UNIVERSITA' DEGLI STUDI DI PADOVA

**DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI
"M. FANNO"**

**CORSO DI LAUREA MAGISTRALE IN
ECONOMICS AND FINANCE**

TESI DI LAUREA

OPTIMAL BANK RECOVERY: THE ITALIAN CASE

RELATORE:

CH.MA PROF.SSA BALDAN CINZIA

LAUREANDO: DAMIAN FILIPPO

MATRICOLA N. 1103562

ANNO ACCADEMICO 2015 – 2016

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Tables of Contents

Introduction

The Euro Area summit of June 2012 marked the turning point in the approach to tackle the crisis. For the first time, European leaders recognised that the economic distress was not confined only to the fiscal difficulties of certain countries. Instead, they realised that it was imperative to break the link between Member States' public finances and the health of their banks. In fact, national backstops, that were used to recapitalise banks, produced a sharp increase of countries' debts and started a vicious circle between overindebted sovereigns and undercapitalised banks. Therefore, the European leaders committed themselves to the launch of the Banking Union, which is the most important policy initiative since the start of monetary union in 1999, necessary to enhance the euro-area integration. This new regulatory framework involves the transfer of responsibilities for the banking policy, from the national to the European level. In a longer-term perspective, the Banking Union was also established to develop a substantially more effective single market. A centralized supervision and resolution can indeed give the necessary policy push to encourage the return to financial integration. Even, the so-called "outs" should take into consideration the option to join the Banking Union, given the fact they exhibit a high degree of cross-border banking activity.

The significant milestones in the process of building a more robust and resilient banking system in Europe started with the creation of the Single Supervisory Mechanism (SSM), led by the European Central Bank (ECB), and the launch of the Single Resolution Mechanism (SRM), led by the Single Resolution Board (SRB), which is also responsable for the Single Resolution Fund (SRF). In addition, in November 2015, the Commission adopted a proposal for a European Deposit Insurance Scheme (EDIS), which is still a missing piece of the Banking Union. The fundament of these three pillars consists in the so-called European Single Rulebook, that is a set of harmonised laws to ensure a more resilient, transparent and efficient banking sector. A particularly important role is played by the Bank Recovery and Resolution Directive (BRRD), adopted by the European Union in May 2014. On the one hand, it provides a collection of resolution tools, among which the bail-in is the most important one. This was a reaction to the global reform effort to mitigate moral hazard in banking systems, known as the "Too-Big-To-Fail" problem. In fact, bail-in rules, together with the Single Resolution Fund, ensure the minimisation of taxpayer funding. On the other hand, the BRRD has also improved the regulatory attention to the period preceding the resolution. In particular, the rules on early intervention offer the possibility to a bank to be restored to normal conditions before it is forced to be solved. In this way, the early management of a likely failing bank would be extremely important to help the financial system to additionally mitigate the systemic risk.

However, although there is a significant discussion on the triggers for resolution, it might not always be clear when the early intervention should be triggered. In fact, the legislation specifies only in a general manner the conditions to start the recovery phase and appointed the European Banking Authority to issue some guidelines to facilitate their consistent application. In contrast with these guidelines, some studies have elaborated models that try to address the lack of appropriate quantitative indicators to trigger the early intervention. The quantitative approach can have several advantages, such as the possibility, for competent authorities, to reduce the number of mistakes made during the decision to start the recovery, to sanction the institution or not intervene at all.

One of the most recent and significant attempt is provided by Goodhart and Segoviano (2015), a metric which has several qualities. However, it includes also one main limitation, that is the fact that their model, as regards the insolvent banks, employs data of US investment banks, which are found to be decisive in the final results. On the contrary, I tried to develop a model for the Italian banking system, which takes into account the Italian banks that are listed in the Milan stock exchange, excluding the institutions that conduct mainly investment banking activity. In this way, the model allowed me to evaluate and compare both the past and the current conditions of Italian banks, with respect to their probability of default and their ability to absorb the potential extreme losses that may occur. Ideally, such information could also be used by competent authorities to better balance the quantitative intervention threshold. Nevertheless, the results on insolvent banks are not as much reliable as those for the solvent banks, given the lack of data on the former, which is a common problem to all European studies.

This present work is therefore organised as follow. In Chapter 1 I describe the policy responses and the regulatory evolution of the European banking framework, as a results of three different but interrelated periods of financial distress caused by the Global financial crisis. Therefore, I present the pillars and the foundation of the Baking Union project, together with its long term rationale. Then, in Chapter 2, I show how, in this new system, the competences are distributed among authorities, putting particular attention to the three phases defined by the Bank Recovery and Resolution Directive, that are the preparation, the early intervention and the crisis management. By focusing on the second one, I highlight, in Chapter 3, the potential advantages for the competent authorities of having at their disposal a scientific metric based on quantitative thresholds, which can help in the early intervention decision. As a consequence, I specify a model for the Italian banking system, on the basis of the Goodhart and Segoviano (2015)'s paper. After reviewing the relevant literature and presenting how the data were obtained or estimated, I discuss the results, prior to drawing conclusions.

1. The creation of the Banking Union

### 1.1. The consequences of the global financial crisis for the European financial sector

The global financial crisis, which originated in the US financial system, quickly and directly spread in Europe after the collapse of Lehman Brothers in late 2008. The well-known cause for this contagion was the huge exposure to toxic assets of the European financial institutions. In fact, 40% of the investments in securities backed by subprime mortgages, that produced an unsustainable credit risk, were held by European banks. Hence, many of them had to face serious liquidity and solvency problems, after recognising heavy losses on their balance sheets. Initially with this huge systemic banking crisis, governments and international organisations implemented expansionary fiscal measures and offered massive support facilities respectively, to counteract the economic downturn and provide relief to the banking sector. Some argue that the Great Recession and the following European debt crisis functioned as tests to understand how properly the features of European Union have worked (Schmidt, et al., 2011). For example, they allowed to assess the convenience or riskiness of the Union's diversity and complexity. With more uniformity, the 2008 recession may have spread among the financial systems of different countries even quicker. At the same time, however, having *"27 different regulatory systems for banks in place, largely based on national rules and rescue measures"* (European Commission, 2014) did not facilitate, for example, the resolution of some failed banks. These circumstances would have required a much closer and more effective coordination, especially for international banking groups. Moreover, the crisis clearly showed that a deeper integration of the supervisory structures was needed. Yet, a number of difficulties arose due to the divergent views among national authorities, which often softened the prudential requirements for their domestic banks, to avoid putting them under pressure.

In order to present the policy responses and understand how the European leadership reached the actual banking legislation, a brief description of how the crisis evolved during the last decade seems useful. In Hadjiemmanuil's (2015, p. 4) view, the 2007-08 recession triggered in Europe: "*not a single shock, but a set of consecutive and interrelated crises*". The author highlighted three overlapping periods of economic and financial distress, which are characterized by different symptoms, interpretations and reactions. At the beginning, the recession had global proportions affecting the European Member States altogether. The support given to ailed banks, to avoid the collapse of the financial system, produced complicated long-term consequences as well. One of them was the growing belief that a number of large financial institutions would always have been rescued by their government, being "too big to fail". Big

banks deliberately take high risk-return positions, knowing that they will supported whenever they face potential failure. In fact, problems in one of these banks may transmit to other financial institutions and, given their wide interconnections, they could destabilize the entire financial system.

As a result, national budgets worsened and the serious fiscal imbalances affected the ability of many countries to maintain the access to their sovereign debt markets. Indeed, from late 2009 to early 2012, the public finances of many Member States were put under pressure by the international capital markets. The increasing spread between interest rates charged on long term government bonds characterized the second phase of economic distress (Figure 1). Investors recognised that the countries in the "periphery" region had poorer economic conditions than the majority of central European partners. Again, financial assistance programmes were activated, since the unsustainability of their refinancing plans were questioning the survival of the single currency. However, such support measures were associated with the commitment of each distressed Member State to implement extensive structural reforms and follow cost-cutting programmes. European policy-makers introduced also longer-term policies consolidating the rules of the Stability Growth Pact. Lenders of last resort continued to demand austerity measures in order to reduce governments' budget deficits and to demonstrate their fiscal discipline to creditors and rating agencies. In opposition to the "mostly fiscal" narrative as the main cause of the European troubles, Véron (2015, p. 7) claimed that the crisis was financial before it was fiscal. In his opinion, focusing exclusively on fiscal topics "*tends to obscure less-visible dimensions of the crisis that relate to deeper layers of solidarity and trust, or the lack of them*".

*Figure 1: Daily goverment bond spreads in basis points*
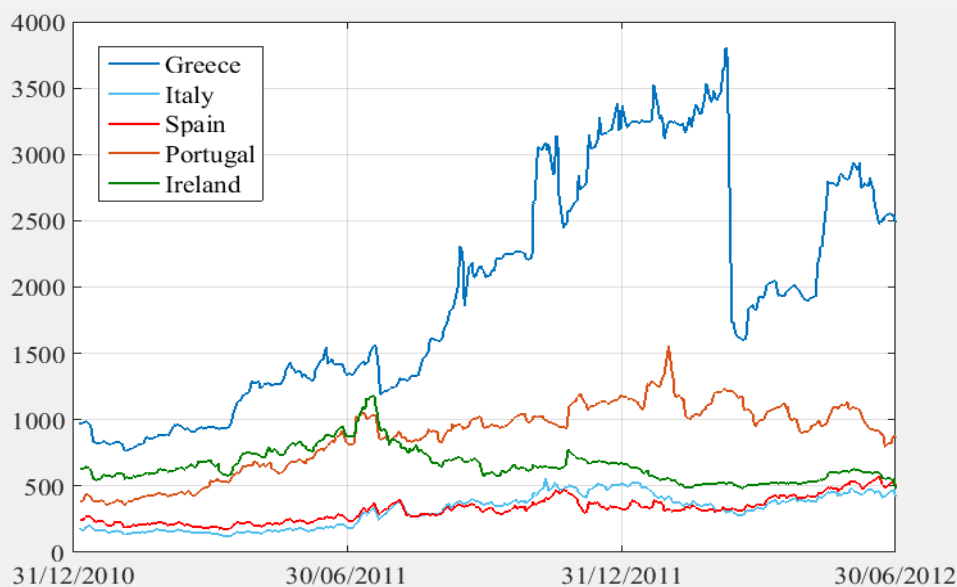
Source of data: Investing.com

In June 2010, the creation of the European Financial Stabilization Fund (EFSF) regularized a temporary bailout mechanism that provided a moderate relief after the rescues of Greece, Ireland, and Portugal. However, the political discordance of having a permanent bailout system initiated a shift in risk perceptions and intensified the uncertainty of the markets. Moreover, at the beginning of 2012, the European Union experienced increasing concerns about its collapse, because of the possible exit of one or more of its Member States. The interbank market deteriorated, making the access to liquidity drastically more expensive and difficult for banks. With a paralysed mechanism of the credit provision, banks' balance sheets worsened, causing again liquidity and solvency problems. In particular, Spain, by launching another large-scale recapitalization of banks, brought the attention to the danger of the so-called "vicious circle" between sovereign debt and weak banks. This diabolic loop, that marked a third phase of the crisis, works in two ways. On the one hand, the deterioration of a government's credit rating automatically undermines the solvency of the country's banks, as they hold large amounts of their own governments bonds. On the other hand, a weakening of a country's banking system deteriorates the government's budget because of the potential bailout cost and the lower tax revenues, resulting from the subsequent economic downturn (Figure 2).

The troubles of Spain, which is one of the largest economy in Europe, triggered major worries about the sustainability of the currency union, owing to the great chances to affect Italy and reasonably even France. The impending danger of contagion brought the European leadership to recognize the non-fiscal sources of economic distress and review the possible cures. Hence,

Figure 2: Diabolic loop between sovereing debt risk and banking debt risk
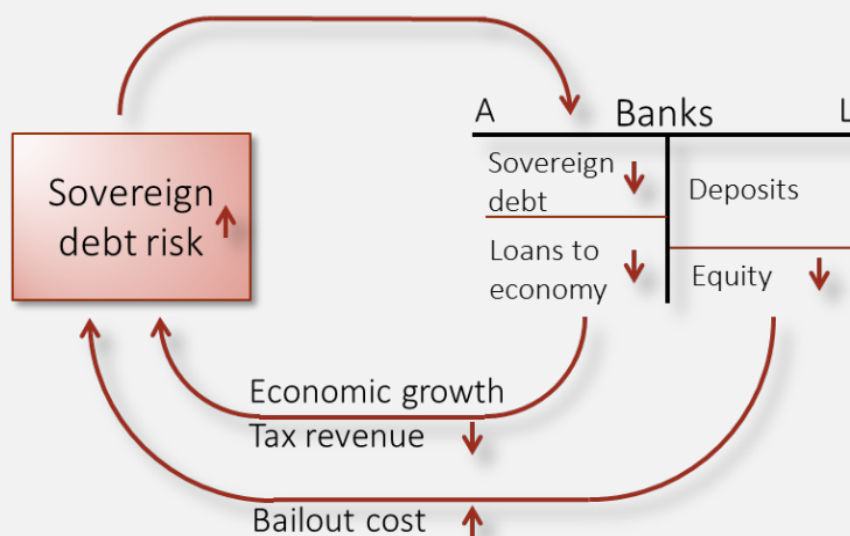
Source: (Brunnermeier, et al., 2011)

in June 2012 at the Euro Area summit, the European Council agreed to create a "Banking Union" as a direct remedy to the crisis. However, that meeting was only one of the last steps of a complex evolution process, devoted to the renewal of the European banking regulatory framework.

1.2. The evolution of the European banking regulatory framework.

The Euro Area summit held on 28th and 29th June 2012 marked the turning point in the approach to the crisis. For the first time, European leaders recognised that the economic distress was not confined only to the fiscal difficulties of certain countries, but was the consequence of a more challenging issue. In order to effectively break the vicious circle linking Member States' public finances and the health of their banks, they proposed a regulatory framework pooling the banking policy at the European level. However, this was not an innovative concept. As shown by Mourlon-Druol (2016), this idea dates back to the early 1960s, when European policy-makers clearly planned a monetary integration, a financial integration and the banking regulation and supervision altogether. Even if it was premature and it largely failed, this initial project explains that the intentions to create common mechanisms for the banking sector were not crisis-driven. At that time in fact, sovereign-bank loop was not an issue, due to far lower levels of government deficit and debt.

The scenario drastically changed during the 2000s when, the transfer of responsibility for banking policy became necessary. The introduction of the single currency contributed to the growth of cross-border capital movements and the integration of banks. In a speech at the London School of Economics, Tommaso Padoa Schioppa (1999) anticipated that the monetary union would have needed a "multilateral mode" giving the banking industry a proper supranational supervisor, as efficient as the national authorities. As a result, since 2000, many initiatives about European cooperation have been proposed at different levels. Boccuzzi (2016, pp. 23-30) identified three restructuring phases. The reforms began with the "Lamfalussy Process", which was designed to significantly simplify and rationalize the drawing up of financial rules. Established in 2001, this process initially supported the harmonisation of the financial markets laws to promote integration, but it was later extended to banking and insurance sectors. Lamfalussy conceived four levels, each of them focuses on a precise stage of the law implementation. At the third level, national authorities work on coordinating new regulations with other Member States. In 2004, three Committees were created at this level, in order to promote supervisory convergence and cooperation. In particular, the Committee of

European Banking Supervisors organization was created to function as "*an independent body for reflection, debate and advice for the Commission in the field of banking regulation and supervision should be established*" (European Commission, 2004).

However, the distribution of responsibilities for the exercise of supervision firmly remained confined to national authorities. As a consequence, the existing regulation and structures for tackling banking emergencies were not able to cope with the Great Recession. For this reason, the Commission decided to undertake a review of the Lamfalussy process to reinforce the supervisory convergence, by giving a new organisational structure to the old committees. The debate for a more sophisticated regulatory regime led to the report chaired by Jacques de Larosiére (2009). Among many thing, his Group of work recommended that national supervisory authorities should be strengthened at first, in order to upgrade the quality of supervision. Then, they suggested that three innovative European authorities for closer cooperation in the regulation and supervision of cross-border financial institutions should be created. In fact, Recommendation 22 states that the EU should establish an integrated European System of Financial Supervision (ESFS). The European Banking Authority (EBA), the European Securities and Markets Authority (ESMA) and the European Insurance and Occupational Pensions Authority (EIOPA) shaped the European Supervisory Authorities (ESAs). This new architecture was approved by the European Parliament in 2010 and, at the beginning of 2011, replaced level-three Committees. Together with ESAs, that is responsible for micro-prudential supervision of the financial system, the European Council approved the

Figure 3: European System of Financial Supervision
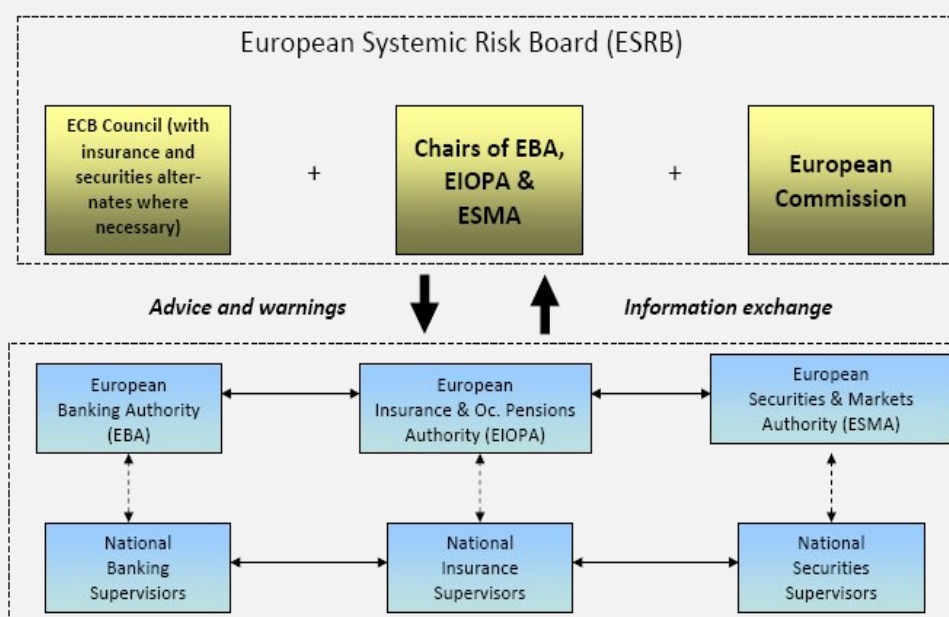
Source: European Securities and Markets Authority

formation of the European Systemic Risk Board (ESRB), charged instead with the macro-prudential supervisory tasks (Figure 3).

This new institutional structure denoted a substantial step towards the integration of the EU financial supervision. For the first time, the supervisory powers were allocated at European level, even if not in absolute terms. However, the "de Larosiére Report" was only an intermediate step, useful to set the conditions for a more complete integration. The point of arrival for a truly centralization of supervisory functions was the Single Supervisory Mechanism (SSM). Indeed, its introducing Regulation of 15th October 2013 reported that "*the crisis has shown that mere coordination is not enough, in particular in the context of a single currency*". In other words, the SSM marked the transition from the traditional principles of cooperation and coordination between national authorities to a centralization of supervisory functions at European level.

Furthermore, the "de Larosiére Report" highlight the need for regulatory revision. The policy reactions focused on the correction of the banks' governance and risk management and also on the reduction of the incentives responsible for excessive risk-taking. The European Commission proposed about thirty packages of common rules to strengthen financial markets regulation and supervision and to preserve the integrity of the internal market. They were incorporated into a "Single Rulebook", which is a set of harmonised laws that must be respected by all banks across the EU. The Rulebook ensures a more resilient, transparent and efficient banking sector. Instead of 27 different set of rules, it guarantees that all institutions apply, for example, the same capital requirements, thus making institutions more comparable. Indeed, its three key components are the prudential requirements and supervision, the management of banking crises and the insurance schemes for deposits.

First of all, in order to recognise the Basel III agreement, on July 2011 the Commission adopted a legislative package to replace the old capital requirement rules with a new directive and a regulation, respectively the Capital Requirements Regulation (CRR) and the Capital Requirements Directive (CRD IV). These new rules, which were applied from 1st January 2014, were meant to reduce the frequency of bank distresses, by providing ampler cushions to absorb losses. The insufficient level of capital, both in terms of quantity and quality, was the reason behind the provision of extraordinary assistance programs. Instead, the new structure made EU banks more solid, with higher capacity to effectively manage the risks linked to their activities. Then, on 6th June 2012, the Commission proposed a bank recovery and resolution framework to ensure that, even if a bank shows difficulties, it can be resolved without systemic repercussions on the financial system. Almost two years later, the European Parliament adopted

the Bank Recovery and Resolution Directive (BRRD) for all the 28 Member States, signalling the end of banks bailouts. The BRRD provide powers and tools to national authorities in order to restructure banks, prevent them from failing and allocate losses with a defined hierarchy. It requires also that banks have to arrange recovery plans to overcome problematic situations. Up to June 2016, almost all the Member States have fully implemented the BRRD. However, countries like Belgium, Croatia, France and Latvia have mostly done it, while Poland and Slovenia have not fulfilled the requirement yet (International Swaps and Derivatives Association, 2016). Switzerland, even if it is not obliged, introduced a regime with similar characteristics to BRRD. Moreover, outside the EU, Liechtenstein, Iceland and Norway, could be required to introduce a similar regulation in the future, if BRRD will be incorporated into the European Economic Area Agreement. Moreover, together with the CRD IV package and the BRRD, the Rulebook includes rules to strengthen deposit insurance. On 15th April 2014 the European Parliament adopted the Commission's proposal for the revision of the 1994 Deposit Guarantee Schemes Directive (DGSD). Both a higher coverage and new insurance fees are essential features for the intensification of confidence in banking systems, which prevents depositors from making panic withdrawals from their bank. Additionally, by charging the banks with the full cost of deposit protection, the excessive risk-taking would be discouraged. In conclusion, the Rulebook is also completed by the guidelines and recommendations of the European Banking Authority. In fact, one of the EBA's most important functions is to support the development of the Single Rulebook. EBA can formulate Binding Technical Standards in order to specify certain aspects useful for the implementation of legislative texts. These standards become legally binding and directly applicable in all Member States as soon as the Commission adopts them.

1.3. The birth of the Banking Union

The SSM represented the birth of the first pillar of the so-called "Banking Union", an expression that started to be used during the public debate at the end of 2011. It was Véron (2011) who used the term "Banking Union" in parallel to the earlier promoted idea of Fiscal Union. He pointed out that a European framework of banking policy, that would not take into account banking and political structures at the local level, is essential for the survival of the monetary union. Progressively, the new expression became commonly adopted by the media and among European officials in the spring of 2012. During that period, the first organization to put on the policy agenda the idea of Banking Union was the IMF. Its managing director, Christine Lagarde

(2012), suggested a fully centralized legal and institutional arrangement for the euro area's banking system, since a single market cannot depend on a framework driven by asymmetric national interests. According to her report, this arrangement should have the shape of a single supervision authority, a single resolution authority with a common backstop and a single deposit insurance fund. The same framework was recalled in the European report "Towards a Genuine Economic and Monetary Union", which was published on 26th June 2012. In this report, the European Council President Van Rompuy (2012) identify the integrated financial framework as one of the four essential building blocks crucial for a stable and prosperous EMU. The other milestones he suggested were a stricter regulation of member states' budgets, a more integration on economic policy and a stronger democratic legitimacy and accountability.

The following Euro Area Summit on 28th and 29th June represented the key moment for the approval of the Banking Union project. During this event, the European political leadership recognized that it was imperative to break the vicious circle between banks and sovereigns. In order to do so, leaders committed themselves to two specific policy interventions. First, they invited the Commission and the Council to take into consideration the SSM legislation procedure with urgency. Second, they agreed to allow the European Stability mechanism (ESM), which was the permanent bailout system in the process of being established, to recapitalise banks directly under certain conditions. The ESM, replacing the fiscally vulnerable governments, would have ensured the same governance level between the exercise of supervision and the responsibility for bailouts. However, in July 2012, some countries backtracked on the last commitment, causing a quickly reverse of the earlier positive market reaction, with new peaks of volatility and uncertainty. Nevertheless, almost a month later, the famous Mario Draghi's remark on the 26th July *"whatever it takes to preserve the euro"* and the announcement of the Outright Monetary Transaction (OMT) programme triggered a new major turnaround in market perceptions. With this move, the European Central Bank (ECB) announced that it was ready to buy considerable amounts of sovereign bonds to stabilize their prices of a country that was under extraordinary and unjustified market pressure. OMT announcement had huge impacts, even without requiring actual implementation. Its strength, combined with the launch of the Banking Union, was enough to stop the turbulence and boost market confidence. Indeed, from July on, the desired effect of reducing the bonds yields of the governments of the euro area's periphery was remarkable (Figure 4).

