COPENHAGEN BUSINESS SCHOOL

Master's Thesis

MSc of Advanced Economics and Finance

The Resolution of Banco Popular:

Investigating the effects of the BRRD and testing the early-warning capacity of regulatory ratios

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Number of pages: 108

Number of characters: 240439

May 15, 2018

Abstract

The financial crisis of 2008 revealed significant weaknesses in the banking regulations in Europe. Without a harmonised framework for bank failures, governments all over Europe found themselves in the position of having to choose between taxpayer-funded bailouts or risking a systemic collapse. This was the build-up for the Bank Recovery and Resolution Directive (BRRD). A harmonised framework for dealing with distressed banks in the EU in a way that would no longer place the burden on taxpayers, but rather make financial institutions responsible for the consequences of their risk-taking. This thesis studies the first European resolution case since the banking union and its supervisory pillars were established: the failure of the Spanish bank, Banco Popular. We study the case in two parts: from the point of view of its resolution and from an early-warning signal perspective.

By investigating the resolution case, we evaluate the performance of the resolution framework of the banking union, namely the Single Resolution Board (SRB) and the BRRD. We see that the case demonstrates how under the BRRD the taxpayers are spared and creditors and shareholders are made to contribute to the losses by effectively enforcing a combination of the bail-in and sale of business tools. We critically discuss the transparency of the process and question the implications for various stakeholders of the bank. Our findings show that the key issues of the resolution and the framework as a whole is the lack of transparency in the valuation process, which has the potential to undermine the credibility of both the SRB and BRRD in the future. After a detailed discussion of the resolution of Banco Popular, we question whether its distress could have been detected earlier using key regulatory ratios, CAR, CET1, leverage ratio, LCR and NSFR. We find that historical observations do not reveal great variation in the sample of six Spanish banks. However, we take our analysis further and use the IMF method to stress test the sample with 2016 data. Our test reveals that Banco Popular's capital ratios are significantly more sensitive to external shocks than its peers due to under-provisioning and low levels of Tier 1 capital. In addition, our investigation of these results together with the 2016 EBA stress test reveals how Popular's bad asset quality and build-up of non-performing loans had a major impact on its failure, and argue that the EBA test falls short in comprehensively assessing asset quality. Finally, we conclude that stress testing should be used to determine the underlying causes for capital deterioration, and only after investigation of their sensitivity, can capital ratios be used as effective early warning signals for financial distress.

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1. Introduction

The financial crisis of 2008 was the starting point to a number of tightened regulations on banks and financial institutions as regulators from around the world agreed that matters needed to be taken to prevent such a crisis from happening again. In the EU, the crisis revealed many existing gaps and shortfalls on the supervision of banks. Without a single harmonized mechanism in place, distressed financial institutions fell into chaotic liquidations and bailouts that eventually ended up costing taxpayers millions of euros. This was the birth ground for the Banking Recovery and Resolution Directive (BRRD), banking union and a new resolution mechanism, which is meant to accommodate orderly resolutions for financial institutions within the union, yielding the authority of the BRRD.

In this paper we have chosen to study the effects of the implementation of BRRD, and how it has affected the process for failing financial institutions. In our investigation, we use the banking union's first case of bank failure since the crisis, the case of Spain's Banco Popular S. A. We will discuss Banco Popular from two main perspectives: first, from the resolution point of view, to evaluate how the process was handled by the SRB. Second, from an early-warning perspective, to see how the both the public, investors, the regulators and the bank itself could have been warned about the deterioration of Banco Popular. To evaluate the early warning signals for the bank, we look at key ratios imposed by the regulators.

The main research question we work with is as follows:

How has the implementation of the BRRD changed the resolution process in the banking union and have financial regulations improved early detection of financial distress with the case of Banco Popular?

Along with our main clause, we have chosen a sample of sub-questions to aid us in tackling this topic:

- What are the key differences between bank resolutions in the EU before the BRRD versus now?
- Based on the case of Banco Popular, what are the key strengths and weaknesses of the BRRD?
- How can key ratios (like capital adequacy) of Banco Popular and its peers act as early-warning signals in stressed scenarios?

Our thesis has been divided into an introduction, five main parts, discussion and a conclusion.
In chapter 1 we will provide an introduction to our thesis topic as well as details of our main research question and sub-questions. We will also discuss the limitations of this study.

Chapter 2 will discuss the theory of banking regulations and its economic and political motives. This chapter lays the foundation for studies of modern frameworks by theoretically evaluating banking regulations, and introducing the cornerstones of regulations: the Basel accords.

Chapter 3 will fully introduce the BRRD and the resolution framework present in the banking union today, and provide a snapshot of the history of bailouts and the consequent motives for a harmonized resolution framework. We will critically discuss the different resolution tools provided in the BRRD and the implications these tools have on financial institutions and their stakeholders. We will follow the topic by providing a brief comparison with European resolution frameworks outside the banking union, using Denmark as an example, and the Dodd-Frank reform in the United States.

Chapter 4 offers a full introduction and analysis to the case of the Spanish bank, Banco Popular S.A and its failure in 2017. We start by providing a brief history of Popular and its path from the financial crisis to its failure. We discover Popular's continuing struggles with non-performing loans and follow their path from capital shortfalls to the eventual liquidity crisis which sealed their failure. We question why Popular was able to remain above minimum capital requirements in the EBA stress test in 2016 despite its problems. We then discuss the resolution decision and process, and attempt to ascertain how their resolution reflected the principles outlined in the BRRD. Finally, we compare the resolution case to the liquidation of the Italian banks, Banco Veneta and Banco Popolare di Vicenza, and see how SRB's decision not to resolve these banks changed the process.

Chapter 5 follows from our discussion in chapter 4 of how the regulatory ratios can be useful for regulators in detecting distress with financial institutions. By looking back into the case of Banco Popular and using the information we have available post-failure, we study the key health indicators, CAR, CET1, LCR, NSFR and the leverage ratio. We discuss how they are built and how useful they were in detecting signs of weaknesses in handling financial distress. An additional discussion on a theoretical ratio from literature is included. We find it to be necessary to study the sensitivity of the ratios under a stressed scenario to determine whether they serve their purpose as early warning signals. This conclusion brings us to the next chapter.

Chapter 6 starts by looking into the performance of Banco Popular in the EBA stress test in 2016, where the test was conducted with 2015 figures. We observe and discuss the results of Popular and the reactions of its CAR, CET1 and the leverage ratio. We then take a step further, perform an IMF stress test on a sample of six Spanish banks (including Banco Popular) on their 2016 figures, and study the results a year later. We do this to empirically observe the sensitivity of Popular's capital position compared to its peers under several external shocks, and discuss how impacts of non-performing loans, provisions and interest rates affect the capital levels of an institution.

Chapter 7 offers a final discussion on the lessons learned from the case of Banco Popular, and provides some predictions on the future of regulations, such as impacts from Basel IV and liquidity stress testing, as well as areas for further research.

Chapter 8 gives our conclusion and recommendations we have made based on our findings. We conclude our thesis by offering two main recommendations for future resolution processes and two recommendations for the early-detection of distress.

1.1 Limitations

At this stage we would like to acknowledge some key limitations that should be beared in mind when reading this paper.

Firstly, the topic of resolution decisions and supervision of distressed institutions suffers from lack of publicly available information as many of the relevant documents are only available to the resolution authorities. We acknowledge that our analysis is very much limited to the information available to the public and could be taken further with access to additional information, such as the original valuation of Banco Popular. Furthermore, the case of Popular is still a new one and lawsuits around its resolution have not been settled. We suggest that a more in-depth analysis will be possible in a few years when more of the information becomes available to the public.

Secondly, our key ratio analysis has been somewhat hindered by the underdevelopment of the liquidity ratios and lack of available data to test for liquidity. To further develop our view on early-warning signals, liquidity stress testing would be desirable.

Finally, it should be noted that the IMF stress test conducted in this thesis is a simplified model and for example ignores the more complex derivative operations and trades of banks. Furthermore, it has been subject to data availability and some educated assumptions have been used when data has not

been available. Thus, while we believe our test to be a good indicator of capital sensitivity, results would probably differ if we had access to full internal data.

2. Theory of banking regulations after the financial crisis

2.1 Purpose

In this section, we dive into the theory of banking regulations and discuss why they are necessary and what have been the major stepping-stones on the way to the current framework in the EU. We commence by discussing theory and literature on contemporary banking theory and try to establish a strong argument for the supervision of financial institutions. We then move on to the foundation of modern regulations and supervision framework; the Basel Accords, which are relevant in building a starting point for the rest of the paper.

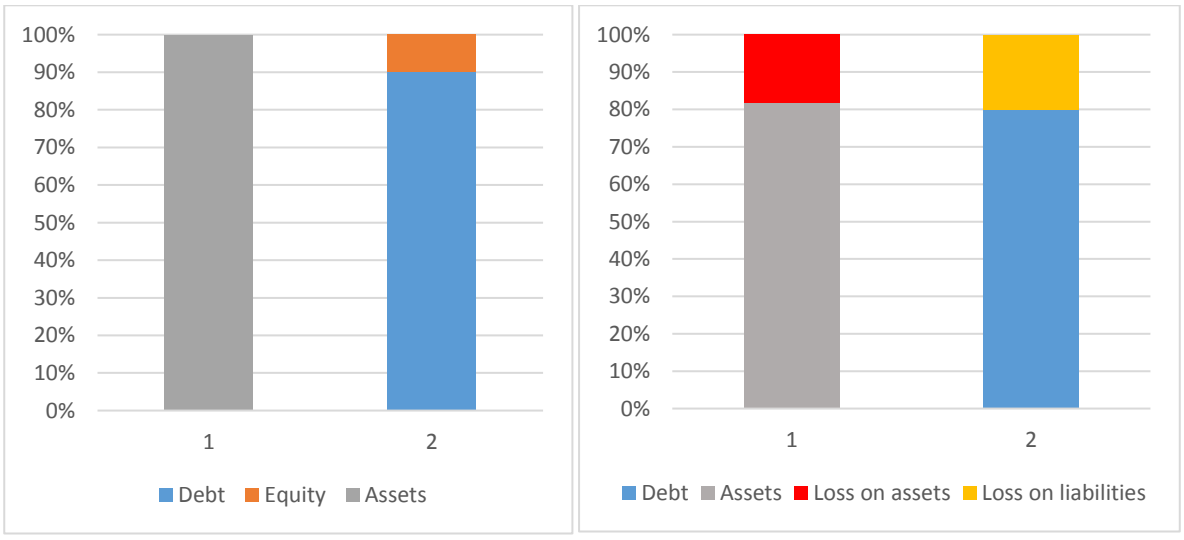
2.2 Why the need for banking regulations?

Banks play a central part of any economy and influence all sectors via their different functions. As providers of capital and liquidity in the market, banks hold power over both microeconomic and macroeconomic environments in a country. As providers of loans, investment facilities and risk diversification, they serve a crucial function to businesses, governments, households and large corporations. By providing these services, banks will always occur a level of risk, whether it is due to counterparty risk, credit risk from loans or even simply maturity mismatches. It is due to this risky nature of banking activities and their wide-reaching influence within the economy that governments and authorities have found it necessary to regulate their activities. From a theoretical perspective, there are multiple motives for banking regulations: varying from purely economic to political grounds. From a purely economic perspective, Grossman (2010) states that regulations are merely an attempt to correct a market inefficiency resulting from asymmetric information and a traditionally oligopolistic industry that tend to lead to a social suboptimal. On a management level, agency issues can arise when incentives between depositors, investors, directors and management differ (Kohn, Saunders & Senbet, 2000). When arguing from socio-economic or a political perspective, banking regulations promote public interest and overall economic stability (Harnay & Laurence, 2016).

Liquidity risk is a natural consequence of basic banking operations as banks use deposits from retailers and households to finance their lending activities. With this mismatch of short-term liabilities and long-term assets, banks expose themselves to liquidity risk. In this paper, we will observe this risk become real as we talk about the Spanish Banco Popular and its failure, which was caused by a liquidity crisis due to large deposit withdrawals. This type of liquidity risk has been considered in the current Basel framework and ratios such as Liquidity Coverage Ratio (LCR) and Net Stable Funding

Ratio (NSFR) have been introduced to further fortify the liquidity positions of banks. However, liquidity is by nature a difficult aspect to regulate and liquidity shocks tend to be unexpected by nature (as discussed by Diamond & Dybvig, 1983). It therefore not surprising that liquidity risk is the most undeveloped side in banking regulations, with both LCR and NSFR still very much underdeveloped and liquidity stress testing almost nonexistent. The development of such measures continues to be one of the key goals for the future (BCBS, 2014a). A more mature side of banking regulations consists of minimum capital levels intended to act as a loss-absorbing buffer in case of asset quality deterioration or other unexpected losses. The reason behind this is simple: bank's liabilities are made of equity and debt, and by the accounting equation, it must equal to bank's assets. If a bank then experiences a deterioration in assets, two things can happen: if the hit is not too large, the capital buffer can absorb it. If, however, the hit is large enough to drain equity and fall into the debt side of the balance sheet, then this debt becomes unpayable, as there are no assets to back up for it, and the institution falls into insolvency (see figure 1). Capital levels were one of the first issues addressed in regulators, starting from Basel I. Since then, the capital level requirements and specifications have been adjusted multiple times, both in Basel II and III, in an attempt to come up with the most accurate result. More specifically, Basel III introduces minimum capital levels on financial institutions in the form of ratios like capital adequacy ratio (CAR) and Common equity tier 1 ratio (CET1), both of which will be discussed later on in this thesis.

Figure 1. Illustration of the effects on a bank's balance sheet from losses on assets



Source: Own adaptation

It has become apparent from the recent financial crisis that the interdependency between financial institutions all over the world is becoming stronger and stronger. Therefore, we cannot consider bank failures and distress as an individual incident anymore but we must consider the national and global implications a failure might have. Authorities have acknowledged that the modern financial environment no longer allows us to let banks to fall into insolvency on their own, especially if there is are signs of systemic risk and threats to overall financial stability. With this, however, we also run into the issue of moral hazard. Public intervention and state guarantees, while potentially useful in preventing a system wide failure, causes a shift of responsibility, which can accommodate excessive risk taking (Allen, Carletti, Goldstein & Leonello, 2015).

Therefore, the modern developments worldwide and in the EU have put a special focus on the orderly resolution of banks and a minimization of public funds use: a view, which we will follow throughout this thesis.

2.2.1. Supervision of Global Systemically Important Financial Institutions (G-SIFIs)

Our intention in this section is to highlight the importance of large systemically important institutions and provide the reader a better understanding of their role in shaping the modern banking regulations and resolution frameworks.

The concept of "too big to fail" is a phrase left behind from the financial crisis and even today holds a dark echo in the modern financial world. In the US, the biggest six banks hold twice as much in assets than the next 30 banks combined (Onaran, 2017). These largest players in both the EU and the US, not only have millions of customers and depositors, they also hold large exposures to each other, creating a web of interconnectedness. As discussed in the earlier section, this type of exposures and connections in the market took a central seat after the financial crisis after multiple large institutions needed to be bailed out due to the risk of collapsing the entire sector. Later in the paper, we will discover how this contagion effect has influenced the development of the new bail-in tool used by resolution authorities.

After the crisis, it was decided by the Basel Committee that the largest banks needed to be identified and face additional requirements to address the systemic risks they bear if they were to fail. Ever since 2011, this has been done by the Financial Stability Board (FSB) as they have identified banks known as G-SIBs, "Globally Systemically Important Banks". The list is updated annually based on new data, and the banks on it are required to report various indicators to their individual national

supervisory authorities. In 2013, the requirements were updated and the FSB started to identify Globally Systemically Important Insurers (G-SIIs). Combined, G-SIBs and G-SIIs make up Globally Systemically Important Financial Institutions (G-SIFIs) which are evaluated under an integrated policy framework (FSB, 2018a). The Basel Committee is responsible for the methodology that assesses G-SIBs, while the International Association of Insurance Supervisors (IAIS) assesses G-SIIs (FSB, 2018a).

In 2017 there was identified 30 G-SIBs (Financial Stability Board, 2017a). The FSB member authorities are required to apply an additional G-SIB capital buffer of 1%-2,5% of CET1, depending on the level of systemic importance to these banks as well as increased supervisory expectations and a new loss-absorbing measure, TLAC (total loss-absorbing capability). The TLAC is by nature similar to the Minimum Requirements for Own Funds and Eligible Liabilities (MREL), however the latter applies to all European institutions under the BRRD as a way to ascertain appropriate funds in the case of a resolution. TLAC differs by only being applicable to G-SIBs. TLAC is still under development and will be implemented fully in January 2019 (KPMG, 2016).

2.2.2 Moral hazard as a justification for regulation

We have given a definition for the G-SIFIs and highlighted the regulatory requirements that are posed on them based on their systemic importance. Now, we discuss some literature and theories behind the concept of moral hazard, that has been pivotal in the development of both the new resolution frameworks and the tightened regulatory standards for G-SIBs. Moral hazard was described in the words of Ugeux (2015*): "- you no longer bear the responsibility of your actions and are thus more likely to engage in reckless behaviour that others will incur the cost of."*

This statement describes the issue that was raised in the aftermath of the financial crisis in Europe, where it became more of a rule than an exception that large banks got bailed out by their respective sovereigns, as an attempt to alleviate the effects of the crisis and prevent it from collapsing the entire sector. Whilst these actions were warranted at the time, it has been pointed out in literature that it could have been the promise of a public bailout that had amplified the crisis in the first place. Masera (2011), Hellman, Murdock & Stigliz (2000) and Nier & Baumann (2006) have each concluded through their empirical and theoretical results that government aid of any kind decreases the incentives for banks to hold capital. Nier & Baumann (2006) additionally find that the effect of market discipline and disclosure requirements is reduced by the existence of government safety nets. Schenck

and Thornton (2016) have contributed to the discussion by claiming government safety nets directly increase the probability of making risky investments. It is clear from the support in research as well as observations from the financial crisis that moral hazard is a real issue with larger financial institutions, and allowing governments to catch failing banks has a downside of unintentionally promoting risky behaviour. As responsibility is shifted and the same stakeholders that profit from the risk taking are not the ones carrying its risks, problems are bound to rise. It follows from this argument that modern regulation has placed a greater emphasis on placing the losses on stakeholders that profit from risk taking, such as shareholders and investors. It is not a simple task. Cordella and Yeyati (2003) describe the regulator's and a government's dilemma as a trade-off of being too 'tough' and thus risking a failure impacting other institutions and causing systemic crisis, or too 'soft' and incentivising reckless risk-taking. Therefore, we conclude that a successful resolution framework can only work while there is an equally efficient framework monitoring capital and liquidity, to minimize the risk of going into resolution in the first place.

2.3 Basel Committee on Banking Supervision

Banking regulations are not a new phenomenon and the Basel Committee on Banking Supervision (BCBS) is a demonstration of one of the earliest forms of banking regulation standards. Dating back to 1974, the BCBS was developed as a response to the turmoil in the currency and banking markets and to the failure of Bankhaus Herstatt in Germany (BIS, 2017a). The purpose of the committee, headquartered in Basel, was to promote and improve financial stability via supervision quality and integration, most notably, to address international supervisory gaps so that banks would face the same level of supervision and regulation regardless of where they were based. The first important step towards this goal was made in 1997 when the committee released *"Core principles of effective banking supervision"* (BIS, 2017a). After several adjustments, it now includes 29 principles, covering all issues of supervision from early intervention, supervisory expectations and compliance to timely supervisory actions. The most known publications of the committee are however the articles on capital adequacy: Basel I, II and III.

2.3.1 Basel I: the Basel Capital Accord

The first Basel accord, known as the 1988 Basel accord, and later Basel I, focused mainly on setting minimal capital requirements for financial institution to minimize credit risk that had been in the rise due to the debt crisis in Latin America (Clement & Maes, 2013). The increased volatility in the markets had caused the capital ratios of major banks to decrease which had raised the worry for credit

risk escalation. As an attempt to address that concern, risk-weights and different tiers were introduced as a method of valuating capital. Tier 1 was to make up at least half of the regulatory capital requirement (8%), and tier 2 was to be at least half of tier 1 capital. The capital in tier 1 was to act as core capital and consisted of shareholder's equity and retained earnings (or other disclosed reserves), whereas tier 2 included undisclosed reserves, capital instruments and subordinated debt, provisions and loan loss reserves and hybrid debt and equity. The assets were classified by the risk weights of category on balance sheet assets. This was ranging from risk-free assets such as cash, claims on governments, central banks and OECD governments, to 100% risk assessed assets such as private sector debt, real estate and other investments, non-OECD bank debts with a residual maturity of over one year, premises, plant and equipment and capital instruments issued by other banks[1]. Thus the Tier 1 capital ratio was calculated as tier 1 capital over aggregated RWA.

Adapted from Basle Committee on banking supervision (BCBS, 1988), the total of tier 2 (supplementary) elements will be limited to a maximum of 100% of the total of tier 1 elements;
(ii) subordinated term debt will be limited to a maximum of 50% of tier 1 elements;
(iii) where general provisions/general loan-loss reserves include amounts reflecting lower valuations of asset or latent but unidentified losses present in the balance sheet, the amount of such provisions or reserves will be limited to a maximum of 1.25 percentage points, or exceptionally and temporarily up to 2.0 percentage points, of risk assets;1
(iv) asset revaluation reserves which take the form of latent gains on unrealised securities (see below) will be subject to a discount of 55%

The Basel I has been criticized for having several shortcomings. The main grounds for it were based on the limited differentiation of credit risk: Basel I only had one pillar which accounted for credit risk, market risk and operational risk, thus making the contributions from specific risk categories rather opaque. Additional issues included static measure of default risk and having no recognition of term-structure of credit risk. Diversification effects for portfolios were also ignored which caused a distorted view on risk management, as diversified portfolios were treated the same way as undiversified ones. Regardless of these shortcomings, Basel I was an important milestone in banking regulations and paved the way for the more detailed and sophisticated Basel II and III accords.

[1] See Appendix A1 for full list.

2.3.2. Basel II: The Revised Capital Framework

Following substantial losses in the international markets during the 1990s due to poor risk management, it had become apparent that a revision to the original Basel I accord was warranted. William J. McDonough, Chairman of the Basel Committee said in a 2001 press release that *"the new framework is intended to align regulatory capital requirements more closely with underlying risks, and to provide banks and their supervisors with several options for the assessment of capital adequacy"*. (BIS, 2001). In 2004, the new framework was published. Basel II introduced the current three pillar structure, intended to fortify the awareness of underlying risk and market supervision. Pillar I remained the same as in the original Basel I framework and contained the minimum capital requirements meant to minimize potential shortfalls and risks from credit risk, market risk and operational risk. However, the approach to calculating the minimum capital changed as it became possible for banks to assess underlying risks in their portfolios using an Internal Ratings-Based (IRB) models. This change consequently lead to banks having lower solvency ratios as they could now more accurately price the risk in their balance sheets and thus reduce the value of their risk-weighted assets.

Pillar II was dedicated to regulatory supervision and was labelled as the supervisory review process. It was intended to highlight the importance of management's internal capital assessment processes and setting prudent an appropriate capital targets. In addition, it provided a framework for the regulation of pension risk, systemic risk, concentration risk, strategic risk, reputational risk, liquidity risk and legal risk, all combined in the accord below the title Residual Risk (IBM, 2018a). It was also under pillar II where the general stress tests were introduced by the committee as a risk management measure to assess the responses of their assets and liabilities under adverse conditions. Additionally, banks using the IRB models in assessing their capital levels were required to have credit risk stress tests to evaluate the robustness of their capital assessments (BIS, 2009). Stress testing plays a big part in our paper and will appear again in more detail in part 6 where we discuss the responses of Banco Popular to stressed scenarios.

Finally, pillar III was introduced to complement the first two pillars by including in market discipline into framework via enhanced disclosure methods of how capital requirements are calculated and what is included in it. The disclosures can be seen in the form of mandatory pillar III reports, demanded

from all banks, describing risk management measures and providing details on risky operations, capital levels and so forth[2].

