, resulting in continuing pressure to achieve consistent coverage of the stock of non-performing exposure (NPE) in the medium term. Calendar provisioning included in the ECB Addendum will require an impairment equal to 100% of the new flows of NPE in 2/7 years for unsecured/secured exposures. In other words, the Addendum specifies the minimum levels of prudential provisions from January 2018: banks are expected to provide full coverage for the unsecured portion of new NPLs (loans originated before January 2018 because they become non-performing after that date) within 2 years (7 years for secured portions). The ECB also stated that "it is immaterial whether the delays in realizing the security were due to reasons

[8] The Common Equity Tier 1 ratio (CET1), pure equity as a percentage of risk-weighted assets, is a measure of bank solvency and the effective minimum for European banks under Basel III is 4.5%, even if it was first introduced in 2014 as a precautionary means to protect the economy. It consists mostly of common stock held by a bank or financial institution.

beyond the bank control (e.g. length of time it takes to conclude legal proceedings)" (ECB, (2017), page. 10).

1.2 Non-performing loan (NPL) definition

There is no global definition of non-performing loans. Anyway, to reduce uncertainty in the NPL issues, the EBA has proposed harmonized forbearance and non-performing exposures definitions to apply to all loans and debt securities on-balance-sheet. The first EU-wide application of the harmonized definition of NPL was in 2014 for the AQR exercise. In October 2013, the EBA released two definitions as amendments of the common EU-wide IFRS Supervisory reporting framework (FINREP): the definition of forbearance (FBE) and the definition of non-performing exposures (NPE). Following the financial and sovereign crisis in the EU, concerns raised about the forbearance policies and non-performing exposures management across the EU, and in addition, various national and bank definitions led to missing comparability of reported figures for forbearance and non-performing exposures. This situation called for a single definition within the EU.

In particular, according to the EBA definitions, forbearance measures are concessions towards a debtor facing or about to face financial difficulties (loan, debt securities, commitments, with no trading exposure). Forbearance measures may or may not lead to a loss upon application: exposures do not need to be non-performing/past-due for a modification/refinancing to qualify as forbearance when granted. The exposure is performing and no other exposure to the debtor is more than 30 days past-due, or two years have passed since the date the exposure has been considered as performing.

A non-performing exposure (NPE), instead, is an exposure that is:

1) 90 days past-due (material exposure) or unlikely to be repaid in full without collateral realization (irrespective of any past-due amount or of the number of days past-due),
2) impaired or defaulted according to the applicable accounting or regulatory frameworks.

Given that the use of different NPL definitions (and different accounting procedures) made it difficult to compare the situation in different Member States, the EBA initiated a uniform definition of NPEs which banks are encouraged to use.

Exposures can be non-performing on an individual or debtor basis but all exposures to a debtor are non-performing when on-balance sheet exposures more than 90 days past-due is greater than 20% of the on-balance sheet exposures to the debtor. A common understanding

of these two concepts leads to a better comparison of the credit quality of portfolios across banks and countries. Moreover this EBA definition allowed to draw the same line for all institutions between performing and non-performing exposures.
These definitions match the principles established in 2004 by the Basel II Acord, where defaulted exposures had to meet the objective criterion (some minimum delay in payments), the subjective criterion (the obligator being unlikely to pay in full) or both.

According to the European Parliament, non-performing loans are usually defined as loans that are either more than 90 days past-due, or unlikely to be repaid in full, taking into account both the debtor's past and the future performance. The classification of loans as non-performing is done independently of whether the debtor has provided collateral for the loan. Non-performing loans and non-performing exposures are usually used interchangeably in the documentations of the European authorities.
Specifically, according to the European Central Bank (ECB), when customers do not meet their agreed repayment arrangements for 90 days or more, the bank must set aside more capital on the assumption that the loan will not be paid back. This reduces the capacity to provide new loans. Moreover, if a bank has too many bad loans on its balance sheet, its profitability will suffer because it will no longer earn enough money from its credit business. In addition, bank will need to put money aside to safety net in case it needs to write off the full amount of the loan at some point in time. In the worst-case scenario, the borrower is completely unable to repay the loan and the bank needs to correct the value of the loan on its balance sheet, sometimes even to zero: this is referred to as "writing off" a loan, but I will explain this concept in section 1.4.

Today two European authorities publish statistical information about NPLs, based on bank's supervisory reporting:

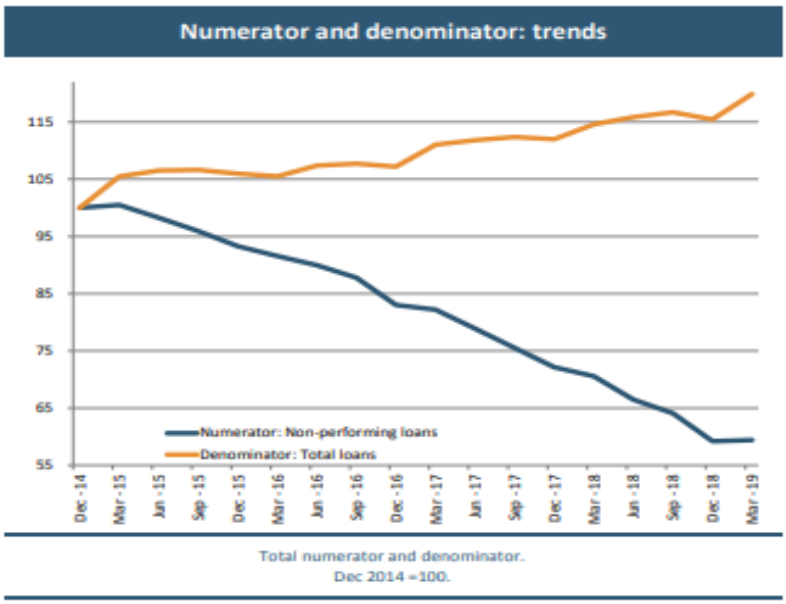
- with respect to the entire Banking Union, the EBA publishes the Risk Dashboard, based on a sample of European banks, covering more than 80% of the banking sector by total assets;
- with respect to the significant banks in the euro area, the ECB publishes the Supervisory Banking Statistics[9].

[9] The Supervisory Banking Statistics includes information on all banks in the euro area that are designated as significant institutions and so directly supervised by the ECB (as July 2019: 114 entities).

Since the financial crisis of 2007, the credit quality of loan portfolio has declined sharply in most European countries and the stock of Non-Performing Loans was around 1.0 trillion euros at the end of 2016 (i.e., 5.1% of total loans)[10]. The relevance of the NPLs issue in Europe is made clear by the statement in 2017 from Danièle Nouy[11]: "The quality of the assets of the banks continues to be a serious challenge in the banking union as a whole, but the problem is also concentrated in certain countries. Large volumes of non-performing loans are contributing to low bank profitability and making banks less able to provide new financing to the real economy" (Cerulli et al., 2017). Conversely, NPLs are not a critical problem in other countries, as it was observed by EBA in the 2016 report: "a cross-country comparison suggests that the average NPL ratio is up to three times higher in the EU than in other global jurisdictions".

In the European Union, the average NPLs is slowly decreasing, from 6.4% in December 2014 to 5.4% at the end of 2016, and to 3.6% in June 2018. It is the result of two effects: a decrease of the stock of non-performing loans and the increase in the volume of total loans. This is also evident from the following figure (Figure 1.2) showing the trends of both the non-performing loan volume (the blue line) and the total loans quantity (the orange line) from December 2014 to March 2019.

Figure 1.2: Non-performing loans and total loans trend from 2014 to March 2019.



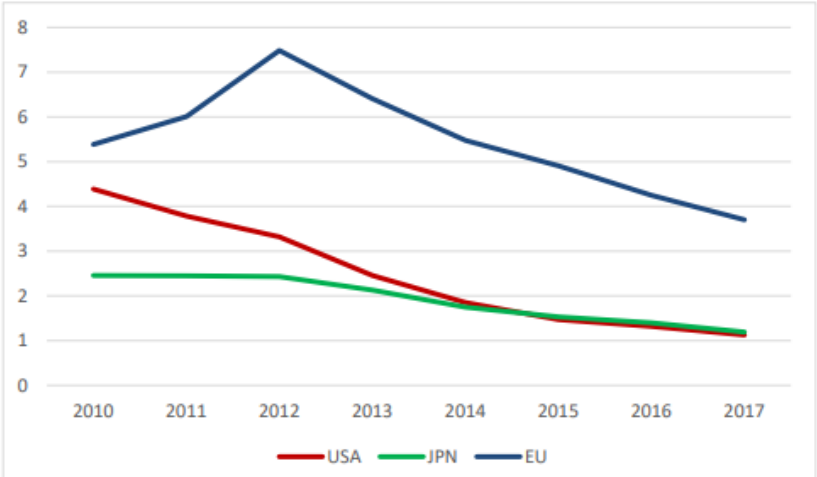
Source: EBA Risk Dashboard (data as of 1Q 2019).

[10] Source: data of ERSB 2017

[11] Danièle Nouy was the Chair of the Supervisory Board at the European Central Bank from January 2014 to December 2018. Today, Andrea Enria is the chairperson of the Supervisory Board.

As the following figure shows (Figure 1.3), the level of NPLs in the EU is still higher than in other major developed economies: the World Bank reported NPL ratios (even if the definition is different from the EBA's one) close to 1% for the USA and Japan at the end of 2017, as shown in the following figure.

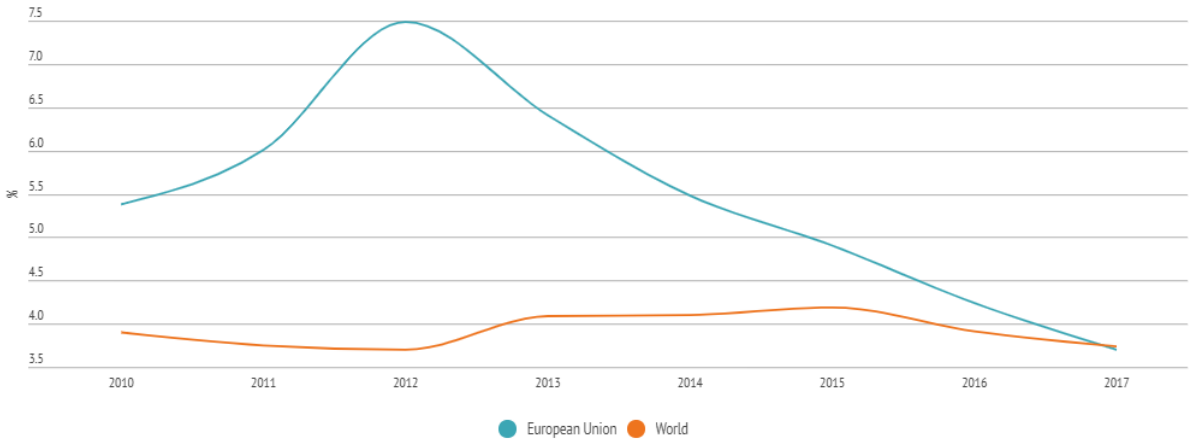
Figure 1.3: Non-performing loans in EU, Japan and USA from 2010 to 2017 (in %).



Source: World Bank data on NPLs.

Overall, figure 1.4 makes a comparison between the stock of NPLs in the European Union and the NPLs of the rest of the world from 2010 to 2017: the EU displays an increase until 2012 and a slow decrease reaching the same level of the rest of the world in 2017. As a matter of fact, as of 2017, the ratio for the EU stood just below the world average of 3.74%, at 3.7%, suggesting that non-performing loans are no longer a specific European trouble. It is evident that the highest level of bad loans is around the 2012, while in the rest of the world the level does not suffer at all.

Figure 1.4: NPL to gross loans, EU and world average comparison (2010-2017).



Source: EBF with IMF and World Bank data.

Since the financial crisis, the distribution of NPL has been different and unequal among the Member States. Moreover by the end of June 2018, three countries, receiving assistance from the EU in the past, still suffered a higher level of NPL (Greece, Cyprus and Portugal).
In the last report of the EBA the ratio of non-performing loans has further declined to 3.1% from 3.2% in the Q4 of 2018, but at a slower pace than in the previous quarters[12]. This decrease of NPL ratio was mainly driven by an increase in the total volume of loans (3.4% growth quarter-over-quarter).

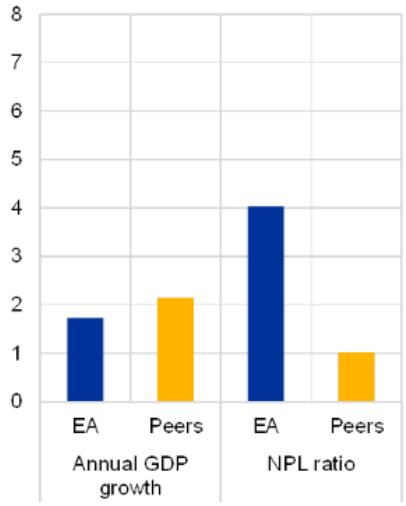
Recently, in August 2019, the ECB published data about the evolution of NPLs: by the end of March 2019, numbers show that the volume of non-performing loans in the European banks is almost the half of the volume in March 2014, being now around 587 billion euro, with the NPL ratio at 3.7%. Despite recent progress, the ECB considers it of the highest importance that the level of NPLs is further reduced, while economic conditions are still favorable. Furthermore, the ECB has recently decided to soften the rules for non-performing loans written in the Addendum revising supervisory expectations for prudential provisioning for new NPLs to account for new Pillar 1[13] requirements for NPEs[14].

[12] EBA Risk Dashboard of Q1 2019.
[13] Basel II Accord, approved in 2004 and setting up risk and capital requirements, rests on three pillars: Pillar 1 about the minimum capital requirement and addressing the maintenance of capital required for three major risks (credit risk, market risk and operational risk), Pillar 2 about supervisory review and finally Pillar 3 about market discipline, promoting greater stability in the financial system. Pillar 1 refers to minimum capital that all banks are legally required to hold under the Capital Requirements Regulation, so the new EU regulation, which outlines the Pillar 1 treatment for NPEs, is Regulation (EU) 2019/630 of the European Parliament and of the Council of 17 April 2019 amending Regulation (EU) No 575/2013 as regards minimum loss coverage for non-performing exposures (entered into force on 26 April 2019).
14 In the documentation, NPL and NPE terms are used interchangeably.

The new regulation, entering into force in 26 April 2019, complements the already established rules and requires a deduction from own funds when NPEs are not sufficiently covered by provisions.

Figure 1.5 shows a comparison between the average annual growth of GDP from 2011 to 2018 and the NPL ratio in 2018: Euro area (EA) bank profitability dampened by low growth and high NPL ratio. The lower profitability of the euro area banks compared with their global peers[15] partly is caused by the weak growth environment and high non-performing loans. GDP growth in the euro area has been slowing behind that in other major economies in recent years. However, the euro area significant institutions aggregate NPL ratio has fallen by around 2%, to around 4% in late 2018 (ECB, 2019).

Figure 1.5: Annual growth of real GDP and NPL ratio: peers vs Euro Area (EA).



Sources: Financial Stability Review (May 2019)[16].

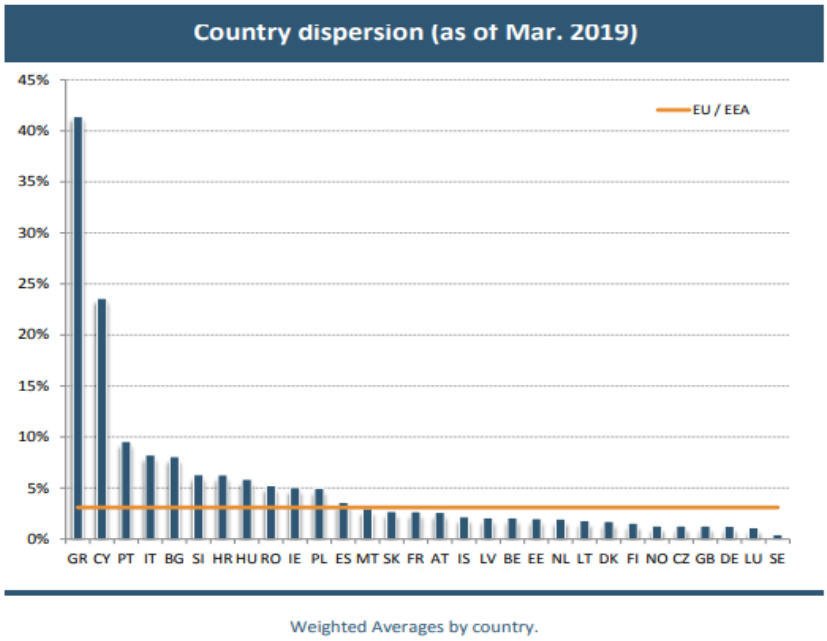
Moreover, according to the last report of the European Commission of June 2019[17], risk reduction in the EU banking sector has maintained the strong momentum, built up over the past years. The NPLs in the Union are continuing their declining trend: the robustness of this downward move should encourage the EU and the member states to keep up their collective effort in order to convincingly address remaining NPL stocks and prevent future

[15] Peers are weighted average of large banks in Denmark, Norway, Sweden, United Kingdom and United States.
[16] In particular, source: Standard & Poor's, Bloomberg, IMF Financial Stability Indicators, IMF World Economic Outlook, Federal Deposit Insurance Corporation, national central banks, Eurostat, ECB and ECB calculations
[17] The Fourth Progress Report on the reduction of NPLs and further risk reduction in the Banking Union.

accumulations thereof. Particularly, in some European countries, NPL ratios remain a challenge and deserve continued attention.