The President of the European Council stated that: *"Central Bank was only able to take this [OMT] decision because of the preliminary political decision, by the EU's Heads of State and Government to build a Banking Union"* (Van Rompuy, 2014, p. 4). This declaration is a proof

Figure 4: 10 Year Government Bond Yields
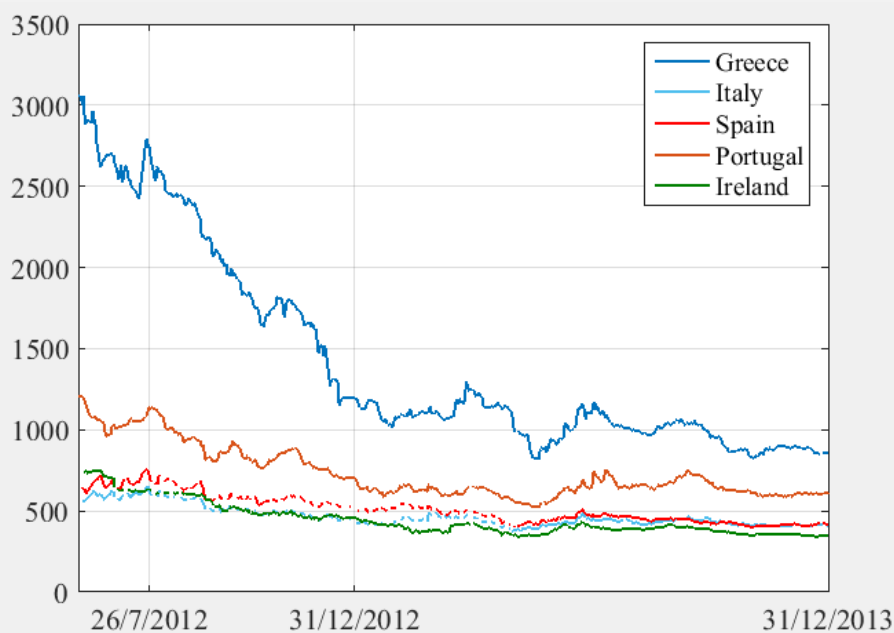
Source of data: Investing.com

that the decision to start a Banking Union and the following OMT announcement had a causal relationship (Véron, 2015, p. 4). Policy-makers and leaders affirmed that OMT was a necessary measure to defend the singleness and promote the correct transmission of monetary policy, while the SSM represented the indispensable prerequisite for the other pillars of Banking Union. Before any further steps involving financial risk-sharing, the system required a neutral and central point of supervision of all banks. The Council and European Parliament decided to entrust the ECB with the ultimate responsibility for specific supervisory tasks of Eurozone banks, reaching an agreement on 19th March 2013. The following September the SSM Regulations was favourably voted by the Parliament, while on 15th October 2013, when the European Council gave its approval, the SSM was finally enacted. Between November 2013 and October 2014, ECB carried out its supervisory role with a comprehensive assessment of 130 euro-area banking groups covering approximately 82% of total bank assets. It was an essential condition in preparing the SSM to become fully operational. Indeed, on 4th November 2014, some days after the publication of the results of the stress test and asset quality review, the ECB formally assumed its supervisory authority.

However, it is important to highlight that, even with an improved supervisory framework and intensified prudential requirements, the threat of a bank suffering a liquidity or solvency crisis could never be totally excluded. Against this possible background, the European Commission (2012) emphasised that a Banking Union should also have embraced a more centralised

17

management of banking crises, as a logical complement to the supervisory arrangement. Hence, based on the communication entitled "*Roadmap Towards a Banking Union*", the Commission recommended the creation of a Single Resolution Mechanism (SRM), administered by a Single Resolution Board (SRB). Applying the rules of BRRD, the Board has more capabilities to manage cross-border bank crises than a network of national resolution authorities, given the necessity of prompt intervention and credibility. On the presentation of this proposal, Michel Barnier stated that: "*ensuring that supervision and resolution are aligned at a central level, will allow bank crises to be managed more effectively in the Banking Union and contribute to breaking the link between sovereign crises and ailing banks*" (European Commission, 2013). In accordance with the Commissioner Barnier, the resolution mechanism would have worked if it had involved all relevant national players and it had been backed by a suitable resolution funding arrangement. For this reason and to support the restructuring of defaulting credit institutions, a Single Resolution Fund (SRF) was proposed as an essential part of the SRM. The new single resolution system was quickly legislated by the end of 2013 and adopted by the European Parliament on April 2014. Before being fully operational at the beginning of 2016, many measures and legislative acts were adopted, in particular to decide the calculation criteria for the contributions to the fund. In addition, during this period the European Commission reintroduced the State aid control as a temporary substitute for the management of distressed banks. With this coordination instrument Commission authorised only restructuring plans that encouraged the restoration of the bank's long-term viability and that included an adequate burden sharing among shareholder and junior creditors, thus largely excluding the need of public support. Moreover, the plans had to include measures to minimize competition distortions and to maintain a level playing field in the internal market.

As regards the construction of the SRF, all Member States, except the UK and Sweden, signed in May 2014 an Intergovernmental Agreement (IGA) to avoid any risk of legal challenges. Starting from 2016, they agreed to collect resources up to 1.0% of insured deposits through bank levies raised at national level. Initially, it would involve national compartments that would be progressively merged over (Figure 5). However, this gradual mutualisation between compartments implies a temporary weakness. In fact, during this phase a portion of responsibility for funding failing banks stays at the national level, hence weakening the breaking effect of the bank-sovereign nexus. On the contrary, creating the fund in this way helps to guarantee that banks' lending capacity to the real economy is not negatively affected in the short-term. Another possible shortcoming is that the SRF may need additional financing to manage potential funding shortfalls, especially through the transitional phase. (Although it

Figure 5: Construction of SRF

Available part of own national compartment
Available part from all national compartments

Source: ECB
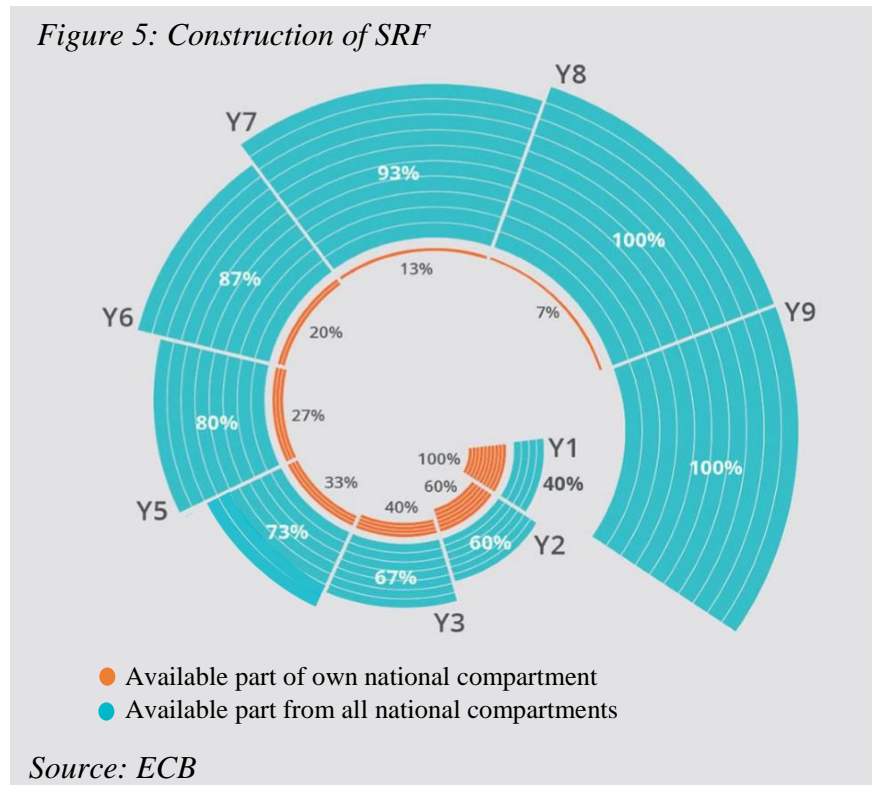
is widely acknowledged, including by EU official statements, that the SRF needs some kind of public backup in case its funding revealed insufficient to meet emerging needs, e.g. following failure of a large cross-border banking group or a large number of banks at the same time, no agreement has been reached so far on the set up of such a last resort facility. The ESM has been taken into consideration, in this context, as a potential provider of financial support to the SRF, but not as a direct participant in risk sharing). The SRM, without an explicit backstop that would lend to the SRF, could be ineffective. Hence, in December 2013, the EU finance ministers made a statement emphasising that a bridge financing would be available during its construction period (European Council, 2015). They decided that additional national sources would be backed by the ESM in conformity with existing procedures or by ex-post contribution from the banking sector. Therefore, at the end of 2015, each Banking Union's member joined a harmonised Loan Facility Agreement, which is meant to provide a national individual credit line to support its own national compartment in the Single Resolution Fund. De Groen and Gros (2015) studied the size of this bridge facility. Their work, which was requested by the European Parliament's Economic and Monetary Affairs Committee, is based on the euro area bank resolutions that took place between 2007 and 2014. They estimated an additional €45 billion requisite if an economic downturn occurs during the transition period. Given this result, they concluded that a facility with a capacity similar to the €60 billion of the ESM could be appropriate. Moreover, in line with the statement of December 2013, a common backstop to the SRF will also be developed, to become fully operational at the end of the transition period. In

addition, the well-known "5 President's Report" pointed out that both the system of national credit lines and common backstop should be fiscally neutral over the medium term and should also ensure equal treatment across all participating countries, as well as no costs for those which did not join the Banking Union.

The 5 President's Report was elaborated by the European Commission President Jean-Claude Juncker (2015), with the collaboration of the Euro Summit President, Donald Tusk, the Eurogroup President, Jeroen Dijsselbloem, the European Central Bank President, Mario Draghi, and the European Parliament President, Martin Schulz. According to them, there are four fronts, in which legislative proposals need to be undertaken. They are the Economic Union, to boost competitiveness and structural convergence, the Fiscal Union, to deliver fiscal sustainability and stabilisation and the Political Union, to enhance democratic accountability. The fourth front is the Financial Union. The already presented call for an agreement to provide adequate bridge finances and the demand for a credible common backstop to the SRF were only two points of the program towards the completion of the Banking Union, that is one fundamental objective to achieve the financial integration. The first steps in these directions will characterise the so-called "Deepening by Doing" stage. During it, immediate actions will be taken using existing instruments and the current treaties.

One of the first most important goal, necessary for the correct functioning of the SRF, is the full implementation of the Bank Resolution and Recovery Directive (BRRD). Under the new bail-in system, shareholders and creditors will bear the costs of resolution before any external assistance is provided. Galliani and Zedda (2015) demonstrated that the additional buffer financed by the bail-in tool can be really effective in breaking the vicious circle, thus stopping the contagion from banks to public finances. The transposition into national law is decisive for the SRF, since the fund is meant to provide assistance only after the bail-in of 8% of banks' liabilities has taken place. In other words, SRF, which can also be used only for a maximum of 5% of total liabilities including own funds of the institution under resolution, is just a complement of the bail-in. For these reasons, the target size of the fund (€55 billion) appears much lower than the experienced losses of the last financial crisis (€313 billion). If we apply this new framework in the period from 2007 to 2014, only half of the almost sixty aided banks would have received public support from the fund (De Groen & Gros, 2015). Policy-makers expect that the substantial bulk of the resolution requirements will be administered through the bail-in and that the remaining part will call for a marginal intervention of the fund. Indeed, the suitability of the SRF in providing a credible backstop to the SRM is often overstated. Clearly,

this procedure is probably able to cope with the failures of individual banks, but it could be argued that the SRF, even at its final target size, might be insufficient in a new systemic crisis.

In addition, after the collapse of a large cross-border bank, greater chances of systemic crises are associated with the absence of a common deposit insurance. Hence, to reinforce the resilience of the banking sector, the last desirable step mentioned by the Five Presidents is to provide Banking Union with supranational deposit insurance, alongside SSM and SRM. Consequently, on 24ᵗʰ November 2015, the Commission adopted a proposal for a European Deposit Insurance Scheme (EDIS). The function of EDIS will be to ensure an equal protection of deposits across countries of the Banking Union, regardless where the deposit is located. National schemes guarantee up to €100,000 of deposits if a bank goes bankrupt. However, they are less resistant to large local shocks than a common single scheme. Indeed, EDIS will have more widely distributed risks and collect resources over a much larger pool of financial institutions. In this way, the resilience of the banking sector against future crises will be enhanced and thanks to the greater confidence in bank deposits also lending will increase, meaning more growth and jobs for Europe.

A Deposit Insurance Fund will be gradually built up in three stages. In the first one, the re-insurance stage, EDIS funds can be accessed up to a certain level, only after exhausting national Deposit Guarantee Schemes (DGS). Then in the second one, the co-insurance stage, EDIS will contribute from the first euro of loss. The share will progressively increase until the full insurance stage, when EDIS will assume 100% of risks (Figure 6). The total amount, which

Figure 6: Evolution of EDIS funds compared to the funds of a participating DGS
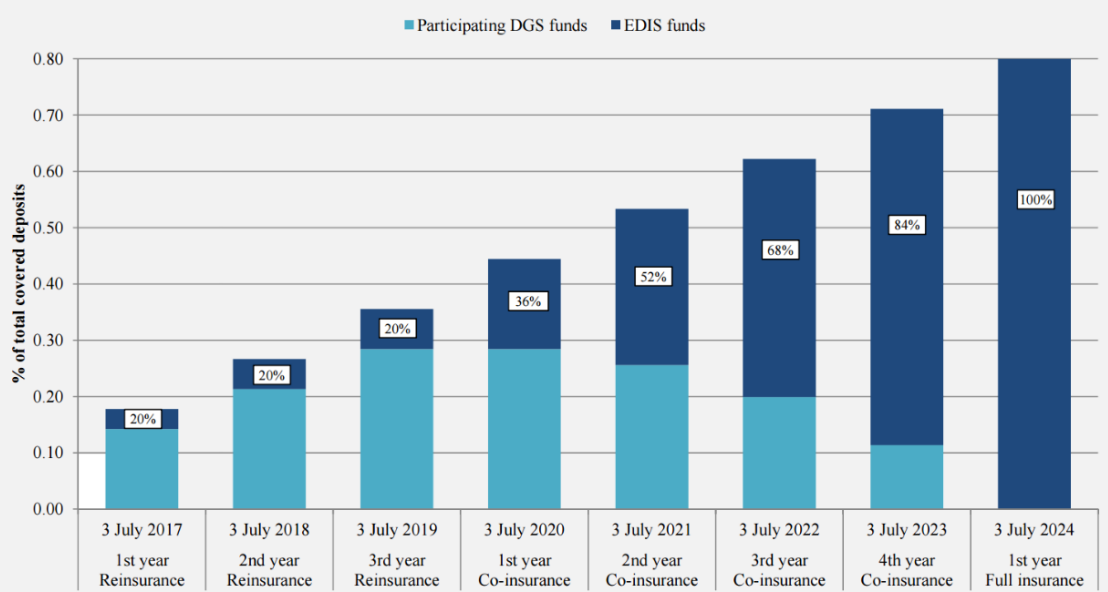
Source: European Commission

will increase automatically if the banking sector grows, is planned to be 0.8% of the covered deposits of all banks in the Banking Union. After July 2024, the national DGS will continue to exist in order to manage any pay-out events and to work as an intermediary for depositors and banks. Moreover, it might also collect funds in addition to the 0.8% of covered deposits. EDIS will intervene if a defaulting bank is liquidated and its deposits need to be paid out. Besides this, to ensure that deposit access is not interrupted, EDIS will finance the transfer of the deposits to another institution when a failing bank is resolved. Following the Commission's proposal, the decision to trigger EDIS would be at the discretion of the existing Resolution Board, with a dedicated governance structure for its new tasks. In fact, a strong and independent authority is required, for example to decide and monitor the contributions inflows from the banks and manage pay-out cases. Therefore, the SRB will administrate both the resolution and deposit insurance funds, thus becoming the first point of contact in case of crisis management (European Commission, 2015).

In November 2015, the Commission also declared that, in parallel to the work on EDIS's legislative proposal, a full package of actions to reduce risks and ensure a level playing field in the Banking Union will be pursued. For example, it will make proposals to amend CRD IV/CRR to follow up Basel III. Moreover, the commission planned to implement Total Loss Absorbing Capacity (TLAC) requirements for banks by 2019 and also diversify their exposures to sovereign debts. Finally, a more consistent application of bail-in rules under BRRD and further harmonisation of national DGS schemes will be ensured, as well as the full transposition into national laws of the corresponding directives (European Commission, 2015).

1.4. The long-term rationale for joining the Banking Union

As previously discussed, the introduction of the Banking Union in June 2012 was the first reaction to tackle the sovereign-bank loop problem. However, another consequence of the crisis is that banks also diminished their foreign businesses. Moreover, banks, after having received support by national authorities, were asked to prefer domestic lending to the foreign one. Therefore, given this reduction of cross-border banking activity inside the European Union, many commentators emphasised that, in a long-term perspective, the Banking Union was launched to restore the European banking market (Schoenmaker, 2015) (Geeroms & Karbownik, 2014). Similarly, Véron (2015) stated "*the underlying logic of Banking Union is that of the single market*". A genuine single market develops if banking groups are able to transfer excess capital and liquidity across the borders. To measure the international orientation

of banks, we can look at the outward or inward cross-border banking claims. On the one hand, a country characterized by outward cross-border activities has multinational banking groups that operate substantially outside the domestic market. On the other hand, inward cross-border activities identify the foreign banking exposures inside the country in question.

However, the presence of strong cross-border activities would lead to coordination failure if supervision and resolution are not consolidated at the central level. This happens because national authorities are likely to adopt conflicting regulatory approaches, which may lead to an adverse concentration of risk in certain countries, increasing the likelihood of bank failures, contagion and, ultimately, disintegration of the Single Market. Schoenmaker (2011) identified these issues with the so-called "financial trilemma", which adapts the "monetary trilemma" to the international finance. This new concept provides a theoretical foundation to have a Banking Union, since it highlights the impossibility of having financial integration, national financial policies and financial stability altogether (Figure 7). In accordance with Geeroms and Karbownik (2014, p. 16), the financial stability can logically be achieved only in two ways: "*either, one returns to a world of segmented national banking markets and forgoes the benefits of integration, or one moves towards supranational structures for financial supervision and resolution*". In this way, centralized authorities are released from local pressures and can revise the condition of banks independently and in a systemic context. As a result, they concluded that a Monetary Union requires a Banking Union.

The so-called "Outs" may also consider to join the Banking Union given the fact they exhibit a high degree of cross-border banking activity. Despite this fact, only the members of the single

Figure 7: The Financial Trilemma

1. Financial stability

2. International banking   3. National financial policies
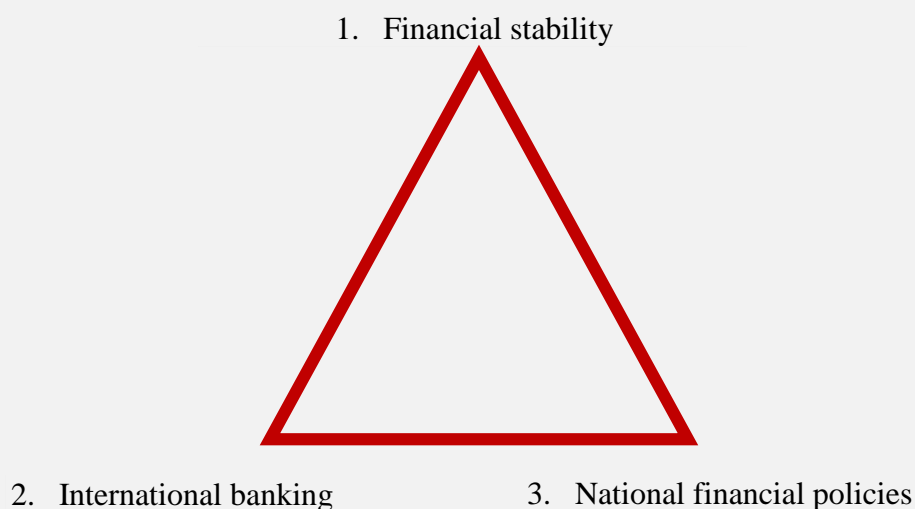
Source: Schoenmaker (2011)

currency have been included in all the features of the Banking Union by default. In the current situation, the governments outside the single currency are liable for bailing out the banks headquartered in their territory. As shown by the recent global financial crisis, such a fiscal backstop function can be very costly. For these reason, opting-in makes sense to reach financial stability and avoid coordination failure. Therefore, a central strategic issue for these countries is whether or not they should join the Banking Union. In general, if the Outs join the single currency, they will automatically participate in the Banking Union as well. Meanwhile, even without adopting the euro, they are allowed to take part in the Banking Union by notifying the request to enter into a "close cooperation" agreement. In particular, they must guarantee that their national supervisory authorities will adopt any measure requested by the ECB, accept any guidelines or instructions and provide all information on credit institutions. Close cooperation could also be terminated, both on the initiative of the country or the ECB.

In order to understand the possible benefits of joining the Banking Union, Hutt and Schoenmaker (2016) verified, in their policy contribution, the level and the typology of the cross-border banking claims of the nine non-euro area countries. Starting from the outward banking claims, they showed that Sweden and Denmark's top banks own assets for about 18% and 12% respectively in countries inside the Banking Union, especially in the Baltic region. Similarly, 22% of the Barclays's holdings, the second UK bank in terms of assets, are in Italy, Spain, Germany and France. Mervyn King's well-known aphorism that "*banks are international in life, but national in death*" summarizes perfectly the problem in such a situation. If supervision and resolution are at the national level, the risk that the countries' authorities consider and rescue only the domestic share of a bank's business is quite high. In this way, it would cause both inefficient and detrimental consequences for systemic stability. On the contrary, particularly high inward cross-border claims characterized the central and eastern non-euro countries. Czech Republic and Croatia have been documented to have the highest share, about 80% of foreign-owned subsidiaries from members of the Banking Union. For Bulgaria, Romania, Poland the share is reduced to almost 60%, while for Hungary is around 40%. The United Kingdom has also high inward cross-border activities, but the majority of claims come from banks headquartered outside the EU. In fact, London represents the gateway to Europe for the large US and Swiss investment banks. This manifests its importance as an international financial centre, that would gain intensified cooperation by joining the Banking Union. However, its recent decision to exit from the European Union made the arrangement impossible. A Banking Union that does not contain the U.K. is expected to generate regulatory and political problems more than economic ones. Likewise, Sweden declared that it does not

have the intention to take part in the project, even if joining the Banking Union would mean increased effectiveness and efficiency of supervision and resolution procedures. (Economics and financial affairs, 2016). However, the Banking Union can possibly still succeed even without their participation, as long as there is sufficient coordination between the national institutions and those of the Banking Union.

By contrast, the decision to join the Banking Union is just a matter of time for all the countries that planned to adopt the single currency. Indeed, Bulgaria and Romania are convinced about adhering to it. In July 2014, Kalin Hristov, the Bulgarian Minister of Finance, declared that both the scheduled asset quality review and the stress test of banks will put his country in a position to join the EU's Banking Union. He emphasized a rapid entry in order to boost the trust in the banking system given the fact that the poor supervision led to the collapse of a major Bulgarian bank (Tsolova & Williams, 2015). Similarly, in a speech in Rome on July 2014, Mugur Isărescu., the Governor of the Romanian National Bank, set out several arguments in favour of a quick adherence to the Banking Union, through the close cooperation arrangement. First, Romanian domestic banking sector is mostly dominated by banks headquartered in the euro area. The Banking Union membership would also discourage the deleveraging on the part of banks with foreign capital and help to build a more competitive market by removing distortions and entry barriers. Moreover, there could be potential benefits which relate to eliminating the possibilities of jurisdictional arbitrage.