Basel II has perhaps been unlucky in being the main risk management framework in place before the financial crisis and therefore having been under the most scrutiny. It has been blamed for being pro-cyclical by nature with a mathematical weakness in its risk calculations, leaving the banks with capital buffers that were too low and optimistic, based on calculations from a relatively calm period: a consequence of the function used in the IRB method, the minimum capital requirements were higher in decline periods and lower in times of boom. The lower requirements in a good period can attribute to an increase in credit supply, which in turn has been blamed for creating economic bubbles on activities that require loans, such as real estate (IBM, 2018). The IRB approach has also been blamed for providing the banks a back door to lower capital requirements by allowing for lower risk weights. While the framework had been designed to incentivize better internal risk management practices (and the market discipline and supervisory review in pillars II and III were believed to counter the incentive for lowering capital), many banks still entered the crisis with insufficient capital buffers and too much leverage (IBM, 2018). This combined with poor risk management resulted in an excess credit growth and poor predictions of liquidity and credit risk.

2.3.3. Basel III: International Regulatory Framework for Banks

As a response to the financial crisis and the critique of the Basel II accords, Basel III was released in 2011 and it remains as the most comprehensive reform in financial regulation to date. The objective of Basel III was to respond to the deficiencies that had become apparent in the financial crisis, and provide a framework which would decrease leverage, increase liquidity and strengthen the capital requirements. Since many banks had been caught off guard by the liquidity crunch in the financial crisis, new measures for liquidity management were introduced, the LCR and NSFR being the most significant developments. The former of which focuses on short-term liquidity while the second promotes resilience on the long-term horizon (30 days and 1 year respectively).

While the three pillar structure from Basel II remained the same, several changes and specifications were made. In the capital requirements side the total capital ratio remained the same at 8% but additional buffers were introduced. The capital conservation buffer of 2.5% is intended to absorb losses in times of economic distress and is intended to be met only with common equity. As an

[2] For a full pillar description, see Appendix A2.

extension to the Conservation Buffer, Countercyclical Capital Buffer was introduced and is implemented based on country-specific circumstances (IBM, 2018). Additions were also made to the Common Equity Tier 1 (CET1) which was increased from 2% to 4.5% of risk weighted assets (RWA) and an additional buffer was implemented for G-SIFIs to account for their larger risk contributions. Additionally, an unweighted leverage ratio of 3% was implemented, dependent on balance sheet and off-balance sheet exposures. Changes were also made to address counterparty credit risk and exposures to central counterparties (CCPs). From experiences in the financial crisis, it had become clear that counterparty credit risk and the scope of interconnections between institutions had been underestimated and overlooked in Basel II. Thus, higher capital was introduced for inter-financial sector exposures due to the increased contagion risk as an additional measure to safeguard the financial sector from another systemic crisis.

Pillar II also experienced changes and additions, most notably, the inclusions of Internal Capital Adequacy Process (ICAAP), Internal Liquidity Adequacy Process (ILAAP) and Supervisory Review and Evaluation Process (SREP). The aim of ICAAP and ILAAP is to engage the management body of an institution with risk management and have them calculate the capital and liquidity cushions they expect to need in the future based on their business model and business specific risks. These assessments are then evaluated annually in SREP by supervisors and the bank's internal assumptions validated and ascertained they demonstrate appropriate risk appetite and vulnerabilities and are conservative enough (KPMG, 2017). The SREP is individually tailored for each bank, and it assesses the health of an institution from a comprehensive point of view, looking at capital, liquidity, business model and overall governance and risk management practices.

When assessing capital levels, supervisors review the ICAAP and then make their own evaluations of adequate capital buffers to absorb unexpected losses. On occasion, it can be that the capital levels reported by the bank are lower than the ones determined in the SREP, in which case the supervisors will communicate the need of additional capital and give the bank a new capital ratio requirement (European Central Bank, 2016). Consequently, different capital ratios can exist for the same institution: a public reported one and the private level reported back to the bank from SREP. Due to data availability, this thesis will only use the publicly available ones.

3. Evolution of Resolution Mechanisms: From bailout to bail-in

3.1 Purpose

We have now discussed the evolution of the Basel accords and the main drivers for the regulatory reforms, the biggest one being the bad experiences from the financial crisis.
In this section, we focus on the different resolution and supervisory mechanisms that are present in and out of the banking union and how they were evolved. A "resolution" is defined as the process with which a distressed financial institution can fail in an orderly manner and cause minimum impact on the financial stability (Bank of England, 2018).

We find relevance in this section as it sets up the stage for the later discussions for the resolution of Banco Popular, and the evaluation of the performance of the regulations in that instance. A discussion on the functions of the Single Resolution Board (SRB) is included to pave the way for a credible discussion on the resolution mechanisms.

We discuss the BRRD and its role in the supervisory scene in Europe. We then shift our focus to the resolution mechanisms, both inside and outside of the banking union. The reader should note that this thesis is not a legal paper and therefore does not go into the specific legal frameworks surrounding these regulations or directives.

3.2. Responses to bank failures during the financial crisis

To be able to understand the new resolution framework and their objectives, it is necessary to take a step back in time and discuss the driving factors for the reform, beginning of the financial crisis, and how the bank failures were handled then.

The financial crisis followed an economic upturn and a boom period characterised by loose regulations, rising housing prices, asset securitization and development of complex financial instruments. A crisis that started from the US rapidly spread across the world due to interconnections and hit Europe with force. Liquidity crisis followed a series of losses from mortgage defaults and murky balance sheets, as the market grew insecure and eventually stopped lending. As the markets everywhere were faced with extreme conditions and an increasing number of failing banks, regulators faced an entirely new challenge: calming down a sector that was not only struggling with individual issues but that was also highly linked to counterparties from all over the world, all of which operated under a different authority.

Actions were taken to stabilise the financial sector fast, and in the absence of a uniform framework, governments all around the globe, in the attempt to avoid a worldwide collapse, authorised large fiscal interventions (World Bank, 2017a). In the period of 2007-2009, central bank claims on institutions rose as high as 18,3% (as see in the overview Table 1) and covered a range of different methods, from liquidity facilities, decreased collateral requirements, to purchases of impaired securities (Laeven & Valencia, 2012). A total of € 3 892,6 billion of guarantees of liabilities were authorised in Europe between 2008-2014 by the European Commission, and even then, banks continued to fall and required more and more injections of capital.

The first example of the commencing large capital injections is the Benelux bank Fortis in 2008, which had suffered of a series of write-offs and continuing rumours of insolvency, which had led to a drop in market confidence. Therefore, Fortis fell into a liquidity crisis (on a side note, this series of events is interestingly very similar to the reasons that led to the failure of Banco Popular).

Later in the year, the Dutch government published that they would be purchasing the full stakes of the Dutch insurance and banking branches of Fortis, worth €16,8 billion, while the Luxembourg government announced to buy 52% of the Luxemburg branch. However, given series of national and international complications, it was eventually decided that BNP Paribas would be taking over the largest stake of Fortis, leaving the governments with a minority claim (Edmonds & Marshall, 2010). Following the case of Fortis, European banks went through a stage of major capital injections, including the Belgian bank KBC getting two bail outs worth of €5,5 billion, Bank of Ireland receiving €3,5 billion, followed by many more. The capital injections were not enough to stabilise the failing and strolling banks. A list of different government aids is available in appendix A3.

Eventually the crisis ended up spreading to the other sectors, causing the crisis that is now known as the "Eurozone debt crisis". As the financial and sovereign sectors pressed on each other, it was found that the interdependencies between individual bank risks and sovereign risk was far higher than many had anticipated. As a result of the sovereign crisis, many members of the EU (such as Iceland, Greece, Ireland and Spain), became unable to refinance their sovereign debt and required aid from the ECB and the IMF to bail out national banks. Financing was eventually provided and a special vehicle, the European Stability Mechanism (ESM) as the way to provide the finances necessary.

Table 1: Costs of the Crisis

Nationalisation of Banks	29
Restructuring support for countries concerned (gross)	Between 0,7-7,7 % of GDP
Asset guarantees and purchases	Between 0,2-13,4% of GDP
Liquidity support	Between 1,1- 18,3 %-points

Source: Adaptation from the World Bank: BRRD Guidebook. Page 18.

The financial crisis was the highlight of the regulatory inefficiencies present in the EU and the supervision of its large financial institutions and raised the critical discussion of "too big to fail". It was evident to many that to have institutions that perceive themselves as too important to fail pose a very real danger to the system as they would believe to have a public safety net to fall on and pay for excessive risk taking. Many different authorities came up with recommendations and responses for improving the cross-border supervision and resolution mechanisms, the epitome of this being the Basel III reform, which we have already discussed in this thesis.

For Europe, it was clear that within the EU borders, actions were needed to get the supervision to catch up with the integration of the financial system: this was the set up for the BRRD.

3.3 The EU framework for troubled banks: Bank Recovery and Resolution Directive

The Bank Recovery and Resolution Directive (BRRD) is one the key elements implemented after the financial crisis and, true to its name, establishes rules for the recovery and resolution plans for credit institutions and certain investment firms in the EU. It is a part of the single rulebook, a harmonised set of prudential rules, along with the Capital Requirement Directive (CRD IV) and the Capital Requirement regulation (CRR), agreed upon in 2014, implemented in 2015, and has been a main step in establishing the banking union and the Single Resolution Authority (SRB). The scope of the BRRD includes financial institutions that are subject to prudential supervision and have initial capital of more than 730,000€, that is, it covers credit institutions and larger investment institutions, as well as some holding companies and subsidiaries (Gardella, 2017).

The purpose of the BRRD is to regulate all stages of a problem bank's recovery and resolution and by doing that, improve financial stability and avoid financial distress spreading into other sectors of the economy. Therefore, it should be noted here that the BRRD tools are only applied if justified by public interest; it does not replace bankruptcy or insolvency laws that continue to operate on national

levels as alternatives to resolutions (World Bank, 2017a). For the purpose of this thesis, we do not pay much attention to the recovery aspect of the BRRD but will rather focus on its effects on resolutions. While traditional insolvency laws focus on maximizing the value of the company for the creditors, the BRRD is rather meant to preserve taxpayer money and aim for a resolution that has the least impact for financial stability. The specific objectives as stated by law are described in the World Bank Guidebook (2017a) as *"-, ensuring the continuity of critical functions; avoiding significant adverse effects of the financial system; protecting public funds by minimizing reliance on extraordinary public financial support; protecting insured depositors; protecting client funds and client assets."*

So what is the ultimate advantage of resolution when compared to regular insolvency proceedings? Firstly, if a bank were to go into liquidation, the liabilities of the institution fall due. The assets are disposed by a trustee and any proceeds are meant to be distributed to creditors, who are all meant to be treated the same. The problem with this approach is the contagion risk to the financial system: as has been discussed before, it was the contagion risk that created the fear of a bigger crisis and justified the use of public funds to keep the distressed institutions open (World Bank, 2017a).

The BRRD specifies a set of tools for the SRB to use either together or separately, based on individual cases. The tools include sale of business, asset separation, creation of a bridge institution, the bail-in tool, and as the last option, government stabilization tool. Of these, the bail-in tool is perceived as the highlight and main contribution of the BRRD.

The choice of resolution tools follows a tree of decisions, starting from the decision between recovery and resolution. In the case where resolution conditions are met, evaluation is needed of whether bail-in is an appropriate tool to use. In the cases where it is not, then bridge financing is organised until other tools can be implemented. The other resolution tools (broadly labelled as 'transfer tools', see table 2), all provide a mechanism for a transfer of all or parts of the impaired institution's assets. The first option is the sale of the entire business, which under the BRRD can be done without the consent of the shareholders as a measure of ensuring continuing operations. In a case where this is not possible, the process moves to the carving of the business, where parts are separated and treated by a sale, bridge institution or an asset separation vehicle.

Table 2: Division of resolution tools

	Action	*Process*
Bail-in	Shareholder and capital instrument participation Creditor participation	Write-down of debt and equity OR conversion of debt and equity
Transfer tools	Sale of business	Entire entity is sold under specific conditions
	Asset separation	Non-critical functions and impaired assets are transferred.
	Creation of bridge institution	Critical functions and assets are transferred to a bridge institution.

Source: Own adaptation

The bridge institution tool is a measure where a publicly owned entity is formed by the resolution authority and critical functions (assets, liabilities, shares and rights) are maintained and preserved. Bridge institutions can only operate for up to two years, after which the business can be sold back to the institution or to third parties (World bank, 2017a).

Finally, the last transfer tool is the asset separation tool. It works similarly to the previous tool, however, unlike with a bridge institution, asset separation does not attempt to preserve the business functions. A separate publicly owned entity is formed, but its function is more like a bad bank, and its goal is to wind down or sell assets that are deemed impaired.

While all of the tools serve a purpose and are applied in combinations with other tools when needed, special attention should be given to the bail-in tool, as it demonstrates the largest change in resolution objectives and mechanisms since the financial crisis. We will now discuss the bail-in tool in detail.

3.3.1 Introducing bail-in: the new age of bank resolutions

This section discusses the most important resolution tool that was specified in the BRRD, which has become the central element in the new resolution framework.

In a traditional bailout, an outside source such as the government injects money into the institution to help make payments that are falling due. The bailout method was heavily used in the latest financial

crisis and has received a lot of critique for the use of taxpayer money to bail out creditors and shareholders, which was one of the driving forces in creating the new legislation.

According to the new SRM regulations that was made mandatory in January 2016, banks are required to recapitalize and absorb losses from within. A bail-in is in essence used to recapitalise the institution to the point where it can continue to operate its authorised activities and gain market confidence. The tool is applied by writing down shares and capital instruments and converting non-excluded liabilities into newly issues of shares (De Nederlandsche Bank, 2017). The Basel committee stated in 2011 that all non-core equity tier instruments would need to have a bail-in feature, that is, all tier 1 and tier 2 non-common instruments need to have a provision that allows a relevant authority to write it off or convert it to common equity (IBM, 2018). Figure 2 shows a demonstration of the bail-in waterfall and the subordination of instruments; if the bailed in amount is insufficient in the previous category, the authorities move down, e.g. from CET1 to AT1 and so on. From CET1 to tier 2, the bail-in power used is either a write-down or conversion of the respective instruments. As a practical example, in the case of Banco Popular, the CET1 and AT1 were written-down and tier 2 was converted to new share capital (FROB, 2017).

The bail-in tool can also be used together with another resolution tool; bridge bank, asset separation or a sale of business. As the reader will find, this kind of a combination of a bail-in and a sale of business was used in the case of Banco Popular.

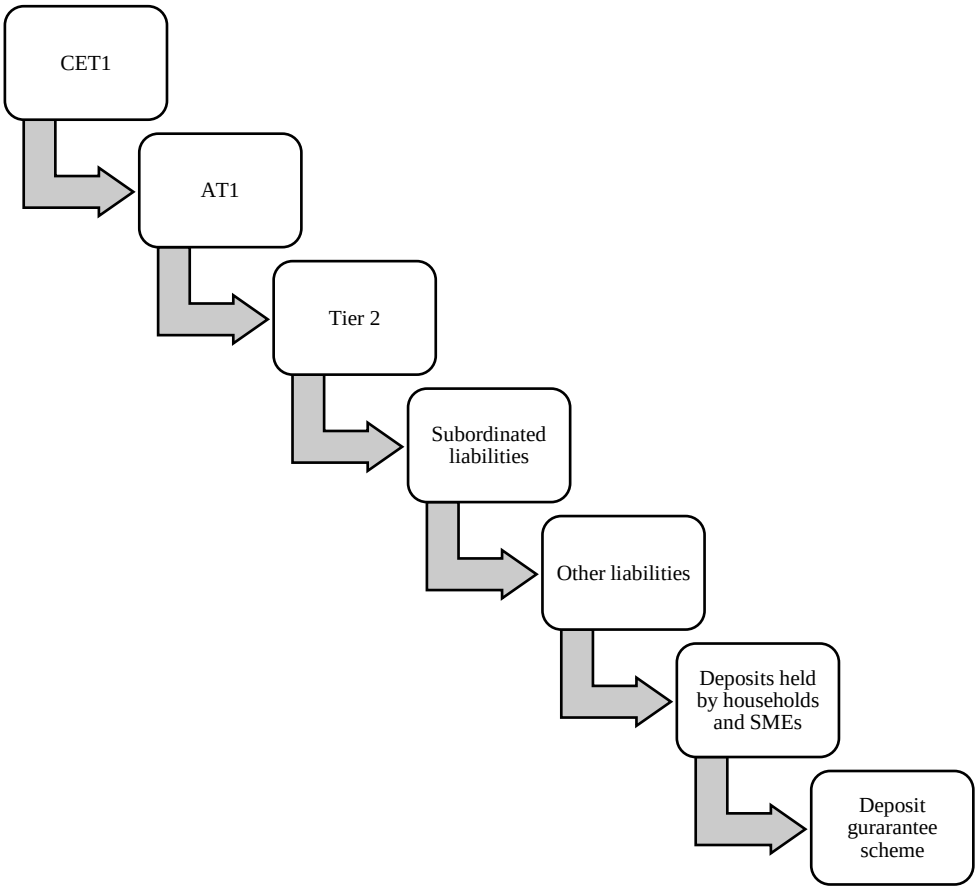
In a bail-in, the creditors are second to shareholders in realising losses and the priority of the claims will in that case follow normal insolvency. The SRB specifies in their report that all creditors of the same class are to be treated equally and creditors are not to experience greater losses that would have incurred under regular insolvency proceedings (SRB, 2017b). According to SRM regulations, all liabilities of an institution (except for covered bonds) are eligible for a bail-in, however, great freedom is given to the SRB to determine whether certain liabilities should be partially excluded under special circumstances (European Central Bank, 2018a).

The bail-in tool is meant for two purposes: firstly, to restore the institution's capability to continue performing authorised activities under resolution and to sustain market confidence. Secondly, to convert equity or to reduce the amount of debt instruments. A rationale for this as provided by Zhou, Rutledge, Boussu, Dobler, Jassaud & Moore (2012), is to prevent a run on repos or other short-term funding due negative signalling effects from the bail-in. They also acknowledge the potential need

for liquidity support in the bail-in process to support market access and to fund potential liquidity outflows.

The bail-in tool offers an attractive option for bank resolutions and works on the grounds of the market-discipline argument: that is, as an investor you should also be exposed to the risk of the investment as well as the profits. Based on financial theory this makes sense; when one is exposed to the risk of the investment, the incentives to monitor it increase and so does market discipline (Avgouleas & Goodhart, 2015). However, on a practical note it can only work as long as banks indeed have sufficient resources to absorb losses posed on them in a resolution. Given that certain liabilities such as covered deposits, secured liabilities and liabilities with a maturity less than 7 days are excluded, it was then necessary to determine a sufficient loss-absorbing level of liabilities (Deutsche Bundesbank, 2016). On a European level, the BRRD determines a minimum requirement for own funds and eligible liabilities (MREL). The MREL acts as a loss-absorbing buffer in the case of resolution. To ensure the usability of the MREL it is important to set requirements for the MREL liabilities and ensure they are indeed available at the time of the resolution: these liabilities need to be ready and available without legal difficulties. Therefore, household-, and SME deposits and collateralised instruments with maturities of less than one year are not considered eligible MREL instruments (Deutsche Bundesbank, 2016).

Figure 2: The bail-in waterfall



Source: Adaptation from Deutsche Bundesbank. (2016). "Bank recovery and resolution – the new TLAC and MREL minimum requirements". Page 8.

3.3.2. Discussion and criticism of the bail-in

Referring here to Bagus, Rallo & Alonso Neira (2014), there are a range of factors that have left the BRRD vulnerable and subject to wide range of interpretations. Only covered deposits (those under 100,000 euros) are safe from conversion into equity. Secured liabilities are also protected and individuals and SME's have preference over claims of large corporations, giving quite a large discretionary power to the government, which has significant decision power on liabilities that it determines excluded from the bail-in procedure. This point was brought forward by the case of the Italian Veneto banks, which is discussed in later parts, and the case highlights the continuing power of national frameworks and governments. Jackson and Steel (2012) have argued with a similar view, stating that the administrative discretion remains too great for the mechanism to work fully efficiently. They also point out potential political reasons for inaction and the historical preference to

shield creditors and shareholders over taxpayers. This claim was, again, proved right by the case of the Veneto banks as the Italian government made the decision to shield senior bondholders over the public.

The decision to exclude secured liabilities has also attracted much critique. Bagus et al. (2014) pointed out that such an exclusion will only lead to regulatory arbitrage and banks adjusting their creditor structure and ultimately leaving the taxpayers with the bill.

The critique concerning the enforcement and execution of the resolution framework has not been the only form of discussion. In a comprehensive discussion by Zhou et al. (2012) multiple sides of the bail-in method were considered and evaluated. It was argued that the bail-in method, while making the investors responsible for the resolution, could cause a contagion effect among the economy as other financial institutions become burdened by the outstanding debt. One of the drivers increasing the risk of contagion is the spread of bonds held in a portfolio: Schoenmaker (2017) and Avgouleas and Goodhart (2015) have stated that while bailed-in bonds should be spread widely over many sectors and countries, in truth, they are often concentrated on the domestic financial sector. Consequently, the losses to debt-holders from a bail-in are rapidly transferred across institutions. A discussion by Schoenmaker (2017) also pointed out that while a bail-in may be an appropriate course of action for a single bank failure, it may lead to a more fragile system as a whole. The justification is simple: while a single bank might act in a prudent manner by selling off a risky asset, when everyone does this, the asset prices decline and build up further problems for the financial system as a whole. According to Schoenmaker (2017), these sort of microeconomic policies act in making individual institutions seemingly sound while the system as a whole becomes more and more fragile. Similar effect has been the concern in the case of Banco Popular (discussed later), as the effects from writing off the debts have been felt in other financial institutions. Contrasting arguments have also been made: Avgouleas and Goodhardt (2015) state that the new framework does in fact work by improving market discipline, as creditors now have and incentive for harder monitoring since their claims are threatened by the bail-in tool in case of distress.

3.4 The banking union and its take on resolution

In this section, the focus will be on the resolution frameworks that are in place in the banking union today. As has been established before, there is clear value in supervising financial institutions due to their importance for the overall economy via their roles as household lenders, creditors and so forth. As was demonstrated by the financial crisis, the level of interdependency in the EU was understated

in many parts, and made it clear there was a need for a more harmonised framework and supervisory mechanism. The internal markets within the EU makes it possible for banks to offer their services internationally, yet, the supervision was left to national authorities. As was pointed out by Schoenmaker (2017), an integrated market needs and integrated safety net – and that was the driving idea behind the banking union.

The decision to form the banking union was finalised in June 2012 by the EU heads of state and government, providing the Euro-area the harmonisation of regulations it was lacking during the crisis. The banking union is based on the power of the single rulebook and its objectives are largely founded on the authority and power outlined in the BRRD.

The union was set to rely on three pillars, which we will discuss in detail now.