The average Tier 1 capital ratio[18] of the euro area banks directly supervised by the SSM has remained stable, amounting to 15.54% in Q4-2018, compared to 15.63% in Q4-2017[19].

Figure 1.6: Country dispersion of NPL ratios in EU (as of March 2019).



Source: EBA Risk Dashboard (data as of 1Q 2019).

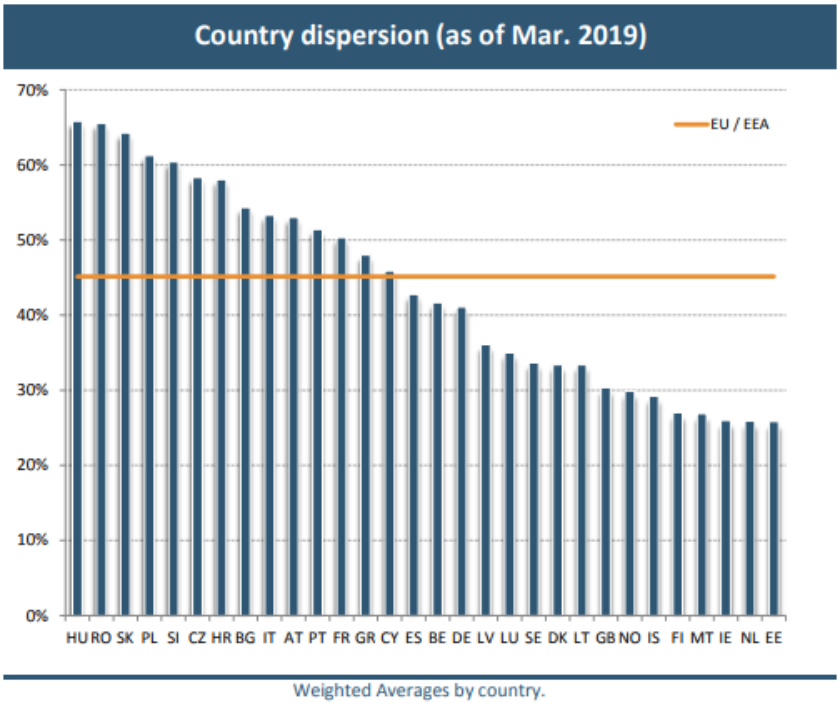
Looking at the country dispersion of non-performing loans within the European Union (Figure 1.6), it is not surprising that Greece shows the highest ratio, followed by Cyprus, Portugal and Italy, higher even than the average EU level (orange line) around 3%. On the opposite, Sweden, Luxemburg and Germany show the lowest level of NPLs of the EU, as of the first quarter of 2019.

The NPLs increase the risk in the balance sheet when the potential future losses are adequately covered or not. This measure is called coverage ratio. Potential losses that are not covered by provisioning should be balanced out by expected future recoveries, by the expected realization of collateral. In addition, the average coverage ratio in the EU was at 46% in the second quarter of 2018[20], but it should be evident that coverage ratios differ from among European economies.

[18] The Tier 1 capital ratio is the ratio of a bank's core tier 1 capital (its equity capital and disclosed reserves) to its total risk-weighted assets and it will better be analyzed in chapter 3.
[19] Data source: ECB's supervisory banking statistics.
[20] Source: European Parliament (October 2018) "Non-performing loans in the banking union, stocktaking and challenges".

As shown by the following figure (Figure 1.7), the coverage ratio of non-performing loans hit the highest value in the Hungarian banks, whereas the lowest level is in Estonia. The orange line represents the average level of the European Union (and European Economic Area).

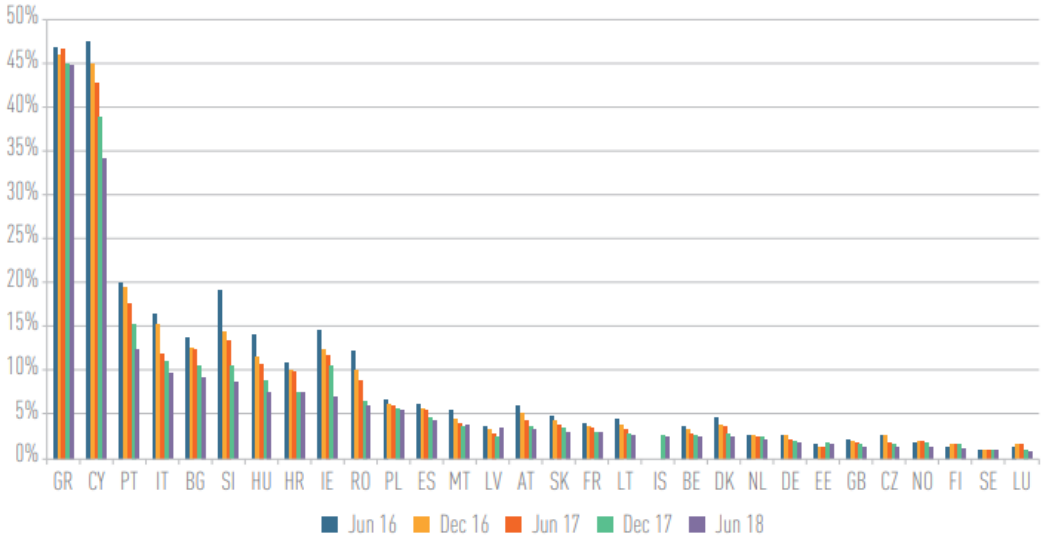
Figure 1.7: Country dispersion of coverage ratio (as of March 2019).



Source: EBA Risk Dashboard (data as of 1Q 2019).

Figure 1.8, instead, represents the non-performing loan ratio as a weighted average by country in the European Union, from June 2016 to June 2018. It does exhibit that nearly all countries have decreased their NPL ratios since 2017, with the exception of only three countries with low NPLs experiencing a marginal increase (Estonia, Latvia and Sweden). The largest decrease in NPLs ratio has been in Cyprus (-8.6 points) followed by Portugal, Ireland and Slovenia.

Figure 1.8: NPL ratio as a weighted average by country in the EU (June 2016 - June 2018).



Source: EBA supervisory reporting data.

Therefore, reducing the excessive level of bank NPLs has become a priority on the agenda of policymakers in Europe, because a high level of NPLs is a signal of an excessive leveraged non-financial sector, thus also economic growth could be negatively affected.

The deep and prolonged recession that hit the Italian economy and lengthy credit recovery procedures have contributed to the high volume of NPLs in Italy's banking system. Banca d'Italia believes that the problem of NPLs in Italy's banks is serious but manageable, that it must be properly defined and dealt with, and that it is wrong to call it an emergency for the whole banking system (Banca d'Italia, 2017).

High NPLs (as well as high provisions) are not only a drag on bank profitability, they also increase bank opacity (Kashian and Opiela 2012). The combination of the two effects reduce investors' willing to lend to banks, leading to higher funding costs and a further negative impact on their ability to generate profits. Clearly, NPLs are risky assets attracting higher risk weights than performing loans. Thus, a large volume of NPLs ties up banks' resources so supervisory institutions have released several reports to shed light on determinants and real effects of NPLs in Europe and to set out the possible solutions (Beck et al. 2013; IMF 2015; Klein 2013).

Authorities need two key pieces of information: the size of NPL problem and the availability of bank capital (and provisions) to absorb losses. Measuring an NPL problem is not

straightforward, as data may be lacking, reporting may have been imprecise, and banks may have an incentive to extend forbearance.

CHAPTER 2 – NON-PERFORMING LOAN MANAGEMENT

2.1 Assessing asset quality

Between 2007 and 2012, EU countries had to deal with liquidity and solvency problems of banks through a number of state aid measures, including:

1) Tier 1 capital injections, guarantees on bank funding instruments;
2) direct liquidity to financial institutions;
3) "asset relief" measures for different types of bad assets.

These measures tried to "relieve" banks from assets that were considered "bad", "impaired" or "toxic", with a market value lower than the intrinsic value.
Authorities have used different tools to assess the size of the NPL problem, as I described up to now. Again, traditional on-site inspections have been complemented with specialized AQR, less reliant on the bank own reporting, and this is generally preferred at time of crisis: this approach was used by the SSM when the last supervisor was set up in 2014. The SSM required clearly comparable approaches across member states.

Legal and judicial constraints

The NPL resolution options may also depend on the legal and judicial framework. In general, loans and their collateral are inclined to lose value during long resolving periods and related judicial proceedings. It is evident that effective insolvency regimes and debt enforcement are essential for debt resolution. The insolvency regime should provide mechanisms for creditors to realize their claims in a predictable, speedy and transparent way. Additionally, an effective insolvency regime is composed by an adequate resolution toolkit ranging rehabilitation to effective liquidation and an effective institutional setting, as reported by the IMF staff discussion note of September 2015[21].

Many countries have reformed their legal framework, after the financial crisis, in order to improve NPL resolution. In Spain a 2013 law allows company to reach a pre-insolvency agreement with creditors and a new system of class voting has been introduced to approve a restructuring plan. Moreover, in Italy a set of reforms were introduced in 2015, including a new debt-restructuring tool, and the possibility of reaching an agreement between the firm

[21] The IMF staff discussion note "A strategy for resolving Europe's problem loans", September 2015.

and its financial creditors (when the firm has more than 50% of outstanding debt with financial institutions). Again, the Ireland's Personal Insolvency Act of 2012 introduces new procedures: a debt settlement arrangement providing for the disposition of unsecured debt over five years and an insolvency arrangement for cash-flow insolvent debtors to settle debt if approved by 65% of all creditors. The last example in Europe is Greece, where a law introduced in 2014 let temporary out-of-court workouts, whereas in 2016 a revision of the bankruptcy procedure leads to a reduction of the time needed for its completion by removing ancillary proceedings (FSI Insights, 2017).

Texas ratio

The Texas ratio provides a link between non-performing loans exposures and capital levels and it is therefore another useful key performance indicator. It is generally calculated by dividing the gross value of non-performing assets[22] of a bank by the sum of its tangible common equity (the equity capital less goodwill and intangibles) capital and loan loss reserves (ECB 2017). A ratio higher than 100 (1:1) means that non-performing assets are greater than the resources which the bank might need to cover potential losses on those assets. It was developed in order to determine potential problem banks in the '80[23] and become almost "a cause cèlebre" among many trying to assess the financial health of financial institutions" (Jesswein K., 2009). This ratio gained quite a bit of notoriety in both the public media and in several areas of the web, in part due to its simplicity and the apparent success rate.

It is important because it takes into consideration relevant factors in a bank health: the number of bad loans and the common equity (used to cover those bad loans). If there is not enough equity in the bank, this will not be able to absorb the many bad loans, leading to a possible failure. In conclusion, it is a relatively straightforward and effective way to determine the overall credit troubles experienced by financial institutions.

[22] That is non-performing loans and the real estate owned by the bank because it foreclosed on the property.
[23] In Texas, by Gerard Cassidy working for the RBC Capital Markets as a method of assessing the credit issues in the banking institutions.

2.2 Policy instruments to resolve NPLs

Different tools might be used to resolve NPLs, such as write-offs, direct sales of these loans, securitization, asset protection scheme and the asset management companies.

Write-off

Write-off is one of the simplest ways to dispose of NPLs, but banks usually have incentive to postpone them. It is a routine practice, but banks normally think twice about writing off NPLs from balance sheet, because of the implications for profits and capital. Banks prefer to keep the full value of these loans on their balance sheet. Low provisioning and capital levels represent a major obstacle to writing-off NPLs, because this approach is contingent on bank capital buffers and provisions, being sufficiently high to be able to absorb the losses. In practice, writing-off the loans does generate losses immediately, reducing bank capital when provisioning is too low (this cost is partly balanced by the fact that when NPLs are written off, the average risk-weights falls).

In the Guidance of the ECB, the authority suggested that banking supervisors have to assist banks in formulating sound write-off criteria[24]. Once an amount has been written off from the balance sheet, it is not possible to write back that adjustment. Instead, for the sake of clarity, write-offs can be held before legal actions to recover the debt are completed against the borrower: the decision to legally lose the legal claim on the debt is called "debt forgiveness".

It must be noticed that write-off criteria under IFRS 9 and US GAAP are not the same and can lead to divergent practices: IFRS 9 requires write-offs if the entity has no reasonable prospects of recovering a financial asset in its entirety or a portion of it.

Direct sales

Another way to deal with NPL accumulation is the direct sales to a counterparty, which is usually another financial institution or investment funds. The selling bank provides prospective buyers with the information they need to conduct diligence. In some cases this instrument has covered packages of loans, rather than individual loans, taking advantage of the diversification of risks through the asset pooling. But the viability of this instrument depends on structural characteristics: the type of NPL influences the possibility to use it or not and transaction costs might be a second obstacle. Information asymmetry can lead to large bid-ask spread and so prevent direct sales: buyers and sellers need to agree on a fair price for

[24] Basel Committee on Banking Supervision (BCBS) 2006 paper, "Sound credit risk assessment and valuation for loans", page 13.

making the sale happen. Bid-ask spread might be caused by banks not fully incorporating the costs of working out impaired assets into their provisioning levels (Fell et al., 2016). In addition, this gap between the prices may be the reason for a small part of the potential tradeable assets.

Public information about NPL sales volumes is scarse, but some data can be found in the reports of private sector companies. In the EU loan portfolio sales were estimated at about 104 euro billion in 2015 (Deloitte, 2017). The market grew from 30 euro billion in 2013, and in 2015, around 66% of loan portfolio transactions are loans collateralized by residential and commercial real estate. The major buyers in the EU market are US hedge funds and private equity funds. Regardless of the rapid growth in Europe's NPL market, the majority of countries still consider the local distressed market to be either too small or not sufficiently effective (EBA, 2016). Countries have, indeed, different approaches to manage direct sales. Authorities may support the creation of mixed public-private investment funds purchasing the NPLs in direct sales. They may rely on both the volatility of buying capacity by the state and its willingness to activate a market for the sale of these bad assets. Another approach regards countries opting to rely on more developed NPL markets abroad: specialized buyers helping to overcome some difficulties of the asymmetric information.

Moreover, direct sales can identify a benchmark and a floor price for NPLs: when direct sales take place, a floor for the NPL valuation is set, giving a benchmark for potential buyers and banks.

NPL sales are sometimes considered as a silver bullet that might help banks to shore up balance sheets, decreasing the recovery risk and increasing the lending capacity to originate new NPLs[25].

Securitization

Securitization is a more complex way of managing NPLs, but it increases the number of possible buyers. In a securitization, the cash flows from NPLs are pooled to create security with senior, mezzanine and subordinate tranches (see Figure 1.9): each tranche has a different risk-reward profile. The advantage of this tool is the risk diversification away from a single credit name, so investors are able to choose the risk-reward combination that best reflects their preferences. Indeed, securitization converts NPLs to marketable securities, which could be chosen by a large pool of buyers, and if guarantees are provided to these securitized assets, the price of NPLs can be higher than the direct sale.

[25] Source: European Parliament (2017).

An example of guarantees is the Italian GACS and Atlante Fund. Non-performing loans securitization has become one of the major topics in Italy when Bank of Italy agreed with the European Commission a Guaranteed Scheme which facilitates the disposal of NPL through a securitization process. This scheme has opened again the door to NPL securitization market which still involves only few investors.

Particularly the Italian supervisors introduced a guarantee scheme to support securitization of NPLs in 2016: "Garanzia Cartolarizzazione Sofferenze" (GACS) covers only the senior tranches of securitization notes and it is priced at market conditions (using as a starting point the single name CDS of Italian Issuers. These conditions helped to avoid breaching state aid rules. Italy led the NPL securitization market in 2017, with euro 22 billion of sales related to securitization. Italian banks sell the NPLs to SPVs established by third-party service provider, which pools NPLs into senior, mezzanine and junior tranches. Moreover, private sector entities set up two funds (Atlante 1 and Atlante 2 created in 2016) which buy the mezzanine and junior tranches.

The main actors about the NPL management have been BPM, with the 7.8 euro billion transfer announced in December 2018, Intesa San Paolo in 10.8 euro billion agreement with Intrum, Unicredit, Iccrea Banca, UBI, Creval, MPS, BPER and Gruppo Delta[26].

For example, more than half of Unicredit euro 17.7 billion project FINO NPL portfolio, the largest GACS, was secured[27], as of February 2018.

By the end of 2019, the group Iccrea is going to sell NPLs amounting to 1.2 euro billion through the GACS. This decision represents "an important signal showing the positive action by the creation of the Gruppo Bancario Cooperativo Iccrea". Moreover, according to CFO Giovanni Boccuzzi, the foreseen securitizations "follows the 2018 ones for a gross book value of over 3 euro billion and it is going to involve over 60 banks of the Gruppo Bancario Cooperativo Iccrea. It takes part of the NPL management strategy with a value of 1.8 euro billion"[28].