Finally, not opting for the Banking Union may involve substantial costs for non-euro area countries, since they are exposed to contagion effects. If troubles materialise, they can only rely on their own mechanisms, resources and instruments, which might not be up to the job (Isărescu, 2014). Similar arguments could be considered by Denmark, Croatia, Czech Republic, Hungary and Poland, which are the remaining Member States that adopted a wait and see approach (Figure 8). These attitudes to postpone the decision are often encouraged by the immature structure of the Banking Union so far. Evaluating the initial performances of the new Banking Union mechanisms and the experiences of the earliest opt-in countries will be decisive for non-euro countries to determine whether to join or not. In general, for central and eastern Europe countries, the Banking Union would represent a more stable configuration for managing financial stability and conserving lending capacity. The membership would give also more regulatory certainties in times of crisis, acting as a coordination tool for all the involved countries. Therefore, it is clear that broaden integration is an expected direction for them. However, while the benefits of participation are still only hypothetical and uncertain, risks are more evident since not all aspects are favourable from their perspective. In particular, compared

Figure 8: Member States' positions on joining the Banking Union
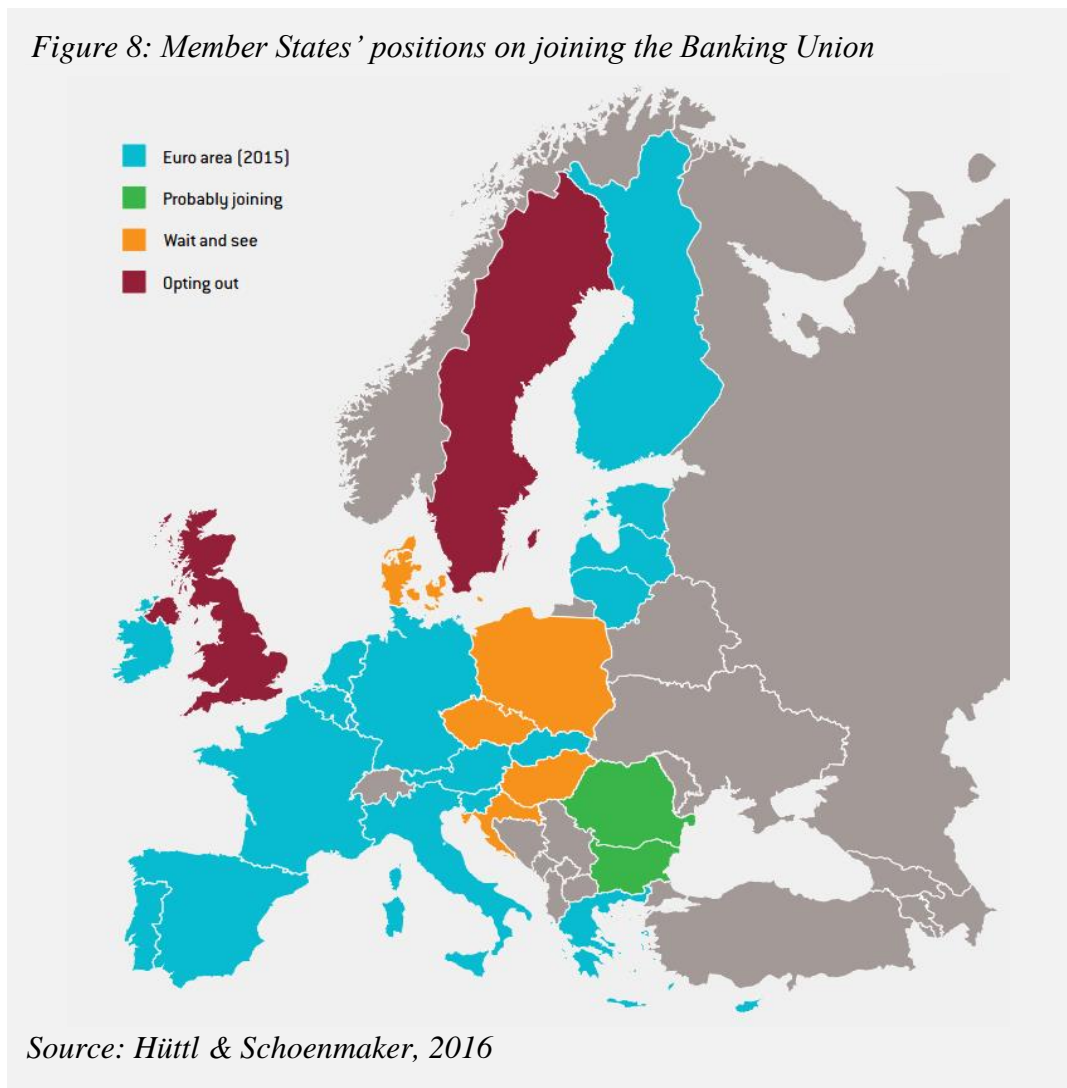
Source: Hüttl & Schoenmaker, 2016

to a euro-area member state, an opting-in country would have restricted influence in the decision-making process within the SSM, because it would not gain a seat in the Governing Council of the ECB, which is the highest decision-making body within the SSM. Other risks regard the weaknesses in the construction of the Banking Union. For example, gradual mutualisation and the small size of the SRF do not favour the opt-in decision. Moreover, while banks of the Eurozone can rely on the ECB liquidity facilities and the ESM funds, opt-ins will still depend on their own national backstops. Finally, the level of development of the domestic banking sectors, which might be formed by banks "too small to matter", could be another risk for these countries (Belke, et al., 2016).

2. The European regulatory framework for bank recovery and resolution

2.1. Features of the new resolution framework

In response to the financial crisis of 2007-08, global leaders initiated an extensive reform program of the banking framework regulation. Many motivations were behind the choices of policy makers. First of all, in order to reduce systemic risk, macro-prudential supervisors and systemic risk boards were established at the national, European and global levels. Then, to further decrease the probability of banks default, policy makers increased the prudential requirements and decided to improve the quality of capital and supervision, with new institutions and tools. However, since the possibility of a bank failure can never be totally excluded, leaders proposed also to expand the competences of authorities with a new resolution process, which is meant to minimize the negative impact on taxpayers, financial markets and the economy. Indeed, given their special nature, banks are highly exposed in times of crisis. Bank's activities, that are vital for the economy, are based on the confidence of depositors and other counterparties, which could be rapidly lost if the bank is not able to maintain its promises. In addition, if there is the perception that the financial institutions will always be rescued by their governments, banks will develop moral hazard behaviours, by taking more and more excessive risky positions, thus raising the possibility of default. Moreover, as a result of the interconnection of the financial system, the expected failure and insolvency of a bank may result in the instability of the whole financial system. For these reasons, a regulation giving the possibility to default, is essential in the Banking Union to solve the "Too-Big-To-Fail" problem and increase the confidence of depositors and other counterparties. In fact, "in order to avoid moral hazard, any failing institution should be able to exit the market, irrespective of its size and interconnectedness, without causing systemic disruption" (BRRD, Recital 45). The new rules represent an effective alternative to the normal procedures and they help to preserve the value that might otherwise be destroyed.

The ordinary bankruptcy procedures managed in courts may take many years to be completed, since they aim to maximise the assets value of a failed business in the interest of creditors. They also typically involve the interruption of critical functions of the institution that, in the context of a bank, could affect the protection of depositors, which in turn alter financial stability. However, usual bankruptcy trials, which remain regulated at the national level, should act as a benchmark for the national authorities. Indeed, "*failing institution should in principle be liquidated under normal insolvency proceedings*" (BRRD, recital 45). Only if specific conditions are fulfilled, certain objectives are pursued and some principles are observed, banks

are put under the new resolution regime. As regards the condition, designated authorities must verify that the bank is failing or likely to fail, there are not alternative private solutions and the resolution action is necessary in the public interest. In particular, an institution is deemed failing or likely to fail when it infringes, or will, in the near future, infringe the requirements for keeping the authorization by the competent authority, when the assets of the institution are or will be less than its liabilities, when the institution is or will be unable to pay its debts as they fall due or when, excluding some circumstances, the extraordinary public financial support is required. When the first condition is fulfilled, the resolution process continues only if there is not the realistic possibility that any private alternative would avoid the bank resolution within a reasonable timeframe. We will see, for example, that early intervention measures and the write-down or conversion of relevant capital instruments may prevent the failure. At the same time, also the third condition must be satisfied. The legislation states that there is public interest when the resolution "*is necessary for the achievement of and is proportionate to one or more of the resolution objectives referred to in Article 31 and winding up of the institution under normal insolvency proceedings would not meet those resolution objectives to the same extent*" (BRRD, Article 32).

Indeed, the resolution must pursue a set of objectives, specifically provided by the BRRD. In particular, the process must ensure the continuity of critical functions, avoid a significant adverse effect on the financial system and protect covered depositors, covered investors, client funds and client assets, as well as public funds by minimising reliance on extraordinary public financial support. During the resolution process, the authorities should choose the tools and powers to best achieve these objectives. At the same time, when pursuing the above objectives, the resolution authority should minimise the cost of resolution and avoid destruction of value, except when it is necessary to achieve them. Unless differently specified, the resolution objectives are taken into account with equal significance and resolution authorities should balance them as appropriate to the nature and circumstances of each case (BRRD, Article 31).

In addition to conditions and objectives, the BRRD determines a set of general principles, which must be observed in all the measures implemented using the resolution tools and powers. In particular, since the rights of shareholders and creditors, enjoying strong national legal protection, might be affected, Article 34 of the BRRD includes some principles to guarantee that resolution procedure is compatible with the European Charter of Fundamental Rights and the safeguards provided by the national legal systems. For example, the legislative text says that "*the shareholders of the institution under resolution bear first losses and creditors of the institution under resolution bear losses after the shareholders in accordance with the order of*

priority of their claims under normal insolvency proceedings", except when expressly provided otherwise. Another principle is that the management body and senior management, which must provide all necessary assistance, should be replaced, unless managers' retention is considered necessary for the realisation of the resolution objectives. Last but not least, covered deposits must be fully protected and creditors of the same class must be treated in an equitable manner. More importantly, creditors must not bear greater losses than they would have incurred if the institution had been wound up under normal insolvency proceedings. This last principle, known as the 'no creditor worse off principle', is meant to fill any lacunae left from the application of the preceding ones. Moreover, as provide by Article 74 and 75 of the BRRD, shareholder, creditor or the deposit guarantee scheme that have incurred in greater losses have the right to receive the payment of the difference from the resolution financing arrangements, after that an ex-post and independent valuation is carried out.

Keeping in mind the principles and objective, authorities are supplied with a full collection of resolution powers to manage the crisis of a bank that met the condition for resolution. In particular, the most important power for resolution authorities is the right to write down and/or convert to equity certain liabilities of the bank. First of all, if the amount of write-down or conversion of capital instruments is enough to recapitalize the institution, they can be carried out without initiating resolution procedures. In other words, this power may be exercised independently or in combination with a resolution action. Besides the situation in which the conditions for resolution have been met, the write down or conversion power can be applied also if extraordinary financial support is required or if the appropriate authority determines that, unless the relevant capital instruments are written down or converted, the institution will no longer be viable (BRRD, Article 59). Moreover, the resolution authorities are obliged to "*exercise the write down or conversion power in accordance with the priority of claims under normal insolvency proceedings*", in a way that leads to the utilisation of Common Equity Tier 1 items first, Additional Tier 1 instruments in second instance and finally Tier 2 instruments, all of them in proportion to the losses and to the extent of their capacity. When the principal amount of a relevant capital instrument is written down, the reduction must be permanent, no liability to the holder of the relevant capital instrument shall remain under or in connection with that amount written down and, generally, no compensation should be paid to any holder of the relevant capital instruments (BRRD, Article 60).

However, against a decision to take a crisis management measure, Member States shall provide the right of appeal. BRRD provides that the review of the decision must expeditious and that national courts should use "*the complex economic assessments of the facts carried out by the*

resolution authority as a basis for their own assessment". Moreover, since the new regulatory framework for resolution is meant to manage situations of extreme urgency and any suspension of the decision process might obstruct the continuity of critical functions, the appeal must not entail any automatic suspension of the effects of the challenged decision, but it should be immediately enforceable and it shall give rise to a contestable presumption that a suspension would be against the public interest. In addition, the invalidation of a decision cannot "*affect any subsequent administrative act or transaction concluded by the resolution authority*", in order to protect the rights of third parties that purchased in good faith shares, assets, rights and liabilities of the institution under resolution. In such a case, to remedy a wrongful decision, the BRRD requires that the losses suffered by the applicant must be compensates (BRRD, Article 85). In conclusion, to further protect the rights of many involved counterparties, such as shareholders and creditors, the BRRD specifies some rules governing the procedural requirements for notification and confidentiality. The resolution framework ensures that resolution actions must be properly notified and made public. "*However, as information obtained by resolution authorities and their professional advisers during the resolution process is likely to be sensitive, before the resolution decision is made public, that information should be subject to an effective confidentiality regime*" (BRRD, Recital 86). Thus, the circulation of that information must be controlled with an effective confidentiality regime, before the publication of the resolution decision. The persons listed in Article 84 of BRRD are prohibited from revealing information obtained during their professional activities or from a competent or resolution authority, to any person or authority unless it is necessary in the exercise of their functions.

2.2. The distribution of competences among institutions

The institutional and regulatory framework of the European Banking Union is largely in place. The transfer of competences to the SSM and SRM brought greater efficiency and consistency in the application of common rules included in the Single Rulebook. However, as shown previously, the absence of a common deposit insurance scheme, which is still under discussion, is a remaining weakness of the system. In fact, these three pillars are essential and mutually dependent for the establishment of a single market for financial services and should be regulated at the same level. As regards the SSM, the architecture developed by the Council is based on a network composed of European Central Bank and National Competent Authorities (NCAs), which ensures that all banks in the euro area are taken into account. The ECB, which is also

responsible for the overall functioning of the system, direct supervises 129 banks that are deemed as significant according to specific criteria listed by Article 6 of SSM Regulation. In particular, the day-to-day supervision of significant institutions is carried out by dedicated Joint Supervisory Teams (JSTs), whose size varies depending on the nature, complexity, scale, business model and risk profile of the credit institution. They comprise representatives from both the ECB and the NCAs of the countries in which the credit institutions, banking subsidiaries or the significant cross-border branches of a given banking group are located. Banks that do not satisfy the criteria to be significant remain supervised by their NCAs, in close cooperation with the ECB. However, at any time the ECB can decide to directly supervise any one of these "less significant" institutions to ensure that high supervisory standards are applied consistently.

Similarly to the SSM, the structural organization of the SRM is based on a network which split the competences between a central agency, the Single Resolution Board, and national resolution authorities (NRAs). Article 3 of the BRRD requires that each member state has to establish a national resolution authority that is invested with a bunch of resolution powers. The legislator expressly provides that they could be "*national central banks, competent ministries or authorities entrusted with public administrative powers*". There is the exceptional possibility that a NRA might coincide with a NCA. However, there are also a number of requirements needed to ensure operational independence and avoid conflicts of interest between the supervision and resolution functions. Then, to ensure financial stability and a consistent application of rules, the BRRD makes clear that the resolution regime should be applied to the same institutions subject to prudential requirements and supervision (BRRD, Recital 11). Therefore, the resolution framework is not only applied to credit institutions, but also to investment firms, financial holding companies, mixed financial holding companies, mixed-activity holding companies and subsidiaries of one of the entities just citied, covered by the supervision of the parent undertaking on a consolidated basis (BRRD, Article 1). Thus, the SRB manages, in close cooperation with NRAs, the resolution framework of significant entities or groups subject to the supervision of the ECB, as well as any cross-border group established within a country of the Banking Union. On the other hand, in relation to the less significant institutions supervised by NCAs, NRAs directly exercise resolution powers. Nonetheless, every time the resolution action resort to the Single Resolution Fund, the resolution scheme has to be adopted by the Board. In addition to these cases, if the Board believes that a NRA undertook a draft decision that does not comply with the Regulation or the Board's general instructions, it can issue a warning to the authority. At any time, just like the ECB, the SRB is able to exercise

directly all of the relevant powers under the Regulation, especially if the warning is not taken into consideration. The general rule within the SRM is that decisions should be taken at the most appropriate level. In particular, when approving their measures, "*the Board and the national resolution authorities should apply the same material rules*" (SRM Regulation, Recital 23). In any case, after a resolution scheme has been adopted, the NRAs are responsible to carry out its implementation, following the national legal system. NRAs must inform and coordinate with the Board about the actions that they are willing to take and implement. In addition, NRAs can be requested by the SRB to adopt the necessary measures to remove obstacles to resolvability and determines the minimum requirement for own funds and eligible liabilities (MREL), which will be analysed later. Moreover, besides crisis management SRB is entitled of some responsibilities in the other phases set out by the BRRD, such as in the preparation and crisis prevention. In particular, during the preparation process, the SRB draws up resolution plans for the entities and groups for which it is the resolution authority, after consulting the ECB or the relevant NCAs and the NRAs. In the early intervention phase, if the SRB is informed of prevention measures taken by ECB or NCAs, it has to notify the Commission and prepares itself for the possible resolution of the institution or group concerned.

Depending on the subject under consideration, the Board operates in executive and plenary sessions, in order to take its decisions. The executive session prepares all decisions concerning the resolution procedure and directly takes the decisions relating to individual entities or banking groups if the use of the Single Resolution Fund remains below €5 billion. In this case the Board is composed by five permanent members, which are chosen among experts and appointed by the European Parliament on the proposal of the Commission, the observers from the Commission and the ECB and the representatives of the NRAs, but only those concerned with the failing institution. Differently, the plenary session of the Board is composed by all the NRAs, in addition to permanent members and observers. Indeed, it takes all decisions of general nature and the decisions relating to individual entities falling outside the competence of the executive session. As regards the voting system, during the executive section, each member, except from observers, has one vote and if a consensus is not reached within the deadline set by the Chair, the decision is taken under a simple majority rule by the five permanent members. Instead, for the plenary section, special majority rules are provided for the most sensitive issues, such as the decision on the necessity to raise extraordinary ex-post contributions, on the voluntary borrowing between financing arrangements, on alternative financing arrangements and on the mutualisation of national financing arrangements in the case of group resolutions.

2.3. The resolution process

The SRB plays a crucial role during the assessment of the condition necessary to take a resolution action. Following the SRM Regulation, the opening of a resolution procedure is made with the assessment of the first condition, the failing or likely to fail, which is normally carried out by the ECB, after having consulted the Board. The Executive Board may also make this assessment if it informs the ECB about this intention and within 3 days ECB does not make it. Then, the Board in executive session makes the assessment of the second and third condition. These decisions are taken by the SRB in close cooperation with the ECB, or, when applicable, by the NRAs, in close cooperation with the ECB. If the SRB judges that all the three conditions for resolution are met, the entity is put under resolution and the adopted resolution scheme defines the application of the resolution tools and the eventual use of the SRF to support the resolution actions. In fact, SRB is the owner and administrator of the SFR. The modalities for the use of the Fund are established by the provisions on financing arrangements of the BRRD and are integrated by the SRM Regulation. In general, only when the resources from shareholders and creditors are exhausted, the losses, costs and expenses incurred with the resolution tools can be supported by the SRF. Whenever the Fund is involved in the resolution of a bank, the SRB has to notify the Commission which check the compatibility of its use in the respect of the rules on State aid. As soon as a resolution scheme is adopted by the SRB, it is immediately transmitted to the Commission to be reviewed. The Commission can endorse the scheme, and therefore it enters into force. Otherwise within 24 hours, if the commission objects

Figure 9: Resolution process
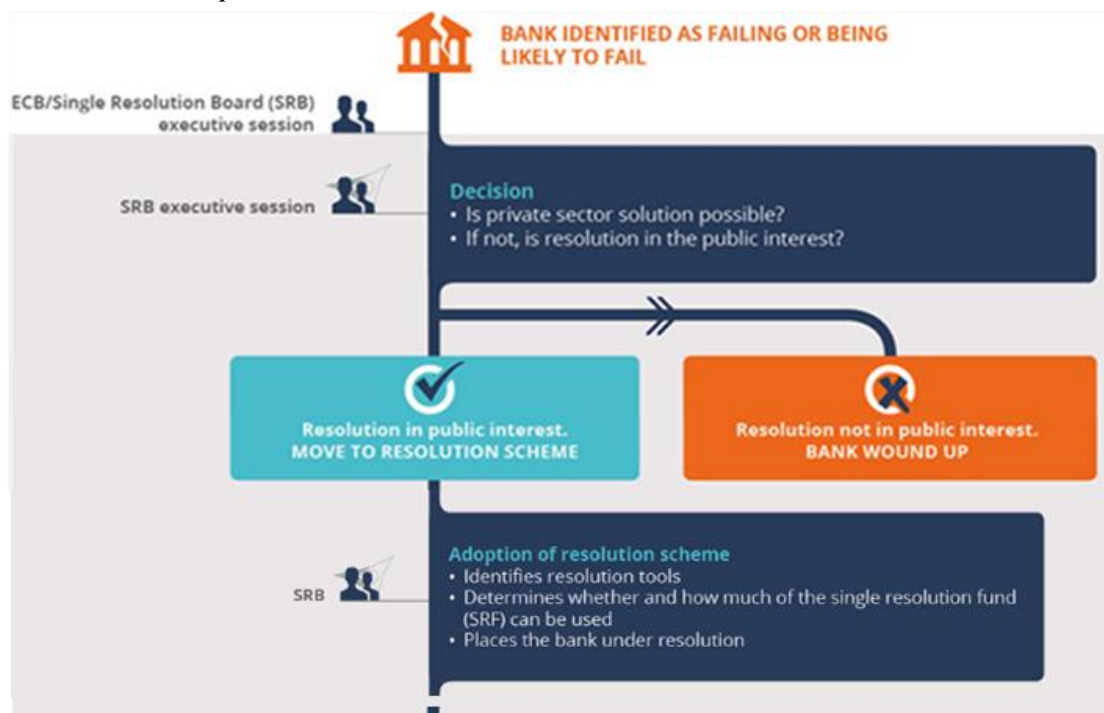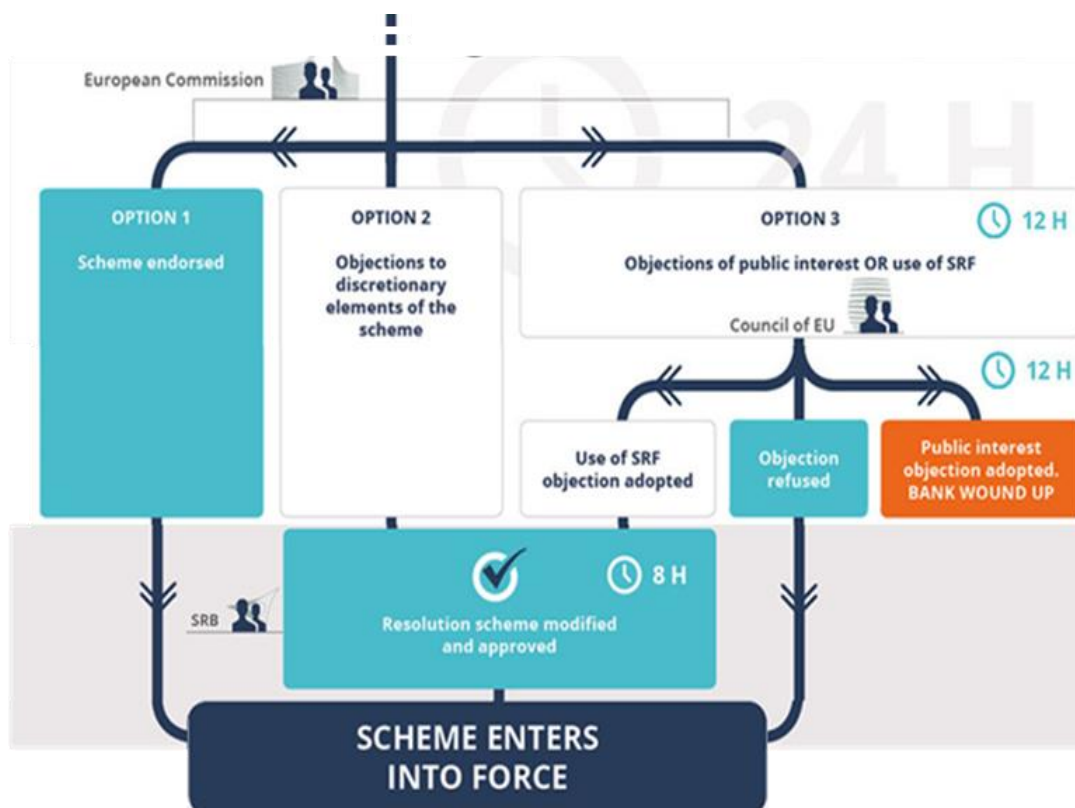
Source: European Council

to discretionary aspects of the scheme, the SRB must modify decision within 8 hours, in accordance with the new requirements. Instead, the Commission has only 12 hours if the revision regards the amount of SRF contribution or the absence of the public interest condition. In both cases, the Council has 12 hours to assess Commission's objection. If the objection about the SRF utilization is adopted, SRB must modify the resolution scheme within 8 hours, taking into account the Commission and/or Council requirements. If the Council agrees that the resolution scheme doesn't fulfil the criterion of public interest, the bank must be wound up in an orderly manner under national law. On the other hand, if the objections are refused, the scheme enters into force. After the decision is final, the SRB instructs the relevant national resolution authorities to take the necessary measures to implement the resolution scheme.