3.4.1 The three pillars of supervision

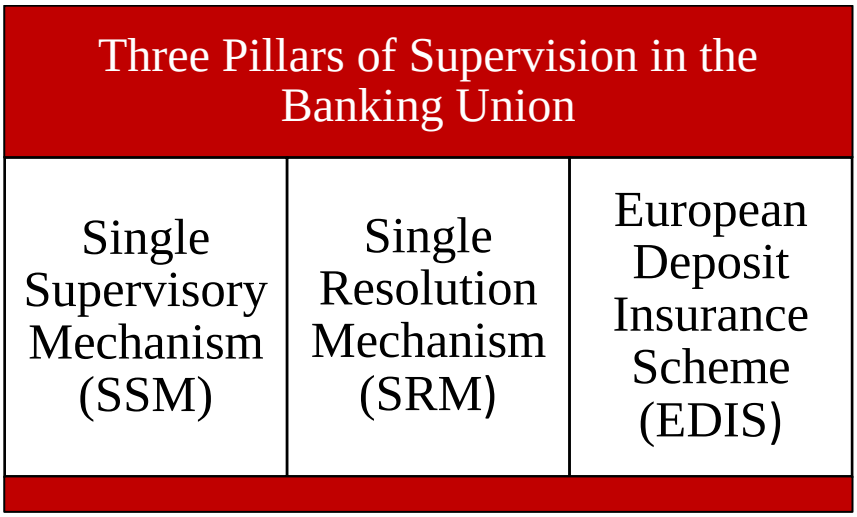
Rules and institutions that have been set to govern the banking union in Europe have been constructed to rely on three pillars, demonstrated in figure 3. The single supervisory mechanism (SSM) and the single resolution mechanism (SRM) came into effect in 2012, continuing the push for a more integrated supervision mechanism within the Eurozone. This would allow systemically important financial institutions (SIFIs) to fall in an organised manner without harming public interests. Under the new framework of the SSM, the supervision of banks is a joint responsibility of the ECB and national authorities and transfers some of the supervision of major financial institutions from national central banks to the ECB. It is important to note here that the aim is indeed not to prevent failures entirely but rather to make the inevitable failures orderly. The goal is to avoid the moral hazard trap described in the earlier section: no bank should believe to be “too big to fail”.

Unlike the BRRD, which applies in all EU countries, the SRM is purely tied to the banking union and voluntary EU members while operating within the BRRD (Ernst & Young, 2015). While the SRM is a centralised authority, it relies heavily on the different National Resolution Authorities (NRAs) to be responsible of execution and enforcement of the SRM decisions. Under the SRM, the single resolution board (SRB) will have the power and authority to yield its bail-in powers when deemed necessary and additionally gives the SRB control over the Single Resolution Fund (SRF). The SRF provides funding support to the institutions, after key stakeholders have been bailed-in to an acceptable level. It is meant to ensure consistency in resolution financing within the SRM and is built up over eight years (2016-2023) with a goal to reach at least 1% of all covered deposits of all credit

institutions in the participating states (SRB, 2017a). Contributions from the SRF are only made when specific conditions are fulfilled, two of which are the most crucial ones: firstly, a loss-absorption contribution of no less than 8% of total liabilities has already been made by the shareholders and holders of capital instruments. Secondly, the SRF contribution must not exceed the limit of 5% of total liabilities.

The third pillar, the European Deposit Insurance Scheme (EDIS) is built on the existing system of national deposit guarantee schemes (DGS) and acts to ensure all deposits under 100 000 euros are protected. EDIS expands this scheme to cover deposits in all banks within the banking union (European Parliament, 2018).

Figure 3: The three pillars of supervision



Source: Own adaptation

Focusing now further on the resolution authority and powers given by the SRM, we will discuss the role of the SRB, which is a both a key player in the resolution case of Banco Popular and a central stakeholder in the new regulatory environment in Europe.

3.4.2. The Role of the Single Resolution Board (SRB)

Considered a young authority, the SRB was founded in 2015 and is located in Brussels. The board draws its authority from the SRM and the BRRD and its purpose is to ensure the resolution of financial institutions with minimum impact on public finances and the real economy. Much like other regulatory reforms we have already discussed, the foundation of the SRB was driven by the financial crisis and the need to shift the responsibility away from taxpayers and public funds. The SRB is

responsible of making resolution plans for over 141 banks, including 126 banking groups and 15 cross-border institutions (SRB, 2017b), as well as administering the SRF, setting minimum requirements for liabilities as well as eventually triggering the resolution process when needed (SRB, 2018). The SRB and the SSM both have powers to bring forth a potential resolution case: which is when the SRB conducts the public interest assessment to see whether a resolution is justified. We use the word "justify" deliberately, as usual liquidation procedures are still the normal way to operate, unless it is justified via public interest that an institution is too important and should be resolved under the SRB instead. The public interest assessment covers the entire EU (not just the banking union), and is only concerned with national and international interests – not regional.

Resolution plans are prepared by the SRB and the NRAs and are meant to contain resolution strategies that should be introduced in the case of resolution: it comprises the descriptions of business lines, critical functions and the preferred tools in the case where regular proceedings are seen as inappropriate. The SRB has divided the resolution plan into a four-part system, consisting of a business analysis, preferred resolution strategy, resolvability assessment and finally the MREL (SRB, annual report 2016).

The cooperation between the SRB and the NRAs is an important part of the functioning the board and the NRAs continue to monitor the operations of less significant institutions (LSIs) and their resolution drafts. These drafts are then assessed by the SRB – a task that will keep growing, given that the banking union currently facilitates nearly 3200 LSIs (SRB, 2016). While the cooperation is seen to be crucial, its ultimate goal of the SRB is to implement the SRM as effectively as possible and thus warnings may be issued to NRAs if the SRB considers their actions and assessments to work against the SRM. It is important to note that the SRB may hold different views than the NRAs when it comes to loss-absorbing capacity and conflicts can be expected during the lifetime of the board.

The other key task of the board is the administration of the SRF; a fund which Deloitte evaluates to reach the value of 55 billion euros by the end of 2023 (Deloitte, 2015), and which is meant to accommodate special cases of resolution. The challenging task there is the identifying and calculating the contribution amounts from different financial institutions, based on various size and risk indicators. The detailed calculations of these amounts are beyond the scope of this thesis and will not be discussed in depth here.

Under the framework, the SRB has a variety of resolution strategies at its disposal, including a private sale or merger, asset separation, forming of a bridge institution and a write-down of liabilities,

conversion of debt (bail-in) and finally using the Single Resolution Fund. All of these strategies are meant to be used in a way that minimizes the burden on public funds and causes the least impact on other parts of the economy.

In the next section we will turn our attention to the resolution frameworks and authorities outside the banking union to further understand the different ways and methods by which banks are resolved globally.

3.5. Resolution Frameworks outside the banking union

In order for us to evaluate the performance of the resolution framework inside the banking union, it is necessary to provide the reader with some comparison cases and discuss how similar situations are dealt with in other jurisdictions.

While there is a variety of EU-wide regulations that affect all the member countries, regardless of their participation in the Euro-area or not, some parts of the regulatory framework have been narrowed down to the banking union.

All EU-members are subject to the Single Rulebook, regardless of whether they use the Euro or not. However, the three pillars of the banking union are purely restricted to the banking union members using the common currency. Thus, for example Denmark, is excluded from the reach of the SRM and SSM. An interesting discussion point is also the resolution framework in the United States which has been a part of the inspiration in the resolution reform in Europe, but which continues to have some key differences. We will now consider the practical and theoretical differences for these countries.

3.5.1 EU members outside the banking union – Denmark

We find Denmark and interesting case to act as a comparison case to the banking union due to its rather famous and renowned frameworks that have guided the Danish financial sector through the financial crisis and into one the best-capitalised countries in Europe.

Denmark's first hit from the financial crisis was the failure of the Roskilde Bank in 2008. At that stage, there was no existing mechanism for winding up banks and Roskilde Bank was eventually taken over by Denmark's National bank[3]. Afterwards there was a consensus among the Danish authorities that a framework for financial stability was necessary in order to maintain a healthy sector. In 2008, "Bank Package 1" was released, including a general state guarantee covering all depositors

[3] Denmark's National Bank: Danmarks Nationalbank

and other unsecured creditors, with the financial sector overing losses to up to DKK 35 billion (IMF, 2014). Currently, five bank packages have been released and full descriptions can be found in the appendix A3.

A new system for orderly resolution was introduced in 2010 along with the "Bank Package III". It specified a framework under which financial institutions were to be resolved and established the "*Finansiel Stabilitet",* or a Financial Stability Company (FSC). It acts as a government owned entity meant to wind up distressed institutions without burdening taxpayers. The scheme involved a transfer of the distressed institution's assets to the FSC, and subjected all unsecured creditors and depositors of over 100 000 euros to haircuts. Notably, the scheme was the first of its kind in the EU and a significant milestone in European resolutions. The case served as a first-mover in pushing the losses onto senior creditors. The process is initiated by the supervisory authority for financial institutions in Denmark, Finanstilsynet, or the Danish FSA and follows specific steps: after the decision has been made, an asset review and valuation is conducted by the FSC, in where they attempt to ascertain the sale value of assets in the case of immediate sale. In the case where there are no private solutions, the assets are then transferred to a subsidiary of the FSC – or a "new bank", who pays in taking over the non-subordinated claims. While secured depositors do not face losses, unsecured senior creditors face haircuts (as in a bail-in). Finally, liquidity is injected to the "new bank" by the FSC in order to continue its operations while FSC continues the sale of assets to third parties (IMF, 2014). The process is conducted over a single weekend.

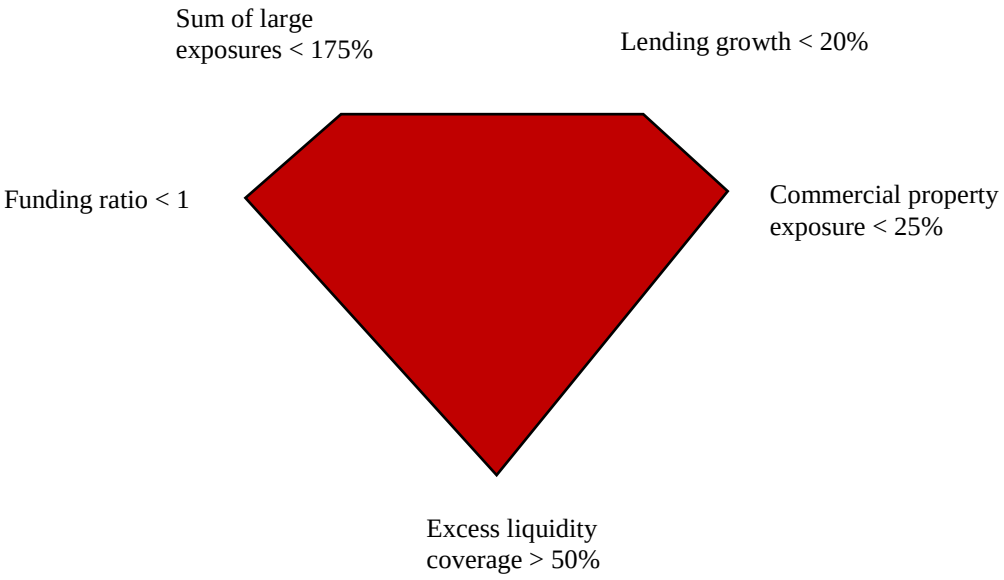
As a practical demonstration of the Danish system, we consider the case of Amagerbanken in 2011: while seemingly this failure might not strike as the most interesting one, it was a first failure after the Danish authorities had cut down the financial support scheme and moved on to the more limited "Bank Package III" that only provided a guarantee for small deposits (under €100 000), while posing haircuts of 16% to its senior creditors. Like described earlier, the FSC set up a new bank that absorbed 58,8% of non-subordinated liabilities of Amagerbanken. More than 99% of depositors had their deposits covered while shareholders and subordinated capital holders lost their entire stake (Poulson and Andreasen, 2011). Amagerbanken thus demonstrates the first case of a resolution that showed a full shift of losses to the institution's owners and creditors.

The Danish system has proven its performance by handling 14 bank closures during the financial crisis but still avoiding bank runs and use of taxpayer money. It is therefore not unwarranted to state that the current banking union resolution framework draws a great deal from the Danish experience

and builds up on the view of making the financial sector responsible for its own failures and the efforts to maintain the continuing business operations over the course of winding up the distressed institution.

Additional measures that were taken to promote financial stability was the establishment of the "supervisory diamond", presented in figure 4, which is meant to detect excessive risks taken by an institution. Established by the Danish FSA, it specifies five benchmarks that act as warning mechanisms for Danish institutions and are meant to minimize risks in the sector. Some of these points will also be relevant in our later section where we conduct a stress test of our own.

Figure 4:



Source: Finanstilsynet (2017)

While Denmark is currently outside the banking union, its participation in the future remains uncertain. It was stated by Danmarks Nationalbank (2017), that it would indeed be in the interests of the Danish financial sector to be a part of a common and harmonised supervisory system. It was argued, and that it would be beneficial for Danish households in the case of a new crisis, given that some of the Danish banks are very large. While there has not been an official decision, it remains and active discussion.

3.5.2. Resolution tools in the United States

In this section, we consider the resolution framework that is at place in the United States. The stability of firms is monitored by the Financial Stability Oversight Council (FSOC), The Federal Deposit Insurance Corporation (FDIC) and the Orderly Liquidation Authority (OLA), whose job is to ensure the health and stability of institutions that could have a large impact on the overall economy in case of failure (SIFIs). The Orderly Liquidation Fund (OLF) is the American version of the SRF and provides financial support to assist with the restructurings and liquidation. In the case of a resolution, the FDIC has two alternative strategies to choose from. "A closed bank transaction", which entails the full closure and ending of an institution. The closed bank transaction can be conducted via purchase and assumption transactions (P&A) as well as deposits pay-off. The second method is alternatively called "open bank transaction", in which case the entity is kept in business via loans, capital injections and different guarantees (The U.S Treasury, 2018). To date, P&A remains to be the most common resolution tool. True to its name and similarly to the European sale of business tool, in a P&A another institution purchases assets of the failed institutions. The acquirer might receive some assistance from the FDIC in order to complete the transaction. The acquirer also generally pays a premium on the deposits, to account for the existing franchise value within the deposit base. The most common forms of all P&As are the loss-sharing transactions and bridge banks. (The U.S Treasury, 2018). In a loss-sharing transaction, the acquirer is only faced with a limited amount of credit-loss as the FDIC absorbs up to 80% of credit losses on shared-loss instruments such as commercial loans and mortgages. The first five years are the shared-loss period, during which the receiver pays the acquirer bank 80% of net charge-offs, and during the recovery period (last two years), the acquirer pays the receiver 80% of recoveries (The U.S Treasury, 2018).

While P&As are a main form of resolution tool, deposit pay-offs are only ever used in a case where P&A is not successful. It entails a deposit insurer to pay out all of the failed institutions insured deposits in full. The receiver is responsible on paying off creditors and liquidating appropriate assets. Examples of recent P&A resolution cases in the U.S are for example, Washington Federal Bank for Savings which closed on the 15th of December in 2017. Its deposit base and all insured deposits were acquired by the Royal Savings Bank[4]. It should be noted at this stage, that all of the resolution cases to-date have been quite small – the biggest institution resolved by the FDIC was the Washington Mutual in 2008 with prior to sale assets worth of $307 billion: as a comparison, Lehman

[4] See the list of failed banks at FDIC (2018). https://www.fdic.gov/bank/individual/failed/banklist.html

Brothers pre-failure assets were $691 billion (Fischer, 2016). Therefore, it is still unclear how the renewed resolution framework would function with systemically important institutions.

The current resolution framework in the U.S is based on the Dodd-Frank Act (DFA), which we will now discuss.

3.5.2.1. The Dodd Frank Wall Street Reform and Consumer Protection Act

The aftermath of the global financial crisis was as big of a wake-up call to the U.S as it was to the European regulatory authorities and revealed weaknesses in the supervisory mechanisms. FDIC lacked the sufficient powers and tools to address struggling institutions, which resulted in undesirable bailout decisions and chaotic and unorderly bankruptcies. Between 2006 and 2008 multiple banks and institutions failed and many had to be rescued by public funds; most of them funded by the Troubled Asset Relief Program (TARP). The size of that contribution reached over 6% of the GDP in the fourth quarter of 2008 alone (Philippon & Salord, 2017). In July 2010 the Dodd-Frank Wall Street Reform and Consumer Protection Act was implemented. The reformation was the most comprehensive in the American history since the Great Depression in 1929 and included articles on credit default swaps and other forms of derivatives, capital requirements, credit ratings, credit cards, loans and mortgages, hedge fund transparency and liquidation of institutions (Gruenberg, 2012). Title I of the reform focuses on the oversight of financial institutions while title II specifies the new resolution powers. The objective of title I was mainly to broaden the supervision and oversight of financial institutions and improve the risk management measures of banks. A main supervisory body in charge of title I and its reforms is the Financial Stability Oversight Body (FSOC) and the Office of Financial Research (OFR).

Under title I, large and complex institutions (with assets of over $50 billion) are also required to have a “living will” (essentially a resolution plan), which specifies the steps for fast resolution in the case of sudden distress or failure. These living wills are meant to act as a type of a “street map” for business lines, funding sources and other relevant matters that can complicate a resolution.

Title II of the act transfers the resolution powers to the FDIC, much like its European counterpart transfers them to the SRB, and aims to extend the authority with which the FDIC operates. While the original bankruptcy code was aimed at maximizing entity value for creditors, the DFA means to preserve public funds and financial stability.

The new DFA framework made resolution powers available to the respective authorities via the OLA, which provides a full process of quick and efficient liquidation of large and complex financial institutions. Similar to the European framework, the objective of the renewed framework is to minimize taxpayer contributions in case of resolution by increasing the capital reserve requirements and increasing the loss-absorbing abilities of SIFIs. The triggers for a resolution are also the same as in Europe, that is, a process is triggered in the case an institution is failing or likely to fail, public interests are at stake and there is no private solution available.

The Dodd-Frank act entails a four-level early-detection system, which is designed to identify risk factors and potential issues before they materialise. The levels consist of (i) Heightened supervisory review, in where a level review is conducted by the Federal Board; (ii) Initial remediation, in which prohibitions on growth and capital distributions are introduced; (iii) Recovery, in where there are limits on executive compensation and a requirement to raise more capital; (iv) Recommended resolution, in where the board considers if resolution should be recommended.
A recommended resolution comes at a point in where Tier 1 risk based capital (RBC) is less than 3%, total RBC less than 6% and where the Tier 1 leverage ratio is under 3% (Gruenberg, 2012).

3.6. Comparison between the Dodd-Frank act and the BRRD

While the underlying reasons behind the renewed the Dodd-Frank act and the BRRD are both focused on taxpayer and overall financial stability protection, there are also key differences that should be noted. For instance, in the U.S, a taxpayer bailout is not considered a potential resolution tool at all, and the Dodd-Frank act forbids the use of public support. In Europe, such actions are highly limited to extreme situations and systemic crisis. A key difference is also the use of restructurings of institutions through contracts: that is, in the US it is not possible at all.

There are also some differences between the use and objective of the resolution funds (OLF and SRF). In Europe under the BRRD, each member is responsible for its financing for the SRF and these funds can then be used as various tools for institutions in resolution, such as guarantees, loans or bridge bank capital. The OLF on the other hand is meant as a borrower for the FDIC and cannot be used for capital or guarantees.

There are also differences in the uses of the two respective funds. The use of SRF is activated in a case where a liability is excluded in bail-in, and after a minimum of 8% of total liabilities have been bailed-in. SRF is then used to cover losses that were not absorbed by liabilities excluded from the bail-in (up to 13% of total liabilities). The financing of the SRF is also done ex-ante (target of 1% of covered

deposits in 10 years), while in the U.S ex-ante level does not exist (Krimminger and Nieto, 2015). The OLF is established by the Treasury, and can only act as a liquidity aid tool without any recapitalisations. It is solely used in a case where customer funding is not available, and the financing happens ex-post contribution via a sale of bridge financial company assets. The differences are shown in the following table 3.

Table 3: Key differences between The Dodd-Frank Act and the BRRD

	The Dodd-Frank Act – Title II	**BRRD**
Authority	FDIC	SRB
Scope	Systemically important non-credit institutions	All credit institutions, some investment firms
Recovery Plan required	No	Annual review required
Resolution Plan required	Annual review required by the banks	Annual review mandated by resolution authorities
Bail-in: Hierarchy of claims	Capital + senior debt + uncovered deposits + covered deposits	Capital + uncovered deposits of SMEs & households + covered deposits
State/Public support	Not Allowed	Allowed in Special circumstances

Source: Adaptation from Krimminger & Nieto (2015).

Clearly, a comparison between the US and the EU also has the difficulty of very different cultural and political backgrounds. In the US the regulations have been developed for a long time and have not suffered from the same complications as Europe since they do not have to consider the impacts of national authorities and have a much higher degree of uniformity in their governance models.

The DFA has received much of the same critique as the European model. For instance, Acharya (2011) argues in his book on the DFA and global finance, that the act makes a mistake in making other financial institutions liable on the risk and failures of SIFIs – in effect worsening the likelihood of contagion into other parts of the sector. According to Acharya (2011), SIFIs should instead contribute to the risk they bring into the system with ex-ante costs, rather than ex-post. At the same time, the paper criticises the relative inflexibility of the DFA and describes the problem as "regulating by form, rather than function." The statement refers to the inability of the Federal Reserve to provide

liquidity support to struggling non-depository institutions (such as swap dealers), and it also does not arrange funding to solvent financial institutions that are hit by a significant event. There are significant systemic risks that can arise when centralized clearing of derivatives is implemented, and there may be need for the Federal Reserve's last-resort funding to ensure safe and orderly resolution in the case where the systemic risks were to materialise.

On a more general note, it has also been noted by Krimminger and Nieto (2015), that while both the American and the European frameworks are very much focused on the promotion of financial stability, neither of these frameworks actually defines what it is. Without a specific quantitative description of critical functions that are important to financial stability, much is left to the power of interpretation and the national authorities. This, as described by Krimminger and Nieto (2015), is a key source of legal uncertainty that is present in both of the models.

4. Road to ruin: Case of Banco Popular

4.1 Purpose

We now enter into a very important part in our thesis, which we have already briefly referred to in previous sections; the resolution of Banco Popular. As one of the newest banking failures in Europe since the crisis, it serves as an interesting base to reflect the discussed resolution frameworks on. The resolution of the Spanish bank has been perceived as the first real test of the BRRD and the SRB, and was widely acknowledged as a general triumph of the new framework. In this section, we dive into the proceedings of Banco Popular's resolution and discuss the reasons behind it. Finally, we hope to evaluate the performance of the process from the point of view of key stakeholders and make a brief comparison between other bank failures, including the Veneto banks in Italy. As before, the reader should bear in mind that detailed legal proceedings are not in the scope of this thesis, and therefore we do not discuss national laws in much detail.

4.2 Introduction and History

Banco Popular Español Group (hereon just referred to as Banco Popular) is a Spanish banking group founded in 1926, operating in 1600 branches over Spain and 135 branches internationally, with headquarters in Madrid (Banco Popular, 2018). It provides commercial banking, mortgage loans, term and other loans, time deposits, demand accounts, savings accounts, pension plans and various forms of insurance. It employed around 10,634 people and has 1,644 branches in Spain and total assets amounting to €147,114 million and own funds of €11,069 million (SRB, 2017c). The group consisted of four creditor institutions: Banco Popular Español S.A (the parent), Banco Pastor S.A, Popular Banca Privada S.A and Banco Popular Portugal S.A, all of which are in full ownership of the parent company, Banco Popular Español S.A.