The new EU Securitization Regulation (the SR)[29] has become applicable across the EU on 1st January 2019, introducing new obligations for originators, sponsors, issuers and investors in securitization transactions, monitoring the correct application of those criteria. This regulation

[26] Source: https://www.abbrevia.it/it/News--Focus/Cessioni-NPL-gli-ultimi-accordi-sui-crediti-deteriorati-del155712730716874

[27] Source: Unicredit website press release of 7 February 2018.

[28] Source: http://www.ansa.it/sito/notizie/economia/2019/07/23/iccrea-bacaverso-cessione-npl-12-mld_88396856-9530-4dc4-bae7-a03a27898b86.html

[29] Regulation (EU) 2017/2402 and 2017/2402 of the European Parliament and of the Council of 12 December 2017.

aims at establishing a more risk sensitive set of rules to discourage credit institutions from adopting complex products. To this end, the new provision defines a set of criteria to identify less risky products, as the Simple Transparent and Standardized (STS) securitization and some common requirements on risk detention, due diligence and disclosure for financial services sectors.

The main difference between the NPL securitization and the standard one, does depend on the non-predictability nature of the cash flows of the assets which are unstable and more difficult to forecast.

The first securitization on NPL was in 1989 in the USA, by the Resolution Trust Corporation that bought assets and recovered almost 90% through structured operation.

In Asia, because NPL represented the major issue for banks, the Korea Asset Management was the first NPL securitization deal in Korea[30]. In Europe, NPL securitization has been used in Italy before the credit crunch of 2007 and slightly in Germany (the first transaction was in 2006).

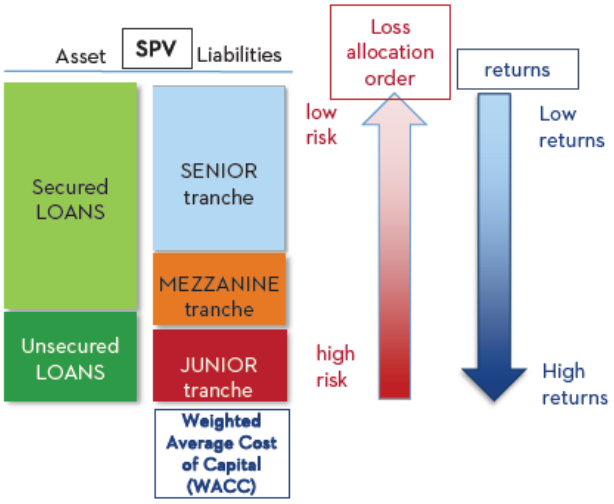
There are differences between the standard structure of securitization on performing assets and the securitization of non-performing loans: the two main ones are true sale and bankruptcy remoteness.

Figure 1.9 shows that the more risky bonds (junior notes) are designed to absorb the first losses whenever recoveries on the assigned receivables fall behind expectations and offer higher returns. In order of attribution of losses, there are the mezzanine notes and lastly the senior notes offering medium-high returns. The liability tranches vary in size according to the expected returns and the risks of the assets side of the vehicle. Potential buyers of senior notes are monetary funds, insurance companies and the other banks, as already explained. Conversely, the junior notes are managed by specialized investors. The benefits of securitizations lie in a smaller average cost of capital (weighted average cost of capital, WACC[31]), that can be obtained through liability tranching, usually with a higher transfer price.

[30] Korea was country heavily hit by the currency crisis in 1997: at that time, NPL were at 20/30% level, so the government was required to mandate Korea Asset Management Company to acquire NPL from the banks backed by bond issuances.

[31] The weighted average cost of capital (WACC) is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds and any other long-term debt, are included in this formula. In other words, it is the average rate of return that a company expects to compensate all investors. The weights are the fraction of each financing source in the company target capital structure.

Figure 1.9: Securitization vehicle scheme.



Source: Prometeia "NPL management insight".

Asset protection scheme

Asset protection scheme (APS) is typically crisis-related instrument to support individual banks with exceptionally high level of NPLs, being an insurance scheme to help banks. APS is created to support credit provision by banks, as NPLs can crowd out new credit, so it is usually put in place during a banking crisis, when the risk of a credit crunch is less manageable. In particular, banks need to agree with the Treasury the amount of assets and what type of assets they can insure, because the original idea was that the Treasury would cover 90% of bank losses, charging a fee for the insurance provided.

An example is UK, where the Treasure launched in 2009 an APS scheme, selecting two banks, but only one agreed to participate to the scheme. Royal Bank of Scotland announced to place GBP 282 billion of assets in the scheme, so the bank undertook to absorb the first losses on the portfolio up to 6% of the value and stipulated a formal commitment to increase the loans to customers (up to 25 GBP billion).

In general, this measure aimed at individual banks, unsuitable for managing systemic risk situations. In terms of public finances, it does not require immediate and direct disbursement, but only the undertaking of a guarantee commitment that may result in greater potential expenditures in future, only in the event of negative evolution of the economic and financial situation of the bank involved.

Asset management companies (AMC)

Another tool that can be used to offload NPLs from the bank balance sheet is the so called "bad bank", also known as "asset management company" ("AMC") or "asset management vehicle" ("AMV"). This refers to a specialized entity (not necessarily a financial institution) buying non-performing exposures at a higher price than private-sector investors, but in line with (or below) the bad loans' "real economic value" (REV). While in principle a bad bank may rely entirely on private money, some degree of public support is often required to ease funding constraints and enhance the vehicle's loss-bearing capacity. As part of its NPL package, the Commission provided Member States with an AMC Blueprint. This document gives non-binding and practical guidance on how they can set up, if they wish so, national AMCs, in fully compliance with EU legislation. The Blueprint elaborated upon some core principles, such as the relevant asset perimeter, the participation perimeter, considerations on the asset-size threshold, asset valuation rules, the appropriate capital structure and the governance and operations of the AMC.

An AMC may prove beneficial in several ways:

1) it prevents banks from disorderly liquidating NPLs (by selling them and/or their collateral at a price lower than the fair value) and provides a means to gradually recover loans and dispose assets once market conditions have reverted to normal;
2) when assisted by some kind of public guarantee, an AMC makes it possible to issue debt at an acceptable cost, which in turn improves the final net value of recoveries; an AMC could be replaced by a "nation-wide securitization special purpose vehicle" raising funds from private investors at acceptable costs, thanks to a public guarantee on senior tranches (Brno et al. 2017);
3) it may benefit from scale economies and specific professional skills that increase the efficiency of the workout process, while improving coordination among multiple banks involved in complex recovery procedure;
4) it may force banks to update and revise their estimates of the transferred asset REV, since an independent valuation is usually required before NPLs can be moved to the bad bank.

The use of AMCs as a tool to manage bank crisis must take into account the provisions dictated by the BRRD and by various communications issued by the European Commission's Directorate General Competition.

Under Article 42 of the BRRD, the Resolution Authority may set up an AMV which some assets and liabilities of the resolved bank can be transferred to, if this is needed to ensure the proper functioning of the latter, in order to avoid adverse market effects of to maximize liquidation proceeds. However, AMVs can only be used in conjunction with other "resolution tool" including sale of business, bridge institutions and bail in. Furthermore, a bail in should always be applied before a bank can benefit from the financial intervention of the Resolution Fund or from public funds. The AMCs can be privately or publicly owned, centralized or bank-specific, and the scope of banking assets to be treated under the AMCs varies. Typically, single-bank AMCs are set up when the NPL issues are limited to a few individual banks (for example the first phase of the Swedish banking crisis), while sector-wide or centralized AMCs are more suitable for systemic problems (for example the Asian countries in the 1990s).

According to Klingebiel (2000), the concept of "bad banks" has a long global history, with troubled banks segregating their assets into two or more categories, allocating risky and illiquid financial assets including non-performing loans to a "bad bank" entity. Many financial and organizational and structural factors need to be taken into consideration when declaring whether assets are "bad". The organizational models might vary: the options are "internal Restructuring Unit" or "External Bad Bank" (Pinedo, 2009; Aggarwal et al., 2012).

Furthermore, AMCs have been used in many crisis-based countries. For example, Securum was established in 1993 in Sweden, as a government-owned company, to work out the NPLs of the state-owned bank Nordbanken. At the start, 20% of Nordenbank's loan portfolio was transferred to Securum. By 1996, the AMC had disposed of 98% of its assets: properties were sold on an individual basis, grouped together in packages, or as whole property companies. Although the lifetime of Securum was initially expected to be 10 to 15 years, it was closed down in 1997.

In Ireland, NAMA (National Asset Management Agency) was set up in 2009 by the government and it created special purpose vehicles controlled by NAMA but with a majority of the shares held by private investors. So NAMA ownership is a private/public hybrid with the aim of acquiring impaired assets from financial institutions. Together with Erste Abwicklungsanstalt in Germany, both established in 2009, these two AMCs are example of state/owned bad banks in the EU.

The last but not the least example is Spain, where SAREB was established in 2012 as a private-for-profit company with a public mandate. Most of the shares are privately owned

(55%)[32], while 45% are owned by the public Fund for Orderly Bank Restructuring, which was established in 2009 to manage the restructuring and resolution of credit institutions. SAREB acquired EUR 106 billion of NPLs from the banks.

In conclusion, the main question remains whether to hold assets until maturity or to sell them (at a fast or slow way). The bad bank's overall cost of capital and its funding environment will determine the need to rapidly release risk-weighted assets at the potential expense o de-leveraging losses.

Summing up the tools, the bank-specific policy instruments available for solving the accumulation of NPLs are listed in the following table (Figure 1.10).

Figure 1.10: Policy instruments to resolve systemic NPLs.

Policy instruments	How it works
Write-off	Loans are written off from banks' balance sheets
Direct sale	Banks or AMCs sell NPLs in dedicated markets
Securitisation	Banks, special purpose vehicles or AMCs pool and tranche loans and sell the securitised products in dedicated markets
Asset protection schemes	State-backed entities offer insurance on loss on NPLs in order to restart banks' credit provision
Centralised asset management company (AMC)	Dedicated companies buy bad assets from the problem bank(s)

Source: FSI Insights on policy implementation n.3 (2017).

[32] The classification, as private entities, implies that transactions, financial assets and liabilities of these institutions are not included in the general government accounts. The classification outside the public sector was determined by the independence of these entities to adopt decisions, since capital is private-held in the main, by their objectives, by the limited duration considered and by the restricted size of potential losses relative to liabilities.

2.3 What's the value of non-performing loans? An overview

Harmonized cost approach

According to the harmonized cost method, it takes care of the discounted future expected cash flows over the lifetime of a loan. The discounting considers the time value of money. Furthermore, according to IAS, the original effective interest rate, *i*, of the loan is used to discount factor[33]. The gross book value (GBV) is calculated as:

$$GBV = \sum_{t=1}^{n} \frac{f_t}{(1+i)^t}$$

Where *f* is the expected cash flows. But when the debtor is not able to repay the loan, the bank has to assess several factors, like the probability of repaying the whole debt by the due time, the recoverable amount and the cash flow recovery time, which is different from the one written in the contract of the loan.

So a new and different estimation of the cash flows is computed. In order to estimate the expected cash flow, f', bank has to consider the direct costs of managing NPLs, even if it does not consider indirect costs, so the NPL net book value (NBV) is:

$$NBV = \sum_{t'=1}^{n'} \frac{f'_{t'}}{(1+i)^{t'}}$$

Where f' is the new cash flows in which are included the direct sots of managing NPLs, but not the indirect costs so it is revised downwards in view of the new financial situation of the borrower.

For this reason, the value adjustment is the difference between these two values:

$$R = GBV - NBV$$

Usually, the book value of a bad loan is much higher than the price that the investors are willing to pay. There are several factors influencing the price of the loan but most important

[33] Source: IAS 39, "Financial instruments: recognition and measurement".

are: the indirect management cost effect[34], the rate of return effect[35] and the overall effect. the last one takes into account the other two[36].

From IAS 39 to IFRS 9

Several researches have studied the information contained in the loans and the relative credit risk disclosures (as Wahlen, 1994; Barth et al., 1996, Nissim, 2003; Kahan and Ozel, 2016) and as a consequence of the financial crisis, interest in the analysis of the credit risk in banks has increased (Blankespoor et al., 2013; Cantrell et al., 2014).

There are different criteria to calculate the value of NPLs in the balance sheet of the banks. The EU is encouraging the development of secondary markets for non-performing loans, which would allow banks more easily to manage or sell bad loans.

Currently, potential buyers of bad loans face barriers to cross-border purchases of credit due to different regulatory regimes in the member state. This has led to an inefficient secondary market for NPLs, with low demand, weak competition and low bid prices (European Council, 2019).

The recovery time is supposed to affect the valuation of a bad loan, both in terms of accounting value and market value.

Moreover, predicting how many of the loans will default is a key for valuation and it is not an easy exercise but certainly an important one as this is a major part of the valuation.

Loans are typically the largest class on the balance sheet of the banks: understanding the value of loans is vital to any assessment of the flexibility of the banking system.

Valuing loans would be easy in perfect markets[37], so loans would be equal to the sum of expected discounted cash flows. But markets are not perfect, particularly for loans. As a result, there are several approaches for valuing loans. Moreover, nature of loans of banks has changed markedly over time.

[34] It refers to the fact that indirect costs of managing these bad loans might account for as much as 6& of nominal expected cash flow.

[35] This means discounting future cash flows with the expected effective rate of return.

[36] Ciavoliello L., Ciocchetta F., Conti F., Guida I., Rendina A., Santini G. (2016), "What's the value of NPLs", Banca d'Italia.

[37] Like perfect competition, no taxes, no transaction costs, information is fully available to everyone at no cost, all financial assets are infinitely divisible, and individuals are rational.

So the international accounting standards board (IASB) in 2014 published the IFRS 9 Financial Instruments, which includes a new standard for loan loss provisioning based on "expected credit losses" (ECL)[38].

Furthermore, for banks reporting under the International Financial Reporting Standards (IFRS), 1 January 2018 marked the transition to the new IFRS 9[39], that is a new era per impairment allowances for the European Union:

1) it simplifies asset accounting in financial statements and measurements;
2) it introduces a forward-looking impairment model;
3) it incorporates new accounting requirements for recording profits and losses on derivatives and the associated hedge instruments.

The new standards require impairment allowances for all exposures form the time a loan is originated, based on the deterioration of credit risk since the initial recognition.
While the definition of "impaired" loan has remained unchanged, IFRS 9 requires amore granular assessment of credit risk in comparison to IAS 39.

Under IFRS 9, applicable entities must place financial instruments into three distinct stages:

1) "performing" (stage 1), covering instruments that have not deteriorated significantly in credit quality since initial recognition or that have low credit risk (provisions are calculated on 12-months ECL);
2) "underperforming" (stage 2), covering instruments that have deteriorated significantly in credit quality since initial recognition, but which do not show objective evidence of credit loss event (based on lifetime ECL);
3) "non-performing" (stage 3), rather that the "unimpaired" and "impaired" categories of IAS 39[40], it covers instruments including events that had a damaging impact on the estimated future cash flows at the reporting date (that is financial difficulty of borrowers), and it is based on lifetime ECL as the previous stage.

The three-stage classification process is used not only to highlight the credit quality of the exposure but also to determine the method used to calculate expected credit losses. Moreover, IFRS 9 assumes that a loan has a significant credit risk when it becomes 30 day past due and so it must be shown in stage 2 or 3, where provisions are based on lifetime ECL.

[38] IASB (2014): IFRS 9 also includes new rules for classification and measurement of financial instruments and hedge accounting.
[39] This standard is effective for fiscal years beginning after 15 December 2019.
[40] Stage 3 is close to the IAS 39 definition of impaired.

Under IFRS 9, lifetime ECL is the expected present value of losses that arise if borrower does default on their obligations at some moment during the life of the financial asset. In other words, the expected credit loss is the weighted average of credit losses with the probability of default as the weight[41].
The relationship between lifetime and 12-month ECL will depend on many factors, including the maturity of the loan, how default risks and recovery values are expected to evolve over the loan life (Cohen B. et al., 2017).

Finally, the new ECL provisioning standards aims at inducing a big change in low banks approach and manage credit risk. While the full impact of this new introduction will not be clear at the beginning, the banks participating in the EBA survey in 2017 expected their provisions to increase by an average 18% due to the treatment of non-defaulted loans with significant increase in credit risk.

2.4 Literature review

Non-performing loans have attracted more attention in recent decades. Several studies examined bank failure and find that asset quality is an indicator of insolvency (Demirguc-Kunt, 1989; Barr and Siems, 1994). Moreover, the empirical literature on the relation between the macroeconomic conditions and the asset quality is wide.
For this reason, the minimization of NPL is a necessary condition for improving economic growth: when NPL are kept for a long time, there will have an impact on the resources that are enclosed in unprofitable areas. Thus, NPLs are likely to hamper economic growth and reduce the economic efficiency (Hou, 2007). The shocks to the financial system can arise from factors specific to the company (idiosyncratic shocks) or macroeconomic imbalances (system shocks).
The literature about the non-performing loans is full of studies trying to analyze and explain bad loans. Many authors concluded that non-performing loans are influenced by macroeconomic variables, like GDP growth of the country, inflation rate, real interest rate, unemployment rate, whereas there are different bank-specific variables that are considered indicators of future bad loans.