2.4. The Bank Recovery and Resolution Directive

Given the legal and technical impossibility to harmonize insolvency laws in all the Member States, policy makers opted to centralize the decisions on starting resolution, keeping the national authorities responsible for their implementation under the national legal systems. In such a context the BRRD provides a set of common rules for the recovery and resolution process. In particular, BRRD not only offers a rich toolbox for crisis management, but also for

crisis prevention and early intervention. First of all, following this three-step approach, its rules are meant to guarantee that banks and authorities are sufficiently prepared in case of crisis, by developing timely recovery and resolution plans (BRRD, Title 2: Preparation). Furthermore, when problems emerge, the BRRD equips the competent authorities with the tools to take a timely corrective action (BRRD, Title 3: Early intervention). Finally, others powers and tools are provided to authorities in order to manage the bank crisis and protect depositors and taxpayers, (BRRD, Title 4: Crisis management).

2.4.1. Preparation

a. Recovery Planning

Article 5 of BRRD states that each institution, that is not part of a group, is required to "*draw up and maintains a recovery plan providing for measures to be taken by the institution to restore its financial position following a significant deterioration of its financial situation*". Alternatively, Article 7 states that the parent undertakings must "*draw up and submit to the consolidating supervisor a group recovery plan*", which contains "*measures that may be required to be implemented at the level of the Union parent undertaking and each individual subsidiary*", to achieve the stabilisation of the group as a whole, or any institution of the group. As regards the requirements, the recovery plans must be updated at least annually or every time that the legal or organizational structure of the bank, as well as its business or financial situation, is subject to a relevant change. Then, a specific set of information, listed in Section A of the Annex of BRRD, should be included in the recovery plans. These plans should contemplate a wide range of scenarios of severe macroeconomic and financial stress relevant to the institution's specific conditions, both system-wide events and specific to individual legal persons or groups. Moreover, plans cannot presuppose any access to the extraordinary public financial support, but it should analyse how and when an institution may apply for the use of central bank facilities and identify the assets suitable to qualify as collateral

After being assessed and approved by the management body, the financial institution must submit their plans to the competent supervisory authority, which consult competent authorities of the significant branches and, for banking groups, the competent authorities where subsidiaries are located. In this case, the competent authorities of subsidiaries have to reach, within four months, a joint decision with the consolidating supervisor on the review of group recovery plan, whether to draw a recovery plan for individual entity and the application of measures at subsidiary level (BRRD, Article 8). The recovery plan is also submitted to the resolution authority and for groups to resolution authorities where subsidiaries are located. They

may make recommendations to the competent authority if they identify that some of the measures contemplated could adversely impact the resolvability of the institution. Successively, the competent authority must assess within six months if the plan, in addition to the general requirements, is adequate to maintain or restore the institution's viability and financial position and if it can be implemented quickly and effectively to avoid adverse effect on the financial system. During the assessment of the recovery plans suitability, the competent authority has to take into account the risk profile of the institution, its capital and funding structure and the complexity of the organisational structure. In the presence of such material deficiencies and/or impediments to resolvability in the recovery plan, the institution or the parent undertaking of the group has to submit a revised plan demonstrating how those problems were addressed, within two months or exceptionally three months. If there are still deficiencies, or the plan was not submitted, the competent authority can direct the financial institution to make specific changes to the plan or, if this is not possible, it can require the institution to identify changes to its business. Again, if the institution fails to do so, the competent authority can direct the institution to reduce the risk profile of the institution, enable timely recapitalisation measures, review the institution's strategy and structure and make changes to the funding strategy and governance structure in order to address the deficiencies in or impediments to the implementation of the recovery plan (Figure 10).

Figure 10: Assessment process for recovery plans
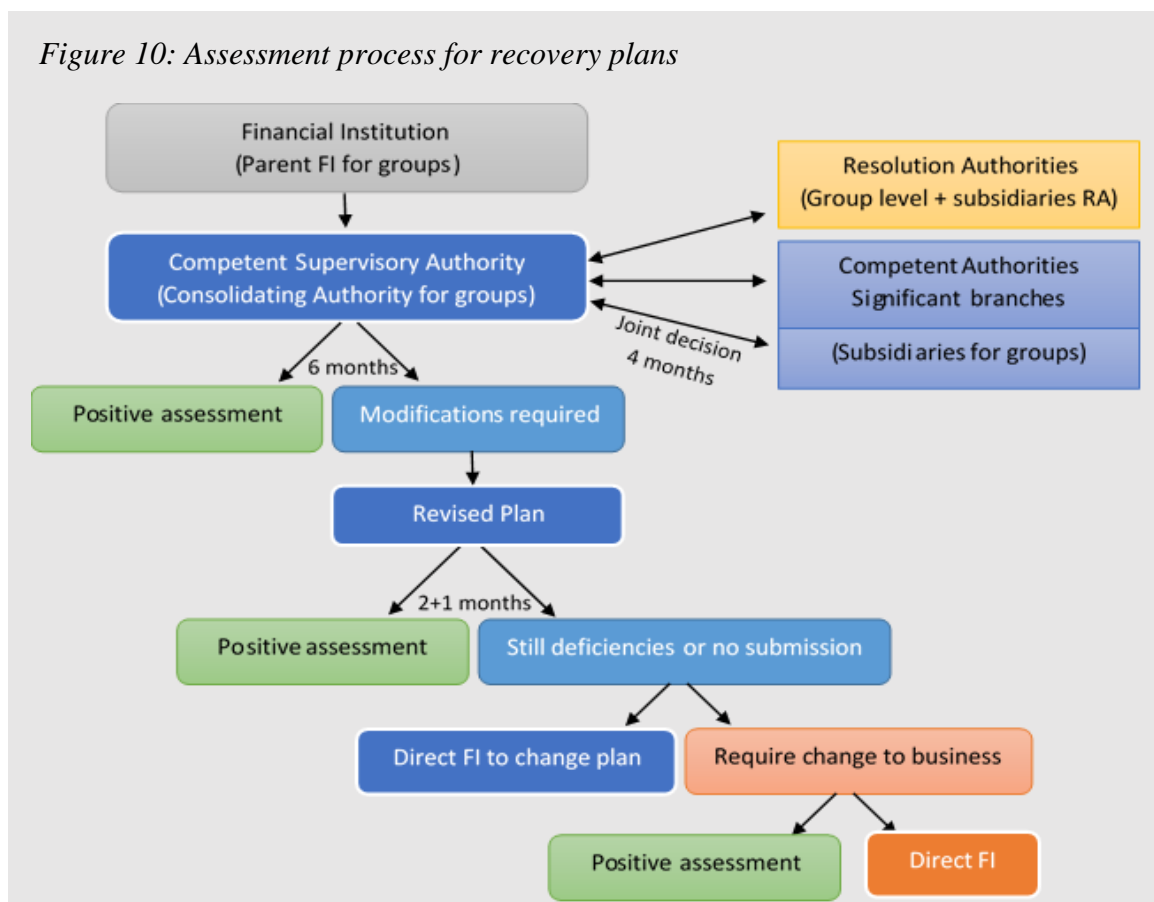
In conclusion, for the purpose of these rules, Article 9 state that "*the competent authorities shall require that each recovery plan includes a framework of indicators established by the institution which identifies the points at which appropriate actions referred to in the plan may be taken*". The nature of indicators could be qualitative or quantitative, and shall be easily monitored, with the institutions putting in place appropriate arrangements for this task. A feature of the quantitative indicators is that, through a progressive metrics, they allow for gradual awareness of the institution before having to consider whether to take the actions referred to the recovery plan. In any case, the decision to take or refrain from taking an action, whether or not the relevant indicator has been met, shall be notified to the competent authority without delay. EBA (2015) specified the minimum list of categories and respective qualitative and quantitative indicators, which should be included in all recovery plans. There are four main categories (capital, liquidity, profitability and asset quality) and two other categories (market-based indicators and macroeconomic indicators) that should be included in the recovery plan unless the institution justifies to the competent authorities that they are not relevant to its legal structure, risk profile, size and/or complexity. However, the Guidelines provide also a list with additional recovery plan indicators for illustration purposes only, since institutions should not limit their set of indicators to the minimum list.

b.   Resolution Planning

When the institution meets the conditions for resolution, authorities must be prepared to effectively apply the powers and tools provided by the BRRD in order to pursue the resolution objectives. Therefore, Article 10 of the BRRD provides that, after having consulted the resolution authorities of significant branches, the resolution authority is required to draw up a resolution plans for the institution. Similarly, Article 12 obliges group-level resolution authorities to draw up group resolution plans, which include a plan for the group as a whole and for the parent and subsidiary entities. The group level resolution authority and the subsidiary resolution authorities form the resolution college, which have to reach a joint decision on drawing up and maintaining resolution plan. Group-level resolution authorities may, at their discretion, involve third-country resolution authorities of jurisdictions in which the group has established subsidiaries or financial holding companies or significant branches. In the absence of a joint decision between the resolution authorities within four months, the group-level resolution authority shall make its own decision on the group resolution plan and each resolution authority responsible for a subsidiary shall make its own decision and shall draw up and maintain a resolution plan for the entities under its jurisdiction. However, if they referred

the matter to EBA, resolution authorities must take the decision in accordance with EBA decision, which should be formulated within one month (BRRD, Article 13).

Like recovery plans, also "*resolution plans shall be reviewed, and where appropriate updated, at least annually and after any material changes to the structure of the institution or to its business and financial position that could have a material effect on the effectiveness of the plan or otherwise necessitates a revision of the resolution plan*". These plans require also confidentiality protection, since they may include highly sensitive information. In fact, resolution authorities have the power to oblige institutions to cooperate as much as necessary in the drawing up of resolution plans and to supply, either directly or through the competent authority, all of the necessary information to draw up and implement resolution plans (BRRD, Article 11). The resolution plan, which are be prepared on the basis of these information, must contain, for example, a detailed description of the different resolution strategies that could be applied according to the different possible scenarios and to the available timeframe for executing the plan. Moreover, the resolution plan shall include a demonstration of how critical functions and core business lines could be legally and economically separated from other tasks to ensure continuity, as well as a description of the processes for determining the value and marketability of the critical functions, core business lines and assets of the institution. In addition, an explanation of how the resolution options could be financed should be included in the plan, without assuming any extraordinary public financial support or any central bank emergency liquidity assistance. The resolution plan shall instead include an analysis of how and when an institution may apply for the use of central bank facilities, identifying which assets qualify as collateral. The BRRD requires also that the plan should analyse the impact of implementation on the employees of the institution and describe the procedures to consult staff during the resolution process, taking into account national systems for dialogue with social partners where applicable. In conclusion, the plan must include a detailed description of both the minimum requirement for own funds and eligible liabilities required pursuant to Article 45, which will be presented later, and the assessment of resolvability any measures required to address or remove impediments to it, which are identified in accordance with Article 15.

c. Resolvability

"*An institution, or a group, is deemed to be resolvable if it is feasible and credible for the resolution authority to either liquidate it under normal insolvency proceedings or to resolve it by applying the different resolution tools and powers*" (BRRD, Article 15). In fact, the institution, or the group, should avoid any significant adverse effect on the financial system and

ensure the continuity of critical functions carried out by the institution or by the group entities. For the purposes of the assessment of resolvability, the BBRD stresses that it must be carried out without any assumption of extraordinary public financial support or central bank emergency or non-standard liquidity assistance. The legislative text provides the circumstances that the resolution authority shall examine. For example, it should consider the extent to which there are arrangements in place to provide for essential staff, infrastructure, funding, liquidity and capital to support and maintain the core business lines and the critical operations, the capacity of the management information systems to provide the information essential for the effective resolution of the institution at all times even under rapidly changing conditions, the amount and type of eligible liabilities of the institution and the credibility of using resolution tools in such a way which meets the resolution objectives, given possible impacts on creditors, counterparties, customers and employees and possible actions that third-country authorities may take.

When a resolution authority determines that there are substantive barriers to the resolvability of the institution, it shall notify the institution, the competent authority, the resolution authorities of the jurisdictions in which significant branches are located and also EBA in a timely manner. The institution has to propose, within four months, some possible measures in order to eliminate the impediments identified in the notification. The resolution authority, after consulting the competent authority, will assess if those actions are suitable to remove impediments, otherwise it will require the institution to take other measures, either directly or through competent authorities. For example, such measures may include the limitation of the institution's maximum individual and aggregate exposures, the divestiture of specific assets, the limitation or ceasing of specific activities, the changing of the legal or operational structure and the compliance with minimum requirements for own funds and eligible liabilities. A specific and more complex provision governs the assessment of resolvability for groups. The group-level resolution authority shall communicate any measure proposed by the Union parent undertaking to the consolidating supervisor, to EBA, to the resolution authorities of the subsidiaries and to the resolution authorities of significant branches. They shall do everything within their power to reach a joint decision on identifying material impediments and the application of alternative measures for all institutions of the group. In the absence of consensus, an own decision on alternative measures should be taken by group level resolution authority or by the resolution authorities of subsidiaries. EBA may, upon the request of a resolution authority, assist the resolution authorities in reaching an agreement, in a similar way of the group resolution plan.

d. *Intra group financial support*

Preparing for a worsening of the financial conditions consists also in the possibility for institutions belonging to the same cross-border group to "*enter into an agreement to provide financial support to any other party that meets the conditions for early intervention*" (BRRD, Article 19). The group financial support may be provided in the form of a loan, the provision of guarantees, the provision of assets for use as collateral or any combination of those forms of financial support, in one or more transactions. The idea behind intra-group financial support is to safeguard the financial stability of the group as a whole, without jeopardizing the liquidity or solvency of the group, given the strong interdependencies between the entities of the same group. The BBRD provides that intra group financial support agreements must be finalised ex-ante, before the parties fulfilled the conditions for early intervention. Each party must be acting freely in entering into the agreement and in its own best interests. The agreement is also subject to prior authorization by the competent supervisory authorities, which will check whether the conditions are met. In case of disagreement between different authorities of different entities the EBA can provide assistance through its mediation powers. Then, competent authorities shall transfer the agreements that they authorised to the relevant resolution authorities. In addition, any proposed agreement must be submitted to the shareholders of every group institution, otherwise it shall be valid only between those entities whose shareholders have approved it.

2.4.2. *Early intervention*

After the preparation phase, the BRRD offers, to the competent supervisory authorities, the possibility to act with special powers when there are signals of financial distress and before there is no alternative than to resolve the bank. When the financial structure of a bank is weakening and the competent authority establishes that conditions for early intervention are met, it shall notify the resolution authority without delay. Then, for each of the measures adopted during this stage, competent authorities are required to set an appropriate deadline for completion and to evaluate the effectiveness of the measure.

Article 27 of the BRRD lists the early intervention measures that competent authorities can implement during this stage. For example, they have the power to convene directly or force the management body of the institution to convene a meeting of shareholders. They can require the management of the institution to implement some of the measures set out in the recovery plan or, alternatively, modify the plan and implement a new and updated one, to ensure that the conditions that triggered the early intervention no longer apply. Moreover, the management body of the institution is required to examine the situation, to identify the measures needed to

overcome any problem. Based on these information, it should draw an action programme, with a timetable for its implementation and also a plan for negotiation on restructuring of debt. Alternatively, competent authorities can impose changes to institution's business strategy, legal or operational structures and may acquire also through on-site inspections all the information necessary to the resolution authority to update the resolution plan and for valuation of the assets and liabilities. Finally, those members of management who are found unfit to perform of their duties can be removed or replaced. However, when this replacement is considered insufficient to remedy the situation, authorities may appoint one or more temporary administrators, who replace the management body or works with it (BRRD, Article 28-29). The competent authority must specify in advance the role, duties and powers of the temporary administrator, which are meant to preserve or repair the financial position of the entity and restore a sound and prudent management. The competent authority can remove the temporary administrator at any time and for any reason. Normally, its role cannot last more than one year. However, the period may be exceptionally renewed, if the conditions continue to be met.

In fact, early intervention measures might be implemented only if the conditions provided by Article 27 apply. First, an institution must infringe or is likely in the near future to infringe the requirements of relevant EU and national implementing legislation. Second, based on the assessment of a set of triggers, there must be a rapidly deteriorating financial condition, whit respect to the liquidity situation, the growth level of leverage and non-performing loans or the concentration of exposures. Given the risk that Member States would apply different practices in assessing the conditions, EBA (2015), published the Guidelines to promote a consistent application of triggers for the decision to apply early intervention measures. The core problem that these Guidelines want to address is the absence of common rules and practices in applying early intervention measures by competent authorities throughout the EU. First of all, the Guidelines do not establish any quantitative thresholds for indicators, since they could be perceived as new levels for regulatory requirements for capital or liquidity, and the triggers do not oblige competent authorities to automatically apply early intervention measures in all cases. Likewise, competent authorities can avoid to apply early intervention measures where such triggers are not met, but they see a clear need for them. Moreover, all these events, together with the reasons for taking or not a measure and the further investigations, should be clearly documented by the competent authorities.

The triggers established on the EBA's document are closely linked to the outcomes of the common Supervisory Review and Evaluation Process (SREP) conducted by the competent authorities. SREP, that is one of the major components of the second pillar of Basel II, has a

structure built around the assessments of the business model, the internal governance and risk management, the risks to capital and the risks to liquidity. Each of these four specific components are evaluated on a scale going from 1, meaning no noticeable risk, to 4, which implicate high risk. The outcomes of these assessments are at basis for the overall SREP assessment, which represents the up-to-date supervisory view of the institution's risks and viability. Similarly, the overall SREP score has four positive grades, 1 to 4, and also one negative grade indicating that the institution has been classified failing or likely to fail and that the procedure for resolution should be activated. Therefore, triggers for early intervention based on the scores of the assessment of various SREP elements and the Overall SREP, can be used to identify any threat to the viability of an institution and the condition of Article 27. In particular, with an overall SREP score of 4 assigned to an institution, the competent authority should take a decision on whether to apply early intervention measures, without undue delay. The competent authority should also consider to take early intervention measures when the Overall SREP score is 3 and the assessment of one of the individual SREP elements result in a score of 4.

Alternatively, the guidelines recognise that the early intervention triggers can be constructed upon other circumstances, which are not included into the outcomes of the SREP assessment. For example, early intervention can be triggered by material changes or anomalies identified in the monitoring of key SREP indicators, but before that their assessment is updated. Moreover, measures could be also triggered by significant events that could put the institution into a situation where conditions for early intervention are met relatively rapidly. Examples of these events may be major operational risk events, such as dishonest trading, fraud, natural disaster, severe IT problems and significant fines imposed on the institutions by public authorities. Then, other significant events to be considered are the deterioration in the amount of eligible liabilities and own funds for the purposes of MELR, the unexpected loss of senior management or key staff, the downgrades by one or more external rating agencies and the need to review the quality of assets following a reputational damage of the institution.

2.4.3. Crisis management

a. Special management

When the situation deteriorates beyond repair, the third part of the BRRD provides a mechanism through which an administrative procedure may be initiated in order to manage the crisis of the institution or group. Chapter 1 of this Title presents the objectives, the conditions and the general principles governing the resolution process, which have been already analysed. In the

second chapter instead, the BRRD establishes that the resolution authority should have the power to appoint a special manager, in order to replace the management body of the institution under resolution. The special manager, whose appointment must be made public, should have the qualifications, ability and knowledge to carry out his functions. Under the control of the resolution authority, he can exercise all the powers of the shareholders and the management body, who no longer retain responsibility and control of the institution. The special manager has the statutory duty to take all the necessary measures to promote the resolution objectives and implement resolution actions. He is required to draw up reports on the economic and financial situation and on the acts he performed. Nonetheless, resolution authorities can set limits to the action of a special manager or require that his actions are subject to the resolution authority's prior consent. Like the temporary administrator appointed in the early intervention phase, the resolution authorities may remove the special manager at any time and his mandate should not last more than one year, although it can be renewed on an exceptional basis. In conclusion, with respect to banking groups, resolution authorities shall decide whether it is more appropriate to appoint the same special manager for all the entities concerned or more special managers (BRRD, Article 35).

b. Valuation for the purposes of resolution

"*Before taking resolution action or exercising the power to write down or convert relevant capital instruments, resolution authorities shall ensure that a fair, prudent and realistic valuation of the assets and liabilities of the institution [...] is carried out by a person independent from any public authority, including the resolution authority, and the institution*" (BRRD, Article 36). In fact, the valuation is needed to provide information in many circumstances, such as during the determination of the conditions for resolution and for the decision on the appropriate resolution action to be taken. Through the valuation, any losses on the assets of the institution are fully recognised at the moment that resolution tools are applied or the power to write down or convert relevant capital instruments is exercised. When an independent valuation is not possible due to the urgency in the circumstances of the case, resolution authorities may carry out a provisional valuation of the assets and liabilities of the institution, which will be accompanied as soon as possible by an ex-post definitive valuation. A valuation that does not comply with all the requirements is also considered to be provisional, until an independent person carries out, as soon as practicable, a fully compatible valuation. As regards the requirements, the valuation must be based on prudent assumptions and shall not assume any potential future provision of extraordinary public financial support or central bank emergency liquidity assistance. The valuation must also indicate the subdivision of the creditors

in classes in accordance with their priority levels under the applicable insolvency law and estimate the treatment that each class of shareholders and creditors would have been expected to receive, if the institution were wound up under normal insolvency proceedings.

c.   *Resolution tools*

The resolution authorities have at their disposal four resolution tools, which can be applied without obtaining the consent of the failing bank's existing shareholders or any other stakeholder and without complying with any procedural requirements under company or securities law. They consist in the sale of the business of the institution under resolution, the setting up of a bridge institution, the separation of the performing assets from the impaired or under-performing assets of the failing institution and the bail-in of shareholders and creditors. The choice of tools will depend on the specific circumstances of each case and on the options laid out in the resolution plan prepared for the bank. In fact, the resolution plan should be generally followed by resolution authorities, unless different measures can achieve the resolution objectives more effectively. Resolution authorities can employ the tools separately or in combination. Moreover, if an institution meets the conditions for resolution, Member States may confer additional tools and powers provided that they do not pose obstacles to effective group resolution and they are consistent with the resolution objectives and the general principles governing resolution (BRRD, Article 37).

As regards the **sale of business** tool, authorities have the power to transfer the shares or other instruments of ownership issued by an institution under resolution or any of its assets, rights or liabilities to one or more purchasers that are not a bridge institution. The transfer shall be made on commercial terms that conform the valuation, having regard to the circumstances, and in accordance with the Union State aid framework (BRRD, Article 38). Moreover, resolution authorities must respect some procedural requirements when putting on sale the assets, rights, liabilities, shares or other instruments of ownership that they intend to transfer. This marketing must be as transparent as possible, free from any conflict of interest and shall not favour or discriminate any potential purchasers. In addition, it shall take into account the need of rapid resolution action, having a view of sale price maximization for the items sold. However, the compliance with these requirements can be avoided if they are likely to undermine one or more resolution objectives, together with a material threat to financial stability and a reduction of the effectiveness of the sale of business tool (BRRD, Article 39).

When an appropriate acquirer cannot be found immediately, the resolution authorities have the power to transfer to a **bridge institution** the instruments of ownership, assets, rights or

liabilities of one or more institutions under resolution. The bridge institution shall be a legal person that it is wholly or partially owned by one or more public authorities and controlled by the resolution authority. It must be created with the purpose of receiving and holding some or all of the shares, other instruments of ownership, assets, rights and liabilities, with the objective to maintaining access to critical banking functions and selling the institution (BRRD, Article 40). In addition, the operation of a bridge institution must respect many requirements. The bridge institution's constitutional documents must be approved by the resolution authority, which decide also on the nomination or approval, remuneration and responsibilities of the management body. The resolution authority approves also the bridge institution's strategy and risk profile. The operations of the bridge institution, which can be restricted by the resolution authority, shall in general be carried out in accordance with the Union State aid framework. In addition, the bridge institution complies with the requirements and is subject to supervision. However, it may be exempted for a short period of time, when it is necessary to meet the resolution objectives. The operation of a bridge institution shall be terminated by the resolution authority as soon as possible and, in any case, two years after the date on which the last transfer to the bridge institution tool was made. Nevertheless, the 2 years-period may extend one or more additional one-year periods, provided that some conditions are fulfilled. Alternatively, the termination of the bridge institution occurs when the bridge institution merges with another entity, when it ceases to meet the requirements of public ownership and scope, when it transfers of all or substantially all of its assets, rights or liabilities to a third party or when its assets are completely wound down and its liabilities are completely discharged (BRRD, Article 41). For the bridge institution tool, but also for the sale of asset tool, the legislation provides that the remaining institution, from which the assets, rights or liabilities have been transferred, shall be wound up under normal insolvency proceedings, within a reasonable timeframe. Both the bridge institution or the purchaser under sale of asset tool are considered to be a continuation of the institution under resolution, in order to enable them to carry out the activities or services acquired and exercise any right in respect of the assets and liabilities transferred.