The bank operates through four segments: Commercial Banking, Asset management and Insurance, Real Estate Area and Institutional and Market Area. Historically, Banco Popular was exceptionally competitive in the small and medium sized enterprise (SME) sector and held a strong reputation in that segment, with exposures to the SME sector totalling 29% while the Spanish average is around 10% (European Parliament, 2017). In other areas, however, the bank had struggled. One of the harder times for Banco Popular was the beginning of the Spanish real estate boom in the early 2000's where the bank found itself in an undesirable situation as it lacked the competitive advantage and the expertise in its real estate sector. Around the same time, Banco Popular named a new CEO Angel

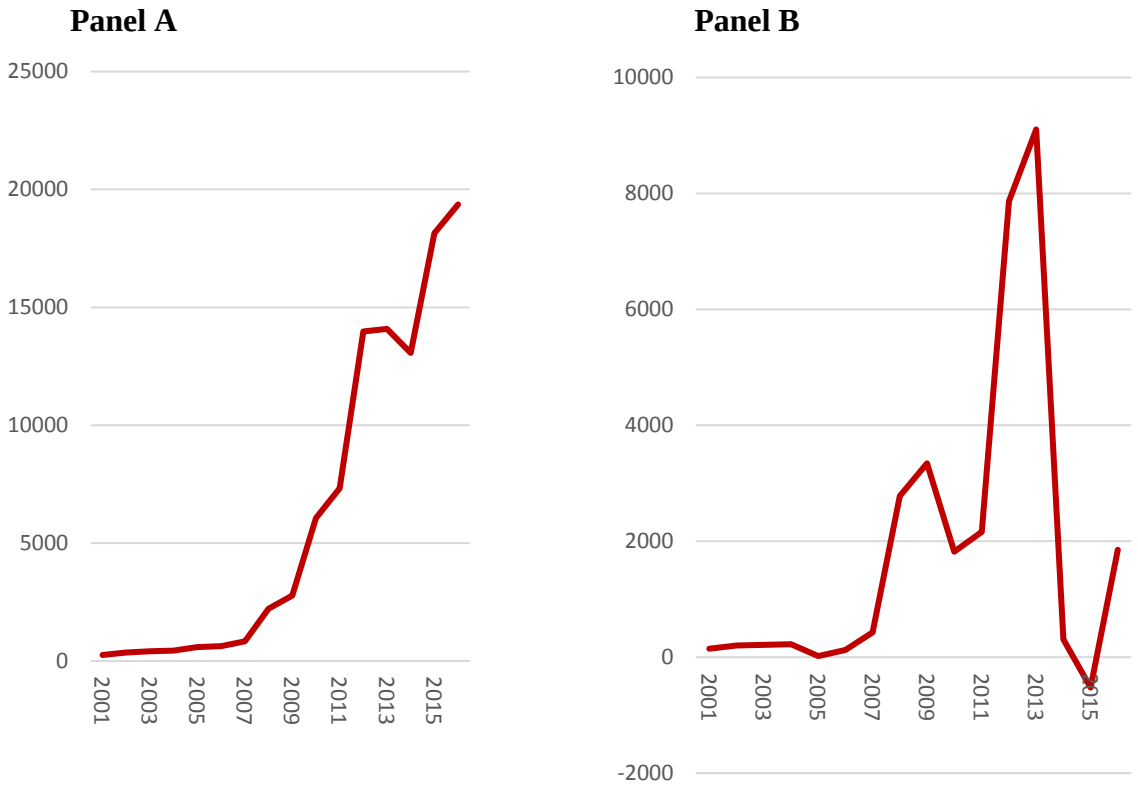
Ron, who afterwards became the chairman of the board. During Angel's term Popular's balance sheet grew rapidly. As is discussed in the paper by Santos (2017), it seems likely that at some point Popular decided to enter the race for the real estate funding. The bank continued the aggressive balance sheet growth, even when other credit institutions began to hold back and tighten the reins on excessive funding activities. Therefore, as again mentioned by Santos (2107), Popular was left exposed to the other institution's skimming activities. Afterwards, some have named Angel's term and the growth of the balance sheet as one of the key factors that later pushed the bank into liquidity problems.

4.3 Banco Popular through the financial crisis

In the prevailing years of the financial crisis Banco Popular had been active in acquiring multiple regional banks and institutions while maintaining their brands and keeping them as independent units. In 2008 Popular decided to consolidate the regional banks (among others, Banco de Castilla) in order to improve their liquid positions, as the market was starting to get illiquid. These types of restructuring and acquisitions kept the losses from Popular's balance sheet for the early years of the financial crisis and delayed its effects. Later on, Popular acquired the oldest Spanish bank, Banco Pastor in 2011, after they failed the European Banking Authority (EBA) stress test earlier that year. This would consolidate its position among the five largest Spanish banks, with a combined level of assets amounting to 161 billion euros (Blakey, 2011).

Meanwhile, Popular still faced problems with its income sheet and the rapidly increasing levels of non-performing loans (NPL's). The evolution of NPL's is demonstrated in figure 5 Panel A. Profitability also took a hit due to write-offs and impairments, second of which had two peaks: in 2012 and in 2016. The peaks can also be observed in the graph presented below. Panel B, shows the net variation of NPL's, which is calculated by subtracting the recoveries from the new NPL's. Historically, this relationship has long been mismatched, as the figure shows.

Figure 5:



Panel A: Evolution of Banco Popular's NPLs in euro millions

Panel B: Evolution of Banco Popular's Net Variation NPLs (new NPLs minus recoveries) in euro millions

Source: Banco Popular Annual Reports 2001-2016

The problems caused by the impairments and write-offs also had a negative impact on Popular in the stock market, as market participants began to notice its distress and the stock price continued on a low trend. Nevertheless, Popular still managed to keep itself above the surface by going to the stock market for extra capital in 2010, 2012 and 2016. The capital raised in these events, is apparent in Popular's tier 1 capital ratio, illustrated in Figure 6.

Figure 6: The evolution of Banco Poular's Tier 1 capital ratio

Source: Banco Popular Annual Reports 1999-2016

In 2010 it issued convertible bonds worth of 500 million euros, as well as entered an alliance with a French institution, Crédit Mutuel, which then became a major shareholder of Banco Popular. While Popular never actually failed any of the stress tests conducted by the EBA in 2009, 2010 and 2011, it did fail the more strict asset quality review (AQR) in 2012 conducted by Oliver Wyman, as determined by the Memorandum of Understanding on Financial Sector Policy (MuO). In there, Banco Popular was indeed found to need more capital to meet the requirements and to remain solvent due to problems in asset quality against which capital was measured. Again, Popular went to the markets for an additional capital boost of €2,500 million (BIS, 2017).

In 2016 another stress test was conducted and the results showed Popular to be above the required capital – although as the weakest of the Spanish banks (evolution of Popular's solvency situation can be seen in the part 5 of this thesis; a detailed discussion of the EBA stress test is in part 6). A mere year later authorities made an announcements deeming Banco Popular into resolution, indicating that the deterioration of the capital position was indeed very fast and had been building up for a long time. It is clear that the problems of Banco Popular ran deeper than most people thought. In 2016 the Spanish economy was experiencing good economic conditions and economic growth. Popular was

then the only larger credit institutions still struggling with write-offs from the financial crisis. As discussed by Santos (2017), this was partially due to the strange decision of not selling the assets to alleviate the stress on the balance sheet caused by the NPL's to the separate asset resolution entity, SAREB, which was set up to help banks to clean up their balance sheets post-financial crisis. From Figure 5 Panel A, it is easy to see the remaining high levels of the NPL's. In 2016, the total levels of NPL's were still at €19,6bn.

Unlike other Spanish institutions, Popular had opted to clean-up their balance sheet with retained earnings from the successful capital raising in 2012, however, this decision lead to one very crucial problem: the investors could no longer differentiate the quality in Popular's loan portfolio as it became less transparent, mixing performing and non-performing loans together. The lack of transparency then leads to a slowness of recognition: a situation, which has been identified as a major reason of transforming issue of asset quality into a solvency crisis and again into a liquidity crisis (Santos, 2017).

The deterioration of Popular's capital position, which thereafter transformed into a liquidity crisis, happened very fast, and is not apparent in annual data. Quarterly data can be seen in table 4 and it demonstrates the fall of capital levels. All indicators of the capital indicators are falling steadily, starting from the last quarter of 2015. Total capital ratio experiences a fall of almost 2%, most of it resulting from a fall in the Tier 1 ratio. While the ratios are still within regulatory requirements, a negative trend is apparent in the figures. The worsened solvency situation did not go unnoticed: in April 2017 Moody's Rating Agency downgraded Popular's credit rating, making the unsecured debt rating B1 and deposit rating Ba3. In their report they stated the outlook to be negative for the future of Banco Popular and claimed poor asset quality as the main driver (Moody's Investor Service, 2017).

Table 4: Quarterly Capital Indicators of Banco Popular

Quarter	*31.12.2015*	*31.3.2016*	*31.12.2016*	*31.3.2017*
CET1 Capital	9.828.9	7.281.1	7.808.1	6.099.5
CET1 Ratio (%)	**13,14%**	**11,53%**	**12,13%**	**10,02%**
Tier 1 Capital	9.827.9	7.281.1	7.808.1	6.616.2
Tier 1 Ratio (%)	13,14%	11,53%	12,13%	10,88%
Tier 2 Capital	493.2	697.2	655.2	635.9
Tier 2 Ratio (%)	0,66%	1,1%	1,02%	1,04%
Total Capital	10.321.8	7.978.3	8.463.3	7.252.1
Total Capital Ratio (%)	**13,8%**	**12,64%**	**13,15%**	**11,91%**
Risk Weighted Assets (RWA) total	74.777.6	63.131.6	64.373.2	60.886.0

Source: Banco Popular Quarterly Report 2017, Annual report 2016.

4.4 The end of Banco Popular

In February 2017, the chairman of Banco Popular, Angel Ron was replaced by Emilio Saracho. From the beginning, it was clear that his objective was to sell or merge Popular in order to aid the struggling bank with recapitalization. In April, 2017, the CEO of Banco Popular, Pedro Larena stepped down (Mount, 2017). Almost immediately after the announcement, the stock prize of Popular fell by 10% (see figure 7), and customers started to withdraw deposits, causing an effective bank run. It should be noted here that due to Popular's large market share in the SME sector, it had always been more exposed to such runs than other similar institutions. Combined with withdrawals from regional governments, Popular was fast running out of liquidity. Later in the spring of 2017 it became evident that Popular could not bear the withdrawals for much longer and was in desperate need of financing and since it had not been successful in finding a private buyer, a resolution decision was made.

Figure 7: Share price of Banco Popular 2016-2017

Source: Adaptation of data from Nasdaq (2018).

4.4.1 Resolution Decision

We now enter the part where the new resolution authorities and legislations make their appearance. On the 6th of June 2017 the European Central Bank (ECB) made an announcement stating that Banco Popular was "failing or likely to fail" due to the significant deterioration of its liquidity (SRB, 2017c). The ECB specified that the recent liquidity development had lead them to believe that Popular would be unable to meet its future liabilities as they fell due. The ECB communicated their assessment to the SRB and the Spanish national resolution authority (FROB). After conducting a public interest assessment, the SRB agreed that Popular was too large to go into liquidation and had too much contagion risk apparent in the Spanish market. It was agreed by SRB and FROB that resolution was in the public interest to ensure financial stability.

The resolution tool used in the case of Banco Popular was a combination of bail-in and a sale of business: in other words, it was decided that relevant capital instruments were to be written-down before the sale (FROB, 2017).

On the 7th of June, 2017, only 24 hours after the ECB announcement, the formal resolution decision was made and consequently all shares and capital instruments of Banco Popular were transferred to Banco Santander S.A for a symbolic price of one euro (European Parliament, 2017). The SRB stated that decision was made to primarily protect depositors of Banco Popular and to ensure the continuity of critical functions, and to avoid large adverse effects to the Spanish and Portuguese real economies and the overall financial stability without using public funds (SRB, 2017c).

The resolution plan followed the EU's bank recovery and resolution rules (BRRD) and was the first case where the framework was tested in practice since its implementation. The EU commission approved the plan on the same day, 7th of June, 2017 and noted that the three conditions (presented in italics) for resolution had been fulfilled:

1. *"The Institution is failing or likely to fail"*

   The announcement was based on the rapidly deteriorated liquidity situation of Banco Popular.

2. *"There are no alternative private measures or supervisory actions that could have prevented the failure within a reasonable timeframe"*

   The SRB concluded the condition to have been met due to the failure of a private sale process as well as the difficulties of mobilising sufficient funds to provide the needed liquidity within the given timeframe.

3. *"It is necessary in the public interest"*

   As mentioned in earlier sections, it was stated that the resolution act was indeed necessary in order to ensure the continuity of critical functions, such as deposit takings from households and non-financial corporations (small and medium sized enterprises (SMEs) and non-SMEs), lending to SMEs, and payment and cash services. Furthermore, it was concluded that the act was necessary for the overall financial stability.

The resolution decision has gotten praise for being fast and agile in responding to the deterioration of Banco Popular's capital and liquidity positions. After all, there is not much use in having these frameworks for resolution in place unless they are operated with efficiency.

4.4.2 The Resolution process

As the resolution decision had been finalised, an independent valuation was conducted in order to ascertain the appropriate resolution scheme. In the valuation conducted, the economic value of Banco Popular in the baseline scenario was negative 2 million euros, and in the most adverse scenario

negative 8,2 million euros (FROB, 2017). Afterwards, this valuation has been questioned by creditors and shareholders and it is still under investigation. The resolution process needed to comply with the two main objective of the BBRD:

- Shareholders and creditors must be the ones to bear losses (additional tiers)
- Losses should not be greater than under normal insolvency procedures.

In the process, the power of write-down and conversion of capital instruments without shareholder consent was exercised by the SRB as a measure of addressing the shortfall value of the institution. The existing shares in Common Equity Tier 1 and the Additional Tier 1 were written down and the Tier 2 instruments were converted into new shares which were then transferred to Banco Santander S.A. Referring back to figure 2 in the previous part which demonstrated the bail-in waterfall, we see that in the case of Banco Popular, the bail-in process went down all the way down to the tier 2, at where the instruments started to get converted.

To execute the power of write-down and conversion, the identification of relevant capital instruments was necessary and done by the Spanish resolution authority (FROB). They estimated that as of 15th of June 2017 Banco Popular's share capital was valued at €2,098,429,046 representing 2,196,858,092 shares at par value of €0,5 each. All of these shares were identical with equal rights and no preference qualities. Tier 1 and 2 capital instruments were identified by the FROB in A5.
The actions taken by the FROB followed the instructions by the SRB and the relevant articles[5]. The specific steps included the writing down of outstanding shares and thus reducing the share capital to a total of zero euros. Secondly, Tier 1 capital instruments were converted into share capital and divided into shares of 1-euro par value (FROB, 2017) and then reduced to zero euros. Thirdly, the all Tier 2 capital instruments were to be converted into new shares (totalling €684,024,000) thus making a simultaneous capital increase.
We examine these actions now in more detail. We follow the resolution description by FROB (2017).

a) Writing down the shares outstanding and reducing share capital to zero euros

It is stated in Article 51.1 that no shareholder or creditor should incur losses greater than under regular insolvency proceedings. Were losses greater, then the relevant participants would be entitled to a payment difference from the SRB. In the case of Banco Popular, it was established that no such action was required as the result was no worse than under normal insolvency. Thus, the write-down of the

[5] Article 37, Article 48.1-48.3, Article 21, Article 59, Article 60

shares did not lead to any compensations and no liabilities to holders remained after the write-down. This step in the process has received criticism as shareholders and creditors have challenged the valuation conducted on Popular – a crucial issue when determining whether these stakeholders are in fact worse off under resolution. Curiously, details of the valuation were not made public to either bondholders or shareholders.

b) Conversion of Tier 1 instruments into share capital and division into shares and the following write-down.

As discussed, it was established that shareholders will incur the first losses and this principle was made true by reducing Popular's capital to zero. After the establishment of the voluntary reserve, next step involved Additional Tier 1 instruments to be converted and corresponding shares issues – effectively creating a capital increase.

FROB (2017) states the case to have been relatively simple as there are not shareholders left in this case and thus no need for a traditional conversion formula: it was agreed that the issue would be at a rate of 1 euro per share.

The reason for the conversion is to write down the shares and thus make the Additional Tier 1 instrument holders the second group to absorb losses after the shareholders. The step is directly related to the hierarchy of stakeholders and the resolution principles which determine that creditors will come after shareholders and that the conversion must not take place before all sub-ordinated capital has been written down.

c) Conversion of Tier 2 instruments into shares.

The conversion of Tier 2 capital was done in order to enable the sale and increase the company's share capital into the total amount that was then transferred to Santander.

The description of the process shows the combination of SRB's two resolution tools, a bail-in of approved capital instruments, followed by a sale of business to Santander. The process is the first of its kind under the new resolution framework, and does hold distinctive differences to the old methods, pre-BRRD. Some key differences between the resolution approach taken by the SRB that significantly differ from how things were handled in Spain during the financial crisis should be mentioned.

Firstly, under BRRD, the ownership of Banco Popular was transferred to Banco Santander, instead of a government. By doing so, the continuing operations of the bank are secured and the government power kept separate.

Secondly, no public funds were used. A fact, which many people consider the most crucial one. In Spain, it was estimated that taxpayers ended up paying 41,8 billion euros in the bank bailouts during the financial crisis (Garea, 2017), and so Popular's orderly resolution that did not require the SRB or the taxpayers to contribute funds was considered a success. However, the cost was borne by someone, which brings us to our third point.

Under the BRRD and the new resolution approach, junior bondholders and shareholders were the ones paying for the failure, with over 300,000 retail investors losing their shares and junior bondholders losing close to 4 billion euros in the writing-off process of tier instruments (Reuters, 2017). These steps are consistent with the BRRD and the new resolution rules within the EU and confirm the theory that has been discussed throughout this paper.

4.5 Discussion and comparison to other bank failures

The resolution of Banco Popular has been widely recognized as the first real test of the SRB and the new bail-in framework that came into effect post-crisis. Many would agree that the process was a success since no public taxpayer funds were used and the impact on the overall Spanish economy minimized. There are however, some considerations one should bear in mind when discussing the final resolution outcome, including issues of conduct and transparency of the authorities, valuation and the process in general.

Firstly, it has been noted by the press that the conversion of the tier 2 instruments did have an adverse effect on other institutions with similar instruments. For example, Liberbank and privately held lender Cajamar felt the impact of an immediate drop in their tier 2 instruments after the Popular subordinated debt was written off. Right after the news of the details of Popular's resolution, Liberbank's €300m issue of Tier 2 bonds at 6,875% dived to 81 cents on the euro, with Cajamar suffering a similar doom (Santos, 2017)

While it has been accepted that the cost to the public was indeed minimized, there has been an expressed concern of what such actions by the ECB and SRB potentially could do to the debt markets. Jérôme Legras from Axiom Alternative Investments stated to the press that liquidity issues to justify bank resolutions have made them more unpredictable and that cases such as Liberbank and Cajamar

show an additional risk of liquidity drying up in the market (Smith, 2017). The very same article by the Financial Times even referred to a potential "Lehman moment" within the smaller banks in the sector, now feeling the pressure from a possibility of a resolution.

Additionally, the valuation of BP has been questioned by investors whose claims were written off overnight. It has been argued that there is a level on opacity in the valuation process – which is critical for the justification of a resolution process and to the payoff of creditors (Davies, 2018). Creditors are not to be worse off in resolution than in a normal liquidation and thus the lack of transparency has understandably caused disarray. Both of these points relate to our discussion in part 3.6, where we stated the new resolution mechanism to suffer from a level of legal obscurity. We argue that the lack of transparency from SRB can act as a strong undermining factor in a resolution case and will eventually reduce the credibility of a supervisory body. In the case of a cross-border institution with multiple interests to consider, we believe that trust from the public and institution's stakeholders is crucial in the long-term which can be damaged by obscure practices.

An additional discussion can be held on the rapid deterioration of Popular's solvency position, which had not been publically addressed before the resolution by the European Central Bank or banking union[6]. In this part we have attempted to identify underlying reasons for the rapid deterioration and have named the levels of NPLs and asset quality as a key driver for the distress. In the following parts we will further analyse the sensitivity of Popular's solvency situation and how it is shown in a stress test conducted with 2016 figures.

While it may have been the underlying assets and solvency that had been eating into the health of Popular, it was the bank run Popular experienced prior to the resolution that was seen to be the final straw that pushed them into a situation where it was unable to meet its liabilities. Notably, the bank run was not an unexpected reaction, and similar situations have been discussed in literature. In their original model, Diamond and Dybvig (1983) argue that a bank run is a self-fulfilling prophecy that can be triggered by an announcement, like a bailout announcement. In Popular's case it can be argued that the run happened as a response to a distress signal triggered by the announcement for capital shortfall and Mr. Saracho's inability to present a sufficient action plan for gaining more capital. It is also likely that the corporate investors and large depositors had knowledge of the capital shortfalls

[6] Note: Reader should note here that this paper will only discuss matters with public information. Any measures carried out by ECB or SRB privately will not be speculated here.

from a non-public source – given that the capital ratios did not indicate a dramatic drop, and the EBA stress test results of 2016 still demonstrated acceptable levels.

As mentioned before, Popular passed the EBA stress tests in all years they were conducted and was found to be above the minimum capital ratios in adverse scenarios. It is a rather puzzling and concerning finding and it makes one wonder whether there are indeed problems in the way stress tests are conducted and why the asset quality issues are not more prominent in the results. Based on this case, we are inclined to agree with Vice-President of the ECB, Costancio, who stated that there is an urgent need for a uniform framework for dealing with non-performing loans (ECB, 2017).

Lastly, it is worth discussing the resolution of Popular from the point of view of Santander. It has been a surprisingly positive development for Santander, after the bail-in of equity and subordinated debt holders of Popular. One of the greater benefits for Santander is its takeover of Popular's expertise in the SME market, with a market share of approximately 14%. The acquisition will almost double Santander's market share in SMEs in Spain, to 25%. This was a well thought through strategy from Santander's part, ending up as the leading bank in both lending in deposits (Santander, 2017). However, this market concentration can be translated into pricing power of Santander, resulting in negative effects for the other participants in the SME market. The question we ask ourselves is if the resolution process should be concerned with issues of market concentration? Thanks to Popular's position in the SME market, it was an attractive acquisition for its rivals, which was facilitated by the use of "sale of business" as a resolution tool. In addition, increasing the franchise value of a healthy bank and its capital loss absorbing capacities has long been in the playbook of supervisors. In addition, no taxpayer's money were used through this mechanism. Nevertheless, perhaps some consideration should be given to the negative externalities that follows a take-over and market concentrations, as it is a common result of financial crisis (Santos, 2017).

4.5.1 Comparison case: The Veneto Banks

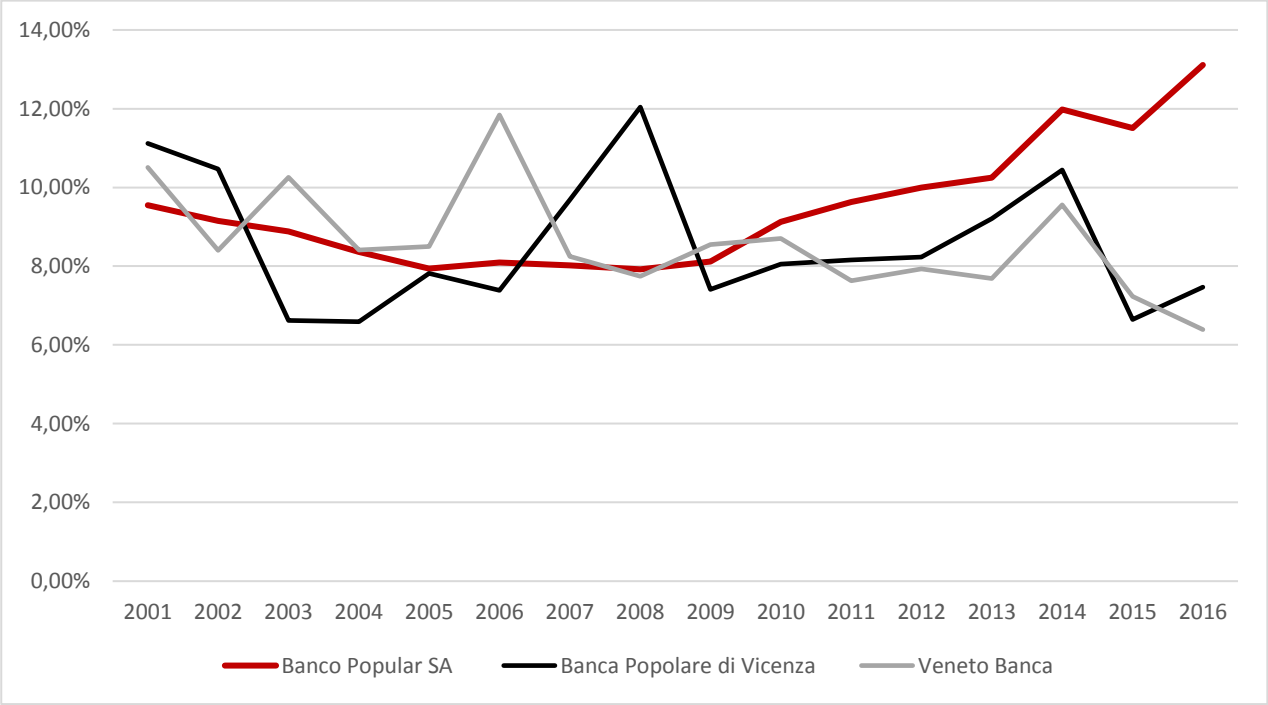
It is impossible to determine the effectiveness of the SRB and BRRD purely on the case of Banco Popular. The nature of the resolution framework makes it sensitive to circumstances and individual consideration: as the intervention of the SRB is based on the expected adverse effects to the overall economy, intervention is not always guaranteed.