[41] Lifetime ECL does consider the amount and timing of payments, so credit loss, that is the credit shortfall, arises even if banks expect to be repaid in full but later than due. Moreover, Lifetime ECL shall continue to be reported for loans in this stage of credit deterioration but interest revenue is calculated on the basis or the lower net amortized cost carrying amount, that is the gross carrying amount adjusted for the loss allowance.

One of the most relevant study regarding this topic is the paper of Louzis et al. (2010) about the determinants of non-performing loans in the Greek banking sector, separately for the different types of loan (consumer, business and mortgage loan). Indeed, using a method of dynamic panel data as econometric approach, they chose a data set of large Greek banks for the period 2003 to 2009, in order to examine the determinants of NPLs for each category of loan. The authors concluded that the stock of impaired loans is driven both by macroeconomic variables (GDP, unemployment and interest rates) and management quality, and in particular the NPL on mortgages are less sensitive to macroeconomic conditions. Their results are consistent with what found by Espinosa and Prasad (2010). As a matter of fact, within a sample of 80 banks in the Golf Cooperation Council (GCC) countries from 1995 to 2008, the authors discovered that the non-performing loan ratio raised when economic growth became lower, the interest rate and risk aversion increased. In other words, their model suggested that the cumulative effect of macroeconomic shocks over a period of three years is actually relevant.

In the paper by Milani (2017), "What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy" examined the macroeconomic and the bank-specific variables that affect non-performing loans (NPLs) in Italy over the period 2006-2015 considering a sample of 482 juridical different banks operating in Italy. Testing nine hypotheses in his dynamic panel model, he found out that there is a strong evidence that bank managers have a relevant role in the increase of NPLs after the financial crisis. Moreover, he concluded that in his case the macroeconomic variables do not have a significant impact on NPLs in Italy in that timespan: in particular, a high level of public debt does not impact NPLs when leverage is included.

Furthermore, Bruno and Immacolata (2016) analyzed the role of banks loan quality in explaining lending patters in the European Union before and after the onset of the Euro sovereign debt crisis, through a difference-in-difference econometric approach. So, the sample has been divided into two timespans: prior the sovereign crisis (2005-2009) and after the crisis (2010-2014). The results highlighted the existence of a negative nexus between poor loan quality and lending: a higher NPL ratio explains a reduced loan growth and a lower allocation to loans at the advantage of government debt. They also stressed the need to manage non-performing loan problem, being poor loan quality a drag on bank lending.

Another paper by Messai and Jouini (2013) examined the determinants of NPLs within a sample of 85 banks in three countries: Italy, Greece and Spain. In the period from 2004 to 2008, they chose the countries that had problems after the 2008 financial crisis and with the worst public finance in the European Union. They found out that GDP growth and return on assets of credit institutions have a negative impact on non-performing loans, while the unemployment rate and the real interest rate affect positively impaired loans of the banks. The bank-specific variables they took into account were the return on assets, the change in loans and the loan loss reserves to total loan ratio, and with the application of panel model approach, the results suggested that provision of banks increased with NPLs.

In addition, the paper by Accornero, Alessandri, Caripinelli and Sorrentino (2017 studied the linkage between NPLs and the supply of bank credit. With a sample of more than 500 Italian banks and 2.5 million borrowers over the last 8 years, the authors used a time-varying firm fixed effect to control for shifts in demand and changes in borrowers characteristics between 2008 and 2015. They also took into account the supervisory intervention of 2014 (the Asset Quality Review carried out by the ECB together with other European supervisory authorities) as an exogenous shock, even if in the end the results suggest that the correlation between NPLs and credit is driven by demand-side effects. Overall, the impact of AQR on bank lending was positive. In particular, the paper compared the lending behavior of AQR banks to that of non-AQR banks before and after the exercise, so from an econometric approach they used a diff-in-diff model, because there has been a systematic downward shift in credit supply for banks that were subjected to the review relative to those that were not. So, they considered 2012-2013 as the pre-treatment period and 2014-2015 as the post-treatment period, because the AQR was announced in October 2013 and conducted throughout 2014 based on bank-balance sheet results of end-2013. The results showed that lending was on average higher for AQR-banks and the differential pattern continued after the supervisory exercise. However, the negative interaction between NPL ratios and AQR dummy shows that AQR-banks which had a higher share of non-performing exposures lent on average relatively less, supporting the case of a differentiated behavior across AQR-banks based on their initial credit quality. Moreover, after the revisions induced by the AQR, the impact of NPL ratios within AQR-banks seemed mitigated: this could be interpreted by the improvement in transparency and confidence yielded by the review, but also other macroeconomic factors may be considered. Overall, despite the causal effects, the AQR didn’t decrease the supply of bank credit, as it will be also confirmed in the second part of the analysis. The second part of the paper tried to identify the impact on credit supply of an exogenous variation in NPLs: the analysis focused

on the flow of provisions over operating profits and the flow of new NPLs over total outstanding loans, both a measure of changes in credit quality. With the use of these tow instrumental variables and including again firm fixed effects, that capture the overall change in credit for each borrower over the period of interest, the authors conclude that exogenous shocks to the banks NPL ratios might have a negative impact on credit supply. Evidences suggest that exogenous NPL shocks must have had a minor role in Italy over that period: NPL ratios did not fluctuate under the influence of exogenous shocks to the bank balance sheets and so they are not significant drivers of bank lending in their sample, also confirmed by the instrumental variables results. In conclusion, the paper suggests that bank's lending behavior is not causally affected by the level of NPL ratio, because the negative correlation between NPL ratios and credit growth is created by changes in firm's conditions and contractions in their demand for credit.

Another study by Abid, Ouertani and Zouari-Ghorbel (2013) about "macroeconomic and bank-specific determinants of household's non-performing loans in Tunisia" examined the determinants of households' NPLs only over 2003-2012, exploring the main effect of macro and bank-specific variables on the quality of loans. This specific analysis on Tunisian banks shows that macroeconomic variables (real GDP growth, inflation rate and the real lending rate) influence the level of NPLs in the country. Also, using a dynamic panel data approach, the authors showed that measures of performance and efficiency of a bank may be used as an indicator for future bad loans, supporting the hypothesis of bad management in the increase of NPLs. They suggest that to prevent future financial instability the authorities should consider the systems of risk management and the bank procedures: the International Monetary Fund (IMF) encourages the solving of management problems at bank level to reduce NPLs.

The last similar paper is the one of Mohanty, Ranjan Das and Kumar (2018) about "determinants of non-performing loans in India: a system GMM panel approach" in which the authors investigated the determinants of NPLs of Indian banking sector from 2001 to 2016, with the use of the system GMM panel estimation approach. This method reduces finite sample bias and any other imprecision by regressing levels and changes in NPLs of its lags and other explanatory variables using lagged levels as instruments. The results showed that economic growth, stock market index and market capitalization ratio had a negative impact on the gross NPL ratio, while expansionary fiscal policy escalates the NPL ratio. The corporate-specific variables, instead, as net sales growth and net profit margin had a statistically negative impact on NPL ratio, while bank-specific variables, as growth in bank branches,

higher return on equity, higher credit deposit ratio lowered the ratio. They also found that higher operating expense ratio had a positive effect on NPLs, concluding that strengthening the balance sheet of private corporate sectors will strengthen the balance sheet of banks by lowering NPLs.

CHAPTER 3 – ANALYSIS SPECIFICATION

3.1 The econometric approach: panel data

I use panel data techniques to analyze and quantify the impact of the introduction of the BRRD on the stock of non-performing loans of a sample of significant European banks from 2011 to 2017. This allows me to capture the bank-specific effects and the unobservable differences between banks. Using a panel data approach, one can control for the biases generated by potential heterogeneity and omitted variables problems. Also, the decision of using panel data comes from the fact that panel data can take explicit account for individual-specific heterogeneity, by combining data in two dimensions. Panel data gives a more data variation, less collinearity and more degrees of freedom, it is better suited than cross-sectional data for studying the dynamics of change, and finally, it is better in detecting and measuring the effects which cannot be observed in either cross-section or time-series data.
Panel data collects information about several individuals (cross-sectional) over several periods and in this case the panel is balanced because all units are observed in all periods. In particular, a wide panel has the cross-sectional dimension (N) much larger that the longitudinal dimension (T) and the same units are observed in all periods.

Panel data approach is a continuously developing field: the basic linear panel model used in econometrics may be described through suitable restrictions of the following general model:

$$y_{it} = \alpha_{it} + \beta_{it}^{\top} x_{it} + u_{it}$$

Where i=1,..,*n* is the individual (group, country) index, t=1,..,*T* is the time index and u_{it} a random disturbance term of mean 0.

Pooled OLS model

First, I use a pooled regression approach. Since panel data combines both time series and cross-section data, it has the advantage to reduce collinearity among explanatory variables especially when the number of years is low and pooling enables to control for exogenous shocks common to all banks (time effects) and reducing the omitted variable bias (unit effects). However, simple pooled regression may not be well designed to capture relationships between the dependent variable and explanatory variables. This is due to the fact that pooled regression assumes homogenous behavior of endogenous variable for all individuals in the

sample (same intercept and same slopes). This is not obviously the case for the variable NPLs, as it varies considerably between countries and over years. Several alternative estimation methods are more suitable for panel data (fixed and random effects).
A pooled model has the following specification, which does not allow for intercept or slope differences among individuals:

$$y_{it} = \beta_1 + \beta_2 x_{2it} + \ldots + \beta_K x_{Kit} + e_{it}$$

Where *i*=1,..,N refers to individual (cross-sectional unit) and t=1,…,T denotes the time period (longitudinal unit), so the total number of observations in the panel is NxT.

To notice that OLS consists of five core assumptions:

1) linearity: it says that the dependent variable is formulated as a linear function of a set of independent variables and the error term;
2) exogeneity; it says that the expected value of error terms is zero or error terms are not correlated with any regressors;
3) Homoskedasticity says that the error terms have the same variance, while heteroskedasticity refers to different variances (its violation is called autocorrelation);
4) The observations on the independent variable are not stochastic but fixed in repeated samples without measurement errors;
5) Full rank assumption says that there is no exact linear relationship among the independent variables (no multicollinearity).

Fixed effect model

The fixed effect model takes into account individual differences, namely different intercepts of the regression line for different individuals. In other words, it is simply a linear regression model in which the intercept terms vary over the individual units *i*. The model in this case assigns the subscript *i* to the constant term $\beta_{1,}$ as shown in the following equation:

$$y_{it} = \beta_{1i} + \beta_{2i} x_{2it} + \beta_{3i} x_{3it} + e_{it}$$

The constant terms calculated in this way are called fixed effects. Variables changing little or not at all over time, like some individual characteristics should not be included in a fixed effects model because they produce collinearity with the fixed effects.

There are several strategies for estimating a fixed effect model: the least squares dummy variable model (LSDV) uses dummy variables, whereas the “within” estimation does not.

These strategies produce the identical parameter estimates of regressors (non-dummy independent variables).

The within estimation does not need dummy variables, but it uses deviations from group (or time period) means. That is, "within" estimation uses variation within each individual or entity (in this case, banks) instead of a large number of dummies. The within estimation is:

$$(y_{it} - \bar{y}_{i\bullet}) = (x_{it} - \bar{x}_{i\bullet})'\beta + (\varepsilon_{it} - \bar{\varepsilon}_{i\bullet}),$$

Where $\bar{y}_{i\bullet}$ is the mean of dependent variable of individual (group) *i*, $\bar{x}_{i\bullet}$ reprensents the means of independent variables of group *i*, and $\varepsilon_{i\bullet}$ is the mean of errors of group *i*. This estimation reports correct sum of squared errors (SSE), even if it has some disadvanges as the other estimations. In addition, the within group estimator requires strict exogeneity of the X's with respect to the error term, but allows for correlation between the X's and the invidual effect. Differently from the random effect as follows, the within group uses only within-group variability and it is less efficient than the random effect when RE is consistent.

Random effect model

The random effects model goes in more detail than the fixed effects by recognizing that, since the individuals in the panel are randomly chosen, their characteristics, measured by the intercept β_{1t} should also be random. Therefore, random effect model has $\overline{\beta}_1$ where is the popolation average and u_i is an individual-specific random term: as in the previous case, this model is also time-invariant:

$$\beta_{1i} = \overline{\beta}_1 + u_i$$

So the final equation is:

$$y_{it} = \overline{\beta}_1 + \beta_2 x_{2it} + \nu_{it}$$

Here, the intercept is constant across individuals, but the error term $v_{it,}$ incorporates both individual specifics and the initial regression error term:

$$\nu_{it} = u_i + e_{it}$$

Moreover, the random effects model has a specific error term: it has zero mean, a variance $\sigma^2_u+\sigma^2_e$, uncorrelated across individuals and with timewise covariance equal to σ^2_u . An important characteristic of this model is that timewise correlation in the errors does not decrease over time. It requires strict exogeneity of the X's with respect to the error term and the very strong condition that they do not correlate even with the individual effect.

In addition, random effects estimator is reliable under the assumption that individual characteristics (heterogeneity) are exogenous, so they are independent with respect to the regressors in the random effects equation. RE estimator combines within-group and between groups variability, even if it is consisent RE is biased in infinite samples.
The idea of the random effects model is that, differently from the fixed effects model, is that the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model.

Generalized least squares (GLS)

Under the random effect assumptions, OLS is inefficient but consistent, so in this case the composite disturbance term means that OLS is not appropriate: GLS (generalized least squares) is the right one, which takes into account the covariance structure of the error term. With the random effects model, the degrees of freedom increases, and greater efficiency might be gained using the generalized least squares (GLS).

In both ordinary least squares and maximum likelihood approaches to parameter estimation, there is the assumption of constant variance, that is the variance of an observation is the same regardless of the values of the explanatory variables associated with it, and since the explanatory variables determine the mean value of the observation, the variance of the observation unrelated to the mean is assumed[42].

Hausman test

The (Durbin-Wu-)Hausman test for endogeneity may be used with the null hypothesis that indivudal random effects are exogenous. A low p-value of the test indicates that the null hypothesis is rejected: random effect becomes inconsistent. This means that the fixed effects model is the correct solution. The Hausam test uses that "the covariance of an efficient estimator with its difference from an inefficient estimator is zero" (Greene, 2008).

[42] Sources are Menke W. (2014), "Review of the Generalized Least Squares method", Springer and Verbeek M. (2004), "A guide to modern econometrics", 2nd edition, John Wiley and Sons, Ltd.

Other diagnostic tests

Fixed effects are tested by the F test, while random effects are examined by the Lagrange multiplier (LM) test (Breusch-Pagan, 1980). In the first test, the null hypothesis is that all dummy parameters except for one for the dropped are all zero:

$$H_0 : \mu_1 = ... = \mu_{n-1} = 0$$

The alternative hypothesis is that at least one dummy parameter is not zero. The F test is based on loss of goodness-of-fit.

The Breusch-Pagan LM test for random effect, instead, examines if individual (or time) specific variance components are zero and it follows a chi-squared distribution with one degree of freedom:

$$H_0 : \sigma_u^2 = 0$$

If the null hypothesis is rejected, there is a significant random effect in the panel data and the random effect model is able to deal with heterogeneity better than the pooled OLS.

Panel data models examine fixed and random effects of individual or time: the main difference between fixed and random models lies in the role of the dummy variables. A parameter estimate of a dummy variable is a part of the intercept in a fixed effect model and an error component in a random effect model, while slopes remain the same across groups or time period in either fixed or random effect model.

The following scheme (Figure 2.1) summarizes the main differences between the two models, fixed and random effects, a comparison of the structural form, assumptions, intercept, error variances, slopes, estimation and hypothesis tests.

Figure 2.1: Summary comparison between fixed and random effect models.

	Fixed Effect Model	Random Effect Model
Functional form	$y_{it} = (\alpha + u_i) + X_{it}'\beta + v_{it}$	$y_{it} = \alpha + X_{it}'\beta + (u_i + v_{it})$
Assumption	-	Individual effects are not correlated with regressors
Intercepts	Varying across group and/or time	Constant
Error variances	Constant	Randomly distributed across group and/or time
Slopes	Constant	Constant
Estimation	LSDV, within effect estimation	GLS, FGLS (EGLS)
Hypothesis test	F test	Breusch-Pagan LM test

Source: Park H. (2011), "Practical guides to panel data modeling: a step by step analysis using Stata", Japan.

How to get away with heteroskedasticity

In many cases, the extent of the dependent variable does tend to depend on one or more independent variables: in the presence of heteroskedasticity, the coefficient estimators are still unbiased, but their variance is incorrectly calculated by the normal OLS method, making confidence intervals and hypothesis testing incorrect as well[43].

The Breusch-Pagan heteroskedasticity test is one of the most common tests for heteroskedasticity: it allows the heteroskedasticity process to be a function of one or more of independent variables, assuming that heteroskedasticity might be a linear function of all the independent variables in the model. In other words, the test statistic follows a chi-square distribution: the null hypothesis is that the error variances are all equal, and a small chi-square value (with a small p-value) indicates that the null hypothesis is true, so that the variances are all equal.

Weighted least squares (WLS)

In the Appendix, other methods are reported: the weighted least squares, that play an important role in the parameter estimation for generalized linear models. In some cases, the errors are uncorrelated, but have unequal variance. In this case, the weighted least squares (WLS) is applied: a weighted sum of the squared residuals is minimized, so each squared residual is weighted by the reciprocal of its variance. In other words, while estimating β, less weight is given to the observation for which the linear relationship to be estimated is noisier, and more weight to those for which it is less noisy.