Similarly to the bridge institution, the **asset separation** tool is designed to avoid further losses caused by the immediate forced sale of the failed bank's portfolio of assets. However, in order to avoid undue competitive advantages for the institution, this tool can be used only jointly with another resolution tool. In fact, resolution authorities have the power to transfer assets, rights or liabilities of an institution under resolution or a bridge institution to one or more asset management vehicles, which manage the assets received with a view to maximising their value through eventual sale or orderly wind down. Like the bridge institution, the asset management

vehicle has the requirements of being owned by one or more public authorities and controlled by the resolution authority. Moreover, the same rules apply on its operation, in particular for the approval, by the resolution authority, of the constitutional documents, the management body and the strategy and risk profile. In addition, there are three conditions that need to be respected to use this tool. First, the liquidation of those assets under normal insolvency proceedings must not cause an adverse effect on one or more financial markets. Second, the transfer must be necessary to ensure the proper functioning of the institution under resolution or bridge institution. Third, the separation between clean and toxic assets must be crucial to maximise liquidation proceeds (BRRD, Article 42).

Finally, the last but most important tool, the **bail-in**, empowers the resolution authorities to force the stakeholders, of a failing or failed bank, to contribute to the financial cost of resolution. In accordance with the resolution principles and objectives, the legislation specifies that this tool can be applied for the purpose to recapitalise an institution, if there is a reasonable prospect that it will restore the institution financial soundness and long-term viability. Otherwise, it may serve to convert to equity or reduce claims and debt instruments that are transferred through the sale of business, bridge institution or asset separation tools (BRRD, Article 43). The bail-in tool must be applied to all liabilities of an institution, except for those that are specifically excluded. In fact, resolution authorities cannot exercise the write down or conversion powers in relation to covered deposits, to secured liabilities such as covered bonds and financial instruments used for hedging purposes, to liabilities with an original or remaining maturity of less than seven days and to any liability owed to employee, commercial or trade creditor, tax and social security authorities or deposit guarantee schemes. Generally, liabilities should be excluded if their inclusion in the bail-in causes higher losses to other creditors. In addition, the resolution authority may exclude or partially exclude certain liabilities from the application of the write-down or conversion powers in exceptional circumstances. For example, if there is no reasonable time to bail-in that liability and when that liability is needed to insure the continuity of critical functions or avoid widespread contagion. However, in the case that a resolution authority excludes an eligible liability, the level of write down or conversion applied to other eligible liabilities must be increased to take account of such exclusions. If the other creditors cannot carry the additional burden, a contribution of the resolution financing arrangements is allowed. In any case, before exercising the discretion to exclude a liability, the resolution authority must notify the Commission which, in order to protect the integrity of the internal market, may prohibit the proposed exclusion (BRRD, Article 44).

Another task of the resolution authorities is to quantify, on the basis of the valuation, the amount of the bail-in, which is composed by the amount of eligible liabilities that must be written down to ensure that the net asset value is equal to zero and the amount of eligible liabilities that must be converted into shares or other types of capital instruments to restore the Common Equity Tier 1 capital ratio (BRRD, Article 46). Then, Article 48 of the BRRD specifies the rules to determine the sequence of write down and conversion during the application of the bail-in tool. First of all, "*when applying the write down or conversion powers, resolution authorities shall allocate the losses equally between shares and eligible liabilities of the same rank, except where a different allocation of losses amongst liabilities of the same rank is allowed*". In particular, Common Equity Tier 1 items must be reduced first in proportion to the losses and to the extent of their capacity, through the cancellation or transfer of shares and/or through severe dilution of existing shareholders, as a result of the conversion into shares of relevant capital instruments or eligible liabilities. If, and only if, the total reduction of losses is less than the previous reduction, authorities can reduce the principal amount of Additional Tier 1 instruments to the extent required and to the extent of their capacity. With the same principle, authorities will then reduce principal amount of Tier 2 instruments. If the total reduction of shares or other instruments of ownership and relevant capital instruments is still less than the losses, authorities must reduce the principal amount of subordinated debt that is not Additional Tier 1 or Tier 2 capital in accordance with the hierarchy of claims in normal insolvency proceedings. Finally, the last possibility to cover the losses comes from the reduction of the principal amount of the rest of eligible liabilities, including the deposits, following the ranking provided by Article 108 (BRRD, Article 48).

Since this pecking order is known, institutions could have the incentive to structure their liabilities in a way which reduces the risk of bail-in, weakening its effectiveness. To prevent this situation, the Article 45 obliges institutions to meet, at all times, a minimum requirement for own funds and eligible liabilities (MREL), "*calculated as the amount of own funds and eligible liabilities expressed as a percentage of the total liabilities and own funds of the institution*". There are several condition for a liability to be included in the amount of own funds and eligible liabilities. The instrument must be issued and fully paid up, the liability must not be owed to, secured by or guaranteed by the institution itself, the purchase of the instrument had not to be funded directly or indirectly by the institution, the liability must have a remaining maturity of at least one year and the liability does not arise from a derivative. After consulting the competent authority, resolution authority will determine the MREL, on the basis of a set of

criteria established by the BRRD and the technical regulatory standards further specified by the EBA (BRRD, Article 45).

In conclusion, after the application of the bail-in tool, the management body or the appointed person, should develop, within one month, a business reorganisation plan and submit it to the resolution authority. In exceptional circumstances, the resolution authority may extend the period up to a maximum of two months, if it is necessary to achieve the resolution objectives. The reorganization plan must be compatible with the restructuring plan that the institution is required to submit to the Commission under the State aid framework. It shall contain a detailed diagnosis of the factors that caused the entity to fail or to be likely to fail, a description of the measures aimed to restore the long-term viability and a timetable for the implementation of those measures. Then, within one month of the date of submission of the business reorganisation plan, the relevant resolution authority shall assess the likelihood of the plan to accomplish its objective. If the resolution authority notifies that the plan is not satisfactory, the management body shall submit, within two weeks, an amended plan, which must be again approved or rejected within one week (BRRD, Article 48).

3. Optimal bank recovery

3.1. The rationale for developing a quantitative metric

In chapter 2, I described how the BRRD has improved the regulatory attention to the period preceding the resolution of a bank. In particular, thanks to the early intervention phase, a bank has the possibility to be restored to normal conditions before it is forced to be resolved. As we saw, in the Banking Union the ECB or the national competent authorities are provided with a set of early intervention powers, which consist, for example, in the implementation of the recovery plans and in the write down and/or conversion of capital instruments. Generally, a bank recovery is preferred to a bank resolution, since the early management of a likely failing bank would help the financial system to additionally mitigate the systemic risk. Therefore, the early intervention phase can be seen as the main point of contact between supervision, on one hand, and resolution, on the other.

At the same time, however, the legislation does not clearly specify the criteria that can trigger the start of the early intervention phase. To trigger the recovery, Article 27 of BRRD establishes that there must be the solid possibility to infringe the requirements of the relevant EU and national legislation or a rapidly deteriorating financial condition, with respect to the liquidity situation, the growth level of leverage and non-performing loans or the concentration of exposures. As one could note, such conditions are largely subjective and formulated in a general manner. Thus, during their assessment, it is reasonable to expect that Member States would apply diverse practices and, as a result, obtain different outcomes. These divergences can also have detrimental effects for the financial system, since they can lead to an uneven playing field for institutions. For example, a different treatment of entities belonging to the same cross-border group, may force the financial institutions to reduce their operations in countries where the regulatory framework is stricter or less predictable and transfer their businesses to jurisdictions which have more favourable regulatory frameworks. Moreover, a lack of clarity about the determination of such conditions, could bring a competent authority to take an unnecessary early intervention measures or, in the opposite case, to reject the implementation of a recovery action when it is necessary. Again, these suboptimal supervisory decisions may lead to several problems and distortions in the European banking sector.

In order to avoid such negative implications, the BRRD appointed the European Banking Authority to issue some guidelines to facilitate the consistent application of early intervention triggers. In fact, the main objective of the EBA's guidelines regards the promotion of an effective and efficient functioning of the EU banking sector. In order to develop, the banking

system requires that the competent authorities must use the same rules and practices, especially if cross-border cooperation is needed. I already mentioned that, following these guidelines, the decision should be taken in connection with the common Supervisory Review and Evaluation Process (SREP), which is already conducted by the competent authorities. In alternative, the guidelines recommend that the early intervention can be triggered on the basis of other circumstances, such as when significant events lead to a rapidly deterioration of financial conditions.

Nevertheless, one of the most important characteristics of the EBA's guidelines is that they do not establish any quantitative factors and thresholds that should be applied by the competent authorities. The reasons behind the decision to implement this type of framework are several. The most important argument is that, having the decision based exclusively on a quantitative threshold could be considered as a new regulatory requirement, both by the institution and the market. Thus, in order to avoid negative consequences, institutions would be forced to stay above the early intervention threshold. In fact, the market can easily overreact to situations when the quantitative threshold is met, or even when it is going to be approached. For instance, the intervention of the competent authority will probably cause a reputational damage, which can lead ultimately to bank runs. In fact, the recovery is a serious and traumatic situation for the management and it should be triggered only when it is vital for the institution. When authorities judge whether or not to proceed with the intervention, they may stumble upon the possibility of taking the wrong decision. On the one hand, authorities may initiate an unnecessary early intervention, while, on the other hand, they may miss a required recovery, which could also increase the costs of resolution at a later stage. As we will see later, a part of the literature discussion is focused on the balancing between Type I errors, missing a required intervention, and Type II errors, initiate an unnecessary intervention. Authorities may have different preferences about this trade-off. In EBA's opinion, taking this decision exclusively using a single quantitative threshold may lead to a number of mistakes, because of the significant variety across institutions and jurisdictions.

In contrast with the approach adopted by the EBA, some studies highlighted the potential advantages of having a scientific metric through which take the intervention decision. First of all, those who proposed the implementation of a quantitative threshold sustain that the numerical parameters of the trigger should not be public, whereas the principle whereby this trigger is set should be known to all. In this way, the negative effects of a possible reputational risk and a subsequent market reaction can be avoided. In second place, a quantitative metric could also deal with the problem originated by the unclear conditions of Article 27 of BRRD.

In fact, it would increase both the convergence of supervisory activities across jurisdictions, as well as the clarity and transparency to market participants and institutions. Last but not least, even if this type of models based only on quantitative factors could be time consuming to develop, difficult to test and costly to update, they can more effective in reducing Type I and Type II errors.

3.2. Literature review

For all the reasons just described, it seems that the development of an objective metric, determining the recovery trigger, should be taken into consideration, especially in the context of the Banking Union. One of the most recent and significant attempt has been provided by Goodhart and Segoviano (2015). With their paper they tried to address the lack of appropriate triggers for the early intervention phase. In fact, it is not always clear when recovery plans or actions should be triggered. Although there is a significant discussion on the triggers for resolution, the models signalling the need to entry into the recovery stage are not as much as developed.

A first part of the so-called "early-warning" literature focuses on discovering structural vulnerabilities and common patterns preceding the financial crises. Several recent research papers aimed to analyse bank failures during the global financial crisis. Thus, using proxies for CAMELS[1] indicators, the majority of these studies exhibit a high success in forecasting the US bank failures. The CAMELS rating system, which was introduced by the US regulators in 1979, is a supervisory tool used to gauge the robustness of financial institutions on a uniform basis and identify those who need special supervisory attention or concern. It plays a central role in these accounting-based models, which employ balance-sheets indicators as significant factors to predict bank failures. Progressively, other studies expanded the pure accounting-based structure with macroeconomic and market price-based indicators, due to their ability to give useful predictive information. An overall review of the empirical results of these studies is offered by Demyanyk and Hasan (2009) in their article entitled "*Financial crises and bank failures: a review of prediction methods*". In particular, the authors examined the financial and economic circumstances associated with the US subprime mortgage crisis and the subsequent global financial distress, which led to severe recessions in many countries. In fact, only a small

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[1] Acronym for Capital adequacy, Asset quality, Management quality, Earnings, Liquidity and Sensitivity to market risk

number of studies dealt with the European banking sector, due to data limitations arising from relatively few direct bank failures in core Europe. Some of them focused on the optimal level of bank capital that an institution should hold to reduce the likelihoods of distress. One example is the contribution of Haq and Heaney (2012), who used information for 117 financial institutions across 15 European countries, over the period 1996–2010, to develop a model that investigates the equity risk. The main result they obtain is that, beside the expected negative relationship between bank capital and credit risk, there is also evidence of a non-linear relation. In particular, a U-shaped relation suggests that capital regulation may have unintended consequences. In the author's opinion it is possible that, if banks are forced to further increase their high level of capital buffer, they may increase also its risk. As a result, they recognised that there are limitations to the utility of capital regulation as a channel to decrease the possibility of bankruptcy. Similarly, but using a different approach, Miles *et al.* (2013) estimated the costs and benefits for banks of having higher levels of loss absorbing capital. Using empirical evidence on UK banks, they defined the optimal level of equity ratios by comparing the extra social benefits, from financial stability, with the extra costs applicable to financial intermediation. They found that the inflection point, which occurs when benefits exceed or are equal to costs, might be much higher than the minimum regulatory requirements. Thus, they concluded that the desirable amount of equity capital is larger than the amount that banks have held in recent years under the Basel III framework.

Rather than predicting failures or distresses at the bank level, a second part of the literature concentrates on the optimal "early-warning signals" for policymakers. In particular, an important concept for these studies is the loss function of policymakers that takes into account the costs for preventive action and the relative preferences between missing crises (Type I errors) and false alarms (Type II errors). An important empirical finding, achieved by Betz *et al.* (2013), is that their early-warning model, employing only publicly available data, produces useful out-of-sample predictions of bank distress, in the period of the global financial crisis. Moreover, based on their results, they stated that a policymaker should be significantly more worried about committing Type I errors rather than Type II errors. Many studies highlighted that, in this trade-off, the former are more important to be minimised than the latter, because of the more punitive effects of bank failures. Recovery, instead, is more reversible, therefore some Type II errors are allowed. However, since the expropriation of existing ownership rights, which may occur with the bank recovery, is a drastic and legally complex measure, it is also important to avoid Type II errors. This opinion is shared by Goodhart and Segoviano (2015). According to them, the recovery trigger should be fixed at a point that minimizes the

combination of both the two types of errors. They argue that their model captures almost all banks that are dealing with severe probabilities of default and only few banks which would have survived on their own. In fact, an optimal recovery decision should in general regard all the banks that would have failed without intervention, and, at the same time, it should not hit too many banks that would have survived anyway.

More in detail, Goodhart and Segoviano (2015) hypothesised an intervention metric built on the comparison between the loss absorbing buffers and the potential extreme losses, that are driven by the institution's default probability. By analysing 19 large European and American banks between January 2007 and December 2012, they identified the periods in which potential losses were equal or larger than the loss absorption buffers. Based on these results, they designed a ladder of sanctions[2], whose degree of intervention is more and more punitive as the loss absorption buffer deteriorates and/or the potential extreme losses increases.

Therefore, they fixed the recovery threshold when the Distance to Default (DD) is equal to 1,50 or, equivalently, when the Probability of Default (PD) is 6,68%. In order set such a trigger level, they calculated the cumulative frequency of those banks whose potential losses exceeded the respective loss absorption buffer. Then, they related those frequencies with the respective level of distance to default. By distinguishing the cumulative distributions of solvent and insolvent

Figure 11: Cumulative distribution of banks whose losses were above the buffer
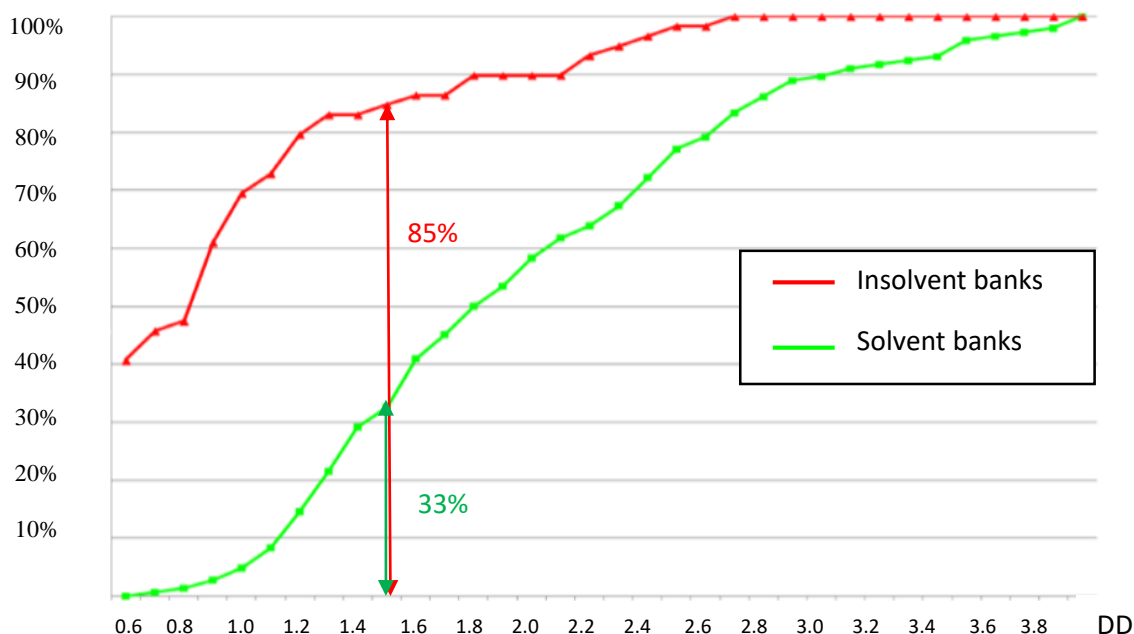
Source: Goodhart and Segoviano (2015)

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[2] From the least to the most severe: frequent visit sanction, pecuniary charge sanction, remuneration sanction, intervention.

banks, they could understand how many banks of both categories would have been exposed to early intervention measures. In Figure 11, the distiction is made by using the green line, which identifies the percentage of banks that remained solvent, and the red line, which shows the percentage of banks that defaulted. Therfore, when a bank satisfies the intervention criterion and the distance to default is at least 1,5 ($DD \leq 1,5$), 33% of solvent banks and 85% of insolvent banks would have been subject to recovery. As a result, the corresponding Type I error is 15%, while type II error is 33%. In other words, only 15% of the insolvent banks would have been excluded from recovery, while 33% of solvent banks would have been intervened unnecessarily. If the threshold is moved to the right, it is possible to obtain lower type I errors, but at the expense of greater type II errors.

Moreover, by setting this recovery threshold, Goodhart and Segoviano identified the lag that there would have been between the intervention and the insolvency announcement of their 4 defaulting banks. Looking at the date when the threshold was reached, they concluded that recovery would have taken place 6 to 8 months before the insolvency. In fact, the recovery phase should be triggered long enough before the bank is put under resolution. In this way, remedial actions, implemented by managers and supervisors, have better probabilities to take effect successfully, to turn the bank around before resolution takes place.

3.3. Model specification

There are several reasons why for competent authorities it is beneficial to have at their disposal a quantitative framework to evaluate the intervention decision. Most importantly, we saw that a common framework would increase the convergence of supervisory activities across the Member States. Moreover, given the fact that the actual trigger level should be not publicly observable, the competent authorities of a certain country or jurisdiction could balance the recovery threshold to obtain different combinations of Type I and Type II errors. Indeed, their decisions should be based on the characteristics of their banking system and on their own preferences, objectives and risk aversion.

I therefore decide to evaluate an optimal recovery framework for the Italian banking system, in order to retrieve more detailed and specific results. My specification is based on the metric developed by Goodhart and Segoviano (2015), which owns several qualities. In particular, being built on observable, verifiable and objective data, their model is less vulnerable to manipulation and more clear and transparent for institutions. In fact, a problem with traditional accounting measures, which are adopted by regulatory framework, is that they rarely report the

true value of the institution, due to lag and/or manipulation. Therefore, these measures are not suitable in the context of early intervention, where it is essential to have prompt and true information. Later, we will see the different approaches to obtain the parameters of interest, which are needed to take the intervention decision. An ulterior advantage is indeed the great flexibility at disposal of competent authorities, which, depending on the characteristics of their financial systems and on the data availability and quality, may decide to implement different methods to recover the desired information. Nevertheless, the accuracy of a specific approach, such as for the determination of the probabilities of default, depends on the theoretical assumptions, since they might not hold in reality.

However, the Goodhart and Segoviano's original effort to address the lack of an optimal recovery threshold has one main limitation. As regards their sample of banks, on the one hand, they employed data of top European banks to judge the behaviour of solvent banks. On the other hand, with respect to the insolvent ones, they used both European and a US data. As I already mentioned, the issue of European studies is the lack of data for insolvent core banks. To avoid this problem, they complemented their dataset with some US banks, specifically Lehman Brothers and Washington Mutual, which are two investment banks. Indeed, including in the sample both commercial and investment banks, which have different balance sheet structures, may lead to unreliable results. In addition, in the period that those banks defaulted, their reported probabilities of default, of approximately 34% and 21% respectively, are much bigger than the probabilities of default of the two European failed banks (13%). Therefore, the shape of the cumulative distribution, which I discussed earlier, is affected in a substantial way.

As a result of these considerations, I tried to develop a model for the Italian banking system, which, ideally, can be used by competent authorities to better balance the quantitative intervention threshold. To do so, I took into account the Italian banks that are listed in the Milan stock exchange, excluding the institutions that conduct mainly investment banking activity[3]. In this way, the model allowed me to evaluate and compare both the past and the current conditions of Italian banks, with respect to their probability of default and their ability to absorb the potential extreme losses that may occur. In addition, after aggregating the results for the banks that remained solvent, it is possible to provide the estimates of Type II error. On the contrary, as regards the insolvent banks and thus the Type I error, the results were not as reliable as the solvent ones. I used data of two listed banks, Banca Etruria and Banca Popolare the Spoleto, that were put under extraordinary administration by the Italian Ministry of Economy and

---

[3] Mediobanca, Banca Finnat, FinecoBank and Banca Profilo were excluded from the sample.

Finance. However, probably due to the small amount of observations of insolvent banks and the relative small importance of those in the sample, the final results cannot be considered satisfactory. Following the idea of Betz *et al.* (2013), a possible solution, which I tried to implement, could be that of consider also the state interventions and mergers in distress, in addition to bankruptcies, liquidations and defaults.

3.3.1. *Criterion for intervention*

The stages of the model implementation are well summarised by Figure 12.