An interesting question arises if we consider what would have happened in a case where the SRB did not intervene and Banco Popular was left to be resolved under the regular insolvency procedures and

FROB. While this is a highly speculative level, it is an important consideration if we are to assess the performance of the bail-in tools used. A potential alternative solution could have been the path taken by the Veneto banks in Italy, Veneto Banca S.p.A. and Banca Popolare di Vicenza S.p. A. (from now on, "Veneto Banks"): the SRB determined them not in need of a resolution intervention and the result was a state funded sale.

The Veneto banks had been under monitoring by the ECB from 2014 due to capital shortfalls (tier 1 ratio evolution can be seen in figure 7). From the figure presented, it is clear that they were experiencing issues with solvency and tier 1 capital distress much earlier than with the case of Banco Popular. This could be due to the fact that Popular still had better access to capital and was able to meet the requirements multiple times. Similarly to Banco Popular, the Veneto banks had also experienced pressure on their assets and profitability through their NPL portfolios and both Banca Veneta and Banca Popolare di Vicenza reported net losses of 3 and 4 billion euros respectively in 2016 (see annual reports, 2016).

Figure 8: Tier 1 evolution of Banco Popular and the Veneto banks (2001-2016)



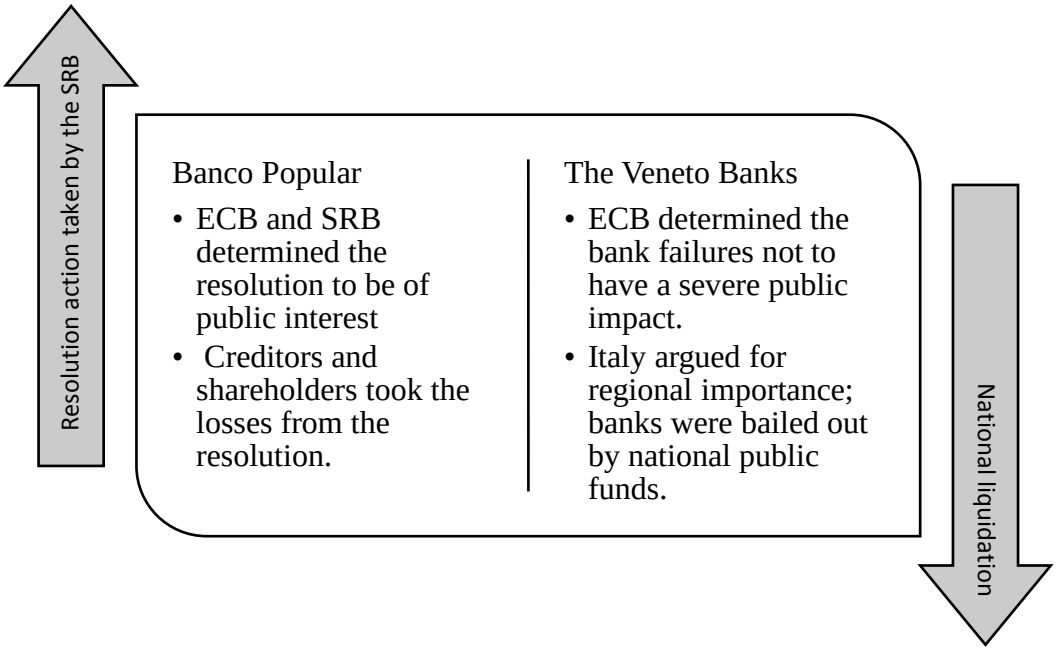
Source: Annual reports

When the decision was made by the SSM that the banks were "failing or likely to fail", the public interest assessment by the SRB failed to justify resolution. The two Italian banks were determined not to have a great systemic risk due to most of their bondholders being retailers rather than other

financial institutions (SRB, 2017d), and thus the SRB decided not to apply its resolution tools in their case. Followed by the decision of the SRB not to intervene in the resolution of the Veneto banks, the Italian resolution authorities presumed the responsibility of the liquidation. It then decided that state-aid would be necessary to avoid great adverse impacts in the Veneto region where the banks were most active. While this type of liquidity support was widely used during the global financial crisis – like in Greece, the European Commission specified that the support should be restricted to banks which have no capital shortfall. An individual notice was made for the Veneto banks and thus in January 2017 guarantee was approved for both of the Veneto banks. In June 2017, the Italian government had already guaranteed senior bonds up to 10 billion euros and provided cash injections of about 4,785 billion euros (European Commission, 2017). The Cash injection was one measure that was implemented in the liquidation of the Veneto banks. The other tools consisted of sale of business, transfer of assets and the bail-in of shareholders and subordinated creditors.

Firstly, the good and performing business operations (as well as branches and employees) were transferred to Intesa Sanpaolo, for a symbolic price of one euro: much like in the case of Banco Popular. Thus, the senior bondholders faced no losses to them as their claims were taken on by Intesa Sanpaolo. The good business operations meant in this case mainly performing loans, deposits, financial assets and senior bonds. The other assets, such as the non-performing loans, were transferred at book value against a claim on entity in liquidation to Societá per la Gestione di Attivitá S.G.A S.p.A. The NPL's are estimated to add up to 10 billion euros in net book value, consisting all of €9 billion of bad debts: it is thus unlikely that the NPL's are recovered in less than 9 years (Humblot, 2017). A comparison between the decisions and actions made for Banco Popular and the Veneto Banks can be seen in the following figure.

Figure 9: Illustration of resolution actions



Meanwhile the resolution of Banco Popular attracted much praise for the new banking regulations and the actions of SRB, the liquidation of the Veneto banks had quite the adverse effect. As the SRB announced that it would "not be in the public interest" to take action on the EU-level, and while the banks held regional importance, it is not in the objectives of the SRB. Given that the combined market share of the institutions was only about 2%, the SRB claimed that there would not be any great adverse impacts on the overall national economy (SRB, 2017d).

The problem in the case of Veneto banks is the conceptual difference between an EU perspective and a national one. As it was determined by the Italian authorities that there would indeed be a great adverse impact in the Veneto region, resulting in job losses and economic distress. They announced a need for state-aid: in other words, a publicly funded cash injection, while the authorities made a decision to protect senior bondholders at the expense of taxpayers Intesa Sanpaolo was paid 3,5 billion euros to offset the effect of the extra assets on its capital ratios and another 1,5 billion to cover costs from integration activities (European Parliament, 2017).

While the use of public funds is allowed, it could be argued to undermine the bottom line purpose of the BRRD and provide a loophole and inconsistency in the regulation meant to protect the public from bearing the burden of the financial sector. It has been noted by the Economist (2017) that as long as separate insolvency procedures exist, the SRB is not acting as a 'Single' Resolutionary Board.

On another note, it has also been stated that the case of the Veneto banks is in fact a good example of the flexibility of the regulatory framework as member countries are still free to hold power regarding key decisions that impact their economies (Maxwell, 2017). While the shareholders and junior creditors occurred losses as determined in the BRRD, it was the decision of the Italian authorities to protect senior bondholders as they claimed many of them to be retail investors and pinning losses onto them could adversely affect financial stability

Strangely, this is contradicting the very argument SRB used when they decided not to take action. A good demonstration of the complex nature of public interest assessments and different perspectives national authorities and the SRB can have: bondholders in retail may be perceived to impact an economy very differently on a national and regional level.

We have now discussed the resolution decision and process of Banco Popular. Next, we take a step back and attempt to determine whether their distress and its underlying reasons were apparent in the regulatory ratios. We do this in chapters 5 and 6.

5. Key regulatory ratios and their role inside financial institutions

5.1 Purpose

In this section we discuss some of the key regulatory ratios that were introduced after the financial crisis and that are meant to improve the prudential regulation of financial institutions and ameliorate their soundness and loss-absorbing capabilities in the case of a new crisis.

We attempt to determine whether these ratios could have been used as an early warning for the distress of Banco Popular, moreover how they were used as a signal. Mindful of the fact that national authorities, economic atmosphere and market conditions are still a major factor in any institution's performance, we have chosen to use a sample of Spanish banks in our demonstrations to aid with comparisons. The sample consists of Banco Popular, Banco Santander S.A, Banco Bilbao Vizcaya de Argentaria S.A (BBVA), Banco de Sabadell S.A, Criteria Caixa S.A.U and BFA Bankia S.A. All of the sample banks participated in the EBA stress tests in 2016 and are therefore of interest as a comparison point later in the paper.

While we acknowledge that there are certainly a number of various indicators that can be discussed as early warning signals, such as the points in the supervisory diamond, discussed under section 3.5.1: sum of large exposures, commercial property exposure, lending growth, excess liquidity coverage and funding ratio, this section does not cover all of these possibilities. In here, we have focussed on the ratios specified in Basel III accords and further used in the stress testing exercises performed of the sample of banks. We observe the evolution of CAR, CET1, LCR and NSFR in the case of our Spanish bank sample and then discuss its usefulness as an early warning signal, focusing on the context of Banco Popular. We extend our analysis to a theoretical ratio suggested by Chernykh and Cole (2015) named as Non-Performing Assets Coverage Ratio (NPACR), which has not been implemented in any regulatory framework yet.

5.2. The Total Capital Ratio (Capital adequacy)

One of the longest standing regulatory ratios for solvency is the total capital ratio (previously known as the BIS ratio). The capital adequacy levels for banks can vary a lot based on their internal requirements, national Financial Supervisory Authority (FSA), and required add-ons based on size and risk. Basel III defined the Total Capital requirement as the sum of Tier 1 Capital plus Tier 2 Capital which must be at least 8% of risk-weighted assets (RWA) at all times (BCBS, 2011). Tier 1 constitutes the core capital whereas the Tier 2 is considered supplementary capital, as discussed in

section 2.3.1. Tier 2 capital is limited to 100% of Tier 1 capital. The RWA assigns a risk weight of 0%, 20%, 50% or 100% for assets and off-balance sheet items, which are further explained in appendix A1. In this paper, the term Capital Adequacy Ratio (CAR) is used for the total capital ratio, as both are frequently used in research.

Table 5 shows the Basel III capital requirements for the sample of banks used in this paper. Certain macroprudential instruments are introduced to further strengthen the capital levels of banks. These are called capital buffers, which are a series of Common Equity Tier 1 capital calibrated as a percentage of the institutions' risk exposures (Banco de España, 2015). The first one is the capital conservation buffer, acting as a buffer for the financial sector as a whole. Following previous periods of lending growth, the capital conservation buffer will act as safety pillow to avoid the question of solvency in times of stress and uncertainty. The capital conservation buffer became applicable in January 2016. Carefully calibrated indicators will guide activation and deactivation of the buffer.

In addition, there is the countercyclical buffer, which became applicable at the same date, and set by Banco de España following guidelines from the ESRB. The buffer was set at 0% in 2016. Recent analysis showed that the credit-to-GDP gap was far off from the threshold of activating the buffer, thus it was reasonable to set it at zero (Banco de España, 2015).

Another buffer applicable is the additional capital add-on for G-SIFI. In this case only Banco Santander qualifies as a G-SIFI. Banco de España has defined additional buffers for banks defined as Other Systemically Important Institutions (O-SII), where the rest of the banks in our sample qualifies. Financial instability or solvency of these institutions may cause serious disruptions in the financial system and carry negative effects on the real economy. The buffer can be up to 2% depending on the systemic importance of the bank. Following the Tenth Transitional Provision of Law, there is a four-year phasing-in period of the G -SII buffer, which is also applied for the O-SIIs (Banco de España 2016). The 2016 requirement, which is applied in this paper, was therefore only 25% of the final requirement of the capital buffer. In addition, the competent authorities may require credit institutions to have a larger amount of capital than the minimum requirements (pillar II) as a result of the SREP (discussed in part 2), however, we have not included these as they are confidential in most cases. The individual total capital requirement for our sample of banks can be found in the following table.

Table 5: The individual Basel III capital requirements

Bank	Minimum CAR (pillar 1)	Capital Conservation Buffer	Counter-cyclical Buffer	Capital buffer for O-SIIs and G-SIIs	TOTAL
Banco Popular Español S.A.	8%	2,5%	0%	0%	**10,5%**
Banco Santander S.A.	8%	2,5%	0%	0,25%	**10,75%**
Criteria Caixa, S.A.U.	8%	2,5%	0%	0,0625%	**10,5625%**
Bankia S.A.	8%	2,5%	0%	0,0625%	**10,5625%**
Banco Bilbao Vizcaya Argentaria S.A.	8%	2,5%	0%	0,25%	**10,75%**
Banco de Sabadell S.A.	8%	2,5%	0%	0%	**10,5%**

Source: Banco de España (2015), Basel Committee on Banking Supervision (2011).

It is worth mentioning that all the banks in our sample reported CAR levels that met the regulatory requirement in 2016 as indicated above.

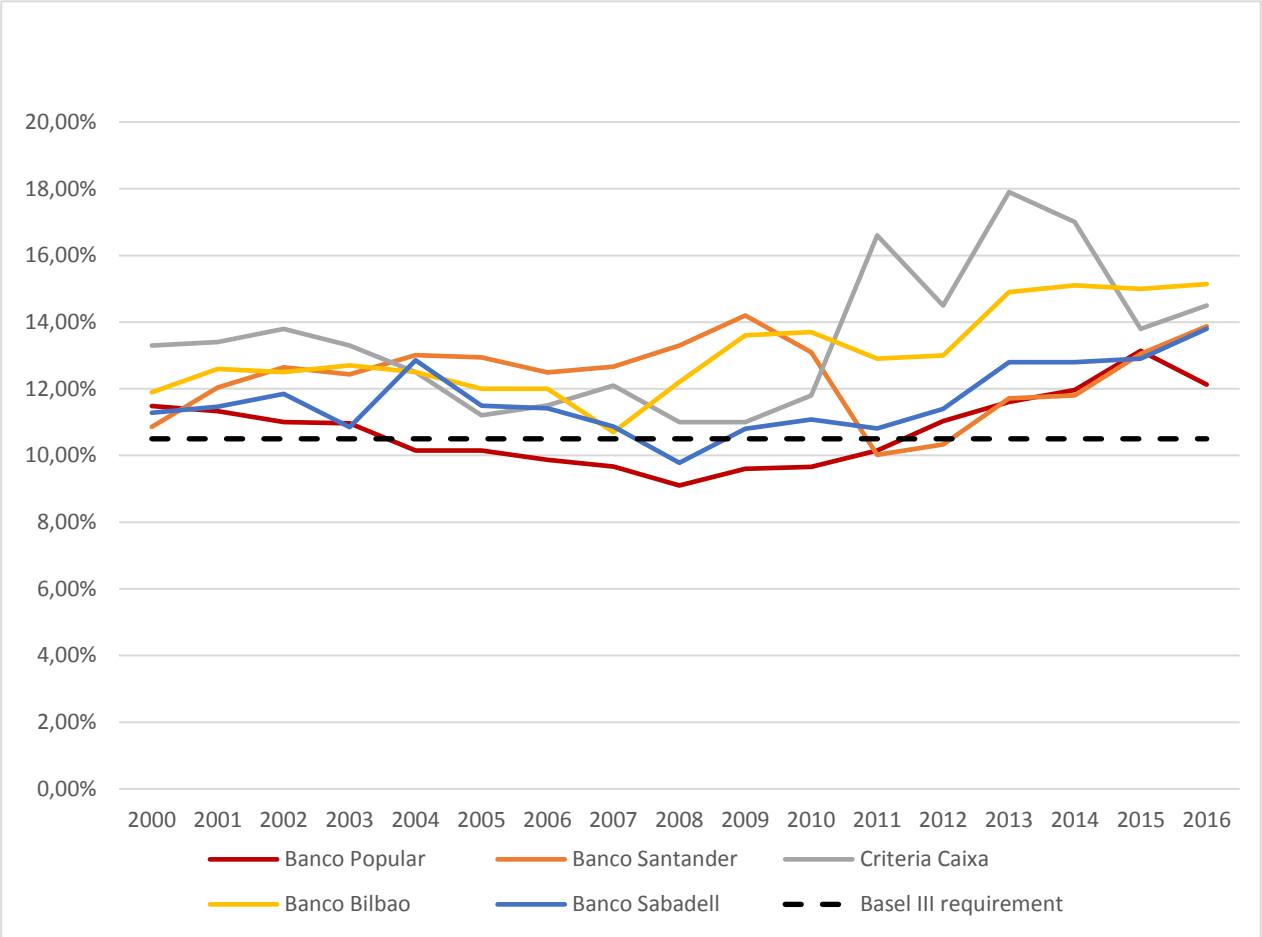
5.2.1 Can Capital Adequacy Ratio (CAR) act as an early warning signal for financial shortfalls?

In this section, we will look into the evolution of the CAR in our sample of banks and discuss the impact the regulatory requirements have on the banking business. Furthermore, we will discuss the role of CAR as a signal of the bank's health.

The capital adequacy has for a long time been a requirement by the Bank for International Settlements, and thus reported by all the banks. The sample of Spanish banks have had a stable evolvement of its capital ratios. Most of them have continuously reported levels above 10,5%[7], however Banco Popular's levels kept being lower than its peers. This evolution is portrayed by Figure 9

[7] General requirement for all banks (without bank-specific buffers)

Figure 10: The total capital ratio reported from 2000-2016 for the sample of banks



Source: Annual reports (2000-2016) for the respective banks

Bankia is excluded from the graph, as it was formed in December 2010 following a union of seven regional saving banks *(Cajas)*. In 2012 it was near a failure, and had to be partially nationalized by the Spanish government. It is to this day one of the largest banks of Spain.

To evaluate if CAR can have early warning properties it is important to look at the optimal level of a bank's capital in relation to the regulatory requirement, as this affects the bank's incentives to bear higher capital levels that what is required. The CAR ratio can be looked at as a solvency indicator, which already makes it a potentially good warning signal. In a regulatory environment, with a higher CAR, the banks have the capability to absorb more risk. Banks can therefore take on more risk as they have the capacity but will then suffer from higher operating costs (Kahane, 1977; Besanko and Kanatas, 1996) On the other hand, due to an increased capability of risk absorption, banks can now enter more diversified risky activities and thus increase their operating income (Furlong and Keeley,

1989; Berger and Mester, 1997). Due to the negative direct impact on costs and the benefits from a safety net of deposit insurance and last resort loans from the authorities and central banks, the bank prefers a lower capital adequacy ratio while the regulatory authorities prefer it to be high. Hence, an optimal capital adequacy level for each bank exists, as stated by (Li et al. 2016). On their study of thirty-one Taiwan banks in the period 2007-2009, they found that approximately 88,2% of the banks have an optimal capital adequacy ratio higher than the BIS requirement of 10,5% and 93,5% higher than 8%. They concluded that the regulatory capital requirements can in fact pivot the Taiwan banking system to reach the efficiency frontier. This can be related to the broad use of the capital levels of a bank, as it could affect their productivity levels and costs, as well as shake up their financial stability when going below the regulatory requirement of 10,5%. It is therefore possible to assume that the capital adequacy ratio is a good signal for early warning of the bank's capability to weather financial distress and a possible crisis. Looking at Banco Popular even though they reported both CAR and CET1 ratios above the regulatory requirement both in 2015 and 2016, their capital levels deteriorated rapidly in the last quarter, as discussed in section 4. To be able to use the Total Capital levels appropriately as an early warning signal, it is important to determine the adequate levels of Tier 1 and Tier 2 capital that a bank should hold. This will be discussed further in section 6.

To sum it up, a higher capital adequacy requirement will improve a banks capability of absorbing losses and risk with robust operations (Berger 1995), but it might limit the benefits from loans. Loosening the capital ratios will relinquish economic growth, however it will increase the risk of using tax-payers money to bail out banks in a crisis scenario, like seen under the financial crisis of 2008-2009.

5.3 The Common Equity Tier 1 Ratio (CET1)

One of the results of Basel III capital rules was the current form of common equity tier 1 (CET1) capital and the specifications for its minimum requirements as well as improving the quality of capital held by financial institutions. It is formed of common shares, stock surpluses from common shares, retained earnings, subsidiary or third party issued and held common shares and accumulated other comprehensive income. Instruments, which are eligible for CET1 but are by nature not common, can be included in the Additional Tier 1 (AT1).

CET1 has been added in the discussion of early warning signals for banks since it is designed to act as a sign of solvency and strength of capital position, thus in the EBA risk indicator assessment, the CET1 and the CET1 ratio is a key tool in assessing solvency risk (EBA, 2018a). The more

informative number is the CET1 ratio which measures the capital position against its risk weighted assets. Under Basel III, the CET1 ratio constitutes an increase from 2% to the current 4,5%, which was fully phased in from 1. January 2015. Again, the application of a capital conservation buffer comes in to further strengthen the capital requirements, as explained in the previous section – 5.2. This leaves the CET1 ratio requirement at 7%, as the countercyclical buffer is 0% for the Spanish banks.

5.3.1 Can CET1 Ratio act as an early warning signal for financial shortfalls?

In this part we take the CET1 ratio under a closer scrutiny and attempt to determine whether it could have been used as an early warning signal for Banco Popular (or if it shows any abnormalities for the other banks in the sample) and what factors are the key drivers for CET1.