3.2 The model and data specification

In this section I describe the dataset, sources and variables used to examine the effect of the introduction of the BRRD on the NPLs ratio through a panel data approach.

In order to have a good representation of the whole European banking industry, I collected data from the first 47 Significant Institutions, as established by the European Central Bank, from 2011 to 2017. I decided to stop at 2017 because in January 2018, the International Financial Reporting Standard 9 (IFRS 9) replaced the previous accounting standard for

[43] One of the assumptions of the Gauss-Markov theorem is homoskedasticity, which requires that all observations of the dependent variable come from distributions with the same variance σ^2.

financial instrument (IAS 39), changing, among other aspects, the approach that banks are required to follow in the calculation of credit losses[44].

The sample covers 17 countries of the European Union which are under the supervision of the Single Supervisory Mechanism and so the BRRD.

The data was collected from the BANKSCOPE, a comprehensive commercial database of bank financial statements provided by Bureau van Dijk Publishing (BvD), collecting unconsolidated balance sheet information and double-checking these numbers by looking at the annual financial statements available on the bank websites. The macroeconomic variables are collected from different sources instead:

- the real GDP was collected from the World Bank database;
- the inflation rate from the Eurostat website;
- the judicial efficiency from the Doing Business of the World Bank database.

In order to avoid strong discontinuities in the balance sheet variables for banks involved in significant M&A transactions during the sample period, some adjustments have been made so as to ensure comparability over time.

The dependent variable

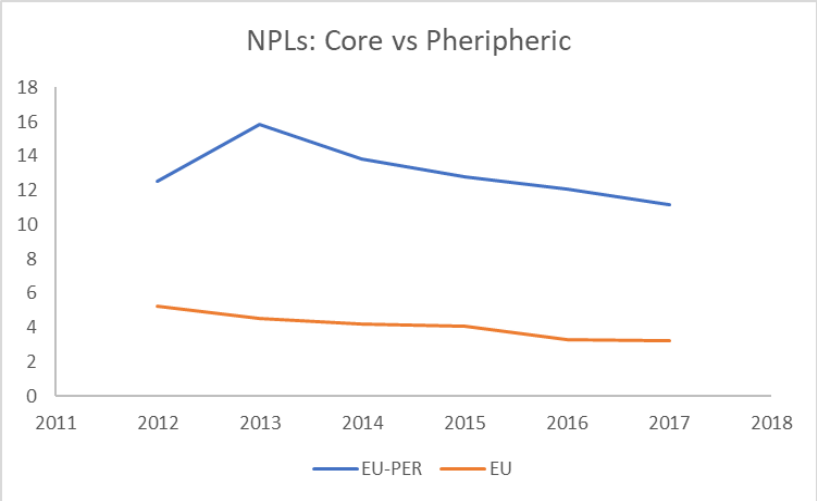
As dependent variable, I used the annual growth of the stock of non-performing loans, measured by the NPLs ratio obtained by dividing total amount of non-performing loans by total gross loans and then I took the first difference between time t and time t-1. The ratio of bank non-performing loans to total gross loans is the value of non-performing loans (gross value of the loan recorded on the balance sheet) divided by the total value of the loan portfolio. It measures the bank health and efficiency by identifying problems with asset quality in the loan portfolio. A high ratio might signal deterioration of the credit portfolio.

In particular, the denominator of this ratio includes: mortgage loans, other retail loans, corporate and commercial loans and other loans.

In this sample, the annual growth of the ratio has a mean of -0.085, denoting that the stock of NPLs of the most significant banks in the eurozone is slowly decreasing year after year, with a standard deviation of 4.653.

[44] With the new accounting standard, provisions need to be calculated with the expected credit loss (ECL) model instead of an incurred loss model. IFRS 9 also requires banks to allocate financial instruments subject to ECL requirements in three different stages (stage 1, 2 for assets that experienced a significant increase in credit risk, 3 for credit that are impaired) according to their credit risk level.

Figure 3.1: Non-performing loans in core and periphery Euro-area countries.



Source: my own elaboration.

Figure 3.1 tackles the evolution of the NPL ratio in my sample over 2012-2017: the sample is divided between Core countries (Austria, Belgium, France, Germany, Luxembourg, Netherlands) and Periphery countries (Greece, Italy, Spain, Portugal, Slovenia, Malta, Slovakia and Cyprus). So, the figure highlights that the periphery countries exhibit a higher ratio than the core ones, even if slowly decreasing year after year, the gap between the two groups is evident, highlighting the different behavior of the banks in the core countries and the ones in the periphery. Moreover, within the Euro area, NPLs are particularly high in Southern countries, notably Greece, Cyprus, Italy and Portugal. Despite the large discrepancies across countries and across banks, bad loans remain a problem for European banks, who compare unfavorably with US banks.

The independent variables

I define some bank-specific factors as independent variables to control the differences among banks: annual growth of total amount of gross loans, return on average equity, loan loss provision, Tier 1 ratio and coverage ratio. Berger and Deyoung (1997), Louzis et al (2012) among others are not likely to consider the determinants of NPL among macroeconomic factors as they are found to be exogenous to the banking industry. In fact, each bank policy choices, such as the emphasis on improving efficiency and the risk management, along with the typical features of the banking sector are expected to influence the evolution of NPLs (Abid et al., 2013). The relationship between NPL and bank specific factors has been indicated by Berger and Deyoung (1997), Louzis et al. (2012) and Sabbah (2013) who investigated the relationship between loan quality, cost efficiency and bank capital.

Furthermore, I consider some macroeconomic variables as the annual growth of real GDP, the annual growth of inflation rate and judicial efficiency (time and cost). Nevertheless, most of the literature is based on country-specific studies. For example, Salas and Saudina (2002) analyzed the problem loans in Spanish commercial and savings banks and found out that credit risk is determined by bank-specific variables, as the bank size net interest margin, capital ratio and market power (in addition to the real GDP). So the authors analyzed the causation from the real economy to non-performing loans.
Quagliariello (2007) looked at the Italian banking sector and analyzed bank behavior over the business cycle, studying if loan loss provisions, NPLs and the return on assets had a cyclical pattern. He found that bank riskiness and profitability were affected by the evolution of the business cycle.

Tier 1 capital ratio

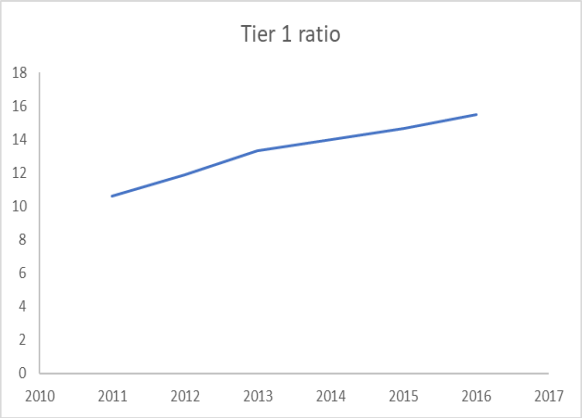
A proxy for bank capitalization is the ratio between the Tier 1 capital and the risk-weighted asset to get the Tier 1 ratio, with a mean of 13.3 in my sample. It is the ratio of a bank's core Tier 1 capital, that is the equity capital and the disclosed reserves, divided by the total risk-weigheted assets, that include all the assets held by the bank and systematically weighted for credit risk. It is considered as an important measure of a bank financial strength, adopted with Basel III Accord[45] on bank regulation. In particular, risk-weighted assets are useful to determine the minimum amount of capital that must be held by the bank and other institutions in order to redure the risk of insolvency; it has been introduced within the Basel III Accord in 2018. This measure aims at preventing banks from losing large amount of capital when a particular class of asset loses value. The minimum level of Tier 1 capital ratio increased from 4% in Basel II to 6% (which is composed of at least 4.5% of CET1). Tier 1 capital is different from Tier 2 capital, which is the bank supplementary capital such as loan-loss, revaluation reserves and undisclosed reserves and it is less reliable or secure than Tier 1 capital.
The formula of the Tier 1 capital ratio is:

$$\text{Tier 1 Capital Ratio} = \frac{\text{Tier 1 Capital}}{\text{Total Risk Weighted Assets}}$$

[45] Basel III is a set of international banking regulations developed by the Bank for International Settlements to promote stability in the international financial system and to reduce damage by banks that take too much risk. It aims to strengthen bank capital requirements by increasing bank liquidity and decreasing bank leverage.

The graph (figure 3.2) shows an increase trend over time: year after year the ratio is slowly increasing, reaching a higher level than in 2011.

Figure 3.2: Tier 1 capital ratio variable over time.



Source: my own elaboration.

When Basel III requirements are fully implemented in 2019, banks will have to hold mandatory "capital conservation buffer" at 2.5% of the bank risk-weighted assets, bringing the total minimum CET1 ratio to 7% (4.5% plus 2.5%).

Return on average equity (ROAE)

In order to measure the profitability of the bank, I considered the return on average equity (ROAE): in my sample, the mean value of this variable is 7.28. ROAE differs from the common Return on Equity (ROE) because ROE does not accurately reflect the business' actual return over a period of time: the equity value considered only includes last-minute stock sales, share buybacks and dividend payments. The ROAE may give a more accurate picture of the company's corporate profitability, instead, especially if the shareholders' equity has changed a lot during the fiscal year. So it is considered an adjusted version of the ROE. When the value of the shareholders' equity does not alter or alters by a small amount during a specific period, the ROE and ROAE numbers should be similar.

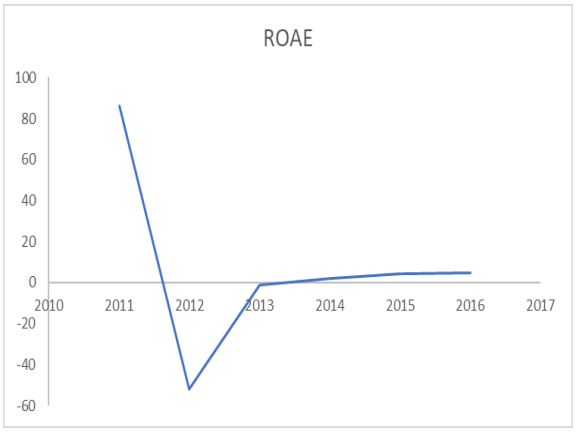
ROAE is driven by profitability, operating efficiency and debt, indeed this ratio also reveals which levers the company is pulling to achieve higher returns and if it is profitability, asset turnover (a measure of asset efficiency) or financial leverage (the average assets divided by the average stockholders' equity and a measure of the firm's debt level).

It is calculated as:

$$Return\ on\ Average\ Equity = \frac{Net\ Income}{Average\ Shareholders'\ Equity}$$

This financial metric is expressed in the form of a percentage which is equal to net income after tax divided by the average shareholders' equity for a specific period of time. The formula suggests how much return an entity generates for its shareholders: it helps to calculate how much profit the shareholders make, investing in the entity or how much money shareholders made for their investment in the entity.
As displayed in figure 3.3, the ROAE variable shows a sudden decline from 2011 to 2012, returning to a positive sign from 2013.

Figure 3.3: ROAE variable evolution over time.



Source: my own elaboration.

Loan loss provision

Loan loss provision measures the amount set aside in the event that the loan defaults and it is an adjustment of loan loss reserves[46], also to mitigate credit risk[47]. So it is a non-cash expense for banks to account for future losses on loan defaults, giving a guarantee on bank's solvency and capitalization when default may occur. It is said to be as a "shock absorber" to offset probable future losses (Kendra, 2001). The loan loss provision allocated each year increases with the riskiness of the loans a given bank makes: a bank making a small number of risky loans will have a low loan loss provision compared to a bank taking higher risks. In other words, when banks take deposits and make loans, they must balance their loan receivables,

[46] Loan loss reserves are balance sheet accounts that represent a bank's best estimate of future loan losses and in particular it is the accumulated loan loss provisions over several years, and it is located in the balance sheet of lending institutions. It is calculated as: (pre-tax income + loan loss provision) / net charge-offs, where charge-off is a debt that is deemed unlikely to be collected by the creditor because the borrower has become substantially delinquent after a period of time, but this does not mean a write-off of the debt entirely.
[47] Credit risk is the risk of loss that might occur from the failure of any part, generally the failure to make required payments on loans. In other words, it is defined as the potential that a bank borrower will fail to meet the obligations in accordance with agreed terms. It is calculated based on the borrower's overall ability to repay a loan according to its original terms.

which is the principal and the interest repayments from borrowers, with the demand for deposits (the request from depositors for all or a portion of their deposits). When some of these loans do not perform as expected, a situation of loss on the expected income for the bank occurs, pushing banks to set aside a portion of the expected loan repayments from all loans in a portfolio to cover most of the loss. This system works as an internal insurance fund, and it is important because it reflects a bank ability to manage its funding costs. From a balance sheet perspective, a loss on loans is still a loss of an asset, so loan loss provision secures that banks will have enough funds to distribute services to the depositors. Loan loss provisions are constantly updated estimates, based on statistics for the bank customer defaults. The bank is presenting an accurate assessment of the financial position, by shelving loan loss reserves and updating estimates.

When Basel I was revised, Basel II was implemented by bank supervisors across several countries in 2007. Under Pillar I, the determination of the minimum capital requirement for banks is based on three approaches: the internal risk-based (IRB) approach, the standardized approach and the advanced measurement (AMA) approach. The IRB approach requires banks to rely on their risk weights: banks should ensure that the expected losses are fully covered via loan loss provisions. When expected losses are greater than provisions, banks have to deduct the difference from capital on the basis of 50% deduction from Tier 1 capital and 50% from Tier 2 capital. If the expected losses are less than provisions, banks should recognize the difference in Tier 2 capital up to a maximum of 0.6% of risk-weighted assets. The standardized approach requires banks to determine risk weights based on external credit ratings, instead. Banks should also include loan loss reserves up to a maximum of 1.25% risk-weighted assets. The AMA approach requires banks to choose their own methodology for assessing risk provided it is exhaustively comprehensive and systemic.

Overall, Basel II Pillar I tried to ensure that bank capital covers unexpected losses while loan loss provisions cover expected loan losses (Majnoni, Miller and Powell, 2004).
It must be said that the distinction between loan losses covered by bank capital and loan losses covered by loan loss provisions is sometimes unclear because bank capital is derived partly from loan loss provisions (or reserves), and because general provision is included in Basel's definition of bank capital (Hull, 2012). Therefore, regulatory capital requirements should include sufficient loan loss provisions due to the close relationship between loan loss provisions and capital.

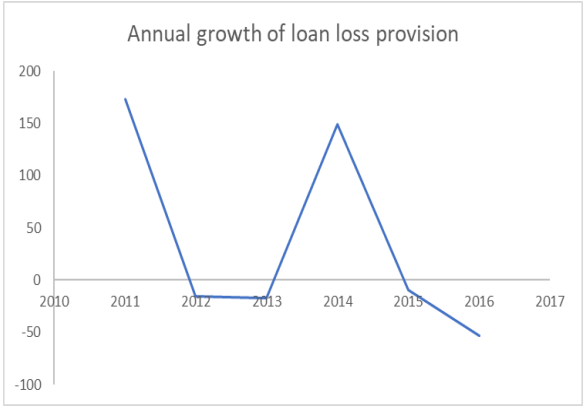
Basel III Accord proposes the expected “through-the-cycle” loan loss provisioning system to be introduced in June 2018. However, the implementation was extended repeatedly to 31 March 2019 and then again until 1 January 2022. Basel II was criticized because loan loss provisioning system allows provisioning only at one point in time, so only at the beginning of the reporting year or quarterly or semi-annually (Hull, 2012; Wezel et al., 2012). In particular, it introduces a loan loss provisioning system requiring banks and financial institutions to set aside specific provisions on newly-originated loans based on individual borrower characteristics that drives the performance of the loan. This implies that the level of loan loss provisions associated with a specific loan will be determined from the beginning based on a set of bank-specific and borrower-specific criteria even though the loan impairment has not incurred yet (Wezel et al., 2012).

Under Basel III, banks are encouraged to improve the quality of loan loss provisions estimates by:

- developing the quality of the underlying data that generates provisions buffers. This allows banks to eliminate flaws in current loan loss provisions models and processes, the imprecisions that usually generate unnecessarily high or low and insufficient buffers, to ensure that data quality on collateral are optimal rather than suboptimal;
- introducing through-the-cycle loan loss provisions estimates, ensuring that the bank is using this approach for probability of default (PD) estimates and expected losses (EL) can improve the accuracy of loan loss provision estimates and decrease the volatility in their estimates.

In this study, the mean of the annual growth of the variable is equal to 37.7, as reported in the summary statistics table (Figure 3.9).

Figure 3.4: loan loss provision (in %) variable over time.



Source: my own elaboration.

As shown in the relative figure 3.4, the variable suffers an intense decrease from 2011 to 2012, increasing again two years later, with a peak in 2014, and then going down below the zero in 2015 and showing still a negative trend in the following years. This up-and-down trend may reflect the fact that in 2014 the AQR review has been made to these banks and so they started increasing the loan loss provisions from the end of 2013 to 2014. Furthermore, the decreasing trend from 2014 may be a consequence of the new regulations introduced for accounting purpose and of the decreasing trend of the dependent variable.