Figure 12: Model implementation steps

Source: Goodhart and Segoviano (2015)
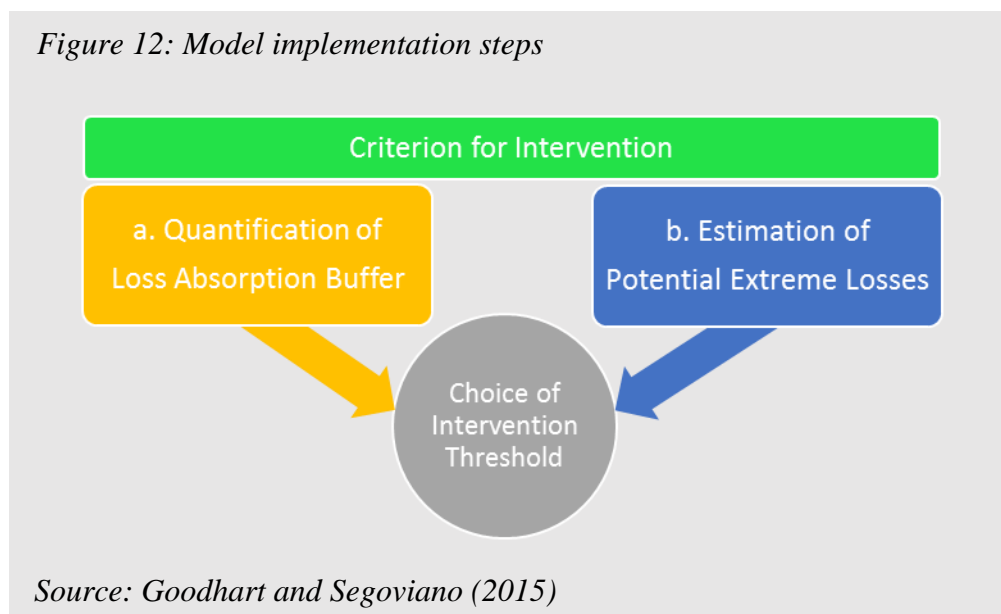
First, in order to choose a threshold, we need to define the criterion for intervention. This will be the critical ratio, through which the institutions that should be subjected to intervention can be identified, whether with recovery or milder sanctions. The easiest solution is to follow the concept that is at the basis of the regulatory framework of the Basel Accord, but adopting some modifications to overcome its problems. In particular, Basel's rules emphasise that expected losses (EL) should be managed through the pricing of credit exposures and through provisioning, since they are viewed as normal a cost component of doing business. On the other side, capital should serve to cover the institution from unexpected losses (UL), up to a certain degree of confidence. Therefore, in order to judge the health of an institution, one should analyse the ability of the institution to absorb both expected and unexpected losses. For these reasons, the loss absorption buffer can be defined as the sum of capital and provisions, while the sum of expected and unexpected losses represents the potential extreme losses. As a result, the early intervention measures should be triggered only when the potential extreme losses are larger than the loss absorption buffer of the bank:

$$Potential\ Extreme\ Losses_t > Loss\ absorption\ buffer_t \qquad (1).$$

Hence, in order to develop this criterion, it is crucial to:

a. define the components of the loss absorption buffer; and

b. specify of an approach to estimate the loss distribution, through which calculate the potential extreme losses.

a. Loss absorption buffer

As regards the first goal, the traditional techniques to assess the level of absorption buffer use the accounting value of regulatory capital expressed in relation to a measure of its risk-weighted assets (RWA). However, these quantities, that are commonly called Capital Adequacy Ratios (CARs), are not reliable in the framework of early intervention. Many researchers sustain that these measures lack in reliability due to the difficulties in assessing the true value of both the numerator and the denominator. In particular, "*despite progress in requiring banks to employ asset valuations that track the economic value of tangible assets better, book equity remains a highly deficient means of measuring the true economic value of equity*" (Calomiris, 2015, p. 4). There are essentially two motivations to avoid the use of accounting measures. First, when institutions experience losses on their tangible assets, such as loans, they typically postpone the recognition of the problems. In addition, this delayed recognition is often permitted, since it is convenient to supervisors and to banks, in order to continue the normal operations. Second and more important, when a bank becomes financially stressed, it is extremely probable that the real value of its equity is already severely impaired before the recognition in the accounting and regulatory values. On the other hand, also the value of denominator presents some problems. Specifically, the measure of the risk-weighted assets might have different regulatory definitions across countries and might be subject to the accounting manipulation problem.

Therefore, an adjustment of the parameters can help to get rid of these issues. In particular, since the book value of equity does not mirror the market perceptions, a correct way to ensure the adequacy of equity capital might be considering the economic value of capital itself. For listed banks such a value is the Market Capitalization. It could represent the right measure not only because it is more accurate and reacts faster to changes, but also because it captures the opinions of the market place, which are important for the sustainability of the institution. However, since it can still be subject to both market over-shoots and temporary crashes, a quarterly moving average of Market Capitalization was implemented. Beside the value of capital, the provisions were also included as part of the numerator of the loss absorption buffer, since they are needed to protect against expected losses. Differently from the market capitalization, these quantities are not subject to market over-shoots and they are usually kept in cash or in low-risk liquid fixed income assets. Moreover, given its simplicity of calculation,

Total Assets (TA) is used as denominator of the buffer. The idea of combination Capital Adequacy Ratios with Leverage Ratios should provide an efficient way to avoid the difficulties in assessing RWAs and allow an easier comparison across institutions. As a result of these considerations, the risk sensitive loss absorption buffer ratio can be defined as:

$$Loss\ absorption\ buffer_t = \frac{MA_4(Market\ Cap_t) + Provisions_t}{Total\ Assets_t} \qquad (2),$$

where

$$MA_4(Market\ Cap_t) = \frac{Market\ Cap_t + Market\ Cap_{t-1} + Market\ Cap_{t-2} + Market\ Cap_{t-3}}{4} \qquad (3).$$

This becomes the target ratio that will be compared with the potential extreme losses, in order to understand which institutions should be subject to intervention. This buffer is able to reflect more closely market perceptions and, at the same time, it is less subject to accounting manipulation or regulatory divergences. In addition, being a more transparent indicator, it is easier estimable by regulators, investors, and markets.

b. Potential extreme losses

The loss absorption buffer must be compared with the potential extreme losses, defined as the sum of Expected and Unexpected losses. In order to measure them, we need the loss distributions of the banks at each period of time. Thus, from the distribution it is possible to retrieve the information about the amount of losses that a bank can potentially experience and their respective probability of occurrence. For example, Figure 13 illustrates how the variation over time of the loss rates lead to the distribution of losses. As reasonable, Expected Losses (EL) can be identified by focusing on the mean value of this distribution. On the contrary, by looking on the high percentiles of the loss distribution, it is possible to infer the value of the Unexpected Losses (UL).

Figure 13: Loss Rates and Loss Distribution
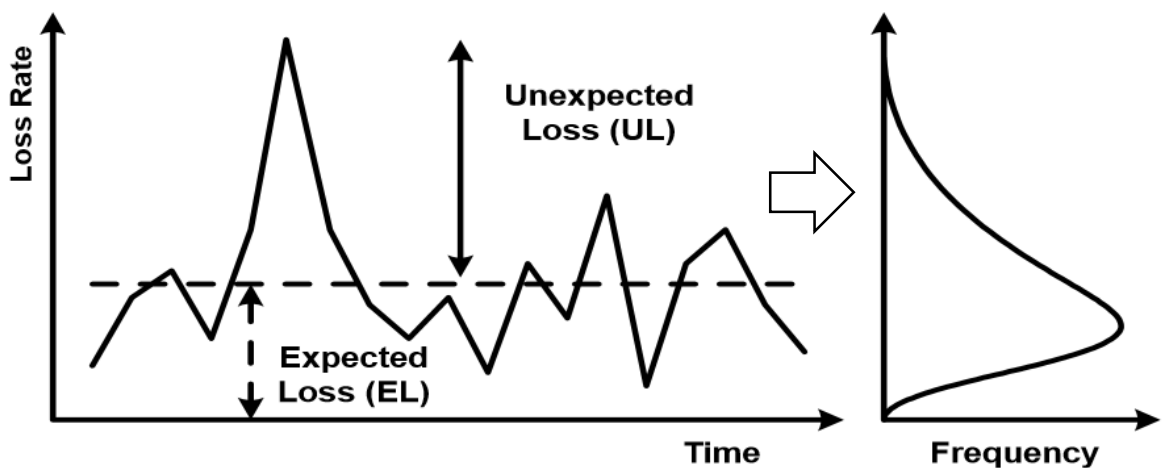
Basel Committee (2015)

There are essentially two techniques to evaluate a loss distribution function. The first is based on Monte Carlo simulation, where losses are simulated and organised in form of a histogram in order to obtain an empirical loss distribution of the underlying portfolio. The second is based on a so-called analytical approximation. Briefly, this approach associates the actual portfolio with an unknown loss distribution to an equivalent portfolio with known loss distribution. In this study, the loss distribution function has been estimated under the Vasicek approach, which belongs to the second category just described. This method is used by the Basel regulatory framework to recover explicitly the default rate of a portfolio of loans, to evaluate the portfolios' loss distributions and, at the end, to quantify the capital requirements for that portfolio. Goodhart and Segoviano (2015) applied this approach to the banks by calculating the probabilities of default and using them as input in the Vasicek's model, which requires an average unconditional probability of default. This approach is highly useful given its theoretical simplicity, but is based on some key assumptions which may fail to hold in the reality. Vasicek (2002) assumed that the number of obligors in a portfolio tends to infinity and that they are homogeneous. Another limitation applying its model is the fact that we cannot measure the portion of systemic risk, which is the contagion that a distressed bank can produce on the other banks of the system. To take into consideration the potential losses suffered owing to the banks' interconnections, Goodhart and Segoviano (2015) implemented the Threshold-approach, which is a non parametric model. Therefore, it is based on fewer assumptions and might be preferred in certain circumstances. At the same time however, the Threshold-approach is based on a more complex theoretical framework and requires an elaborate estimation. As shown by the authors, the Threshold-approach produces, unsurprisingly, lower Type I and Type II errors than under the Vasicek approach. Nevertheless, the final results are very similar.

- *Probability of Default*

In order to determine the probabilities of default for each bank, many different approaches can be used. The most common way consists in the extraction of these probabilities from the well-known Merton's model. Given the sample of banks under analysis and their data availability, I chose to implement this approach. In brief, Merton assumes that the total value of a firm's assets (A_t) follows a geometric Brownian motion, with a mean rate of return (μ_A) and volatility (σ_A). The debt instead is assumed to be a single outstanding bond with face value (F) and maturity (T). The firm defaults at the bond maturity when the value of its assets falls below the amount of debt it has to repay, otherwise it pays its debt in full. Therefore, in Merton's view, the equity (E) is a call option on the firm's assets. As a result, the probability of default at time T, measured at time t, is given by:

$$P_t[A_T \leq F] = N[-d_2] \tag{4},$$

where

$$d_2 = \frac{\ln\left(\frac{A_t}{F}\right) + 0.5 * (\mu_A - \sigma_A{}^2)(T-t)}{\sigma_A \sqrt{T-t}} \tag{5}.$$

To overcome the assumptions made by Merton, the literature provides several specifications of this model. In particular, some of the specifications made by Kealhofer, Merton and Vasicek (KMV), such as the choice of the face value of the firm's debt, have been adopted in this study.

In order to implement the model, the first information required are the economic value of equity and the volatility of the equity returns (σ_E). Therefore, the market capitalization is used as equity value, while to obtain the volatility, the historical values of stock prices were analysed. Hence, I calculated the historical logarithmic returns of stock prices and, from them, I retrieved the annualised standard deviation[4]. In particular, three different time windows of 180 days, 270 days and 360 days have been used to calculate the volatility. Moreover, as regards the values of the expected return on assets (μ_A), I followed the basic formulation of the Merton's model. Thus, I replaced the assets expected return with the risk-free rate (r). In this way, the probability measure that governs the asset and default processes represents risk-neutral probabilities of default. They are only valid in a risk-neutral world in which $\mu_A = r$, but in the real world investors demand $\mu_A > r$. As a result, this leads to an overestimation of the probabilities of default. I compared the results of using the yield of the 1-year BOT and the 10-years benchmark BTP, since they incorporate the risk of the country. In any case, probabilities of default are not sensitive to calibration of different expect returns, since the final results are find to change very slightly. In alternative, the assets expected return could have been estimated separately, by applying the CAPM model[5], but again the outcome on the probabilities of default would have not been significantly different.

For the next step, as it is common to assume, I set the forecasting horizon of one year ($T = 1$). According to this time window, the amount of debt that should be considered for the potential default is the portion of total liabilities that is due in one year. Therefore, the total debt is inadequate since not all of it is due in one year. However, also the short term debt maturing in one year is not suitable since, in case of default, the bank might be forced to serve senior

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[4] $\sigma_{Ea} = \sigma_{Ed}\sqrt{252}$

[5] $CAPM: \mu_A = r_f + \beta_A * MP$ where $\beta_A = \beta_E * \frac{\sigma_A}{\sigma_E}$ and MP is the market premium.

liabilities with longer maturity first. Hence, as suggested by the KMV specification, the face value of the debt to be considered is the short-term liabilities plus half of the long-term liabilities. Like for the equity volatility, the sensitivity of results with respect to different definitions of the default barrier has been checked.

At this point, the remaining input variables are the market value of assets (A_0) and the volatility of assets returns (σ_A). Unfortunately, they are both usually directly unobservable. However, in accordance with the KMV specification, it is possible to use prices of traded securities issued by the firm to identify these quantities implicitly. In fact, such values can be recovered by solving simultaneously the following system of equations:

$$
\begin{cases}
E_0 = A_0\, N(d_1) - Fe^{-rT}\, N(d_2) \\
\\
\sigma_E = \dfrac{A_0}{E_0}\, N(d_1)\, \sigma_A
\end{cases}
\tag{6}.
$$

The first function represents the present value of the firm equity, which can be defined through the Black-Scholes specification. In fact, the Equity holders receive what remains after having paid the debtholders on date T. The second equation, which is obtained by applying the Ito's lemma, determines the relation between the volatility of equity returns and the volatility of assets returns. Therefore, using MATLAB[6], it is possible to simultaneously solve the system of equations (6). However, since there are infinite pair of values of A and σ_A, they were computed by minimizing the following function:

$$
\varepsilon = \left(\frac{Obs\ E_t - Model\ E_t}{Obs\ E_t}\right)^2 + \left(\frac{Obs\ \sigma_E - Model\ \sigma_E}{Obs\ \sigma_E}\right)^2
\tag{7}.
$$

This function sums the squared errors between the observed values ($Obs\ E_t$ and $Obs\ \sigma_E$) and the new obtained values ($Model\ E_t$ and $Model\ \sigma_E$). To start the iterations, the two initial estimates of the unknowns were set as:

$$
A_0 = E_0 + F_0
\tag{8},
$$

and

$$
\sigma_A = E_0 * \frac{\sigma_E}{A_0}
\tag{9}.
$$

---

[6] MATLAB script is presented in Annex A

- *Quantification of Losses*

Once probabilities of default for each bank have been identified, it is possible to implement several methodologies to determine banks' loss distribution and, consequently, quantify their potential losses. These approaches differ significantly in their theoretical foundation, assumptions and data requirements. As already mentioned, I quantify the losses under the Vasicek approach, which is the method employed by the Basel regulatory framework.

Given the fact that in Merton's model the probability of default and the default threshold are linked through the normal distribution function, Vasicek (2002) showed that by applying the inverse normal distribution function to the unconditional probabilities of default ($N^{-1}(PD)$), it is possible to derive the appropriate default threshold for "average" conditions. Similarly, in the Vasicek's formula the required conservative value of the systematic risk factor is also taken into consideration by using the inverse of the normal distribution function of the regulatory confidence level x ($N^{-1}(x)$). In particular, under the Basel II framework losses are computed at the 99.9[th] percentile. The sum of the default threshold and the conservative value of the systematic factor yields to the "conditional default threshold". The new threshold is then used as input into the original Merton model by applying the normal distribution function, which returns a conditional probability of default. All the steps performed are summarised in the following equation:

$$F(x; PD, \rho) = N\left(\sqrt{\frac{1-\rho}{\rho}}\, N^{-1}(x) - \sqrt{\frac{1}{\rho}} N^{-1}(PD)\right) \qquad (10),$$

where x is the regulatory confidence level, PD is the unconditional probability of default and ρ is the asset correlation. This last term can be described as the dependence of the asset value of a borrower on the general state of the economy. Hence, the two elements of equation (10) must be weighted with respect to the asset correlation, since all borrowers are linked to each other by the single risk factor. The asset correlation was estimated following the instructions of the regulatory framework. For corporate, bank and sovereign exposures, the supervisory the asset correlation function, which was derived by G10 supervisors, is built of two limit correlations of 12% and 24%. Between these limits, correlations are modelled by an exponential weighting function that displays the dependency on PD:

$$\rho = 0.12 * \frac{(1 - e^{-50*PD})}{1 - e^{-50}} + 0.24 * \frac{(1 - e^{-50*PD})}{1 - e^{-50}} \qquad (11).$$

The values the EL and UL (Figure 14), expressed as percentage of assets, were obtained by multiplying the conditional probability of default, calculated at the 99.9% percentile of loss distribution, with the Losses Given Default rate (LGD). As suggested by Goodhart and Segoviano (2015), a LGD of 45% has been adopted by credit risk modellers as a reasonable assumption for loss estimation in the absence of data to estimate LGDs.

Figure 14: Loss Distribution

Source: Basel Committee (2005)
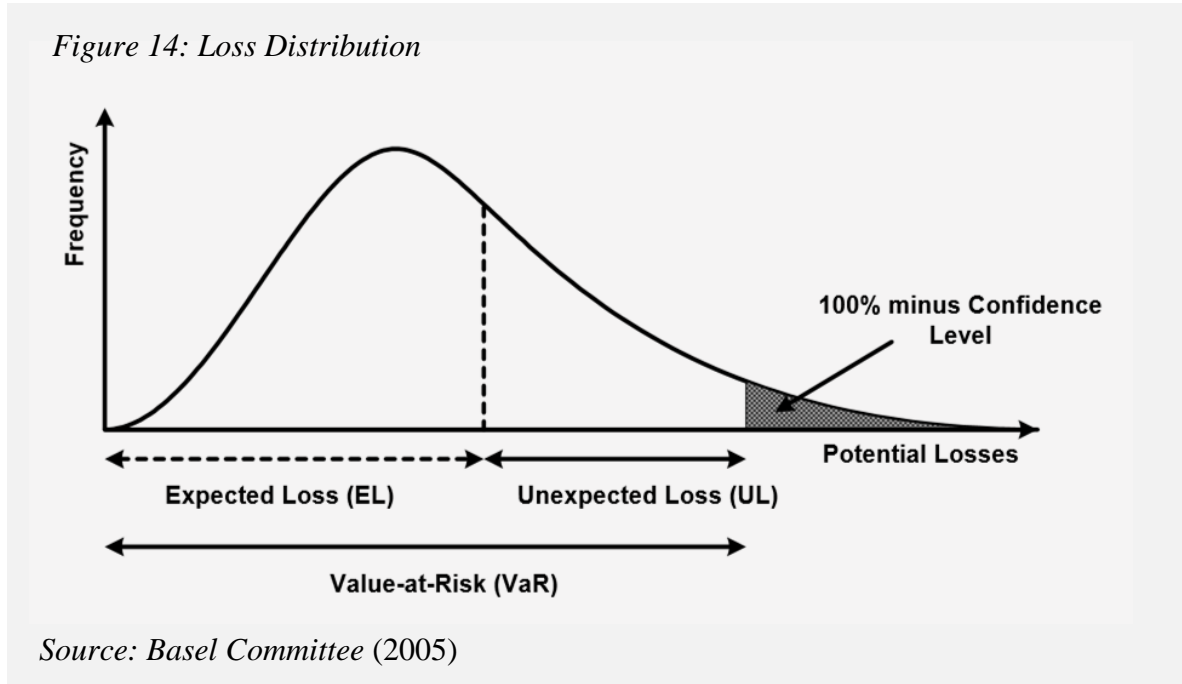
Hence, employing the following equation it is possible to calculate the sum of expected and unexpected losses:

$$EL + UL = N\left(\sqrt{\frac{1-\rho}{\rho}}\,N^{-1}(x) - \sqrt{\frac{1}{\rho}}N^{-1}(PD)\right) * LGD * MA \tag{12},$$

where MA is the Maturity Adjustment coefficient, defined as:

$$MA = \frac{1+(M-2.5)*b(PD)}{1-1.5*b(PD)} \tag{13},$$

where,

$$b(PD) = [(0.11852 - 0.05478 * LN(PD)]^2 \tag{14},$$

and M is the maturity of the instrument. In fact, since credit portfolios consist of instruments that have different maturities, the regulatory framework wants that the longer the maturity the higher the capital requirements. Nevertheless, in my case M is equal to 1 year and consequently equation (13) results in a maturity adjustment coefficient of 100%.

3.4. Data

- *Sample of Banks*

  - Solvent banks: UniCredit, Intesa Sanpaolo, Unione di Banche Italiane, Banco Popolare, Banca Popolare dell'Emilia Romagna, Banca Popolare di Milano, Banca Monte dei Paschi di Siena, Credito Emiliano, Banca Popolare di Sondrio, Credito Valtellinese, Banca Carige, Banco Desio Brianza, Banco di Sardegna.
  - Insolvent banks: Banca Popolare dell'Etruria e del Lazio, Banca Popolare di Spoleto.

- *Input Variables*

  - Daily Frequency: stock prices.
  - Monthly Frequency: 1y BOT, benchmark 10y BTP.
  - Quarterly Frequency: total assets, total liabilities, number of total common shares outstanding.

- *Estimated Variables*

  - Daily Frequency: stock returns, returns volatilities.
  - Quarterly Frequency: market capitalisation, short-term liabilities, long-term liabilities, provisions, asset value, asset volatilities.

- *Summary of data statistics*

I obtained or estimated the previous variables from 31 December 2005 to 30 June 2016, for a total of 2664 daily observations for each the 15 banks analysed. The relevant statistics are summarised in the tables presented for convenience in Annex B. As regards the inputs variables, all the balance sheets information and stock prices were retrieved from the Thomson Reuters Eikon Database. The risk free rates were instead acquired from the statistical database (Infostat) provided by the Bank of Italy. Switching to the estimated variables, I used the end of the quarter number of total common shares outstanding and the corresponding daily stock price (Table 1), to evaluate the market capitalization of each bank in each period (Table 2). With respect to these variables, it is important to observe that, for the majority of banks, the last observations of stock prices are close to the lowest historical values. This is also true if we look at the market

capitalisation. In addition, the market capitalization shows that the Italian banking system is driven by two major banking groups, UniCredit and Intesa Sanpaolo.

Similarly, the same characteristic can be recognised if we look at the Total Assets (Table 3) and Provisions (Table 4). The value of total assets was recovered using the corresponding balance sheet's item from the Eikon database. Provisions were obtained from the same database, but examining, in addition, the original format of the balance sheets and considering the appropriate items for each bank, such as the Provisions for risks and charges, Provision for employee severance pay, Risks/Charges Allowances, Loan Loss Allowances and Other Provisions. Therefore, data on market capitalisation, provisions and total assets were implemented to estimate the Loss Absorption Buffers as in equation (2), whose results are presented in the following chapter.

On the other hand, in order to apply the Merton model and evaluate the Potential Extreme Losses, I estimated the following variables. Beside the information on market capitalization, I obtained the values of Short Term Liabilities (Table 5) and Long Term Liabilities (Table 6), whose sum, in the modality I already described, was used as default barrier. In order to discriminate between the two quantitates, I managed both the standardized and the original formats of the balance sheets provided by the Eikon database. In general, the items Total Deposits, Other Bearing Liabilities, Total Short Term Borrowings and Other Current liabilities were considered Short Term Liabilities, while Total Debt, Deferred Income Tax and Other Liabilities were marked as Long Term Liabilities. In addition, in case of any missing data, I performed both the average between the closest available observations or, in some cases, I added the missing values by searching them in the institutional websites.

Moreover, using daily stock prices I computed the daily logarithmic returns and their annualised volatilities. With respect to the equity volatility, I compared the consequences of using three different time windows (Table 7). As expected, the larger the window considered the smoother the volatilities values. In fact, from Figure 15, which shows the evolution over time of the volatility, we can observe that a small window has more extreme values. In any case, it is clear that peaks of volatilities are reached during the crisis periods. Nevertheless, it is also important to notice that, for many banks, the stock return volatilities assume high values in recent times, specifically in the last period. In fact, the last observations, which for solvent banks correspond to the 30th June 2016, are influenced by the extremely negative returns reached the 24th June after the publication of the results of the British referendum about the permanence in the European Union. That day, the announcement of the so-called Brexit caused a loss of 12,48 percentage points in the FTSE Mib index. In particular, the shares of the banking sector lost

Figure 15: Volatilities Evolution
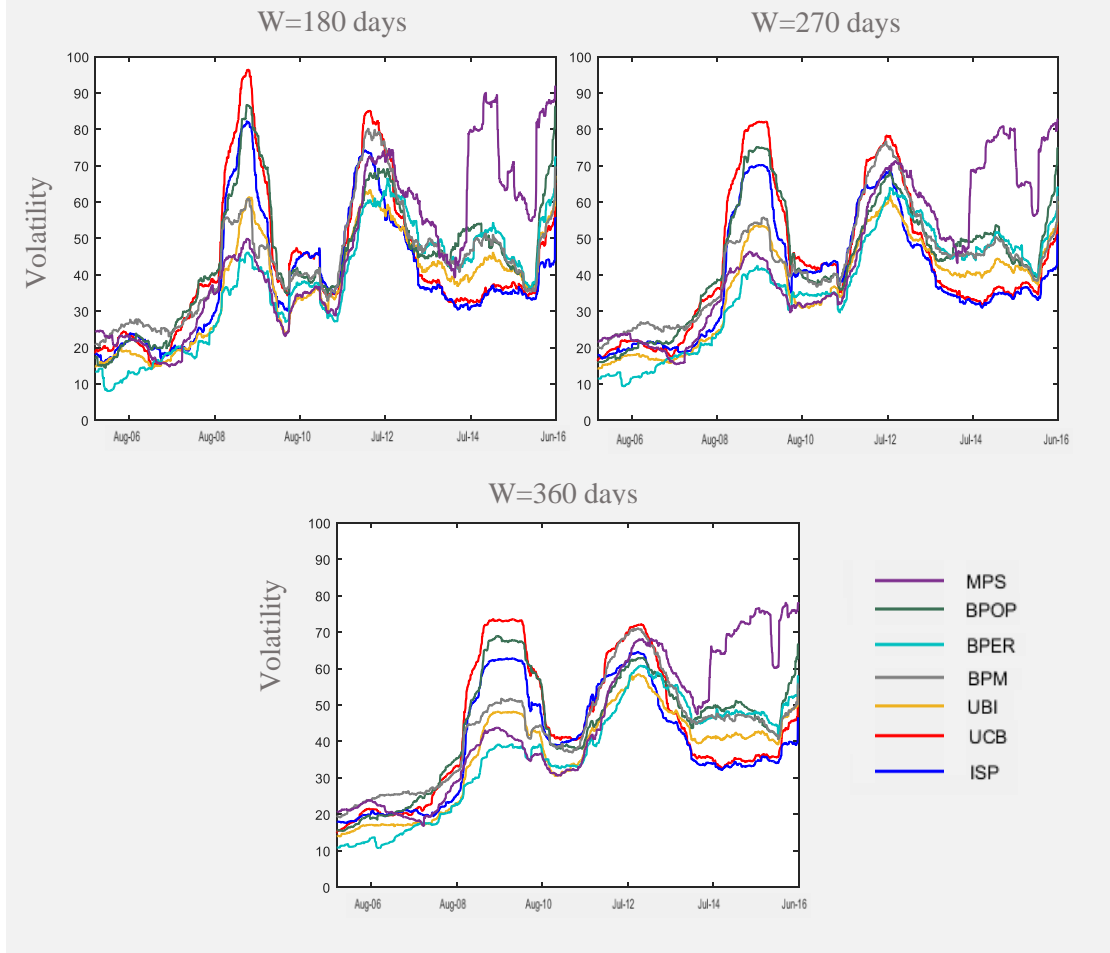
more than 20%. As a result, I expect that the probabilities of default of the last period will be dramatically influenced by both the high volatility values and low stock prices. For these reasons, the results that I will present are based on the equity volatility computed with the 360 days window. In conclusion, following the procedure described earlier, I reported the estimated values of Assets (Table 8), together with the estimated Volatilities of assets returns (Table 9), that were obtained through the minimisation of equation (7). The values of this equation are reported in Table 10.