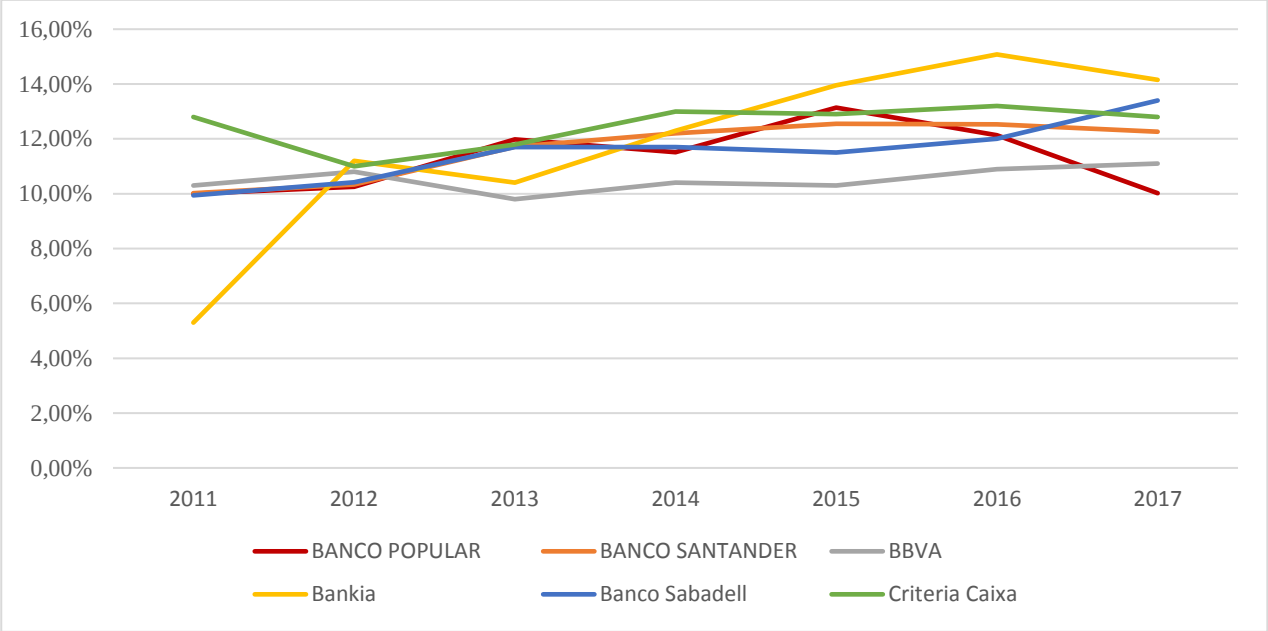
The CET1 ratio is mainly affected via impacts on the RWA: the assets that make up the RWA are weighted by credit risk, market risk and operational risk. Therefore, when a new risk is posed on an asset class, the risk weight for that asset increases, causing the CET1 ratio to decrease. For example, considering the most common form of asset, a loan: the risk weight is determined based on the value of collateral and the source of re-payments. Naturally, when a loan becomes doubtful via missing re-payments or the underlying collateral loses its value, the risk weight for that particular asset increases. Therefore, we observe a relation between an increase in non-performing assets and a decrease in capital ratios: a crucial observation when we consider the case of Banco Popular and the Veneto banks. When we have banks that struggle with NPLs, capital solvency issues typically arise and capital injections are needed to compensate for the increased risk-weights. Hence, we can say the CET1 ratio informs us of the solvency position of an institution: we see how much of common equity is held, when risk weights are posed on the assets. The RWAs can also be used as a signal for asset class bubbles (Avramova & Le Leslé, 2012).

While undoubtedly a useful ratio, there has been some criticism as well, mainly directed towards the RWA method and calculations and its implications for the institution's solvency. From a regulator's point of view, concerns are inaccurate measurements of risk (mainly understating it, leading to too low capital levels), the historical nature of RWAs which may cause them to be too low in good times and rise too low in downturns, and the deliberate underestimation of capital by banks (Avramova & Le Leslé, 2012). These issues can result in capital ratios that are overstated and send too optimistic signals about the actual solvency situation of a bank. Deliberate understatements can additionally cause excessive risk-taking and lead to bank failure via non-prudent actions. On another note, from

the institution's perspective, they face a competitive pressure as the banks with the lowest RWAs need to hold the least amount of capital, and therefore have less costs (also an incentive for deliberate understatements).

There is not much to learn in relation to early warning behaviour from figure 11 which demonstrates the evolution of the CET1 ratios from 2011-2016: the Spanish sample reports very similar ratios, steadily between 10% and 13%. Although sufficient from a regulatory point of view, on a European level, these numbers cannot be considered high and they are on the low end of the European aggregated average 13,78% in 2016 (ECB, 2018b).

Figure 11: Evolution of CET1 ratio, 2011-2017, for the sample of banks.



Source: Annual reports Banco Popular, Banco Santander, Bankia, Criteria Caixa, Banco Bilbao V.A. and Banco de Sabadell, (2011-2017); Quarterly report of Banco Popular (2017).

Banco Popular does not show any apparent signs of distress, and seems in fact average in the sample, although demonstrating somewhat of a downward trend and finishing lowest in the first quarter of 2017. Therefore, while an annual trend does not seem to demonstrate great volatility, we still treat it with caution. As discussed in part 4, the issues Popular was facing had its origin with a steep increase of non-performing loans (NPL), placing pressure on RWAs and consequently the solvency state of the bank. Accordingly, they experienced capital shortfalls caused by the failure to get rid of NPLs, which was the final straw in losing investor confidence and pushing Popular into financial distress in 2017.

However, pure annual observations of the CET1 do not seem to reveal this, as the supposed capital cushion vanished almost completely overnight, and Popular was in need of capital injections. We therefore conclude there to be need for more detailed stressing of the capital ratios, in order to fully understand its functionality as an early warning signal. This will be done in part 6.

5.4 The Leverage Ratio (LR)

To further understand how much indication certain regulatory capital levels can yield, it is important to consider the leverage side of banking systems. The excessive build-up of on- and off-balance sheet leverage was one of the underlying causes of the 2008-2009 global financial crisis (BSBC, 2014c). Many banks had this excessive leverage build up, while maintaining strong risk-based capital ratios, such as Total Capital and Tier 1. In the midst of the crisis, the financial markets forced banks to downsize their leverage which increased the negative pressure on the asset prices causing them to be reduced even more. This aggravated the responsive loop between losses, falling bank capital and shrinking credit availability (BSBC, 2014c). As a responsive measure to the learnings of the financial crisis, the Basel III framework introduced a transparent non-risk leverage ratio, as an auxiliary measure to the risk-based capital requirements. The leverage ratio (LR) requirement thus ensures that banks with a large share of low-risk weighted capital holds additional capital for loss-absorbing, and act as a better measure for protection against losses that are highly correlated in the financial system, and not fully covered under the capital framework. The phased in implementation of the leverage ratio started in 2013, with public disclosure requirements as of 1 January 2015, with a view of migrating it to the Pillar I agreement by 1 January 2018. The leverage ratio will act as a "backstop" measure for the risk-based requirements and is indented to prevent a destabilised deleveraging process. The minimum requirement is set at 3% for EU banks, and it is expressed as follows:

$$Leverage\ ratio = \frac{Capital\ measure}{Exposure\ measure}$$

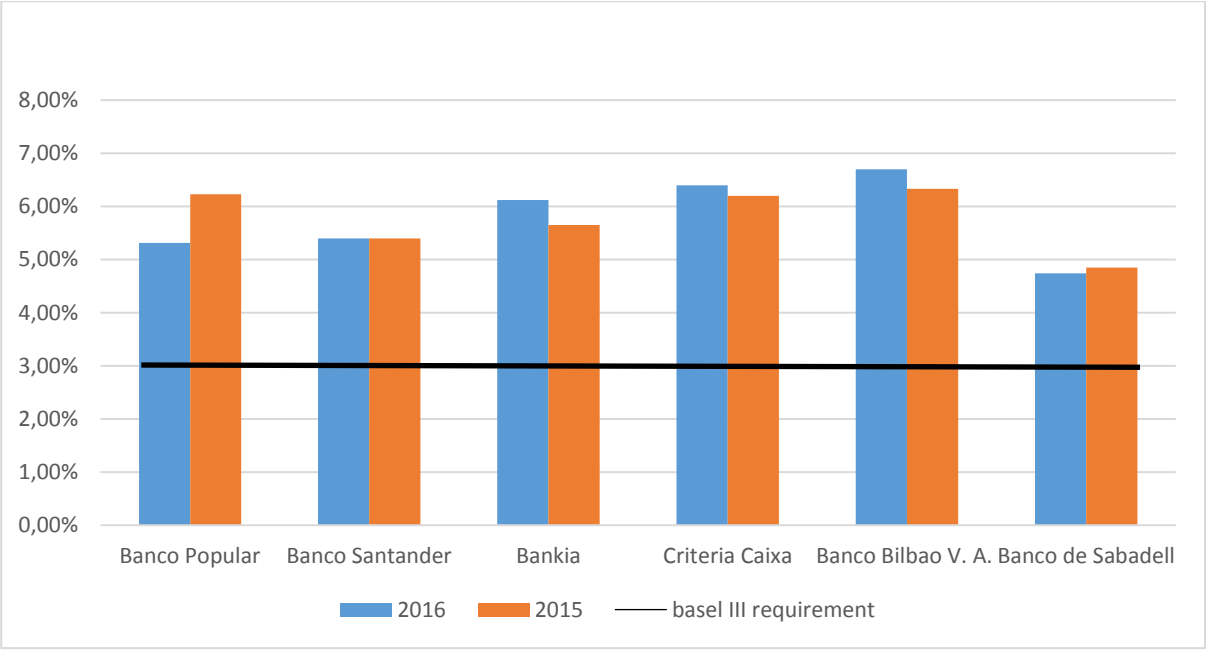
The minimum requirement of 3% is set for a parallel run (i.e. from 1 January 2013 to 1 January 2017), but still the same (2018). In this timeframe, the capital measure consists of the Tier 1 capital. However, the committee will collect data using the total regulatory capital or common equity tier 1 capital to see the impact on the measure of the leverage ratio. The exposure consist of both on and off-balance-sheet exposures, derivatives exposures and securities finance transaction exposures. The

problem of the leverage ratio is its failure to separate assets that have the same nominal value but different riskiness, and hence treated equally. They then face the same capital requirements. This will be discussed further in the next section.

5.4.1 Can the Leverage Ratio act as an early warning signal for financial shortfalls?

To be able to evaluate the reported leverage ratio of Banco Popular and its features, we have to look at it in comparison to its closest peers. From Figure 12, it is clear that all the banks have phased-in leverage ratios well above the regulatory requirement. Banco Popular does not report levels far below its peers, however its leverage ratio decreases from 6,23% to 5,31% from 2015 to 2016, which is an opposite evolution compared to its peers. It is thus possible to assume that its internal struggles was starting to become apparent. Its tier 1 capital had decreased by 2 billion euros between 2015 and 2016, and these effects are shown in the leverage ratio.

Figure 12: Phased-in Basel III Leverage Ratio for the sample of Spanish Banks.



Source: Annual reports Banco Popular, Banco Santander, Bankia, Criteria Caixa, Banco Bilbao V.A. and Banco de Sabadell, (2015,2016)

Again, we want to discuss the use of key regulatory ratios as an early warning signal for the health of a financial institution. The leverage ratio is widely discussed around the world. In EU, the minimum requirement is set at 3% while in the United States it is set 2 percentage points higher, at 5% for their bank holding companies, and 6% for g-SIFIs, which according to the vice chairman of the Federal

Deposit Insurance Corporatom Thomas M. Hoening is still too low (Morgenson, 2017). Under the 2016 EBA Stress Test[8], Banco Popular reported an adequate leverage ratio above the Basel III 3% requirement, even in the adverse scenario. However, due to their rescue in 2017, their capital levels were in the end inadequate, hence Mr. Hoening's view was reinforced. In this case, the leverage ratio did not say much about the adequacy of Popular to weather a crisis, and signalling their stressed levels, therefore further discussion of the leverage ratio is needed.

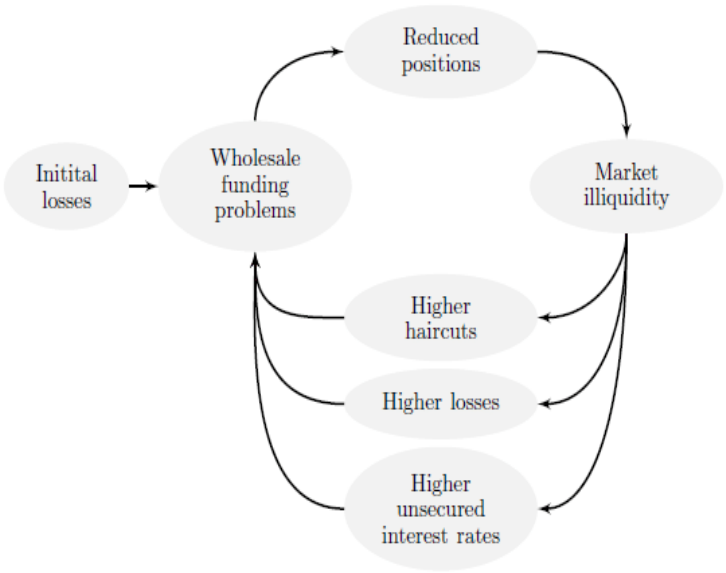
A special feature in the EBA November 2015 Financial Stability Review (Grill, Lang and Smith, 2015) indicated how the leverage ratio might lead to increased risk taking in banks due to the non-risk-based nature of the leverage ratio. They test a large sample of EU banks and find that the increased incentive to take risk is more than compensated for by the loss-absorbing capacity of increased capital positions. This leads to lower probabilities of distress for banks that are under the the demand of leverage ratio. They therefore conclude that the introduction of the Leverage Ratio requirement to the Basel III framework lead to more stable banks. We therefore believe that the Leverage Ratio on its own is not giving too much indication of early warning, but looking at it together with risk-based capital will give a better indication, as the risk-based capital framework and the leverage ratio are mutually reinforcing, covering risk the other indicator is not able to capture. We will continue to discuss the improvement of liquidity measures under the Basel III framework in the following section.

5.5 The Liquidity Coverage Ratio (LCR)

There has always been a lot of focus on having adequate capital levels when it comes to banking regulations and proper projection models. Back in 2007, right before the financial crisis hit, liquidity was taken for granted and assumed available at no or very little cost. As a result, banks suffered from what first started as huge funding liquidity problems to market illiquidity, which was later known as the downward liquidity spiral (Brunnermeier and Pedersen, 2008), as picture in Figure 13.

[8] This will be discussed further in part 6.

Figure 13: The liquidity spiral



Source: Brunnermeier and Pedersen, 2008

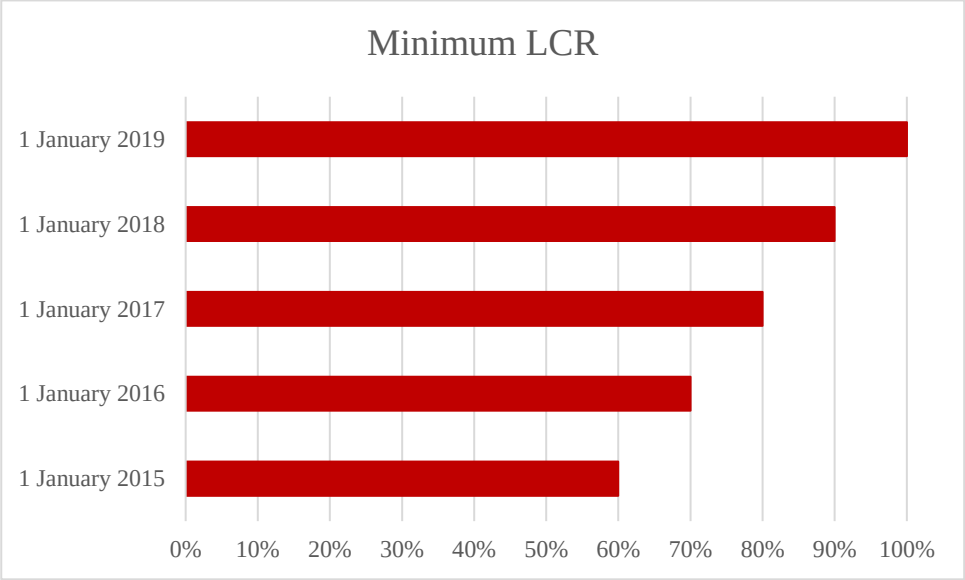
Ever since the 2008 liquidity crisis, liquidity management has been an important topic for both regulators and banks. Therefore, the Liquidity Coverage Ratio (LCR) was implemented as an essential component of the Basel III framework for its liquidity standards. The effect was to strengthen and promote banks short term resilience. As Mervyn King, Chairman of the Group of Governors and Heads of Supervision (GHOS) said in the 2013 press release:

> *"The Liquidity Coverage Ratio is a key component of the Basel III framework. The agreement reached today is a very significant achievement. For the first time in regulatory history, we have a truly global minimum standard for bank liquidity. Importantly, introducing a phased timetable for the introduction of the LCR, and reaffirming that a bank's stock of liquid assets are usable in times of stress, will ensure that the new liquidity standard will in no way hinder the ability of the global banking system to finance a recovery."*

The LCR ensures that the banks have adequate levels of high-quality liquid assets (HQLA) to survive stressed liquidity scenarios over a 30-day period. These assets can be converted in to cash easily in order to meet liquidity needs in the stressed periods, thus ensuring that the banks can absorb shocks that are arising from financial instability, and reducing the risk of a crisis spreading globally, and creating a crisis to the real economy. The committee believes that when the LCR is fully implemented, it will play an important role in having a more robust and resilient banking system.

The implementation of the LCR has happened gradually. When introduced, it was a time of ongoing strains in some banking systems, which led the committee to decide on a step by step approach, to avoid material disruption to the financial system. This process is pictured in Figure 14.

Figure 14: A gradually implementation of the minimum Basel III LCR requirement



Source: BCBS (2013 b)

The LCR require banks to hold an amount of HQLA that is greater than or equal to their net cash outflow over the 30 days stress period, having at least 100% coverage. The formula is as follows:

$$\frac{Stock\ of\ HQLA}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ calendar\ days} \geq 100\%$$

The HQLA are classified in to three different categories, with a decreasing level of quality: level 1, level 2A and level 2B assets[9].

Under Basel III, level 1 has no haircut, level 2A has 15% and level 2B has a 50% haircut. Level 1 assets include cash held at central banks, foreign withdrawable resources, securities issued or guaranteed by specific sovereign entities and multilateral development banks and government bonds. Included in level 2A assets are securities issued by specific multilateral development banks or sovereign entities or U.S. government-sponsored enterprises, all with specific conditions. Level 2B

[9] Full list of HQLA can be found in Appendix A6.

assets include residential mortgage backed securities (RMBS), corporate debt securities, common equity shares, again with conditions.

5.5.1 Can LCR act as an early warning signal for financial shortfalls?

During periods of stress, it is likely that banks would use their stock of HQLA, and thus fall below the minimum requirement. The Basel Committee have acknowledged this and they give guidance to banks falling below the regulatory requirement, following different scenarios and circumstances. There are a number of ways by which banks can fix shortfalls in the LCR. These ways include increasing proportion of liquid assets held such as central bank reserves and sovereign bonds or increasing the maturity of their wholesale funding beyond 30 days (after which it is no longer considered a factor in the denominator). This is a side that has also received its share of criticism. Hartlage (2012) argues that there is a risk of a snowball effect when banks attempt to roll-over their exposures in economic downturns. In the same paper he also notes that efforts to remain within the LCR compliance limits can lead to and excess demand of wholesale funding. Others, such as Schmitz and Hesse (2014) are more optimistic and argue increased demand for low risk instruments to reduce lending rates which would in turn lead to reduced costs of funding.

As we have observed from the financial crisis, liquidity risk will directly affect the business failure of a financial institution, which is why banks usually have implemented contingency funding plan in order to react appropriately in times of a liquidity crisis together with internal early warning signals to monitor liquidity related status. The table below shows reported liquidity coverage ratios for the 6 Spanish banks.

Table 6: Reported Liquid Coverage Ratios for our sample of banks

	2014	2015	2016	2017
Banco Popular Español S.A.	n.a.	179%	135%	
Banco Santander S.A.	100%	146%	146%	133%
Criteria Caixa, S.A.U.	n.a.	n.a.	n.a.	n.a.
Bankia S.A.	n.a.	n.a.	n.a.	n.a.
Banco Bilbao Vizcaya Argentaria S.A.	100%	100%	100%	128%
Banco de Sabadell S.A.	100%	100%	100%	168%

Note: Numbers are subjected to rounding up
Source: Annual reports Banco Popular, Banco Santander, Bankia, Criteria Caixa, Banco Bilbao V.A. and Banco de Sabadell, (2014-2017)

Table 6 gives an indication of the LCR levels reported by the sample of banks used in this paper. Due to lack of data, the LCR was not available for all of the banks, notably Criteria Caixa and Bankia. One can argue if this is due to a slow implementation.

Looking at the ratios, one can deduce that most of the banks have already implemented the regulatory requirement of having a LCR well above 100%. What is interesting about the results of this table is that Banco Popular was also well above the regulatory requirement and should have had a liquidity level that could handle a short term stressed level when we now know their failure to have been due to their shortage of liquidity. The levels do however show a downward trend, which can indicate high levels of cash withdrawls, which in fact was the case as discussed in section 4. Banco Popular was faced with a deposit withdrawal scenario, and thus first requested €2bn in emergency liquid assistance (ELA) from the Spanish central bank followed by another request of €1,6bn the next day (Buck and Brunsden, 2017). Finding itself in the middle of a liquidity crisis, the value of Banco Popular's assets plunged, making it impossible to receive more ELA as it no longer had anything to offer as security. The next morning the bank was sold to its rival Santander for one euro. In Popular's case, liquidity may have been the final breaking point, however, we see from the discussion here and in part 4 that it was the interplay between liquidity and solvency that caused the final collapse.

While our discussion has been limited because the LCR is still a relatively new ratio and will need some time to develop and build up data before an in-depth analysis. Based on our knowledge now, however, we are inclined to conclude that the LCR can be used an effective signal of a bank's health, but when using it as an early-warning signal, it should be considered together with the existing solvency indicators. An argument supported by Van den End and Kruidhof (2012) who stated that under regular economic conditions, a solvent bank should not fail due to illiquidity and a liquid bank can still fail without solvency. Given the LCRs newness in the regulatory environment, it is difficult to determine what its final implications will be, and if it will prove to be useful in predicting financial distress. However, it is reasonable to assume it will act as a short-term signal for liquidity deterioration.

5.6 Net Stable Funding Ratio (NSFR)

As part of the Basel committee's aim to strengthen the liquidity framework, complementary to the objective LCR is the NSFR. The first objective of the framework was to promote a short-term resilience of a bank by ensuring a prudent enough level of HQLA to survive 30 days of stress through the LCR. The second objective is to reduce the funding risk, which led to development of the NSFR.

The committee requires banks to fund their activities with funding from stable sources over a longer period to mitigate the risk of future funding stress. It is a part of the Basel III framework aimed to maintain financial stability and a more flexible banking sector.

Funding risk became apparent during the 2007-2008 financial crisis, but it is no new phenomenon as banks have gone through times of liquidity crisis historically. Many banks, despite meeting their capital requirements have experiences difficulties during these times because they did not manage their liquidity prudently enough (BCBS, 2014a). Due to bank's position as liquidity providers (Kashyap et al., 2002), it requires them to hold large positions of liquid assets, due to the risk of an imbalance between deposit withdrawal and commitment takedowns. The banks' exposure to short terms deposits, which allows depositors to optimize their consumption and thus makes the banks attractive, also makes the banks subject to bank runs (Diamond & Dybvig, 1983), as they accept illiquid assets and offer more liquid liabilities. People withdrawing their deposits was a big part of the failure of Banco Popular.

In the NSFR consultative document by the Basel Committee on Banking Supervision (BCBS, 2014a) it is explained how the NSFR requires banks to maintain a stable funding profile in relation to their composition of short-term assets and off-balance sheet activities. The ratio became a minimum standard requirement of Basel III as of 1 January 2018, and it is calculated as follows:

$$\frac{Available\ amount\ of\ stable\ funding}{Required\ amount\ of\ stable\ funding} \geq 100\%$$

The available stable funding is considered to be the amount of capital and liabilities expected to be certain over a one-year horizon (BCBS, 2014a). This is a function of the institutions liquid assets, residual maturities and their off-balance sheet exposures. A summary of the liability categories and asset categories associated with the available amount of stable funding and required amount of stable funding respectively can be found in appendix A7.

5.6.1. Can NSFR act as an early warning signal?

Again, it is worth discussing the use of the NSFR for preventative measures by the bank towards periods of stress. Findings by Hong et al. (2014) indicates that both the LCR and the NSFR have limited effects on bank failure and systemic liquidity risks. However, one can argue that instead of

being an early warning indicator, this ratio provides banks and supervisors with information useful for a better understanding of the funding risk of an institution.