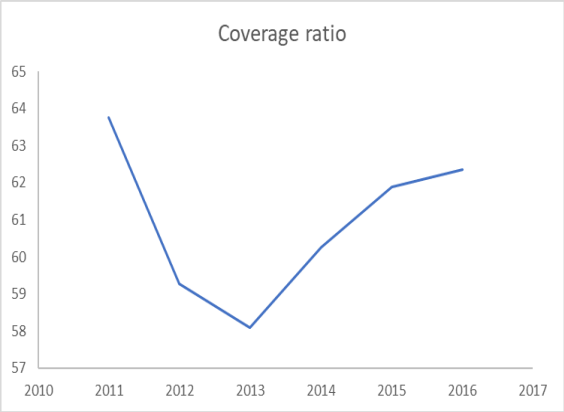
Coverage ratio

The last but not the least bank-specific variable is the coverage ratio, measured as the percentage of coverage of bank total loans, with a mean of 60.9 as reported in the Table 3.9 of summary statistics. Again, coverage ratio is a measure of the ability of the bank to absorb potential losses from non-performing loans and, in other words, it refers to the amount of loan loss provisions in relation to the corresponding gross exposure, so it is the ratio of loan loss reserves to impaired loans. It can be considered as a proxy to provisioning policy of a bank. Coverage ratios do not, per se, provide a complete picture of a bank exposure to credit risk on NPEs: a low coverage ratio is usually a source of concern to supervisors, as it gives an extent to unexpected losses, while a high ratio means that an institution is less vulnerable to future losses.

It may be noticed that cross-country or cross-bank differences could originate from elements that do not suggest higher risks: for example, a low coverage level could be adequate if a financial institution holds a significant amount of high-quality and liquid collateral or coverage ratios might be lower for banks that have sold large portion of NPLs to specialized investors for achieving a quick reduction in NPEs[48].
The ratio between the amount of provisions and the gross NPLs is usually defined as the coverage ratio.
The relative trend shown in figure 3.5 suffered a decrease during 2012-2013, then the coverage ratio slowly increases year after year.

[48] Source: European Parliament (2017), Economic Government Support.

Figure 3.5: Coverage ratio variable over time.



Source: my own elaboration.

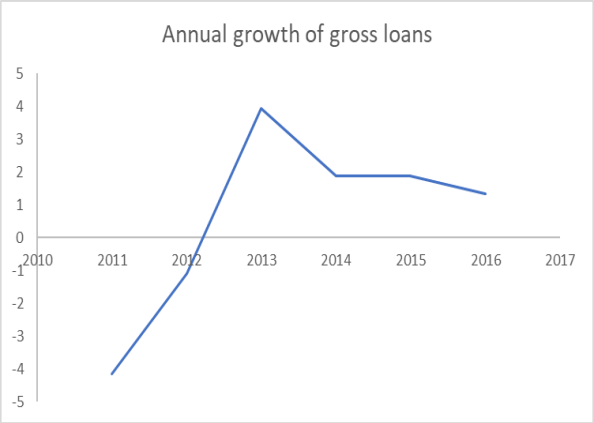
According to the EBA[49], the average coverage ratio of NPLs was 46% as of June 2018 (EU weighted average). This trend has been supported by a faster decline of NPLs than the one of provisions between 2017 and June 2018: higher coverage ratios give banks more room to reduce their non-performing loans through sales or other instruments already explained in the first chapter.

Annual growth of gross loans

Gross loan is the outstanding book value of loans that the bank has made, including non-performing loans before the deduction of specific loan-loss provisions. In other words, this is an asset and is the gross value of the loan as recorded on the balance sheet. In this study, I considered the difference between time t and t-1 of the gross loans of the banks. As shown in figure 3.6, the annual growth of gross loans had a negative sign in 2011, but then sharply increasing and reaching the positive peak in 2013, and then slowing decreasing year after year.

[49] Source: EBA risk assessment of the European banking system as of December 2018: the EBA published its annual report on risks and vulnerabilities in the EU banking sector, accompanied by the results of the EBA's EU-wide transparency exercise, providing detailed information for 130 banks of EU, in a comparable and accessible format.

Figure 3.6: Annual growth of gross loans (in %).



Source: my own elaboration.

Judicial efficiency

Once non-performing loans emerge, they tend to remain for a long time in bank balance sheet owing to another structural weakness of the countries: the length and inefficiency to resolve insolvency. I took two variables as a proxy of this weakness: the efficiency of the judicial system is measured by the days required and the cost to resolve insolvency. In particular the time index, provided by the World Bank database, is the number of years from the filing for insolvency in court until the resolution of distressed assets, while the cost of the proceedings is defined as the percentage of the value of the debtor's estate[50]. In particular, the cost is calculated on the basis of questionnaire responses and includes court fees and government taxes, fees of insolvency administrators, auctioneers, assessors and lawyers and other costs.

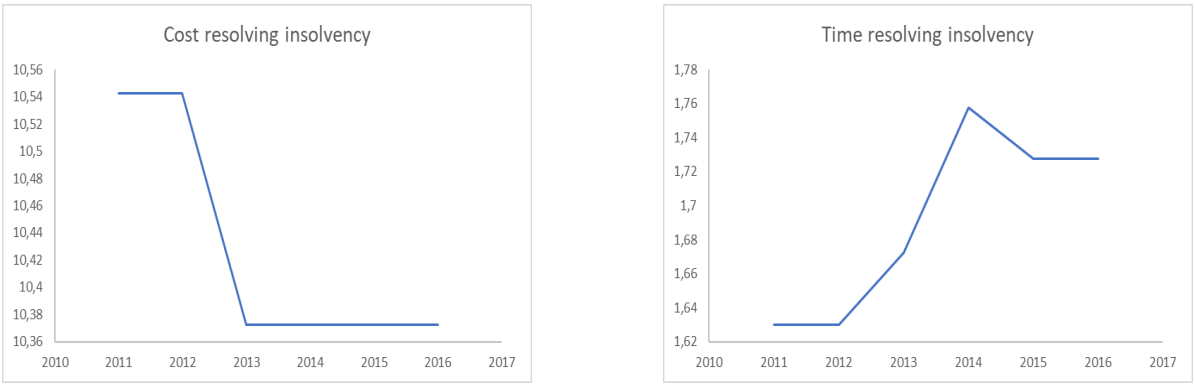
On the opposite, the time variable captures the time for creditors to recover their credit: the period of time is from the company's default until the payment of some or all of the money owned to the bank. In addition, potential delay tactics by the parties, as the filling of dilatory appeals or requests for extension are taken into consideration. In other words, this indicator measures the median duration that incorporation lawyers or notaries indicate is necessary in practice to complete a procedure with minimum follow-up with government agencies and no unofficial payments[51] (World Bank, 2018).

[50] In particular, it is a percentage of the economy's income per capita and all official fees.
[51] It is assumed that the minimum time required for each procedure is one day. Moreover, the time that the entrepreneur spends on gathering information is not measured.

The mean number of the years needed to resolve insolvency is 1.7 and the mean of the cost (in %) is 10.43 (see Table 3.9). Moreover, legal uncertainties and a lengthy foreclosure process limit the options for restructuring influence the time necessary to recover NPLs in a country: as judicial efficiency decreases, the recovery time increase and so do the NPLs. It is reasonable to expect the efficiency of the judicial system to have a positive impact on the NPLs ratio.

Therefore, judicial system efficiency is constantly mentioned as one of the main determinants of NPLs accumulation, Danièle Nouy (2017)[52] stated "I would also like to stress that addressing NPLs requires determined action from all stakeholders, not only supervisors. In addition to our work, legal and institutional measures are required, notably in areas of insolvency and juridical processes" (Cerulli et al., 2017).

Figure 3.7: Cost (left) in % and time (right) in year to resolve insolvency.



Source: my own elaboration.

Many European countries have improved the insolvency regimes in line with international best practice, for example Cyprus, Latvia, Poland and Romania have renewed the whole insolvency regime. Other countries (Greece, Italy, Portugal, Slovenia, Spain) have simplified the process, instead, and countries, like Croatia, Germany, Serbia, Italy and Spain have introduced improved instruments, such as debt-to-equity swaps[53] or other debt-restructuring mechanism. Other countries, like Croatia, Germany, France, Slovenia, Spain adopted pre-solvency procedures, or fast-track prepack insolvency procedures[54] (Croatia, Greece, Italy,

[52] Daniele Nouy was the chair of Supervisory Board at the ECB, from 2014 to 31 December 2018.

[53] A debt-to-equity swap is a transaction in which the obligations or debts of a company or individual are exchanged for something of value, equity. It is a refinancing agreement where a debt holder gets an equity position in exchange for cancellation of the debt. The swap is used to help a company in a difficult situation continue to operate. It is the exchange of equity for debt in order to write off money owed to creditors.

[54] Pre-pack insolvency proceedings is for example the pre-pack sale defined by the Association of Business Recovery Professionals in the UK as an arrangement under which the sale of part or all the company's business or asset is negotiated with a purchaser prior to the appointment of an Administrator. it became a developed market tool to promote corporate rescue. Also, in the USA, there is a variation of the pre-pack called pre-packaged bankruptcy.

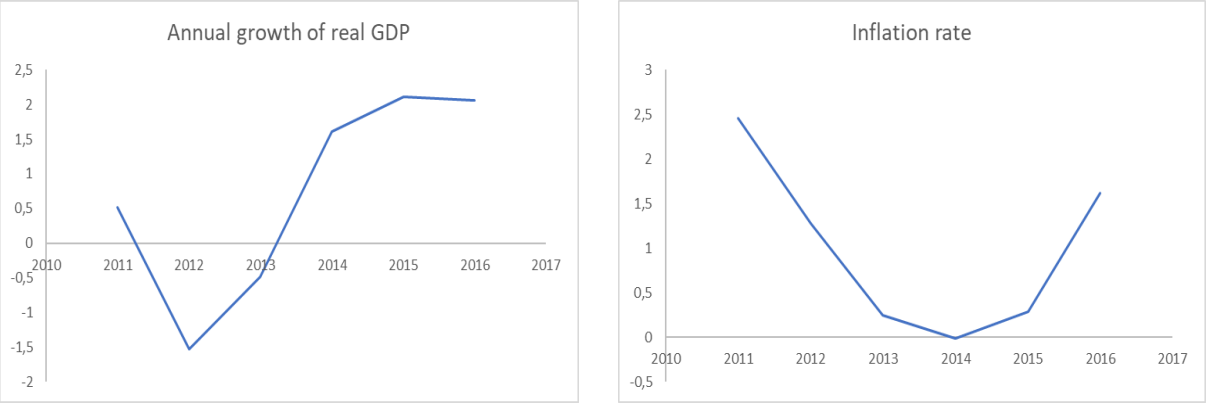
Latvia, Portugal, Serbia). The result is a sudden decrease in the cost to resolve insolvency in the EU, while the time to resolve insolvency is now around 1,7 year (see Table 3.9).
The insolvency regimes for corporations are generally better developed than for households, but deficiencies in both areas remain (IMF 2015). Moreover, an even more serious weakness is the slow and inconsistent implementation of insolvency laws: more than 60% of non-euro area countries do not set strict time limits for the insolvency process, increasing the lengthy proceedings. Then around 60% of the euro area countries instead has a remuneration of insolvency practitioners that is not linked to the outcome of the liquidation, leading to softer incentives for the resolution. Countries used many of the standard restructuring tools during 2012-2014, but there is still room for improvements.

Real GDP growth and inflation rate

I focus on other two macroeconomic variables: economic growth, the inflation. To measure a country's economic growth, I use the annual growth real gross GDP (gross domestic product) rate[55], between period t and t-1: the mean is 0.7 and the standard deviation is 2.521 (see Table 3.9).
Then on the right Figure 3.8, the annual growth of the inflation rate is reported. According to the EUROSTAT definition, inflation rate is here the annual average rate of change (%), also called Harmonized Indices of Consumer Prices (HICPs), giving a comparable measure of inflation as they are calculated according to the harmonized definitions[56]. The HICP has the purpose to be representative of the developments in the prices of all goods and services available for purchase within the euro area for the aim of directly satisfying consumer needs.

[55] GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
[56] The HICP is an indicator of inflation and price stability for the ECB. It is a consumer index which is compiled according to a methodology that has been harmonized across EU countries. Moreover, the euro area HICP is a weighted average of price indices of member states who have adopted the euro. In addition, the main aim of the ECB is to maintain price stability, defined as keeping the year on year increase HICP below or close to 2% for the medium term.

Figure 3.8: Annual growth of real GDP (left) and inflation rate (right).



Source: my own elaboration.

Summary statistics

The variables I just described are listed in Table 3.9, and for economic reasons I use the lagged value of all the independent variables, in accordance also with the literature. As data are collected at annual frequency, the sample of the analysis has a time dimension of six years and the significant banks are 47, for a total of 282 observations. In this table there is the summary of the descriptive statistics of all the variables considered, both dependent and independent ones.

Table 3.9: Descriptive statistics of all the variables.

VARIABLE	OBS.	Mean	St. Dev.	Min	Max	Median	1st QU.	3rd QU.
Δ NPL	282	-0.085	4.653	-41.67	17.83	-0.1554	-0.694	0.5
Δ GROSS LOANS	282	0.626	14.272	-82.422	81.8654	-0.5313	-4.875	4.171
TIER 1 RATIO	282	13.33	4.897	-6	53.2	12.6	11.18	14.68
TIME RES SOLV	282	1.691	0.682	0.8	4	1.5	1.2	1.9
COST RES INSOLV	282	10.43	5.364	3.5	22	9	8	11
ROAE	282	7.283	309.665	-1309.1	4871.17	5.569	1.268	8.23
Δ LOSS PROV	282	37.76	464.523	-766.67	6400	-12.08	-43.88	18.98
COVERAGE RATIO	282	60.94	27.879	23.16	376.81	57.48	46.25	68.67
GDP GROWTH	282	0.713	2.521	-9.1	10.66	1.1	-0.175	2.2
INFL RATE	282	0.978	1.091	-1.5	3.7	0.9	0.2	1.7

Source: my own elaboration.

Correlation matrix

Finally, the correlation matrix of all the variables is given in the Table 3.10: as reported, NPLs are negatively correlated to lagged real GDP growth and so the Tier 1 ratio, while they are positively related to the time to resolve insolvency and the relative cost.

Table 3.10: Correlation matrix.

	Δ NPL	Δ loans	Tier 1	time	cost	ROAE	cov ratio	GDP	Δ prov	infl rate
Δ NPL	1									
Δ gross loans	0.1108	1								
Tier 1 ratio	-0.072	0.0603	1							
time res insol	0.0233	0.0096	0.02267	1						
cost res insol	0.0046	0.0498	-0.1245	0.3121	1					
ROAE	0.072	0.0056	0.0005	0.0161	-0.0072	1				
cov ratio	0.0299	0.1011	0.0438	0.0223	-0.0333	-0.0365	1			
GDP	-0.253	0.0011	0.30183	-0.065	-0.1245	-0.1292	0.13158	1		
Δ loss prov	-0.039	-0.0138	0.33092	0.0153	0.0175	0.00188	-0.085	0.0344	1	
infl rate	0.0203	-0.1711	-0.1151	-0.227	-0.0491	0.01102	0.05058	0.1821	0.0716	1

Source: my own elaboration.

Table 3.10 shows that the time to resolve insolvency has a very low correlation with the annual growth of real GDP, while the cost of judicial efficiency has an even lower correlation with the economic growth. In addition, the ROAE variable shows a positive and low correlation with all the other variables, including the dependent variable, with the exception of the cost to resolve insolvency (-0.0072).

Based on the papers of the literature, I developed various testable hypothesis focusing on the major NPL determinants: for example, when the growth of real GPD of a country's economy increases, borrowers are more able to repay their debts. Conversely, when economic growth slows down or becomes negative, companies and households reduce their cash flows, in turn; this makes it difficult for them to repay banks loans (Salas and Saurina 2002). Therefore, I expect real GDP growth to have a negative impact on NPLs.
Inflation rate is an indicator of price stability instead, and it has a negative relation with the level of non-performing loans as shown in the correlation matrix. This is due to the fact that, during inflationary periods, the real value of payments of the borrower falls (Kurumi and Bushpepa, 2017).

To sum up, in order to address my research question, I use a panel data approach with different specification and look at the balance sheet and macroeconomic factors affecting the

stock of non-performing loans of the significant banks in the Euro-area, before and after the introduction of the Bank Recovery and Resolution Directive in 2015. So in econometric terms, I use a dummy variable for the BRRD year, but because of the high level of anticipation of this event (as we can see also from the graphical representation of all the relevant variables) from the Significant Institutions and the Asset Quality Review of 2014, I decided to use the 2014 as crucial year:

$$D_t \begin{cases} 0 \text{ if } t < 2014 \\ 1 \text{ if } t \geq 2014 \end{cases}$$

In econometric terms, with the use of panel data the baseline equation of this study will be:

$$\Delta NPL_{i,t} = \alpha_0 + \beta_1 \cdot \Delta grossloans_{i,t-1} + \beta_2 \cdot Tier1ratio_{i,t-1} + \beta_3 \cdot timeresinsol_{i,t-1} + \beta_4 \cdot costresinsol_{i,t-1} + \beta_5 \cdot ROAE_{i,t-1} + \beta_6 \cdot \Delta lossprov_{i,t-1} + \beta_7 \cdot covratio_{i,t-1} + \beta_8 \cdot D_{i,t} + \beta_9 \cdot X_{i,t-1} + \varepsilon_t$$

Where the X is the vector of the two macroeconomic variables, that is the annual growth of real GDP and the inflation rate.