3.5. Results

With the described dataset and the estimated parameters, I quantified the loss absorption buffers and the potential extreme losses for each bank in each period of time: these are the components of the intervention criterion. The first step involved the calculation of the daily probabilities of default. Table 11 illustrates the evolution of the one-year probabilities of default, obtained at the end of each quarter through the application of the Merton's model to all the banks under analysis.

Table 11: Estimated One-Year Probabilities of Default

PD	UCG	ISP	UBI	BP	BPER	BPM	BMPS	CE	BPSO	CVAL	CRG	BDB	BSRP	PEL	SPO
Jun-16	3,28%	1,56%	3,92%	9,27%	5,17%	4,26%	15,78%	0,27%	0,41%	2,36%	8,59%	0,38%	0,01%		
Mar-16	1,07%	0,43%	1,72%	3,41%	2,45%	1,69%	15,37%	0,09%	0,27%	1,71%	8,05%	0,13%	0,00%		
Dec-15	0,21%	0,11%	0,47%	0,70%	1,09%	0,66%	6,06%	0,02%	0,11%	0,81%	1,75%	0,01%	0,00%		
Sep-15	0,26%	0,17%	0,77%	1,05%	1,61%	1,05%	14,27%	0,03%	0,20%	1,13%	2,45%	0,01%	0,00%		
Jun-15	0,19%	0,10%	0,79%	1,88%	1,80%	1,33%	13,94%	0,04%	0,19%	1,47%	3,46%	0,03%	0,00%		
Mar-15	0,16%	0,08%	0,62%	2,20%	1,65%	1,48%	12,54%	0,04%	0,14%	1,33%	2,82%	0,03%	0,00%	6,23%	
Dec-14	0,16%	0,10%	0,71%	2,19%	1,79%	1,32%	10,77%	0,06%	0,07%	0,99%	2,74%	0,02%	0,00%	2,65%	
Sep-14	0,08%	0,07%	0,59%	1,94%	1,58%	1,40%	7,76%	0,03%	0,05%	0,56%	1,38%	0,03%	0,00%	2,80%	
Jun-14	0,19%	0,11%	0,62%	2,11%	1,56%	1,61%	8,33%	0,05%	0,12%	0,36%	1,76%	0,02%	0,00%	4,26%	
Mar-14	0,20%	0,10%	0,48%	1,92%	1,25%	1,35%	2,32%	0,04%	0,05%	0,23%	0,76%	0,01%	0,00%	0,82%	
Dec-13	0,43%	0,38%	0,84%	1,29%	1,92%	1,54%	3,60%	0,06%	0,16%	0,13%	0,70%	0,01%	0,00%	1,75%	
Sep-13	1,34%	0,94%	1,60%	2,27%	3,47%	2,47%	4,61%	0,29%	0,37%	0,67%	1,04%	0,14%	0,00%	1,23%	4,40%
Jun-13	2,18%	1,37%	2,02%	3,68%	4,00%	4,58%	6,71%	0,77%	0,49%	1,51%	1,31%	0,18%	0,00%	1,02%	3,82%
Mar-13	6,81%	3,09%	3,24%	5,36%	5,54%	7,86%	9,48%	1,50%	0,51%	1,57%	1,64%	0,21%	0,64%	0,37%	5,41%
Dec-12	10,61%	6,38%	4,36%	6,48%	5,88%	9,91%	9,02%	2,61%	0,75%	1,69%	2,17%	0,25%	0,80%	0,74%	0,54%
Sep-12	12,05%	7,88%	5,24%	7,14%	5,97%	11,44%	9,70%	3,29%	0,97%	1,85%	2,62%	0,19%	0,95%	1,15%	0,56%
Jun-12	10,77%	6,69%	3,98%	6,21%	3,90%	10,47%	7,01%	2,83%	0,48%	1,51%	1,74%	0,07%	0,99%	2,71%	0,23%
Mar-12	8,53%	5,30%	2,87%	4,12%	1,99%	7,84%	4,94%	1,93%	0,23%	0,34%	0,89%	0,00%	0,87%	2,46%	1,07%
Dec-11	4,51%	4,65%	2,05%	2,13%	1,29%	4,59%	1,65%	1,14%	0,12%	0,11%	0,41%	0,00%	0,65%	1,87%	0,88%
Sep-11	2,67%	3,20%	1,09%	1,37%	0,67%	2,79%	0,71%	1,03%	0,15%	0,08%	0,28%	0,00%	0,01%	0,19%	0,48%
Jun-11	0,70%	0,81%	0,18%	0,39%	0,14%	0,70%	0,12%	0,17%	0,02%	0,01%	0,03%	0,00%	0,00%	0,00%	0,00%
Mar-11	0,66%	0,57%	0,12%	0,40%	0,11%	0,34%	0,04%	0,23%	0,01%	0,01%	0,01%	0,00%	0,00%	0,00%	0,00%
Dec-10	0,64%	0,43%	0,04%	0,41%	0,09%	0,45%	0,03%	0,35%	0,01%	0,00%	0,01%	0,00%	0,00%	0,02%	0,02%
Sep-10	1,06%	0,58%	0,13%	0,97%	0,12%	0,70%	0,05%	0,51%	0,01%	0,00%	0,01%	0,00%	0,00%	0,02%	0,02%
Jun-10	4,74%	2,32%	0,89%	4,83%	0,42%	1,13%	0,18%	1,67%	0,01%	0,03%	0,04%	0,00%	0,01%	0,03%	0,00%
Mar-10	7,64%	3,88%	0,95%	6,80%	0,19%	0,75%	0,14%	1,64%	0,00%	0,08%	0,19%	0,00%	0,03%	0,00%	0,00%
Dec-09	12,54%	6,51%	1,79%	9,54%	0,40%	2,60%	0,36%	2,27%	0,03%	0,22%	1,14%	0,03%	0,12%	0,21%	0,00%
Sep-09	12,50%	6,71%	1,77%	9,46%	0,40%	2,57%	0,49%	1,90%	0,01%	0,18%	1,26%	0,04%	0,17%	1,13%	0,10%
Jun-09	12,67%	6,61%	1,75%	9,77%	0,37%	2,44%	0,63%	1,79%	0,01%	0,22%	1,52%	0,09%	0,16%	1,67%	0,71%
Mar-09	11,59%	5,71%	0,94%	7,70%	0,20%	1,90%	0,53%	1,36%	0,03%	0,19%	1,46%	0,14%	0,11%	0,94%	0,82%
Dec-08	5,78%	2,42%	0,16%	2,80%	0,03%	1,23%	0,15%	0,23%	0,01%	0,03%	1,22%	0,05%	0,02%	0,32%	0,60%
Sep-08	0,32%	0,01%	0,00%	0,29%	0,00%	0,17%	0,02%	0,04%	0,00%	0,00%	0,11%	0,02%	0,00%	0,05%	0,10%
Jun-08	0,05%	0,00%	0,00%	0,11%	0,00%	0,04%	0,00%	0,01%	0,00%	0,00%	0,01%	0,01%	0,00%	0,05%	0,13%
Mar-08	0,01%	0,00%	0,00%	0,03%	0,00%	0,01%	0,00%	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	0,01%	0,02%
Dec-07	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Sep-07	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Jun-07	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Mar-07	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Dec-06	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Sep-06	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,01%
Jun-06	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,03%
Mar-06	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,11%
Dec-05	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,03%

First of all, according to my expectations, the last period of observations is characterized by rising probabilities of default for all the banks in the sample. In particular, the highest probability of default of 15,78% belongs to Banca Monte Paschi di Siena, whose difficulties are quite evident. From around 2012, this institution exhibits probabilities of default that are almost always higher than 5%. These extreme values could be explained by the repeated drops of the stock price, which were due to many different reasons. For example, at the end of 2011, MPS recorded a loss of 4,69€ billion and was obliged to recapitalize and to face restructuring. Moreover, on 23rd January 2013, the scandal of the hidden derivatives, used to avoid the disclosure of losses from the bank's financial statements, was revealed, and finally, in October 2014, the bank failed the ECB's stress test, as well as the most recent one in July 2016. Together with Monte dei Paschi di Siena, Banca Carige was the other Italian bank that had to raise capital after failing the ECB stress tests in 2014. From December 2015, we can see from the table that the probability of default raised over 8%. Similarly to Monte Paschi, Carige experienced a huge price drop of its stock price, which reached, on 7th July 2016, the new lowest historical level at 0,2854. Moreover, from the beginning of 2016, the ECB asked Carige, and also Monte Paschi, to provide on a daily basis their liquidity levels. A duty that, after the 2014 stress test, was due on a weekly basis.

On the contrary, Banca Popolare di Sondrio, Banco Desio e Brianza and Banco di Sardegna never experienced probabilities of default over 1%. Unione Banche Italiane, Banca Popolare dell'Emilia Romagna, Credito Emiliano and Credito Valtellinese had also low probabilities of default for all the period under analysis. Instead, by looking at the values of Unicredit and Intesa Sanpaolo, the two leading Italian banks, it is possible to notice how the probabilities of default increased in the period following the Global Financial crisis and the European Sovereign Debt Crisis. The same pattern can be observed in the values of Banco Popolare and Banca Popolare di Milano, two banks that on 24th March 2016 announced their merge. Finally, as regards the two insolvent banks we can see a dramatic jump in the probabilities of default. On the one hand, Spoleto, as at 31st December 2012, had a Tier 1 capital ratio of 6.45% and from February 2013 it was put under extraordinary administration by the Ministry of Economy and Finance; a period that ended the 31st July 2014, after which the institution joined Banco Desio. On the other hand, Banca Etruria was one of the first banks, whose rescue was treated in accordance with the Bank Recovery and Resolution Directive. The 30th June 2014, the Tier 1 capital ratio fell to just 6.1% and in early 2015 the bank was administrated by the Ministry of Economy and Finance.

Similar conclusions can be drawn if we look at the transformation of probabilities of default in distances to default (Table 12). Nevertheless, by focusing on this variable, we can evaluate

Table 12: Distances to Default

DD	UCG	ISP	UBI	BP	BPER	BPM	MPS	CE	BPSO	CVAL	CRG	BDB	BSRP	PEL	SPO
Jun-16	1,84	2,15	1,76	1,32	1,63	1,72	1,00	2,78	2,64	1,98	1,37	2,67	3,62		
Mar-16	2,30	2,63	2,11	1,82	1,97	2,12	1,02	3,11	2,78	2,12	1,40	3,00	4,53		
Dec-15	2,86	3,07	2,60	2,46	2,29	2,48	1,55	3,50	3,07	2,41	2,11	3,82	5,34		
Sep-15	2,80	2,92	2,42	2,31	2,14	2,31	1,07	3,39	2,87	2,28	1,97	3,77	6,01		
Jun-15	2,89	3,10	2,41	2,08	2,10	2,22	1,08	3,34	2,89	2,18	1,82	3,40	5,56		
Mar-15	2,95	3,15	2,50	2,01	2,13	2,18	1,15	3,35	2,98	2,22	1,91	3,40	5,32	1,54	
Dec-14	2,95	3,09	2,45	2,02	2,10	2,22	1,24	3,26	3,20	2,33	1,92	3,48	5,02	1,93	
Sep-14	3,14	3,21	2,52	2,07	2,15	2,20	1,42	3,41	3,31	2,54	2,20	3,47	5,17	1,91	
Jun-14	2,89	3,05	2,50	2,03	2,16	2,14	1,38	3,29	3,03	2,69	2,11	3,49	4,95	1,72	
Mar-14	2,88	3,11	2,59	2,07	2,24	2,21	1,99	3,35	3,28	2,83	2,43	3,65	5,29	2,40	
Dec-13	2,63	2,67	2,39	2,23	2,07	2,16	1,80	3,24	2,94	3,01	2,46	3,83	5,18	2,11	
Sep-13	2,22	2,35	2,15	2,00	1,82	1,97	1,68	2,76	2,67	2,47	2,31	2,99	5,23	2,25	1,71
Jun-13	2,02	2,21	2,05	1,79	1,75	1,69	1,50	2,42	2,58	2,17	2,22	2,91	4,90	2,32	1,77
Mar-13	1,49	1,87	1,85	1,61	1,59	1,41	1,31	2,17	2,57	2,15	2,13	2,87	2,49	2,68	1,61
Dec-12	1,25	1,52	1,71	1,52	1,56	1,29	1,34	1,94	2,43	2,12	2,02	2,80	2,41	2,44	2,55
Sep-12	1,17	1,41	1,62	1,47	1,56	1,20	1,30	1,84	2,34	2,09	1,94	2,90	2,34	2,27	2,54
Jun-12	1,24	1,50	1,75	1,54	1,76	1,26	1,48	1,91	2,59	2,17	2,11	3,18	2,33	1,92	2,83
Mar-12	1,37	1,62	1,90	1,74	2,06	1,42	1,65	2,07	2,84	2,71	2,37	3,93	2,38	1,97	2,30
Dec-11	1,69	1,68	2,04	2,03	2,23	1,69	2,13	2,28	3,03	3,07	2,64	4,14	2,49	2,08	2,37
Sep-11	1,93	1,85	2,30	2,21	2,47	1,91	2,45	2,32	2,98	3,17	2,77	4,30	3,83	2,89	2,59
Jun-11	2,46	2,41	2,91	2,66	3,00	2,46	3,04	2,92	3,61	3,72	3,42	4,90	4,51	4,45	4,50
Mar-11	2,48	2,53	3,03	2,65	3,07	2,70	3,33	2,83	3,66	3,65	3,74	4,76	4,58	4,85	4,93
Dec-10	2,49	2,63	3,33	2,64	3,13	2,61	3,46	2,70	3,63	3,95	3,85	5,00	4,53	3,59	3,60
Sep-10	2,31	2,53	3,02	2,34	3,02	2,46	3,32	2,57	3,74	4,06	3,76	4,86	4,09	3,54	3,52
Jun-10	1,67	1,99	2,37	1,66	2,64	2,28	2,92	2,13	3,63	3,43	3,34	4,04	3,64	3,45	3,90
Mar-10	1,43	1,77	2,35	1,49	2,89	2,43	3,00	2,13	4,19	3,16	2,89	4,06	3,44	4,21	4,82
Dec-09	1,15	1,51	2,10	1,31	2,65	1,94	2,69	2,00	3,42	2,85	2,28	3,46	3,03	2,86	4,36
Sep-09	1,15	1,50	2,10	1,31	2,65	1,95	2,58	2,07	3,65	2,91	2,24	3,35	2,93	2,28	3,10
Jun-09	1,14	1,51	2,11	1,29	2,68	1,97	2,50	2,10	3,67	2,85	2,16	3,12	2,94	2,13	2,45
Mar-09	1,20	1,58	2,35	1,43	2,88	2,08	2,55	2,21	3,39	2,89	2,18	2,99	3,07	2,35	2,40
Dec-08	1,57	1,97	2,95	1,91	3,48	2,25	2,96	2,84	3,66	3,41	2,25	3,30	3,53	2,73	2,51
Sep-08	2,73	3,63	4,22	2,76	4,26	2,93	3,57	3,36	5,09	4,55	3,07	3,49	4,84	3,31	3,09
Jun-08	3,27	4,49	4,87	3,07	5,04	3,36	4,19	3,80	5,31	5,13	3,78	3,70	5,20	3,28	3,02
Mar-08	3,62	4,92	5,17	3,46	5,34	3,76	5,09	4,27	5,49	4,85	3,99	3,82	5,76	3,67	3,52
Dec-07	4,63	5,56	6,17	4,11	5,97	3,97	6,20	4,79	6,08	5,42	5,12	4,18	6,63	4,10	4,29
Sep-07	4,79	5,32	6,05	4,29	6,09	4,09	6,66	4,28	9,32	5,46	5,03	4,19	7,33	5,28	5,66
Jun-07	5,25	5,12	6,18	5,22	6,72	4,04	6,50	4,34	9,47	5,47	5,31	4,22	7,94	6,51	6,58
Mar-07	5,21	5,23	6,23	5,20	7,54	4,19	6,14	4,40	11,18	5,75	5,68	4,49	8,66	6,43	5,77
Dec-06	5,36	5,44	6,22	5,49	8,90	4,24	6,12	4,38	11,58	5,73	5,93	4,51	9,04	4,86	4,54
Sep-06	4,94	5,37	6,28	5,71	8,59	4,32	5,41	4,34	11,26	5,58	6,17	4,70	8,59	4,38	3,63
Jun-06	5,00	5,39	6,29	5,67	8,59	4,51	5,36	4,36	8,52	5,53	6,50	4,36	8,78	4,29	3,40
Mar-06	5,84	5,90	6,86	6,44	9,36	4,80	5,76	5,06	8,85	5,84	8,48	4,35	7,89	4,41	3,06
Dec-05	6,53	6,03	7,24	6,91	9,19	5,35	5,69	5,60	9,16	6,25	9,37	4,40	7,90	4,43	3,45

which institutions felt under the threshold of 1,5 established by Goodhart and Segoviano (2015). Again, Monte Paschi crosses many times the threshold level, together with the last two quarters of Banca Carige. Unicredit, Intesa San Paolo, Banco Popolare and Banca Popolare di Milano showed low levels of DD during the crisis periods. In addition, only Banco Popolare felt under the threshold level also in the last quarter. The other banks would have never triggered intervention with the specified threshold level. Again for insolvent banks the results appear to be unconvincing. However, better conclusions can be achieved if we look at the difference between Extreme losses and the loss absorption capital (Table 13).

Table 13: Difference between Potential Extreme Losses and Loss Absorption Buffers

DIFFERENCE	UCG	ISP	UBI	BP	BPER	BPM	MPS	CE	BPSO	CVAL	CRG	BDB	BSRP	PEL	SPO
Jun-16	6,76%		7,08%	13,47%	8,11%	4,87%	21,33%			5,26%	13,77%				
Mar-16	2,13%		3,10%	5,56%	3,40%		20,57%			3,21%	12,17%				
Dec-15							10,90%				3,87%				
Sep-15					1,41%		19,51%			1,57%	5,33%				
Jun-15				2,87%	2,12%		19,19%			2,70%	6,81%				
Mar-15				3,70%	2,34%		17,79%			2,85%	6,32%			11,99%	
Dec-14				3,99%	3,01%		16,04%			2,42%	5,88%			7,17%	
Sep-14				3,99%	2,75%	1,39%	13,08%			1,17%	3,13%			7,34%	
Jun-14				4,89%	3,25%	2,60%	14,21%				4,45%			9,28%	
Mar-14				5,29%	2,92%	3,01%	7,22%				1,90%			3,12%	
Dec-13			2,65%	4,48%	4,92%	3,80%	9,15%				1,76%			5,93%	
Sep-13	3,62%	1,39%	4,91%	6,55%	7,57%	5,46%	10,44%			3,32%	2,67%			4,99%	10,31%
Jun-13	5,57%	2,81%	5,93%	8,61%	8,13%	8,42%	13,06%			5,69%	3,29%			3,39%	9,39%
Mar-13	11,89%	5,87%	7,88%	10,68%	10,09%	12,38%	16,21%	2,90%		5,38%	3,93%				11,26%
Dec-12	16,06%	10,03%	9,35%	11,84%	10,52%	14,67%	15,44%	4,94%		5,94%	4,35%		1,65%	1,89%	2,49%
Sep-12	17,86%	11,77%	10,53%	12,83%	10,40%	16,82%	15,90%	6,32%		6,06%	4,62%		2,09%	3,75%	2,37%
Jun-12	16,67%	10,49%	8,94%	11,63%	7,59%	16,12%	11,98%	5,93%		5,53%	2,70%		2,43%	7,79%	
Mar-12	13,96%	8,40%	7,16%	8,79%	4,54%	13,55%	7,96%	4,19%					2,03%	6,88%	3,92%
Dec-11	8,79%	7,34%	5,64%	5,61%	2,97%	9,65%		2,20%					1,17%	5,45%	3,04%
Sep-11	5,88%	5,44%	3,41%	4,19%		7,32%		1,35%							
Jun-11						2,62%									
Mar-11															
Dec-10				1,20%											
Sep-10	1,90%			3,31%		1,06%									
Jun-10	7,58%	2,45%		9,49%		1,99%		1,85%							
Mar-10	11,13%	4,52%		11,83%				1,98%							
Dec-09	16,61%	7,68%	2,64%	15,08%		4,20%		3,25%							
Sep-09	17,09%	8,60%	2,37%	14,95%		4,46%		3,71%							
Jun-09	17,42%	8,19%	1,63%	14,07%		4,21%		3,25%						1,62%	
Mar-09	16,03%	6,44%		11,01%		2,89%		1,72%							
Dec-08	8,70%			3,82%											
Sep-08															

In this case, the table highlights the period in which the potential extreme losses, calculated using the probabilities of default, were higher than the loss absorption buffer. In addition, the table excludes the values if the difference is lower than 1%. As expect, the general considerations previously made are still valid. In fact, there are high differences for Monte Paschi, Carige and Banco Popolare, as regards the last quarter. For many banks, such a difference spread out during the financial crises. Besides that, it is possible to see that for the insolvent banks such difference extends drastically 3 or 4 periods before the last available observation. These scores can indeed offer a better insight about their distress. Moreover, from Figure 16, which analyses the evolution of both the loss absorption buffer and the potential extreme losses expressed as percentage of the assets, we can deduct that, for the two insolvent banks, the latter is much bigger than the former. For the remaining banks of the sample, it is important to draw the attention on, first, the descending path of the loss absorption buffer and, second, the peaks of potential losses. The buffer is severely affected by the deterioration of the market capitalization, while the highest potential losses match the period of crisis. Apart from

Figure 16: Evolution of Potential Extreme Losses and Loss Absorption Buffers
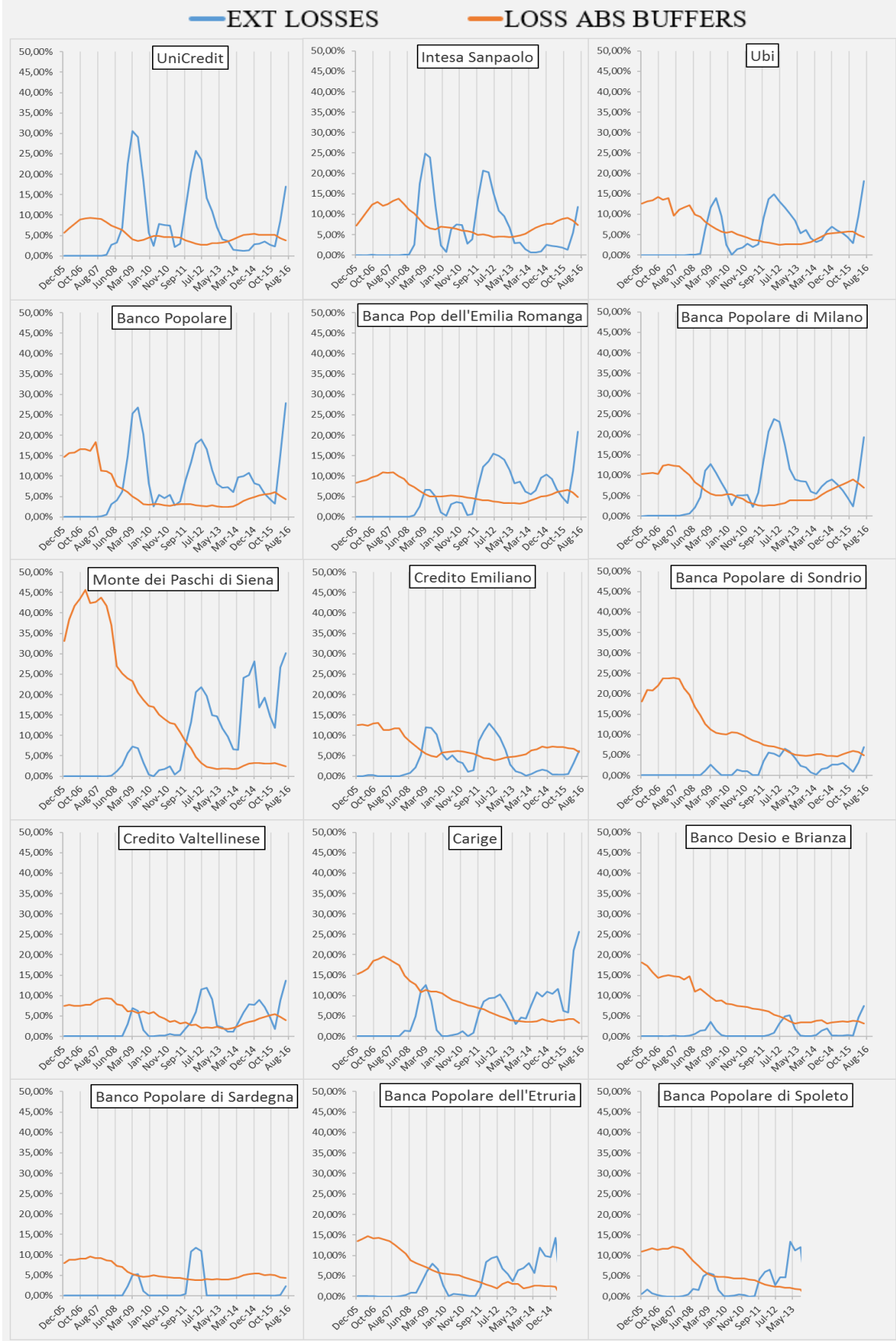
Banca Carige and Monte Paschi, if we exclude the period characterized by the crisis and the last period, all the solvent banks does not satisfy the intervention criterion, or at least they are very close to it. Again, due to the facts presented before, the high volatility and the overall decline of the stock price of Italian banks can explain the rapidly increase of potential extreme losses in the last quarter.