Since the NSFR is a relatively recently introduced requirement, it is difficult to find reported data on this ratio. Banco Popular expressed its comfort of meeting the minimum requirement of 100% at all times (Banco Popular, 2016). However, the challenge of liquidity ratios is to model them correctly as liquidity by nature is subject to extremely rapid and drastic changes. Case in point, the shift in the liquidity levels of Banco Popular in 2017, as explained in section 4. As we see from the case of Popular, a bank that has reported comfortable liquidity levels can still fall under a liquidity crunch. It can therefore be assumed that banks will need to both improve their internal models and to change their funding mix in order to fulfill the set requirement by the Basel Committee (Dietrich et al, 2014). This could be done by lengthening the duration of their funding to attract more deposits or to increase equity. On the other hand, this could lead to increased interest rates, as it is costly to hold long-term debt and equity funding. They could also shrink their asset base, with the risk of losing earning opportunities (Dietrich et al.,2014).

Summing up, the NSFR is in its early implementation stage, and banks are expected to have to change their funding combinations to be able to meet the requirement. We acknowledge that while the NSFR can help decrease the risk of a bank run and has potential to be a good health indicator, it is still too underdeveloped to be useful as an early warning signal in this scenario. It will perhaps prove to be more useful in the future with fully developed models

5.7 Theoretical Addition

In this section we have introduced a concept from literature that focuses on early warning signals of banks. Given our discussion in part 4 about the struggles Banco Popular experienced with NPLs, we think it is relevant to mention a ratio directly related to the levels and coverage of NPLs. As a theoretical addition, we cannot directly observe it historically. However, based on our own calculations from balance sheet data, we investigate how this hypothetical regulatory ratio would have evolved.

5.7.1 The Non-performing Assets Coverage Ratio (NPACR)

Since the ratios defined by Basel III have not produced a clear indicator for Banco Popular's failure, we turn to literature to see whether they provide an answer to this gap. Based on the performance of Banco Popular in EBA stress tests and following the evolution of CAR, CET1 and the liquidity ratios,

it seems like simple observations of historical values do not reveal clear signs of distress, and further testing is needed to establish their sensitivity to stress. Since we have identified the levels of NPLs to have been a major hindrance for Popular, we then consider alternative models which would have been more successful as early warning signals simply by observing the reported ratio.

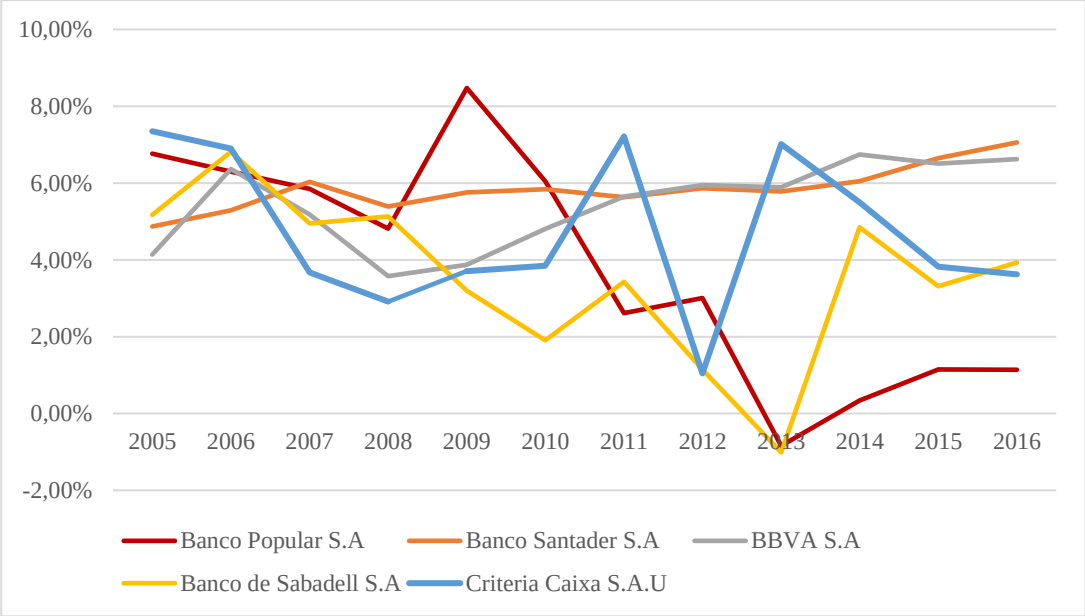
From the paper of Chernykh and Cole (2015), we find a proposed model for non-performing assets, presented as a straightforward ratio: nonperforming asset coverage ratio (NPACR). The paper describes the calculation as follows:

$$NPACR = \frac{Book\ Equity + Loan\ Loss\ Reserves - Nonperforming\ assets}{Total\ End\ of\ Year\ Assets}$$

In where the loan loss reserves represent the amount banks put aside for bad loans. The authors interpret the ratio as simply equity to assets in where NPAs have been counted for. The ratio is built to demonstrate the banks' unwillingness (or inability) to build up necessary reserves for future losses. Chernykh and Cole (2015) find in their testing that the NPACR outperforms the normal Basel III ratios in predicting financial distress among US banks and argue this ratio to be superior by both its performance and the simplicity of its calculation. While this paper does not attempt to redo the original study, we want to examine the NAPCR ratio with our sample banks and see whether it will give a better indication of Banco Popular's distress. We redo the analysis for the selected banks, using the data from the annual reports.

It becomes evident from the figure 15 that the proposed NPACR differentiates Popular earlier and better than the Basel ratios. Popular underperforms its Spanish peers starting from 2013 and remains significantly lower all the way until 2016. While BFA Bankia and Banco de Sabadell also experience low points in their evolution, the trend is still upward going when moving away from the financial crisis and experience a significant rise in 2014, which is when the ECB implemented their stress tests and asset quality reviews (ECB, 2017). Apparently, when the NPLs are accounted for, Popular's equity to assets appears significantly unhealthier and demonstrate the failure to clean up the balance sheets post-financial crisis. The results seem reasonable, as we have already discussed one of the more puzzling facts about Banco Popular was their decision not to sell off their non-performing portfolio the SAREB along with the other banks.

Figure 15: NPACR evolution of the sample of Spanish banks.



Source: Annual reports Banco Popular, Banco Santander, Bankia, Criteria Caixa, Banco Bilbao V.A. and Banco de Sabadell, (2005-2016)). Calculations based on Chernykh & Cole (2015)

5.8. Are the key regulatory indicators able to act as early warning signals?

In this part of the thesis we have discussed five of the key regulatory ratios outlined by the Basel Committee for Banking Supervision, which are developed to promote a better resilience in the financial system. We also included a theoretical addition to take the discussion a step further. Looking at the development of these ratios for Banco Popular, it is clear that a ratio on its own does not tell us much. Popular was able to comply with the regulatory requirements before its failure, and only showed a slight decline in the ratios from 2015 to 2016 which may not cause grounds for concerns. In addition, even though introduced in the 2010 document of international framework for liquidity risk measurement, standards and monitoring, the liquidity standards have still yet to be fully implemented.[10] We found that some of the ratios act better as an early warning signal when analysed together with other regulatory ratios. For example, the leverage ratio and the risk-based capital ratios such as CET1 and CAR are mutually reinforcing, covering risks that the other indicator is not able to capture. However, these indicators do not tell us much on their own, and further investigation is needed, which is why we will look into stress testing in the following section. As liquidity is still under development, we will focus on the regulatory capital ratios in the following section, to develop a better understanding of their potential use as early warning signals.

[10] LCR will be a minimum requirement as of 1 January 2019 and NSFR will be a minimum requirement as of 1 January 2018.

6. Early detection of financial instability: Stress Testing

6.1 Purpose

In this section of the paper, we take a closer look to the stress testing of a sample of Spanish banks to see if their capital levels are sufficient and robust enough to withstand a crisis scenario and still comply with the Basel III requirements. While looking at the capital levels in stressed scenarios, as well as the level of change in NPLs we want to investigate how the ratios presented can act as early warning signals for banks, regulators and the society.

The section will briefly explain what stress testing is, as well as mention its weaknesses. Afterwards, it will focus on the 2016 EBA stress testing results, mainly on our sample of Spanish banks to evaluate their performance as well as reactions that came after the publication of the results. Following, it will present a different approach to stress testing, namely the IMF model, to, hopefully, challenge and confirm the findings of the EBA test. We hope to develop an increased understanding of a possible broader use of stress testing results, such as early warning signalling.

It can be argued that since the banks use their own models in the EBA stress test, the results can be calibrated in a way to get the desired outcome. Therefore, it is interesting to look at the IMF stress tester as a comparison to bank's internal models, where the data used comes from published databases and reports as well as the banks' individual Pillar III disclosures. However, the moral hazard issue has been recognized and supervisors are starting to look at how the bank generated the results, not just the number generated by the test, as stress tests are becoming more and more comprehensive and important (Huertas, 2015). Models are the best tool available at the moment, though imperfect, which is why it is interesting to see the performance of a different calibrated test. It is important to mention that the IMF test is calibrated using end-of-year 2016 data, instead of 2015 data, like the EBA test. The purpose of our stress tester is to look at the sensitivity of capital-, and NPL ratios of Banco Popular and its peers and to evaluate whether it is possible to predict capital shortfalls and liquidity instability in the future based on their reactions to shocks, in addition to see whether they hold sufficient capital to survive a crisis. Therefore, it is more interesting to see the development of Banco Popular's ratios from 2015 and closer to the date it was deemed failing or likely to fail (6 June 2017) by the ECB.

6.2 What is stress testing?

Stress testing is a method of finding weaknesses in operations and portfolios via hypothetical scenarios and shocks. It has been used for many years in various formats, typically to identify interest rate risk (Dowd, 2013). The importance of stress testing has been increasing ever since 1977 and the methods are becoming more sophisticated; typical scenarios for stress tests today include credit and liquidity shocks as well as more specific market scenarios such as exchange rates.

Dowd (2013) and Rebonato (2010) both acknowledge the growing importance of stress tests and in his book notes that stress test results in fact comply with the theory of coherent risk measures[11]. He states that stress testing has especial use as it tends to perform better in quantifying loss in a crisis situation, that is, when market relationships break down and cause distortions to value-at-risk (VaR) and expected shortfall (ES) results. For example, in a crisis, correlation relationships that are considered normal can break down. Since VaR is based on assumptions of normality, its losses can be severely understated – as was seen in the financial crisis in 2008. Dowd (2013) also identifies losses of liquidity, concentration and macroeconomic risks to be cases where stress tests can outperform traditional risk measures. They can reveal an excessive concentration to a single risk factor or business cycles and clarify relationships between collateral requirements, interest rates and other market factors that might otherwise go unnoticed.

There are both hypothetical stress tests designed to simulate crisis scenarios, and historically based stress scenarios that aims to reproduce past occurring crisis events, the latter being the most plausible. As mentioned by Haldane (2009), the understanding and realism of a crisis increases with a long historically observation period, which again affects the "plausibility" of stress tests and their origin. Even though banks have their internal risk management strategies, stress testing helps provide an indication of the capital levels needed to absorb losses should one or more shocks occur. The Basel Committee issued in 2009 a constructive document (BCBS, 2009), highlighting principles for sound stress testing in order to endure deteriorating economic conditions. The stress-testing tool is important in; (1) providing forward-looking assessments of risk; (2) overcoming limitations of models and historical data; (3) feeding into capital and liquidity procedures; (4) supporting internal and external communication; (5) distribute information about banks' risk tolerance; and (6) facilitating the development of contingency plans across stressed scenarios. The stress tester data provided by the authorities then allows for further investigation of the Basel III requirements and its relationship with

[11] Coherent risk measures as found in Hull, 2105: Monotonicity, sub-additivity, homogeneity and translation invariance.

possible bank failure for the EU largest banks and differences between them (Chiaramonte & Casu, 2017).

6.2.1 Weaknesses of stress testing

While there are many benefits to stress tests and they can serve a good purpose in identifying if banks hold enough capital to withstand unfavourable environments (generally apparent in the capital ratios we have discussed earlier), weaknesses persist. Firstly, stress tests rely on a huge variety of shocks, risk factors and scenarios which are ultimately largely determined by the judgement and experiences of the test conductors. This can obviously be a major hindrance as some unexpected scenarios can be overlooked. The tests, while simple in theory, can be extremely complex as market variables have interdependencies and chain reactions that are sometimes hard to predict. Dowd (2013) also notes that stress tests need to consider the more fundamental theories of finance, such as zero arbitrage and consider that some prices cannot move independently from each other as it would violate zero arbitrage.

Secondly, gathering sufficient data is still a major issue for most institutions. When the data is insufficient, links between risk factors become frail and limit the usefulness of the test (Thun, 2013). Data is still especially scarce in times of distress and therefore is a problem when scenarios are designed. The liquidity side of stress testing is more underdeveloped than others and requires big amounts of data, most of which are still not available for institutions. Basel III responded to the lack of regulatory measures for liquidity with the LCR and the NSFR, however, there's still no widely used method for conducting stress tests for liquidity. While the stress tests have experienced significant improvements, according to the Vice-President of the ECB, Vitor Costâncio, it is still very much a solvency assessment and only considers liquidity in terms of exogenous shocks (ECB, 2015). The ECB has expressed its intention of developing liquidity stress tests further. Given the strong relationship between solvency and liquidity, both are needed to have a thorough understanding of the institution's position. Further test-specific weaknesses (ref. EBA and IMF) will be discussed under the respective sections.

6.3 Introduction to EBA stress testing

Like many of the topics discussed earlier, stress testing experienced a reform after the financial crisis. The first EU system-wide stress test was brought forward by the Committee of European Banking Supervision (CEBS). Where bank-wide stress tests are designed to aid management with portfolio

decisions and identify weak spots, system-wide tests are meant to identify and address systemic weaknesses.

Initially the CEBS led stress tests were meant to increase the level of information sharing and best practices and transparency, rather than evaluate capital shortages of individual banks. The objectives changed after EBA came into force, and more emphasis was put on recapitalisation needs and capital shortages of banks. Failing banks were then required to inject more capital into them, above the existing requirements (Ayadi & De Groen, 2014).

Today, EU-wide stress tests are done with the aim of monitoring and assessing market developments, identify trends, risks and vulnerabilities. Starting in 2009, they followed the Asset Quality Review (AQR) and made up a core element of the Comprehensive Assessment (CA) which was conducted at the implementation of the SSM. Since 2009, there has been launched five EU-wide stress test exercises, with the next coming up in 2018.

6.3.1 The 2016 EBA Stress Test and its results

We now turn to investigate the stress test results of our sample of Spanish banks for the EBA stress test in 2016, with a special focus on Banco Popular's performance, bearing in mind that they passed the test, but with a poor outcome. Passing in this context means that the CET1 ratios, total capital ratios and leverage ratios were above the regulatory requirements in the adverse scenarios, as EBA did not set pass or fail thresholds, since the aim is to use it as input for the Pillar 2 capital guidance. 51 banks participated in the 2016 EU-wide stress test all from 15 EU and EEA countries, covering approximately 70% of the assets in the EU banking sector. 29 July 2016 EBA published the results of the stress test, where all of the six banks in our sample were included.

The test is based on a macroeconomic scenario that entails a downturn adverse scenario over a 3-year period using 2015 year-end figures. While it is noted that the test is not meant to capture all possible shocks and scenarios as well as it assumes static balance sheets, it still gives an overview of the impact of a macro-level downturn on individual banks. The test required the banks to use and shock variables such as GDP, inflation, asset prices and interest rates in order to infer implications for capital, leverage and profitability. One of the most important systemic risks was identified as a change in consumer preferences and reluctance to hold long-term fixed income securities, consequently causing a reallocation to short-term instruments and a rise in risk-free rates and risk premia across asset classes

(EBA, 2016c). The outcome from the different adverse macro-economic scenarios for different variables are used to estimate the potential adverse impact on profit generation and capital.

Since we are still in the transitional period of the CET1 ratio and pillar III, we will focus on the transitional values of the ratios and only mention the fully loaded ones. The mandatory effect of the Basel III requirements is from 2019 while the transitional phase-in period is before then. The fully loaded Basel III ratios are calculated as if the transitional period has ended. On an aggregated level, the EU banking sector has improved its capital level significantly with end 2015 CET1 ratio of 13,2%. It has increased by 200 bps from 2014 and 400 bps from 2011. The stressed scenario brings the CET1 ratio down by 380 bps to a level of 9,4% at the end of 2018. This is still well above the 7% Basel III requirement (Pillar 1)[12]. The impact of the capital levels is driven by credit risk losses, operational risk losses and market risk across all portfolios. We will present the CET1 ratio, total capital ratio and the leverage ratio results of our sample of banks in the tables below.

Table 7: EBA Stress Testing Results of the CET1 ratio

Bank	Actual Values (31.12.15)	Baseline Scenario (31.12.2018)	Adverse Scenario (31.12.2018)
Banco Popular	13,1%	13,5%	**7,0%**
Banco Santander	12,7%	13,2%	8,7%
Criteria Caixa	11,7%	11,7%	9,0%
Bankia	14,6%	15,1%	10,6%
Banco Bilbao V.A.	12,0%	12,0%	8,3%
Banco de Sabadell	11,7%	13,0%	8,2%

Source: *http://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2016/results*
Note*: Numbers rounded up*

The table shows three different values, where the actual values are the ones reported in the end of 2015. The baseline scenario shows the estimated values for end of 2018 if there is no crisis, and the adverse scenario shows end of 2018 values throughout stressed environments.

None of the banks ends up below the Basel III CET1 ratio requirement, however it is clear that Banco Popular struggles the most. It is able to meet the requirement at the exact minimum level, as well as it ends up over 1 percentage point lower than the second lowest performer in the adverse scenario.

[12] Minimum requirement of 4,5% plus a capital conservation buffer of 2,5%. Other buffers may apply to different banks, but we will use this requirement going forward at an aggregated level

Furthermore, they would not meet the requirement with their fully phased values, as many of its peers would (see Appendix A8.1). Overall, they did not show impressive results, and all indications from the test results suggests that they needed to shore up their capital levels to weather any unfavourable scenarios. It is therefore interesting to look at their total capital ratio that constitutes common equity tier 1 plus additional tier 1 capital as well tier 2 capital, as discussed in section 5.2. Table 8 shows the stress testing results of the total capital ratio (capital adequacy ratio).

Table 8: EBA Stress testing results Total Capital ratio

Bank	**Actual values (31.12.15)**	**Baseline scenario (31.12.2018)**	**Adverse Scenario (31.12.2018)**
Banco Popular	13,76%	15,92%	**9,46%**
Banco Santander	14,59%	16,29%	11,71%
Criteria Caixa	13,82%	13,54%	10,78%
Bankia	15,54%	17,02%	11,89%
Banco Bilbao V.A.	14,92%	16,15%	12,31%
Banco de Sabadell	13,12%	14,11%	**9,36%**

Source: *http://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2016/results*
Note: *Numbers rounded up*

The Total Capital Ratio table shows slightly more worrying results as both Popular and Sabadell falls below their individual regulatory requirements[13]. Having accounted for the additional capital buffers and g-SII requirements *(ref 5.2)* the results indicate that Banco Popular and Banco de Sabadell would be below the Basel III requirements in an adverse scenario. Banco Popular is 104 basis points below its requirement while Banco de Sabadell is 114 basis points below. Overall, Banco de Sabadell performs the worst in this test, which is due to their initial low levels of Tier 2 capital and decreasing levels of Tier 1 capital. We will now look closer into the leverage part of the stress test.

[13] See table 5 for an overview of the individual total capital requirements and their respective calibration

Table 9: EBA Stress testing results Leverage Ratio

Bank	Actual values (31.12.15)	Baseline scenario (31.12.2018)	Adverse Scenario (31.12.2018)
Banco Popular	6,2%	7,2%	4,2%
Banco Santander	5,4%	6,2%	4,3%
Criteria Caixa	6,2%	6,6%	5,1%
Bankia	5,8%	6,2%	4,3%
Banco Bilbao V.A.	6,3%	7,1%	5,2%
Banco de Sabadell	4,8%	5,6%	3,5%

Source: *http://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2016/results*
Note*: Numbers rounded up*

These results show that the Leverage Ratio Banco de Sabadell would reach the lowest level of the sample of banks, with Banco popular 70 bps higher. However, the drop is due to decreasing Tier 1 capital, as the leverage exposure (i.e. denominator of the ratio) is assumed to remain constant throughout the test (EBA, 2016b). The minimum requirement of the Leverage Ratio is set at 3%. This ratio was introduced into the Basel III framework to reduce the risk that comes with deleveraging scenarios in the future. It is however interesting to see how Banco Santander shows a similar leverage ratio to Santander in the adverse scenario. Furthermore, Santander falls below Popular in the fully phased levels (see appendix A8.2) However, this is not surprising, as according to EBA (2016 b) the larger banks are, on average, more leveraged than the smaller ones. However, leverage ratios vary considerably depending on the business model.

The EBA stress test portrays one adverse scenario, which happens at the end of 2015 and lasts for three years, to the end of 2018, reflecting four systemic risks. These risks are identified by the European Systemic Risk Board (ESRB) as representing the highest material threats to the stability of the financial sector. The first risk, which is assessed to be the most significant, is a sudden reversal of compressed global risk premia, reinforced by low secondary market liquidity. These effects are due to a change in investor preferences, notably in the United States, where there is an increasing aversion to hold long term fixed income securities. This leads to a change in portfolio allocation as investments in short term assets increase, hence the long term risk-free interest rates will rise along with the risk-premia across all asset classes. A long period of global uncertainty would follow, which would eventually lead to a decline in domestic demand in EU, lower property prices and a widening of the credit spreads of sovereigns (ESRB, 2016). The described first systemic risk acts as a trigger

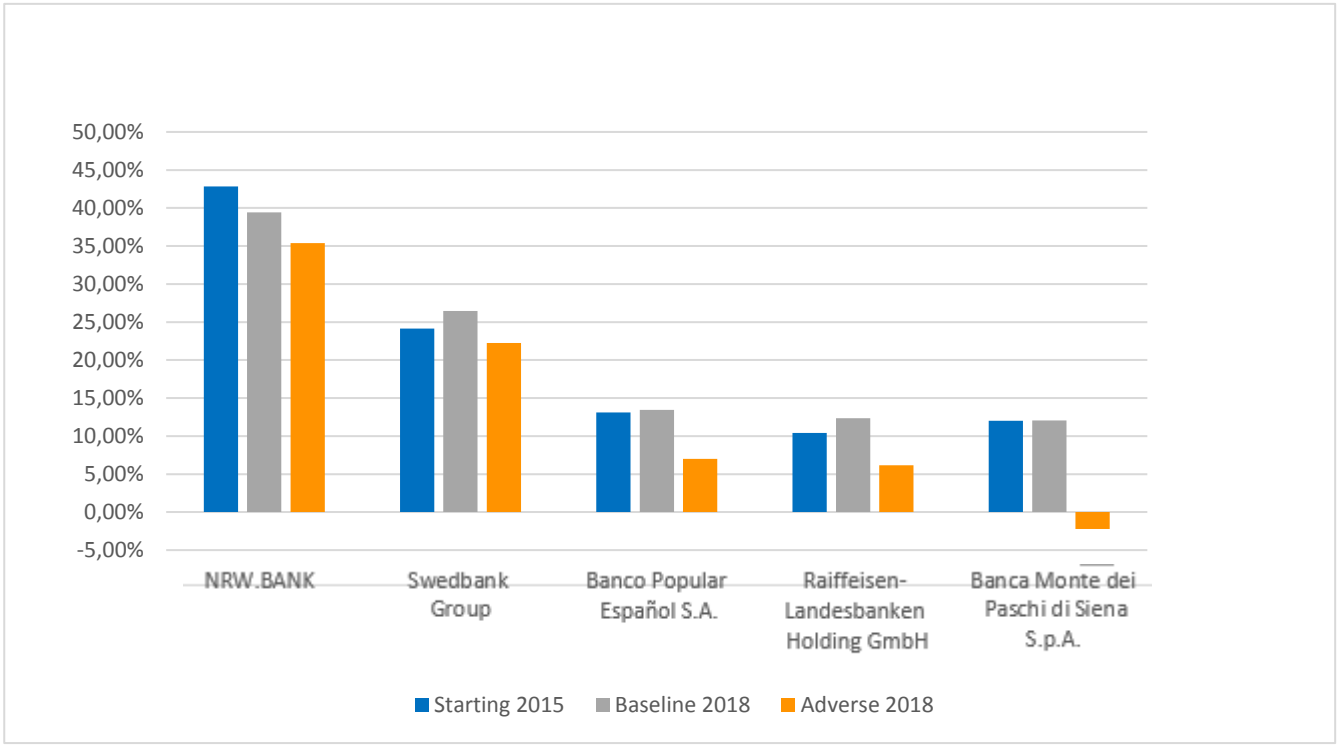
for the following three risks; first, due to a low nominal growth environment there is weak profitability prospects for banks and other financial institutions, second, amid the low nominal growth there is a rise of debt sustainability which concerns the public and non-financial private sectors, and third, the rapid growing shadow banking sector is sensing potential stress which is amplified by spill over and liquidity risk.[14] The different shocks originate from a sudden 250 basis points increase long term United States treasury securities yield. This would affect fixed income securities in Europe. Notably the ten-year Spanish bond yields would remain 87 basis points above the baseline levels in 2018, due to a stable impact on the sovereign bond yields. The EU sector would be affected overall, as long-term interest rates in the EU would be 71 basis points higher in 2016, 80 basis points higher in 2017 and 68 basis points higher in 2018 (ESRB, 2016). As a trigger, the nominal exchange rates of central and eastern European countries depreciate against the Euro. The increase in global risk premia has a series of more effects on the European market. Global equity prices would decline (36%), EU stock prices would fall (25% annually), all from 2015 baseline scenario to end of 2016. Commodity prices would decrease having oil prices being negatively affected and fall by 48% in 2016. Furthermore, the money market rates would increase by 33 basis points and as a response, swap rates would go up by 44-58 basis points. As an indirect shock, consumer confidence would go down, causing a slowdown in the property market. A combination of these shock would drive house prices in the EU sector, *(exceptions with greater decrease; Denmark, Ireland and Slovakia)* down 13,5% as well as lowering the EU GDP with 1,2% from its baseline in 2016.[15]

Overall, credit risk was the main source that affected the capital contributing to a -370 basis points impact on the CET1 ratio. However, the test can be restrictive since it is based on static balance sheets. As an example, the ratios do not include any capital injections adopted after 31 December 2015, such as the capital increase made by Banco Popular in July 2016. Even though they increased their capital levels, Banco Popular reported in 2016 a CET1 ratio of 12,13%, 163 bps lower than 2015. As mentioned, the bank was also one of the poorest performers of the EBA stress test, and had the worst outcome of the sample of Spanish Banks. These results could all be indicators that Banco Popular had fragile capital levels. Even so, the Spanish Banks showed overall an appreciative degree of resilience.