CHAPTER 4 – EMPIRICAL RESULTS

Even if high NPL ratios do not discourage banks from lending, an exogenous variation in these ratios may push them to change their lending policies: in this case, NPLs do not constitute a drag for the credit market but their fluctuations can cause a temporary contraction in the supply of credit. To examine NPLs, I adopt an "event study" approach and study the lending dynamics around the 2014: the analysis aims at investigating the relationship between the European directive and the stock of non-performing loans of the banks.
In this chapter, the results from the econometric analysis implemented in the RStudio software are described in detail.

To better analyze the impact of the European directive on the non-performing loans ratio of this sample of banks, the study considers different specifications and interactions and for all the following tables, the estimated coefficients are reported for each variable and each model, whereas in parenthesis the corresponding p-value.

The introduction of the European Directive by the European Central Bank with the BRRD on the Significant Institutions (SI) of this sample leads to a decrease of the annual growth of the NPL ratio of the banks: the dummy of the BRRD has a significance at 0% level. Furthermore, the results confirm that higher levels of judicial efficiency in one year are related to greater levels of NPLs in the following year. This implies that longer time periods to enforce a contract are related to a higher stock of non-performing loans in the following year, even if the result is not statistically significant in these specifications.

It will be glaringly obvious that in all the models the dummy of the European Directive is significant and has a negative relationship with the dependent variable: from the introduction of this directive, the annual growth of NPL ratio of the banks has decreased, leading banks to hold less bad loans.

The decision to use 2014 year as dummy is also driven by the econometric model estimation (using a dummy for the year in the fixed effect model). Indeed, running a regression with time fixed effects, it controls for variables that are constant across entities but vary over time. The model generates T-1 dummies that are included in the model, because the intercept is considered. This approach eliminates omitted variable bias caused by excluding unobserved

variables that evolve over time but are constant across entities (see Appendix for detailed results). The results of this analysis suggest that the critical year is 2014.

Estimation results for the baseline model (column 1) without macroeconomic variables and the other models incorporating bank-specific variables are shown in Table 4.1.
Specifically, in column (1), the OLS model is reported, without taking into account the two macroeconomic variables.
To notice that the dependent variable is the annual growth of non-performing loans: results show that the relationship between the annual growth of gross loans and the dependent variable (annual growth of NPL ratios) is statistically significant at 1% level, with a positive sign.

Table 4.1: OLS and pooled OLS models.

	(1)		(2)		(3)	
ΔGross Loans	0.0480307	*	0.0431325	*	0.04803065	*
	(0.013873)		(0.02568)		(0.0138728)	
Tier 1 ratio (t-1)	0.004303		0.0441201		0.00430305	
	(0.945855)		(0.48909)		(0.9458547)	
time res insol (t-1)	0.284581		0.165665		0.28458095	
	(0.498973)		(0.69788)		(0.4989731)	
cost res insol (t-1)	-0.0148348		-0.0258909		-0.01483477	
	(0.783611)		(0.62818)		(0.7836112)	
ROAE (t-1)	0.0009831		0.000638		0.00098307	
	(0.263109)		(0.46594)		(0.263109)	
Δ loan loss prov	-0.00053		-0.0005316		-0.00052996	
	(0.403957)		(0.39577)		(0.4039566)	
coverage ratio (t-1)	0.0012881		0.0057015		0.00128805	
	(0.896274)		(0.56208)		(0.896274)	
BRRD (2014)	-2.3380411	***	-1.8856266	*	-2.33804112	***
	(0.000204)		(0.02871)		(0.0002041)	
% GDP growth (t-1)			-0.3635103	**		
			(0.00809)			
inflation rate			-0.0890428			
			(0.80339)			
constant	0.9941402		0.5610739		0.99414023	
	(0.437607)		(0.71427)		(0.4376066)	
Observations	282		282		282	

*Notes: ***, **, *, · denote significance at 0%, 0.1%, 1% and 5% levels, respectively.*

In column (2), the lagged annual growth of real GDP and inflation rate have been added to the baseline model, instead: as expected, an improvement in the economic growth of the previous

year leads to a decline in non-performing loan ratio of banks, implying a negative effect of the economic environment on the stock of non-performing loans from an econometric point of view, as the literature has previously confirmed. The impact of the BRRD on the annual growth of the NPL ratio continues to be negative, even if at a lower level of significance: from 2014 the annual growth of non-performing loans shows a decreasing trend. This implication suggests that the introduction of the new instruments of the directive pushed banks to revise their balance sheet and reduce the amount of bad loans.

In column (3), the Pooled OLS is run on the entire sample without considering the two macro-variables: the annual growth of gross loans variable has an estimated coefficient with a 1% level of significance, meaning that when the banks have more loans in their balance sheet, the proportion of non-performing loans increases.

Table 4.2: Random effect estimators and interactions.

	(4)		(5)		(6)		(7)	
ΔGross Loans	0.04803065	*	0.04313252	*	0.04670876	*	0.04652225	*
	(0.0132665)		(0.024869)		(0.0151821)		(0.0161185)	
Tier 1 ratio (t-1)	0.00430305		0.04412013		-0.21725483	.	-0.0308776	
	(0.9458049)		(0.488498)		(0.0524946)		(0.6400161)	
time res insol (t-1)	0.28458095		0.16566499		0.2342172		0.25263287	
	(0.4983998)		(0.697577)		(0.5746259)		(0.5465742)	
cost res insol (t-1)	-0.01483477		-0.02589091		-0.0075877		-0.0143792	
	(0.7834032)		(0.62779)		(0.887414)		(0.789066)	
ROAE (t-1)	0.00098307		0.00063797		0.0009937		0.00098285	
	(0.2621235)		(0.465312)		(0.2529431)		(0.2602993)	
Δ loan loss prov	-0.00052996		-0.0005316		-0.0010055		-0.0022221	.
	(0.4032257)		(0.395016)		(0.1273098)		(0.0501983)	
coverage ratio (t-1)	0.00128805		0.00570155		0.0009903		0.00167147	
	(0.8961779)		(0.561594)		(0.9194057)		(0.8650242)	
BRRD (2014)	-2.33804112	***	-1.88562656	*	-6.3611198	***	-2.3646402	***
	(0.0001666)		(0.027865)		(0.0003922)		(0.0001323)	
% GDP growth (t-1)			-0.36351034	**				
			(0.007631)					
inflation rate			-0.08904277					
			(0.803199)					
constant	0.99414023		0.56107386		3.5456372	*	1.54266363	
	(0.4369334)		(0.713979)		(0.0325127)		(0.2388868)	
Tier 1 ratio*BRRD					0.32685181	*		
					(0.0169776)			
Loss prov*BRRD							0.00248531	.
							(0.0726837)	
Observations	282				282		282	

*Notes: ***, **, *, · denote significance at 0%, 0.1%, 1% and 5% levels, respectively.*

Table 4.2 shows the estimated coefficients of the Random Effect estimator in different specifications:

- Without the macro-variables (column 4);
- With the annual growth of GDP and inflation rate variables (column 5);
- The interaction of the Tier1 ratio variable with the dummy of BRRD (column 6);
- The interaction of loan loss provision variable with the dummy of BRRD (column 7).

So quite consistent with the literature of the first chapter, all models show a significant and negative relationship between the lagged real GDP and the annual growth of NPLs. In other words, the improvement in the real economy is generating a reduction in the annual growth of non-performing loan portfolios of the most relevant European banks, being the GDP growth one of the main drivers of non-performing loans at macro level. On the contrary, the annual growth of gross loans has a positive relation with the annual growth of the stock of non-performing loans in all the models as in the previous table.

The lagged coverage ratio variable has no significance in neither model instead, exhibiting a positive sign in all the estimations. In principle a low coverage ratio does not necessarily imply a risk of under-provisioning, since it may reflect rigorous lending practices or a strong insolvency framework (where for example repossession is easy for creditors). Nevertheless, in countries with weak legal framework and judicial efficiency, a low coverage ratio may suggest a potential source of instability. This situation can dampen credit supply especially in crisis years, when negative shocks further affect the credit quality of borrowers. Consistently, we consider a low coverage ratio as a symptom of under-provisioning or delay in the recognition of losses (Beatty and Liao 2011).
Many actions have been taken in Europe in the last years in order to increase the coverage ratio of non-performing loans and so to favor the resolution of the NPL problem.

Looking at column (6) of Table 4.2, the interaction between the Tier 1 ratio variable and the dummy of the Directive is significant at the level of 0% and positive, meaning that from 2014 to 2017 the Directive had a positive impact on the banks' financial strength. On the opposite, the lagged Tier 1 ratio variable has a negative and significant estimated coefficient at a level of 5%: the role of capitalization is associated to a higher level of NPL ratio in all the other model with the exception of this particular case. The dummy is still highly and negatively significant: the increasing supervision of the ECB from 2014 led to a decreasing level of NPLs in the balance sheet of the supervised banks in the Euro area.

Moreover, the interaction in column (7) of Table 4.2 suggests that a positive and significant correlation exists between the dummy on European Directive and the lagged loan loss provision variable: from 2014 Significant Institutions (SI) hold less risky loans and therefore also less provisions. Bank loan loss provisions continue to receive much attention from bank regulators because the volume of loan in the balance sheet of the banks makes banks vulnerable to loan default arising from deteriorating economic conditions which affects borrowers' ability to repay (Leaven and Majnoni, 2013). Also due to the fact that loan loss provisions are usually procyclical and could worsen an existing recession if not anticipated, as evident from 2008 global financial crisis, leading to an increase of loan loss provisions and so eroding bank profit (Ozili and Outa, 2017).
This is also confirmed by the positive and significance of the loan loss provision variable: it increases with the riskiness of the loans a given bank makes, so a small number of risky loans implies a low value of loss provision.
The negative and significant relationship of the BRRD with the NPL ratio is confirmed together with the positive significance of the annual growth of gross loans at 0% and 5%, respectively.

The relationship between the time to resolve insolvency and the annual growth of the NPL ratio is positive in all the estimations: an increase in the years for the resolution of distressed assets leads to an increase of NPL ratios in the balance sheet of these European banks, meaning that in countries with low juridical efficiency the NPL ratio is high.

Analyzing the ROAE variable, the lagged value of the variable is positive and not significant in all estimations: even if it is expected to be negative, it is not easy to predict the relationship between this variable and the NPL ratio. In this case, an increase of investments made which could turn out to be non-performing, then a positive relationship with the annual growth of NPL can be detected.

Inflation rate, instead, shows a negative but not significant relationship with the dependent variable, even if it should be expected to positively affect the NPL ratio. Inflation rate is treated as a relevant macro-economic determinant of NPLs because it is an indicator of economic instability. The rise in inflation decreases the purchasing power of money and the real value of an income, which weakens the debt servicing and hence increases the NPL level. Actually, during the time-span I consider, the inflation rate of the European countries does not suffer high changes, so I might suppose that it is not a relevant macro-economic variable in

this study: higher inflation made debt servicing easier by reducing the real value of the unpaid loan that caused low NPL level.

4.1 Diagnostic tests

Multicollinearity test

Running the multivariate multicollinearity test, called Variance Inflation Factor (VIF), it can accept the introduction of these control variables together only if the thresholds VIF values are respected[57]. The variance inflation for a variable is computed as:

$$VIF = \frac{1}{1 - R^2}$$

VIFs are calculated by taking a predictor and regressing it against the other predictors in the model. The result is the R-squared values to be plugged in the VIF formula.
The VIF estimates how much the variance of a regression coefficient is inflated due to multicollinearity in the model. So the result of the tests I conducted show the absence of a multivariate multicollinearity problem: all VIF values are identified less than 4, the threshold cited by Fox (1991), as reported in the Appendix. The numerical value for VIF, in decimal form, reports what percentage the variance is inflated for each coefficient.

Hausman test

To get the most appropriate model, the Hausman Test is used to choose between the random effect and the fixed effect model. The p-value results equal to 0.3171, suggesting that the random effect estimator is preferred, so this is the reason why I dropped to report the estimated coefficients of FE in the previous tables[58].

Breush-Pagan test

Heteroskedasticity is a major concern in linear regression models, because it is the violation of the assumption that the model residuals have a constant variance and are uncorrelated, as explained in the previous chapter.
Running the Breusch-Pagan test for heteroskedasticity, the p-value is less than 2.2e-16, detecting heteroskedasticity (see Appendix for details). Therefore there are two possible ways

[57] Multicollinearity is when there is a correlation between predictors, that are the independent variables, in a model. Its presence can adversely affect the regression results.
[58] See Appendix for numerical details.

to correct heteroskedasticity. The first one is using the robust covariance matrix to account for it in the previous models, a technique to obtain unbiased standard errors of OLS coefficients. The second solution is the introduction of the Feasible Generalized Least Squares (FGLS) estimator, but it is anachronistic today and it is not appropriate when Fixed Effect is not consistent, as in this case.

4.2 Heteroskedasticity correction: robust standard error

I used the first alternative using the robust standard errors and computing again the main models, with macro-economic variables and interactions between explanatory variables: the results will not be too far from the previous ones. The following Table 4.3 shows the estimated coefficients and the p-values in parenthesis of the different estimations.

Table 4.3: Corrected OLS and Pooled OLS estimator.

	(1)		(2)		(3)	
ΔGross Loans	0.04803065		0.04313252		0.04803065	.
	(0.1122461)		(0.171305)		(0.068257)	
Tier 1 ratio (t-1)	0.00430305		0.04412013		0.00430305	
	(0.9626681)		(0.631638)		(0.959641)	
time res insol (t-1)	0.28458095		0.16566499		0.28458095	
	(0.4560148)		(0.683837)		(0.383495)	
cost res insol (t-1)	-0.01483477		-0.02589091		-0.01483477	
	(0.7345979)		(0.577076)		(0.535798)	
ROAE (t-1)	0.00098307		0.00063797		0.00098307	
	(0.4223875)		(0.512148)		(0.435688)	
Δ loan loss prov	-0.00052996		-0.0005316		-0.00052996	
	(0.7322217)		(0.736496)		(0.732982)	
coverage ratio (t-1)	0.00128805		0.00570155		0.00128805	
	(0.8575303)		(0.407722)		(0.84596)	
BRRD (2014)	-2.33804112	***	-1.88562656	**	-2.33804112	**
	(0.0004097)		(0.006613)		(0.003133)	
% GDP growth (t-1)			-0.36351034	*		
			(0.016005)			
inflation rate			-0.08904277			
			(0.781116)			
constant	0.99414023		0.56107386		0.99414023	
	(0.5569365)		(0.738359)		(0.516525)	
Observations	282		282		282	

*Notes: ***, **, *, · denote significance at 0%, 0.1%, 1% and 5% levels, respectively.*

In the column (1) of table 4.3, the OLS model with corrected-heteroskedasticity standard errors leads to a high significance of the European Directive with a negative sign as in the

previous estimation. In this case, I used the heteroskedasticity and autocorrelation consistent (HAC) standard errors, or simply Newey-West standard errors[59].

Even adding the two macro-variables (column 2), the significance of the variables is similar to the previous estimation: the BRRD is again significant and the lagged value of the growth of real GDP too, at 0.1% and 1% respectively.

Moreover, in the Pooled OLS estimator (column 3), the only two significant variables are the same as in the first models with heteroskedasticity: annual growth of gross loans with a 5% level of significance and the BRRD dummy at 0.1% level.

Table 4.4: Random effect estimator and interactions.

	(4)		(5)		(6)		(7)	
ΔGross Loans	0.04803065	.	0.04313252	.	0.04670876	.	0.04230311	.
	(0.068257)		(0.087214)		(0.05533)		(0.080753)	
Tier 1 ratio (t-1)	0.00430305		0.04412013		-0.2172548		0.01394834	
	(0.959641)		(0.596325)		(0.12217)		(0.774716)	
time res insol (t-1)	0.28458095		0.16566499		0.23421725		0.15398781	
	(0.383495)		(0.558602)		(0.42471)		(0.574152)	
cost res insol (t-1)	-0.01483477		-0.02589091		-0.0075877		-0.02521979	
	(0.535798)		(0.23363)		(0.73239)		(0.237578)	
ROAE (t-1)	0.00098307		0.00063797		0.00099372		0.00065014	
	(0.435688)		(0.514771)		(0.41173)		(0.508375)	
Δ loan loss prov	-0.00052996		-0.0005316		-0.0010055		-0.00189526	
	(0.732982)		(0.734552)		(0.54153)		(0.707195)	
coverage ratio (t-1)	0.00128805		0.00570155		0.00099035		0.00578012	
	(0.84596)		(0.283691)		(0.89266)		(0.252825)	
BRRD (2014)	-2.33804112	**	-1.88562656	**	-6.3611198	*	-1.88412163	**
	(0.003133)		(0.002108)		(0.01187)		(0.002404)	
% GDP growth (t-1)			-0.36351034	**			-0.35003182	
			(0.005545)				(0.009854)	
inflation rate			-0.08904277				-0.05538815	**
			(0.747844)				(0.832124)	
constant	0.99414023		0.56107386		3.54563723		0.95634623	
	(0.516525)		(0.640186)		(0.11728)		(0.305465)	
Tier 1 ratio*BRRD					0.32685181	*		
					(0.04377)			
Loss prov*BRRD							0.00200046	
							(0.692841)	
Observations	282		282		282			

*Notes: ***, **, *, · denote significance at 0%, 0.1%, 1% and 5% levels, respectively.*

[59] Newey and West (1987) have proposed a more general covariance estimator that is robust to heteroskedasticity and autocorrelation of the residuals of unknown form.