In conclusion, some considerations can be drawn about the optimal choice of an intervention threshold. In order to set an optimal trigger, it is necessary to evaluate the Type I and Type II errors. In other words, I had to identify how many wrong decisions the supervisory authority would have taken, if a certain threshold had been implemented. To do so, I collected all the value of distance to default[7] that occurred when the potential extreme losses were equal or larger than the buffers. Rearranging the value from the lowest to the highest, it is possible to construct the cumulative distribution function. Moreover, since I employed different combinations of equity volatilities and default barriers obtaining very similar results, I can state that the shape of the distribution is not due to the specification of the model. Therefore, for a specific distance to default, the distribution gives the number of solvent banks, expressed in percentage, whose potential extreme losses were above the loss absorption buffer. For example, we can infer that 50% of all the banks that satisfied the criterion, would have been subject to early intervention, if the distance to default level was set approximately at 2. Therefore, it is possible to state that this intervention threshold would have caused an unnecessary recovery of solvent banks in half of the occasion. In other words, a Type II error of 50%.

For supervisory authorities, the cumulative density function is a useful tool to define the intervention thresholds and to understand the probabilities of committing Type I and Type II errors. However, given the data limitation problems about insolvent banks, I could provide reliable estimate only of the second type of error. Compared to the findings obtained by Goodhart and Segoviano (2015) (Figure 11), the cumulative distribution for the Italian solvent banks (Figure 17) appears to have more concentrate levels of distance to default. In fact, using the Italian dataset, the optimal threshold of $DD = 1,5$ proposed by Goodhart and Segoviano would have led to a Type II error of about 20%. This means that for one bank out of five the early intervention would have been triggered. Equally to them, when the distance to default is equal or lower that 2,8 ($DD \leq 2,8$), all the banks that satisfied the criterion for intervention are taken into account or, equivalently, no other banks had potential losses over the buffer when the distance to default is greater than 2,8. Unfortunately, with this dataset it is not possible to

---

[7] $DD = d_2 = -N^{-1}(PD)$ and $PD = N(-DD)$.

Figure 17: Cumulative Distribution of banks fulfilling the Criterion of Intervention
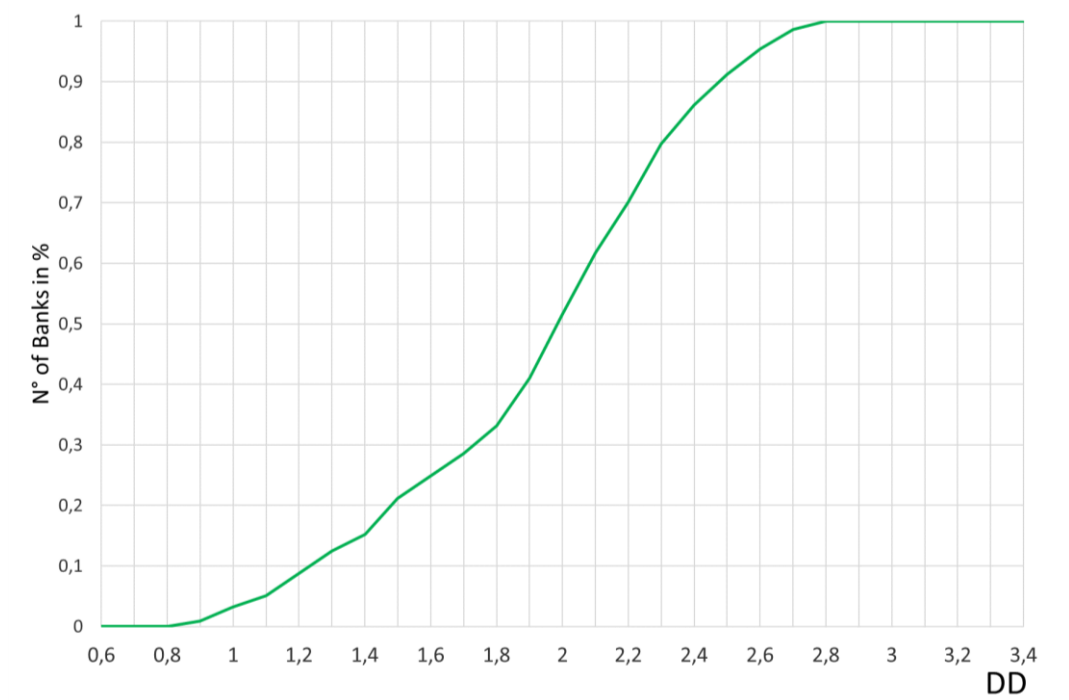
retrieve coherent estimates of the Type I errors, which, however, are very important information for supervisory authorities. If I consider Monte Paschi and Carige together with the insolvent banks, the distribution moves to the left, but the final results are still not much informative. In alternative, if I assume that the distribution function is similar to that obtained by Goodhart and Segoviano, it is possible to say that authorities might prefer to increase the threshold in order to reduce the Type I errors.

Conclusions

On the basis of the Goodhart and Segoviano (2015)'s model, I analysed the context of the Italian banking system, with respect to the early intervention stage. This phase, which is laid down by the BRRD, is an important characteristic of the new Banking Union project. However, the models signalling the need to entry into the recovery stage are not as much developed as those studying the triggers for resolution. I highlighted how a framework based on quantitative indicators could be beneficial to competent authorities when they have to decide whether to the start a recovery. For example, since the legislation does not provide a clear definition of the conditions that can trigger the early intervention phase, a quantitative metric would increase the convergence of supervisory activities across the Member States and, being built on observable, verifiable and objective data, it would be less vulnerable to manipulation and more clear and transparent to institutions. In addition, even if these models could be time consuming to develop, difficult to test and costly to update, they can be more effective in reducing and balancing the Type I and Type II errors.

As regards the model specification, I explained that the criterion for intervention consists in the evaluation of the institutions' ability to absorb both expected and unexpected losses. In fact, on the basis of the Basel regulatory framework, the expected losses should be managed through the pricing of exposures and through provisioning, since they are viewed as normal a cost component of doing business, while capital should serve to cover the institution from unexpected losses. Therefore, on the one hand, specific definitions were applied for the identification of the components of the loss absorption buffer, in particular by adopting some adjustments to the regulatory values of capital and risk weighted assets. On the other hand, to quantify the potential extreme losses, I employed the Merton's model and the Vasicek's model, to recover the probabilities of default and the loss distribution functions respectively.

The results I obtained are based on a sample of Italian banks listed in the Milan stock exchange, excluding the institutions that conduct mainly investment activity. Therefore, I evaluated and compared both the past and the current (up to 30/06/2016) conditions of the Italian banks, with respect to their probability of default and their ability to absorb the potential extreme losses. First of all, the difficulties of Banca Monte dei Paschi di Siena were clear under all the analyses made. Then, I also showed that the peaks of potential extreme losses and the highest probabilities of default for bigger banks match the periods following the global financial crisis and the European debt crisis. In addition, the last period of observations deserved a specific remark, since the results are substantially influenced by the very high volatilities values registered after the so-called "Brexit". On the contrary, the smaller and solvent banks did not

exhibit particular outcomes, while the insolvent ones displayed their distress prior the insolvency, but not at a noticeable level as one could expect. Moreover, I illustrated the general descending path, since the end of 2005, of all the loss absorption buffers, that is more or less pronounced depending on the bank under examination. In conclusion, after aggregating the results for the banks that remained solvent, it is possible to provide the estimates of Type II error. For example, the optimal threshold of $DD = 1,5$, identified by Goodhart and Segoviano (2015), would have led to a Type II error of about 20%. This means that for one bank out of five, the early intervention would have been triggered unnecessarily. On the contrary, due to limitation on the availability of data of insolvent banks, it was not possible to provide consistent estimates of Type I error.

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Annex A: MATLAB script

```matlab
1 -    clear
2 -    clc
3
4      % LOAD VECTORS OF INPUTS
5 -      load inputsdailypd
6              % Mktcpd          % MARKET CAPITALISATION
7              % ShortTermd      % SHORT TERM LIABILITIES
8              % LongTermd       % LONG TERM LIABILITIES
9              % Stockvol        % STOCK VOLATILITY
10             % Riskfree        % RISK FREE RATE
11 -           alpha=0.999;      % CONFIDENCE LEVEL
12 -           LGD=0.45;         % LOSS GIVEN DEFAULT
13
14     % PRE-ALLOCATION
15 -           Asset           = zeros(2664,15);
16 -           Assetvol        = zeros(2664,15);
17 -           d1              = zeros(2664,15);
18 -           d2              = zeros(2664,15);
19 -           PD              = zeros(2664,15);
20 -           DD              = zeros(2664,15);
21 -           RHO             = zeros(2664,15);
22 -           POTEXTLOSS      = zeros(2664,15);
23 -           LOSSABSBUF      = zeros(2664,15);
24 -           error           = zeros(2664,15);
25
26     % LOOP
27 - for j=1:15;
28 -     for i = 1:2664;
29 -         E   = mktcp(i,j);
30 -         D   = ShortTerm(i,j)+0.5*LongTerm(i,j);
31 -         Se  = Stockvol(i,j);
32 -         r   = Riskfree(i,j);
33
34         % FUNCTION TO BE MINIMISED
35 -         fun = @(x)(((E-(x(1)*normcdf((log(x(1)/D)+(r-0.5*x(2)^2))/x(2))-...
36             exp(-r)*D*normcdf((log(x(1)/D)+(r-0.5*x(2)^2))/x(2)-x(2))))/E)^2+...
37             ((Se-(x(1)/E*normcdf((log(x(1)/D)+(r-0.5*x(2)^2))/x(2))*x(2)))/Se)^2);
38
39         % INITIAL VALUES
40 -         x0 = [(E+D),(E*Se/(E+D))];
41
42         % MINIMISATION
43 -         x   = fminsearch(fun,x0);
44
45         % STORE OBTAINED VALUES
46 -         Asset(i,j)    = x(1,1);
47 -         Assetvol(i,j) = x(1,2);
48
49         % ERRORS COMPUTATION
50 -         error(i,j) =    (((E-(x(1,1)*normcdf((log(x(1,1)/D)...
51                         +(r-0.5*x(1,2)^2))/x(1,2))-...
52                         exp(-r)*D*normcdf((log(x(1,1)/D)+...
53                         (r-0.5*x(1,2)^2))/x(1,2)-x(1,2))))/E)^2+...
54                         ((Se-(x(1,1)/E*normcdf((log(x(1,1)/D)+...
55                         (r-0.5*x(1,2)^2))/x(1,2))*x(1,2)))/Se)^2);
56
57         % PDs AND DDs COMPUTATION
58 -         d1(i,j) =   (log(Asset(i,j)/D)+r+0.5*(Assetvol(i,j)^2))/Assetvol(i,j);
59 -         d2(i,j) =   d1(i,j)-Assetvol(i,j);
60 -         PD(i,j) =   normcdf(-d2(i,j));
61 -         DD(i,j) =   -norminv(PD(i,j));
62
63         % POTENTIAL LOSSES COMPUTATION
64 -         RHO(i,j)= 0.12*(1-exp(-50*PD(i,j)))/(1-exp(-50))+...
65             0.24*(1-(1-exp(-50*PD(i,j))/(1-exp(-50)))));
66
67 -         POTEXTLOSS(i,j)=normcdf((sqrt(RHO(i,j))*norminv(alpha)+...
68             norminv(PD(i,j)))/sqrt(1-RHO(i,j)))*LGD;
69
70         % LOSS ABSORPTION BUFFERS COMPUTATION
71 -         LOSSABSBUF(i,j)=(mean([mktcp(i,j),mktcp(i+60,j),mktcp(i+120,j),...
72             mktcp(i+180,j)])+Provisions(i,j))/TotAssets(i,j);
73 -     end
74 - end
```

81

Annex B: Tables of summary statistics

Table 1: Stock Prices and Total Common Shares Outstanding

	Prices			Shares			
	LAST	**MAX**	**MIN**	**LAST**	**MAX**	**MIN**	**MEAN**
UCG	1.97	39.76	1.97	6180295	6180295	1935700	3887729
ISP	1.7	5.49	1.12	16784969	16784969	13131258	14877281
UBI	2.47	20.39	2.47	898510	901747	367441	744525
BP	2.14	123.08	2.14	825703	825703	72082	258298
BPER	3.28	17.02	3.28	480853	480853	262047	337109
BPM	0.37	3.8	0.27	4390260	4390389	1418662	2560156
BMPS	0.38	87.43	0.38	2932080	2932080	457246	1219997
CE	5.44	11.79	2.75	330869	332392	278605	317698
BPSO	2.31	10.7	2.31	449727	453789	238150	409425
CVAL	0.41	7.63	0.41	1108812	1108812	134901	512982
CRG	0.37	47.23	0.37	829962	829962	95840	216002
BDB	1.7	9.6	1.7	130202	130202	130189	130202
BSRP	6.17	20.38	6.17	51749	51749	49140	51303
PEL	0.58	42.1	0.39	212564	217191	20557	69865
SPO	1.79	12.12	1.7	29702	29749	18242	24612

Table 2: Market Capitalisations

	MktCap			
	LAST	**MAX**	**MIN**	**MEAN**
ISP	28568017	74431713	16143979	40385929
UCG	12175181	79061430	12175181	38553843
UBI	2222914	11847392	2222914	5714130
CE	1798273	3318884	914078	1919218
BP	1770307	14886181	1770307	5183515
BPM	1616933	5452299	676151	2498296
BPER	1576236	4747099	1393428	2721220
BMPS	1111845	74172040	1111845	27484254
BPSO	1037070	4077499	1037070	2197262
CVAL	455611	1809036	380867	953930
BSRP	319291	1001473	319291	571088
CRG	303683	4876430	303683	2418800
BDB	220692	1249417	220692	544801
PEL	123925	868992	79093	336302
SPO	53285	249583	50345	124863

Table 3: Total Assets

	TA			
	LAST	**MAX**	**MIN**	**MEAN**
UCG	891476677	1060152000	787283930	908656191
ISP	717292000	717292000	534379000	639874256
BMPS	164385500	251868000	150061000	199103987
BP	123698857	138908784	59758387	119567386
UBI	116660235	133628369	68863634	117305539
BPER	62450390	62577865	43045741	56166419
BPM	49697726	55970026	37900913	47815782
CE	38087132	38087132	21129084	30086306
BPSO	35622700	36603608	10937562	26089304
CRG	28174078	48836762	23066391	35616204
CVAL	27149323	30721360	12981639	24206760
BSRP	12553935	14140049	11477099	12857237
BDB	12498588	12923023	5423602	8862323
PEL	12308280	17728034	6685627	11138446
SPO	3879142	3879142	1779038	2611423

Table 4: Provisions

	PR			
	LAST	**MAX**	**MIN**	**MEAN**
UCG	9876290	10810531	6534979	8499987
ISP	8733000	10268000	5262000	9260116
BMPS	1314700	2293016	1293000	1557534
BP	1001457	3565817	592681	1348343
UBI	931147	3565817	592681	1346708
BPER	429549	642592	279419	509292
BPM	409908	662766	391213	475330
BPSO	218680	223042	123015	172940
CE	207253	243850	146199	191198
CRG	168034	529058	168034	448764
CVAL	164141	274719	62892	153962
PEL	162372	389837	162372	271919
BSRP	138283	182778	113336	137704
BDB	73191	118219	45343	74501
SPO	15148	21927	12985	17258

Table 5: Short Term Liabilities

	ST L			
	LAST	**MAX**	**MIN**	**MEAN**
UCG	662552628	736949000	507021230	614973277
ISP	462311000	462311000	265758000	370689128
BMPS	104333400	158207958	84864628	124252087
UBI	75277422	78332229	41837577	66617134
BP	75151069	75151069	32999859	61029047
BPER	47519387	47722798	28996416	39683232
BPM	38035547	40566551	28038354	34133534
CE	31440577	31440577	17279191	23759910
BPSO	28138092	29421270	8428779	21001480
CVAL	19995362	21669729	8012613	16143892
CRG	17909067	29137290	11295495	19371772
PEL	10908474	15323451	5066838	8726306
BSRP	10082112	10686778	8152363	9487055
BDB	9506131	9506131	3355187	5690494
SPO	2571651	2571651	1098866	1601699

Table 6: Long Term Liabilities

	LT L			
	LAST	**MAX**	**MIN**	**MEAN**
ISP	159281000	186354000	157045000	171722058
UCG	125504281	226304299	125504281	184007543
BMPS	50097400	80912761	49507687	64106532
BP	39584570	65245156	22620430	49245087
UBI	32064830	49964140	20925250	40093740
BPER	9269179	15968641	9269179	11997139
CRG	7980735	18549816	7980735	13538509
BPM	7070866	13860338	4749751	9780872
CVAL	5042827	8173810	4015280	6126740
BPSO	4852597	5030798	1501653	3214054
CE	4226137	6961424	2549046	4467757
BDB	2068792	3493250	1690761	2421396
BSRP	1219653	2449866	1219653	2164369
SPO	1113609	1113609	561774	834227
PEL	865893	2988215	865893	1750885

Table 7: Stock Volatilities for different windows

σ_E									
180d			270d			360d			
	LAST	MAX	MIN		LAST	MAX	MIN		LAST	MAX	MIN

180d				270d				360d			
	LAST	MAX	MIN		LAST	MAX	MIN		LAST	MAX	MIN
BMPS	91.71	91.71	15.63	BMPS	82.6	82.6	15.59	BMPS	77.6	77.6	18.27
BP	86.12	86.12	14.92	BP	74.78	74.78	16.12	BP	66.66	67.95	15.49
CRG	81.31	81.31	12.44	CRG	71.35	71.35	11.36	CRG	65.25	65.25	11.67
BPER	72.4	72.4	8.45	BPER	64.08	64.08	9.7	BPER	58.01	59.92	11.22
BPM	69.66	77.73	21.6	BPM	61.36	76.54	20.68	BPM	55.79	70.79	19.76
UBI	67.16	67.16	15	UBI	59.87	59.87	15.29	UBI	54.56	58.13	14.61
UCG	65.07	92.73	15.51	UCG	58.11	82	17.56	PEL	54.47	54.47	19.39
PEL	60.19	60.19	16.14	PEL	57.74	57.74	18	UCG	52.47	73.02	16.09
CVAL	59.12	59.12	15.04	CVAL	53.06	53.06	16.51	CVAL	49.36	49.36	16.69
SPO	55.74	58.37	16.16	ISP	50.87	69.55	17.2	SPO	48.23	48.23	20.78
ISP	55.71	80.03	16.21	SPO	50.38	51.25	17.55	ISP	46.54	64.32	17.88
BDB	45.26	45.26	18.6	BPSO	41.03	43.72	9.65	BPSO	38.22	43.29	9.81
BPSO	44.43	44.43	9.3	BDB	41.01	41.01	20.05	BDB	37.64	37.64	20.85
CE	43.23	58.07	18.26	CE	39.77	57.93	18.84	CE	36.7	53.07	19.07
BSRP	34.75	55.47	10.48	BSRP	31.17	48.68	10.62	BSRP	28.03	43.1	11.59

Table 8: Estimated Assets Values

	A			
	LAST	MAX	MIN	MEAN
UCG	726930990	853189725	651374620	717504601
ISP	562628651	562628651	393438584	479187548
BMPS	128543260	212475569	128543260	177503999
BP	95288763	100510633	49278817	87476210
UBI	92195873	98951757	57681308	88966861
BPER	52957508	52957508	36456880	46630165
BPM	42572466	45800331	34868545	39992247
CE	34867249	34867249	20531892	26917759
BPSO	31159943	32989873	10801463	23956302
CVAL	22645490	25140839	10550876	19419405
CRG	21878717	36365316	19026911	27525711
PEL	11318395	15761127	6157630	9535728
BSRP	10856948	11821829	9703330	10728254
BDB	10609030	10646517	4852829	7192539
SPO	3042656	3042656	1528771	2052188

Table 9: Estimated Volatilities of Assets Returns

	σ_A		
	LAST	**MAX**	**MIN**
UCG	0.91	5.04	0.91
ISP	2.4	5.9	1.95
UBI	1.37	3.62	1.17
BP	1.36	4.93	0.96
BPER	1.82	3.57	1
BPM	2.21	4.51	0.63
BMPS	0.8	9.15	0.72
CE	1.9	4	1.55
BPSO	1.28	3.44	1.28
CVAL	1.02	2.74	0.68
CRG	0.99	8	0.91
BDB	0.79	4.46	0.79
BSRP	0.82	1.76	0.7
PEL	0.62	2.87	0.27
SPO	0.86	4.15	0.8

Table 10: Minimised Estimation Errors

	ε		
	LAST	**MAX**	**MIN**
UCG	1.6162e-23	1.6162e-23	1.5694e-25
ISP	1.9303e-24	1.0626e-23	4.9783e-26
UBI	2.0788e-22	6.8598e-22	5.9088e-24
BP	2.7147e-22	7.2907e-22	4.6626e-24
BPER	1.5253e-22	1.7695e-21	6.1765e-24
BPM	4.4976e-22	3.0731e-21	4.5975e-23
BMPS	1.9894e-21	1.9894e-21	2.0663e-25
CE	4.465e-22	1.1733e-20	4.0836e-23
BPSO	4.4887e-22	3.2269e-21	2.9706e-23
CVAL	1.578e-21	2.1566e-20	9.4931e-23
CRG	1.5094e-20	1.5094e-20	4.4545e-23
BDB	6.8091e-20	6.8091e-20	5.8796e-22
BSRP	1.4783e-20	5.1409e-20	8.2218e-22
PEL	2.8162e-19	5.0539e-19	1.1334e-21
SPO	1.5268e-18	2.4557e-18	6.5849e-21