Again, as Table 4.4 shows, the results are almost in line with the previous analysis: in all these models the value of the lagged real GDP has a negative impact on the annual growth of the NPL ratio when we control for the macro-economic variables.

Again, the annual growth of gross loans has a positive and a 10% level of significance in all the specifications except for the OLS model, that is the positive impact between the annual growth of NPL ratio and the annual growth of gross loans of these banks. The macro-economic factors have a negative impact on non-performing loans, and this is in line with the literature shown in chapter 1.

In column (7) when I introduce an interaction between the BRRD dummy and the loan loss provisions, this variable is no longer significant, while the BRRD dummy is still at 0.1% level of significance and the annual growth of gross loans has a 10% level of significance as already shown. To notice that the inflation rate variable is significant for the first time with a significance level of 0.1% and with a negative sign: inflation rate has -0.055 points negative relationship with NPL considering other factors constant.
The lagged value of the return on average equity variable is not statistically significant in all models, having a positive relation with the dependent variable and meaning that an increase of ROAE leads to an increase in the stock of non-performing loans of the banks.
Finally, the coverage ratio has the same positive sign without any significance in these models.

In conclusion, it looks like the only relevant bank-specific variables are the annual growth of gross loans in the balance sheet of the European significant institutions, while the only macro-economic driver is the lagged growth of real GDP. This implies that the economic environment has some effect on the quality of the balance sheet of the supervised entities in the euro area.

4.3 Clustered standard errors

The importance of using cluster-robust variance estimators (i.e., “clustered standard errors”) in panel models is now widely recognized. Clustered standard errors account for situations where observations within each group are not i.i.d. (independently and identically distributed), and they might be thought as a generalization of White's heteroscedasticity-robust standard errors. While White standard errors allow elements on the diagonal of the covariance matrix

to be different, clustered standard errors allow the covariance matrix to be block-diagonal. Thus, clustered standard errors allow for heteroscedasticity and correlation in the error term within a cluster. What matters is that both White and clustered standard errors are asymptotic results.

Trying to cluster over time and over group (in my case, over banks) in both the Pooled OLS and the RE estimator, I end up with the results that are not too far from the previous ones, confirming the sign and the significance of the growth of gross loans and the European directive, as we can see in the following tables (Table 4.5 and 4.6).

Table 4.5: Clustered standard errors of Pooled OLS over time and over group.

```
> coeftest(pool2, vcov=vcovHC(pool2, type="sss", cluster="time"))

t test of coefficients:

                        Estimate  Std. Error t value  Pr(>|t|)
(Intercept)           0.99414023  1.33942643  0.7422    0.4586
pdata$deltagrossloan  0.04803065  0.03018171  1.5914    0.1127
pdata$`Tier 1 ratio`  0.00430305  0.07618371  0.0565    0.9550
pdata$`time res insol` 0.28458095  0.54426306  0.5229    0.6015
pdata$`cost res insol` -0.01483477  0.07613381 -0.1949    0.8457
pdata$ROAE            0.00098307  0.00090588  1.0852    0.2788
pdata$deltaprov      -0.00052996  0.00076670 -0.6912    0.4900
pdata$`coverage ratio` 0.00128805  0.00921947  0.1397    0.8890
pdata$BRRD           -2.33804112  0.58205143 -4.0169 7.629e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> coeftest(pool2, vcov=vcovHC(pool2, type="sss", cluster="group"))

t test of coefficients:

                        Estimate  Std. Error t value Pr(>|t|)
(Intercept)           0.99414023  1.56953975  0.6334 0.527005
pdata$deltagrossloan  0.04803065  0.02690779  1.7850 0.075370 .
pdata$`Tier 1 ratio`  0.00430305  0.08712323  0.0494 0.960644
pdata$`time res insol` 0.28458095  0.33434353  0.8512 0.395425
pdata$`cost res insol` -0.01483477  0.02453891 -0.6045 0.545986
pdata$ROAE            0.00098307  0.00129144  0.7612 0.447181
pdata$deltaprov      -0.00052996  0.00159141 -0.3330 0.739380
pdata$`coverage ratio` 0.00128805  0.00679275  0.1896 0.849746
pdata$BRRD           -2.33804112  0.80433551 -2.9068 0.003951 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

*Notes: ***, **, *, · denote significance at 0%, 0.1%, 1% and 5% levels, respectively.*

Table 4.5 reports the estimated coefficients and the corresponding p-values of the pooled OLS model estimated with clustered standard errors over time (in the first part of the table) and over banks (the second part of the table). Both estimations do not take into account the two macroeconomic variables (the real GDP and inflation rate). Again, the significance of the European directive is confirmed: from 2014, the annual growth of non-performing loans has decreased.

Table 4.6: Clustered standard errors of RE estimator over time and over group.

```
> coeftest(random2,vcov=vcovHC(random2, type="sss", cluster="group"))

t test of coefficients:

                          Estimate  Std. Error t value Pr(>|t|)
(Intercept)             0.99414023  1.56953975  0.6334 0.527005
pdata$deltagrossloan    0.04803065  0.02690779  1.7850 0.075370 .
pdata$`Tier 1 ratio`    0.00430305  0.08712323  0.0494 0.960644
pdata$ROAE              0.00098307  0.00129144  0.7612 0.447181
pdata$deltaprov        -0.00052996  0.00159141 -0.3330 0.739380
pdata$`coverage ratio`  0.00128805  0.00679275  0.1896 0.849746
pdata$BRRD             -2.33804112  0.80433551 -2.9068 0.003951 **
pdata$`time res insol`  0.28458095  0.33434353  0.8512 0.395425
pdata$`cost res insol` -0.01483477  0.02453891 -0.6045 0.545986
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> coeftest(random2,vcov=vcovHC(random2, type="sss", cluster="time"))

t test of coefficients:

                          Estimate  Std. Error t value  Pr(>|t|)
(Intercept)             0.99414023  1.33942643  0.7422    0.4586
pdata$deltagrossloan    0.04803065  0.03018171  1.5914    0.1127
pdata$`Tier 1 ratio`    0.00430305  0.07618371  0.0565    0.9550
pdata$ROAE              0.00098307  0.00090588  1.0852    0.2788
pdata$deltaprov        -0.00052996  0.00076670 -0.6912    0.4900
pdata$`coverage ratio`  0.00128805  0.00921947  0.1397    0.8890
pdata$BRRD             -2.33804112  0.58205143 -4.0169 7.629e-05 ***
pdata$`time res insol`  0.28458095  0.54426306  0.5229    0.6015
pdata$`cost res insol` -0.01483477  0.07613381 -0.1949    0.8457
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

*Notes: ***, **, *, · denote significance at 0%, 0.1%, 1% and 5% levels, respectively.*

In table 4.6 the random effect estimator with clustered standard errors is presented. In the upper part of the table, estimated coefficients and corresponding p-values are clustered over banks, while on the lower part they are clustered over time. Both estimations lead to similar results, confirming the effect of the introduction of the BRRD on the annual growht on NPL ratio.

The time to resolve insolvency, the return on average equity, coverage ratio and the Tier 1 ratio have a positive relationship with the annual growth of the NPL ratio in both Pooled OLS and RE estimators. On the contrary, loan loss provision, cost to resolve insolvency and BRRD have a negative correlation with non-performing loans. In this specification, I did not take into consideration the annual growth of real GDP and inflation rate.
To conclude, also this method confirms the evidences I found in the previous econometric approach.

Overall, the annual growth of real GDP affects the stock of non-performing loans in all the specifications, following the literature, meaning that in my model and dataset, this macro-economic variable is relevant. Regarding the bank-specific variables, it seems that only the

annual growth of gross loans has a positive relationship with the annual growth of non-performing loans of the banks I took into consideration.

CONCLUSIONS

The problem of non-performing loans is very complex. One of the fastest resolution methods available to banks is the direct sale or securitization of these activities on the market. Exploring the determinants of the credit risk, taking the form of non-performing loans, is an issue of substantial importance for regolatory authorities. This NPL issue affects financial stability and also bank management.

The European NPL problem has reached dramatic proportions as Bruno, Lusignani and Onado (2017) stress and it is delaying economic recovery. A Euroepan solution or, rather, a combination of resolution tools and strategies has to be carried out in order to face this challenge.

Regulatory initiatives at the international and EU levels are essential in establishing a sound and robust framework for financial institutions, markets and infrastructures. Moreover, strenghtening the regulatory framework for non-bank financial intermediation is crucial in order to limit regulatory arbitrage and improve the resilience of the entire financial system (Financial Stability Review, 2019).

This study addresses a key policy relevant question, that is if the introduction of the BRRD had an effect on the stock of non-performing of the supervised entities by the ECB. The sample is composed of banks (currently labeled as “significant” under the SSM) in countries in the Euro area between 2011 and 2017.

From my econometric analysis, I conclude that there is no room for doubt about the reaction of the most relevant banks to the introduction of accurate supervision from the European authorities. From 2014 the annual growth of non-performing loan ratio has slowly decraeased, leading in 2019 the ECB to revise the expectations for prudential provisionings and relaxing the time for NPL flow. The study I carried out suggests that the statistically significant macroeconomic variable is the annual growth of real GDP, as widely analysed by the literature. To notice that in this timespan the inflation does not suffer unexpected fluctuations.
From an econometric point of view, I had to correct for heteroskedasticity with the introduction of robust standard errors. Moreover, with the use of the clustered standard errors of the random effect and pooled OLS models over banks and time, I tried to examine in depth

the relation between the dependent variable and the independent ones. The results confirm the previous evidence and highlight the statistically significance of the European directive.
Finally, the analysis suggests that with the introduction of the new instruments in the directive, the supervised banks are reducing the stok of bad loans, improving the quality of the balance sheet.

Regarding the August 2019 news, the European Central Bank did a press release stating that supervisory expectations for prudential provisioning for new NPLs have been revised, but the supervisory expectations for coverage of stock of NPLs did not change. This situation is due to the fact that at the start of the ECB Banking Supervision in November 2014, the volume of NPLs held by the Significant Institutions stood around 1 euro trillion, but by the end of March 2019, the volume has fallen almost by the half (NPL ratio at 3.7%).
It is reasonable for regulatory authorites and supervisors to closely monitor the evolution of non-performing loans, but with industry profitability at historic lows and the emergence of new digital competitors in the market, it is essential that regulation and supervision strike a balance in such a way that regulation preserves fianacial stability without causing an adverse effect on the sector’s ability to make a profit.

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APPENDIX

A) Hausman test:

```
        Hausman Test

data:  pdata$deltanpl ~ pdata$deltagrossloan + pdata$`Tier 1 ratio` +  ...
chisq = 9.3066, df = 8, p-value = 0.3171
alternative hypothesis: one model is inconsistent
```

The Hausman test suggests that there is strong evidence in favour of the random effect estimation. This means that there is no correlation between the unique errors and the regressors.

B) Time dummy fixed effect model results:

```
Residuals:
    Min      1Q  Median      3Q     Max
-41.366  -0.876   0.168   1.334  16.273

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)               1.5612089  1.9880516   0.785  0.43298
pdata$deltaloan          -0.0079023  0.0338920  -0.233  0.81581
pdata$deltagrossloan      0.0503127  0.0316803   1.588  0.11344
pdata$`Tier 1 ratio`      0.0373461  0.0656967   0.568  0.57020
pdata$`time res insol`    0.0215218  0.4373768   0.049  0.96079
pdata$`cost res insol`   -0.0281369  0.0532125  -0.529  0.59741
pdata$ROAE                0.0005219  0.0008835   0.591  0.55526
pdata$deltaprov          -0.0005270  0.0006474  -0.814  0.41640
pdata$`coverage ratio`    0.0058098  0.0097843   0.594  0.55316
pdata$`GDP growth (t-1)` -0.4310530  0.1544566  -2.791  0.00564 **
pdata$`infl rate`        -0.3730022  0.5164455  -0.722  0.47078
factor(pdata$YEAR)2013   -0.3526858  1.0896065  -0.324  0.74643
factor(pdata$YEAR)2014   -3.8051647  1.4152864  -2.689  0.00763 **
factor(pdata$YEAR)2015   -1.7207271  1.6275152  -1.057  0.29135
factor(pdata$YEAR)2016   -2.5155398  1.5480191  -1.625  0.10535
factor(pdata$YEAR)2017   -1.0816298  1.1252417  -0.961  0.33730
```

C) Random model with interaction results:

```
Balanced Panel: n = 47, T = 6, N = 282

Effects:
                 var std.dev share
idiosyncratic 21.960   4.686     1
individual     0.000   0.000     0
theta: 0

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-38.82021  -1.01075   0.14348   1.02804  17.10131

Coefficients:
                             Estimate  Std. Error z-value  Pr(>|z|)
(Intercept)                1.54266363  1.30981314  1.1778 0.2388868
pdata$deltagrossloan       0.04652225  0.01933416  2.4062 0.0161185 *
pdata$`time res insol`     0.25263287  0.41902839  0.6029 0.5465742
pdata$`cost res insol`    -0.01437918  0.05374920 -0.2675 0.7890660
pdata$`Tier 1 ratio`      -0.03087760  0.06602345 -0.4677 0.6400161
pdata$ROAE                 0.00098285  0.00087311  1.1257 0.2602993
pdata$deltaprov           -0.00222205  0.00113470 -1.9583 0.0501983 .
pdata$`coverage ratio`     0.00167147  0.00983322  0.1700 0.8650242
pdata$BRRD                -2.36464024  0.61868243 -3.8221 0.0001323 ***
pdata$deltaprov:pdata$BRRD 0.00248531  0.00138472  1.7948 0.0726837 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    6083
Residual Sum of Squares: 5572.1
R-Squared:      0.084
Adj. R-Squared: 0.053691
Chisq: 24.9431 on 9 DF, p-value: 0.0030347
```

D) Weighted least squares

Weighted Least Squares (WLS) attempts to provide a more efficient alternative to OLS. It is a special version of the feasible generalized least squares (FGLS) estimator. Instead of the sum of squared residuals, their weighted sum is minimized. If the weights are inversely proportional to the variance, the estimator is efficient. Also, the usual formula for the variance-covariance matrix of the parameter estimates and standard inference tools are valid. We can obtain WLS parameter estimates by multiplying each variable in the model with the square root of the weight, in R there is a more concise syntax and it takes care of correct residuals, fitted values, predictions, and the like in terms of the original variables.

Typically, we don't know the variance function and have to estimate it. This feasible GLS (FGLS) estimator replaces the (allegedly) known variance function with an estimated one.

The results are reported in the following Table.

```
Weighted Residuals:
     Min       1Q   Median       3Q      Max
-18.2571  -0.5133  -0.0243   0.3797   9.5698

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)             -1.3962371  1.1180269  -1.249   0.2128
pdata$deltagrossloan    -0.0464592  0.0094972  -4.892 1.71e-06 ***
pdata$`Tier 1 ratio`     0.0218441  0.0453893   0.481   0.6307
pdata$`time res insol`   0.8225123  0.5304416   1.551   0.1222
pdata$`cost res insol`   0.0391689  0.0281903   1.389   0.1658
pdata$ROAE               0.0015224  0.0007812   1.949   0.0523 .
pdata$deltaprov         -0.0091750  0.0013624  -6.735 9.69e-11 ***
pdata$`coverage ratio` -0.0008970  0.0039038  -0.230   0.8184
pdata$BRRD              -0.9124439  0.5464768  -1.670   0.0961 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.487 on 273 degrees of freedom
Multiple R-squared:  0.304,     Adjusted R-squared:  0.2836
F-statistic: 14.91 on 8 and 273 DF,  p-value: < 2.2e-16
```

E) VIF results:

```
pdata$deltagrossloan   pdata$`Tier 1 ratio` pdata$`time res insol` pdata$`cost res insol`             pdata$ROAE
               FALSE                   FALSE                  FALSE                  FALSE                  FALSE
     pdata$deltaprov pdata$`coverage ratio`             pdata$BRRD
               FALSE                   FALSE                  FALSE
vif(ols) #this says no multicollinearity
pdata$deltagrossloan   pdata$`Tier 1 ratio` pdata$`time res insol` pdata$`cost res insol`             pdata$ROAE
            1.042421                1.307772               1.118369               1.140107               1.002729
     pdata$deltaprov pdata$`coverage ratio`             pdata$BRRD
            1.180205                1.030401               1.170245
```

F) Breusch-Pagan test for heteroskedasticity:

```
BP = 1374.3, df = 54, p-value < 2.2e-16
```