[14] See appendix A9 for the financial and economic shocks originating from these risks.
[15] See appendix A10 for contributions of individual shocks to the deviation of the EU GDP.

Taking a closer look at the CET1 ratio, Banca Monte dei Paschi di Siena S.p.A. was the worst performer overall, with a CET1 ratio in the adverse scenario of -2,23%. Following, Raiffeisen-Landesbanken-Holding GmbH showed the next weakest CET1 ratio of 6,14% followed by Banco Popular's 7,01%. The highest CET1 ratio in an adverse scenario was reported by the German bank NRW.BANK with 35,40% followed by Swedbank with 22,26%, which can be seen in figure 15. The CET1 ratio of Banco Popular is far away from both extremes (highest and lowest). As it is barely above the minimum Pillar I requirement and one of the poorest performers of the test, it does show a cause for consern.

Figure 16: The Transitional CET1 ratio – best and worse performers



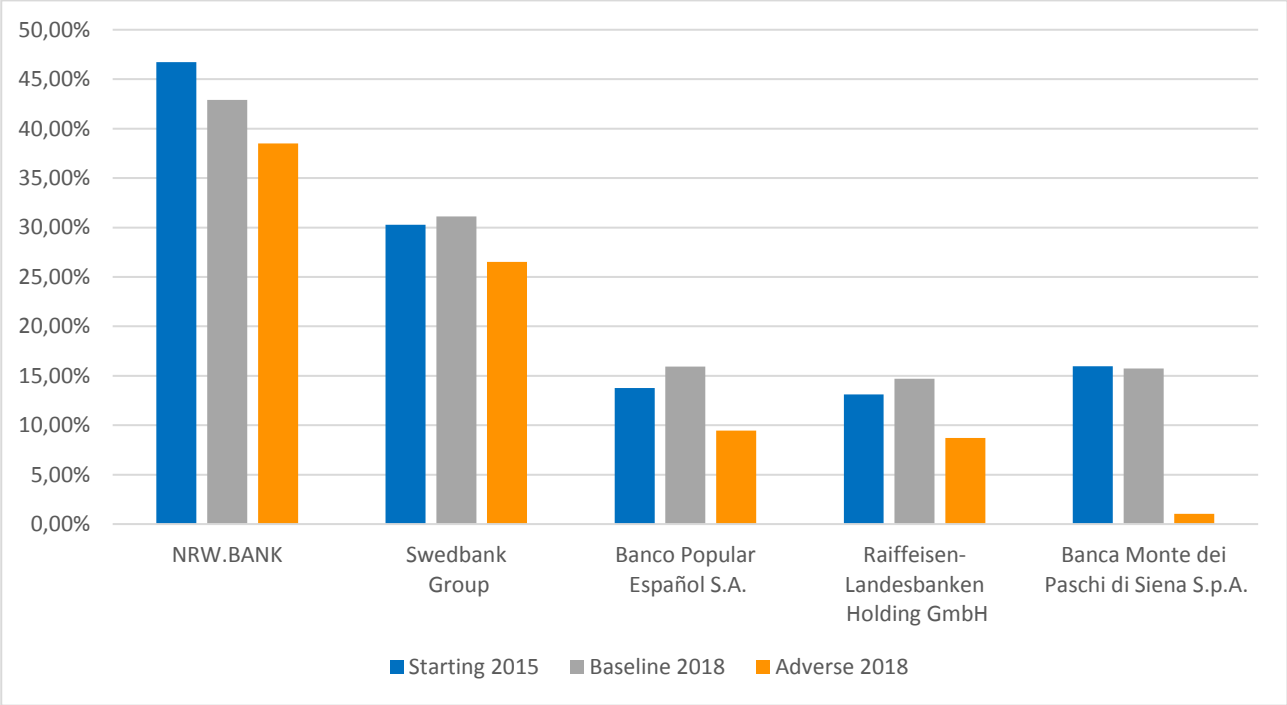
Source: European Banking Authority (2016 b)

Even though the CET1 ratios were above the requirement, the leverage ratios showed more worrying results. If the EBA scenarios turned out to be true, three of the tested banks would be below the minimum Basel III requirement of 3%.[16]

[16] Banks with leverage ratio below requirement: Bayerische Landesbank, Banca Monte dei Paschi di Siena S.p.A., N.V. Bank Nederlandse Gemeenten with leverage ratios of 2,95%, -0,65% and 2,08% respectively.
We will not go deeper into the leverage ratio as we focus on the capital ratios for further comparison with the IMF model, which will be introduced later.

Again, Banco Popular is above the requirement with a leverage ratio of 4,18%. However, its delta change is -204 basis points which is one of the highest level of changes for the banks tested.
Similarly, the total capital ratios show sensitivity towards the adverse scenarios, as three of the Spanish banks ends up below their individual requirements.[17] Figure 17 shows the difference between the performance of the mentioned banks.

Figure 17: The Transitional Total Capital Ratio – Best and worst performers



Source: European Banking Authority (2016b)

Again, Banca Monte dei Paschi di Siena S.p.A. is the worst performer with a total capital ratio of 1,03% in the adverse scenario and a delta change of -1492 basis points, indicating that their capital levels are completely wiped out under a crisis scenario. The performance of Banca Monte dei Paschi di Siena S.p.A. (dei Paschi) clearly is alarming. It was stated that the bank planned to raise capital after the failing tests. In addition, the Italian treasury stated that the bank would not need any state bailout (Glover, Sirletti and Speciale, 2016). Even though there is a large difference between Banco Popular and Monte dei Paschi, they both performed poorly, and EBA stated in 2017 that both banks were dropped from the 2018 stress test (Banco Popular had then been taken over by Santander after deemed failing or likely to fail), even though they were originally included. Ever since the Italian

[17] Minimum requirement 8% with individual additional capital conservation buffer and SIFI add-ons.

bank flunked the EBA test, they have been restructuring as well as getting a rescue deal from Brussels and Rome (Barker & Sanderson, 2017). This is a good example of how the tests are used as early warning indicators for banks and authorities to take action if the adverse capital levels are worrying as it might spiral downwards. Overall six banks ended up with total capital ratios lower than 10,5% (minimum 8% requirement + capital conservation buffer)[18]. Again, the German bank NRW.BANK is the best performer with a total capital level of 38,51% in the adverse scenario, followed by Swedbank with a ratio of 26,51%.

6.3.1.1 Criticism of the EBA Stress Testing Exercise

When comparing the performance of the banks, it is important to mention that the included banks are Europe's biggest lenders. This is the most comprehensive test of their balance sheets in the EU using the same methodology. However, it has received critiques which is important to discuss as well as look at areas of improvement, as it is startling that Banco Popular went into failure the year after the publication. Larry Elliot (2016) was fast to criticise the EBA stress test citing that they are revealing their own lack of credibility. Even though the tests are designed to spread confidence in the biggest lenders in EU, after the publication of the 2016 results, bank shares across Europe were falling (3%) as a response.

Another weakness mentioned is the failure to include banks from Greece and Portugal, two of the most struggling economies in the EU. By ignoring banks from these countries, contagion risks are downplayed as some of the larger banks might have exposure towards these countries. In 2014, the stress test included 123 EU banks in addition to having pass or fail thresholds. Two Greek banks ended up failing the test, giving them 9 months to shore up their finances, which indicates a stronger use of stress testing as an early warning to banks, as well as indicating contagion risks. However, EBA now went away from this type of stress testing, as discussed previously. Even though EBA is not in a position to sanction banks, the pass and fail thresholds makes better use of stress tests as early warning signals, as was shown with Monte dei Paschi when they raised 5 billion euros following the publication of the stress tester results.

A third mentioned weakness by Larry Elliot is how they ignored the Brexit scenario, which will happen in 2019. Ever since UK was voted to leave the EU, financial institutions have announced their disinvestments in the UK and their planned relocating to other EU financial capitals. A prolonged

[18] Not counting in additional SIFI add-ons and countercyclical buffers as they are different for all banks.

period of negative interest rates is likely to further weaken the profitability of European banks following Brexit. However, for the 2018 stress test that will be published later this fall, EBA reportedly made a Brexit scenario, to make sure the banks can withstand this doomsday. Their model implies a GDP contraction of 2,2% in 2019, but a growing economy in 2020 (Binham, 2018).

Summing up, the EBA stress test is an easy comprehensible and well-developed stress test that is widely used in both research and real life. It provides supervisors, market participants and financial institutions with consistent data to "contrast and compare EU-banks' resilience under adverse market conditions" (Chiaramonte and Casu, 2017). Even though it has its mentioned weaknesses, it still looks like a viable tool to help estimate banks' financial stability in times of distress, as the example of Monte dei Paschi showed.

6.4 Introduction to IMF stress testing

The IMF was founded in a UN conference in 1988 as a response to the Great Depression that had shaken the economy in 1930s. The IMF is one of the pieces in the supervisory spectrum whose job is to assure the stability of the international monetary system. The purpose was previously mainly focused on exchange rates and payments but in 2012 the objective was updated and now covers all financial sector issues that might negatively impact global financial stability.

The IMF conducts most of its stress tests in cooperation with the World Bank, as a part of the Financial Sector Assessment Program (FSAP). The IMF focus has long been in developing the advanced stress testing techniques while collaborating with many supervisory authorities, such as central banks and the EBA. Various forms of contagion and interbank risks are an ongoing concern for the FSAP and in recent years they have focussed on forming various analytical methods for stress testing such issues within an economy. New methods and models have been developed and are adjusted constantly, to respond to changing market conditions. Meanwhile, the FSAP official goal remains similar to those of the EBA: highlighting the vulnerabilities and weaknesses in economies and banks, promoting financial stability and transparency as well as strengthen the economy against future financial crises. When discussing IMF stress testing models, we are largely following the book by Ong (2014).

6.4.1 Stress Tester 3.0

The stress tester 3.0 is constructed by the IMF to illustrate the stages of a stress testing exercise, from the identification of vulnerabilities, construction of scenarios, performance of numerical analysis, to

the interpretation of the results. The exercises are modelled on stress tests conducted in several of the Financial Sector Assessment Program (FSAP) missions. However, the test is simplified to make it suitable for the data available, as IMF is under confidentiality restrictions. There are two main methods to iterate macroeconomic shocks into financial sectors: the "top-down" approach and the "bottom-up" approach. For this test, we used the top-down approach, as the impact is estimated using aggregated data. The main reason for choosing this method was limitations of public available data on each individual bank, as we are using the same sample as introduced in part 5. The data was mainly retrieved using Orbis Bank Focus database, annual reports and disclosed pillar III reports. As mentioned by Ong (2014), the disadvantage of a top-down approach is the possibility that it overlooks interbank contagion risks and the individual exposure towards other institutions due to the use of aggregated data. Interbank data is included in our tests, merely based on assumptions. However, we have not tested for an interbank contagion solvency risk scenario, which is an important scenario to include.[19] The bottom-up approach on the other hand uses data on individual portfolios, and is more suitable to capture contagion risk and risks of systemic failures and deliver results that are more precise. However, it is subject to data insufficiency and complex calculations.

In the Stress Tester 3.0, a variety of variables can be tested such as profitability, liquid assets, capitalization among others. We will focus on different capital levels and compare these to regulatory requirements, to develop a better understanding of how they are reacting in stressed scenarios. Furthermore, as mentioned by the ECB, the capital levels of Banco Popular had been under strict supervision for some time, so a better understanding of these levels in stressed scenarios can help understand the build-up of the liquidity crisis that hit Popular before their failure. Following the responses of the capital levels under stress can also help reveal its functionality as early warning signals, which will be discussed further on. Throughout the test, assumptions had to be made, which are heavily based on published reports[20] and historical data. In addition, the assumptions are made, to the widest extent possible, similar as what is used in the 2016 EBA Stress Test. The theory and overall results will be discussed in the following sections. For more details about the data and the assumptions made in the model, see Appendix A11.

[19] This could be included in further studies, as contagion risk plays a big role in stress testing.
[20] These reports are consolidated documents by the Basel Committee on Banking Supervision, to understand maximum requirements and further make appropriate assumptions.

6.4.1.1 Credit Risk

Credit risk is the risk that counterparties in loan transactions will default on their loan obligations (Hull, 2015). This has traditionally been a key risk in banking as lending is usually part of the core business, hence it is normally the risk that requires the most regulatory capital. To model credit risk in the stress tester 3.0 a mechanical approach is used. Other common approaches can be either based on loan performance data or on corporate sector data.

There are four different credit risk shocks that will be applied to the sample of Spanish Banks used. The first shock is "*adjustment for underprovisioning",* with the purpose of increasing focus on the underlying value of the bank. This value can differ between banks as items that should not be reported as regulatory capital sometimes is included and treated the wrong way. To get clearer results in the stress test, credit shock 1 adjusts the reported data to get a better picture of the baseline situation of the bank. Hence this shock is applied in all of the following three shocks. The assumption of 0% haircuts is used, as EBA states that no regulatory haircut should be applied in the EBA Stress Test (EBA, 2016a).

The second credit shock, *"increase in NPLs",* models the general decline in the banks' asset quality, when we assume that there is a set, proportional, increase in the non-performing loans. It is assumed that during stressed situations and crisis', the level of NPLs is likely to increase. This means that banks would have to undertake additional provisioning, which again will decrease the value of RWA and capital. The smaller the risk weight, the smaller the effect on the RWA. However, a common assumption is that the affected assets have a weight of one in the RWA. For simplicity, we have used this assumption that the weight is 100%. In addition, we made the increase in NPLs proportional to existing NPLs instead of existing performing loans. This assumption builds on the fact that there have not been any structural shocks lately and probably not in the nearest future. A structural shock could make future NPLs disproportionate to existing NPLs, which happened in early 2000s Central and Eastern Europe as one saw a switch from corporate lending to household lending with very different parameters and qualities of NPLs (Ong, 2014). However, to this day the level of a bank's NPLs can be used as a good proxy for their risk management. In the stress tester 3.0 we have assumed an increase of 25% of NPLs as a credit shock to see the impact on CAR, CET1 and NPLs to RWA.

The third credit risk shock is the *"sectoral shocks"* where the stress tester tool can model different shocks for selected economic sectors. The goal is to see how each bank is affected by a shock to sectors where they have different levels of credit exposure. The included sectors are agriculture,

manufacturing, construction, trade, tourism (including transport), credit institutions & insurance and other. By applying a shock to one or more economic sector, the model will show the level of new and increased NPLs in the affected sector, and thus indicate if the bank's level of NPLs is moving towards an unstable level. The sectorial shocks can be calibrated and based on a historical scenario (e.g. a terrorist attack), or an empirical model which explains default rates in different sectors as a function of explanatory variables such as macroeconomic ones (Ong, 2014). We have simulated a scenario of a terrorist attack in this test, where the trade and tourism (incl. transport) sectors are affected.[21] Due to lack of data, assumptions had to be made on the positions of the banks in each sector. These were carefully developed with the data that was available for certain banks and certain sectors as a percentage of NPLs.[22] The assumed provisioning rate is set to 25% for all sectors, and the increase in NPLs is assumed to be proportional to the bank's credit exposure to the different sectors.

The fourth and last credit risk shock is *"concentration risk",* also called *"large exposures".* A certain amount of large exposure are assumed to suddenly default on their loans, causing banks to increase their provisions. This allows to test for the effect of failure of the largest counterparties and the effect this will have on each individual bank. Again, due to lack of public data, assumptions had to be made. Each of the five large exposure is assumed to represent 2,5% of eligible capital. This assumption is stretched in a sensitivity analysis in appendix A12. The purpose of that exercise is to see how bank's capital levels are affected by the assumptions made. For simplistic reasons, the five exposures are assumed the total for each bank, whereas in reality they are exposed to many more institutions. The implications on capital lies between approximately 0,60%-1,00%, hence an assumed level of 2,5% (in between the extremes) seems reasonable. This assumption is based on the consultative document presented by the Basel Committee (BCBS, 2014b), where average large exposure levels are mentioned as well as the maximum limit of all of bank's exposures to a single counterparty, set at 25% of a bank's Tier 1 capital. Furthermore, it is assumed that three of the largest exposure will fail in the shock scenario with an assumed provisioning rate of 100%.

6.4.1.2 Interest Rate Risk

We will account for interest rate risk in both the direct and indirect form. Direct interest rate risk comes from the mismatch between assets and liabilities due to interest rate sensitivities which creates a gap. A nominal increase in the interest rates typically result in a lower capital adequacy for the

[21] See Appendix A11.2 for complete list of assumptions.
22 See Appendix A11.3 for comlete list of assumptions to sectors

banks as the duration gap between assets and liabilities increases (Ong, 2014). This gap will be modelled in our stress testing analysis.

In addition, the banks are faced with the indirect interest rate risk which is a part of credit risk. Changes in interest rates will affect customers creditworthiness and their ability to repay their loans, which causes a risk for the banks. Similar to the direct risk, an increase in nominal interest rates is likely to have a negative effect on the credit risk of the banks, as it will make it harder for the borrowers to repay their debt. As the banks are exposed to this credit risk, and increase will eventually lead to a decrease in their net worth, holding all else constant. Findings made in a country study shows that there is a positive relation between higher interest rates and non-performing loans or loan losses (Ong, 2014).

In our model, we test the impact of our sample of banks from an increase in the interest rates and look how using an interest rate risk stress tester can be a tool to assess future warnings for the banks. We want to make assumptions which corresponds both to the 2016 EBA stress testing exercise and the ECB "Sensitivity Analysis of (Interest Rate Risk in the Banking Book) IRRBB – Stress test 2017". Therefore, we have assumed a 98 bps interest hike *(EBA)* and a 200 bps interest hike *(IRRBB)*.

6.4.1.3 Foreign Exchange Risk

Foreign Exchange Risk is the risk that changes in exchange rates will affect the local currency value of financial institutions' assets, liabilities and off- balance-sheet items (Ong, 2014). There are three types of foreign exchange risk (FX risk):

- *Direct solvency risk:* Coming from banks' net open foreign currency positions and those in local currency that are indexed to exchange rates.
- *Indirect solvency risk:* The risk that comes from the positions borrowers have on the FX market and this impact on their creditworthiness and thus ability to repay loans to their financial institutions.
- *Foreign exchange liquidity risk:* Resulting from liquidity mismatches in foreign currency.

In our stress testing tool, we have modelled a foreign exchange shock to the direct solvency risk. When testing for the direct FX risk, we use the position in foreign exchange as of end 2016, and calculate the impact based on the methodology from the *Financial Soundness Indicators Compilation Guide (IMF, 2004).* The test is set so that there is an assumed 10% depreciation in the EUR against USD. A depreciation will benefit banks that have long (positive) open position in foreign currency

and hurt banks with a short (negative) position (Ong, 2014). Usually, the foreign exchange positions to capital is regulated, and thus the direct foreign exchange solvency risk is rather small. In our stress testing tool, we assumed that in case of a 100 percent depreciation, 10 percent of the FX loans will become non-performing loans, requiring a provisioning rate of 50 percent.

6.4.2 The Breaking Point Method

As seen under the Stress Tester 3.0, the main limitations were lack of data. In this section we follow another test from Ong (2013) and use the breaking-point method. The breaking-point method is described to be useful in the cases of poor data and works as a reverse test in finding the maximum level of NPLs before the solvency levels of the bank fall under the regulatory minimum. Data assumptions are only needed for the provisioning rate against non-performing loans as well as normal-, and pass loans; other data is readily available in the bank's balance sheet (total capital, total risk-weighted assets, performing and non-performing loans and loan provisions). The method itself uses assumptions when calculating CAR from inputs. Firstly, the RWA is assumed to remain constant and not decline post-shock like they do in the stress tester 3.0 due to increased provisioning. Thus, the breaking-point will have a more emphasised and harder impact on capital than the stress tester 3.0. Secondly, all profits are assumed to be zero, thus reflecting all impacts from rising NPLs on capital. This assumption will most likely not result in great deviations from the reality, given that profits tend to be close to zero or negative in times of financial distress, thus leaving the capital buffer to act alone. Finally, it is assumed that loans are fully provisioned for when the shock hits. If this was not the case, impacts would be understated.
The method studies the impact on CAR of increasing the proportion of NPLs gradually. We find this test to be of interest, especially given the case of Banco Popular and its struggle and history with non-performing assets. Ideally, we would hold historical data on the sizes of shocks to have credible results. Since in this case we lack such historical econometric data, increasing shocks have been chosen to see the build-up and iterative impacts on capital adequacy ratio. It should be noted that the breaking-point method should not be used as the sole method of stress testing but rather a complimentary test to provide a crude illustrative view on the impact of NPLs on solvency. In our paper, the breaking-point method serves as a companion to our main model, stress tester 3.0.

6.5 Results

In this section, we will discuss the results from the two IMF stress testing models, namely the Stress Tester 3.0 and the breaking point method. We will have a special focus on the performance of Banco Popular to analyse and evaluate how the mentioned capital and non-performing loans ratios could act as early warning signals.

6.5.1 IMF method: Stress Tester 3.0

We have mainly focused on the credit risk part of the stress tester, where there are three scenarios that are being tested *(ref section 6.4.1)*. The following credit shocks are modelled:

1. Increase in NPL
2. Sectoral shocks
3. Large exposure defaults

Please see appendix A11.2 for detailed assumptions for all scenarios. In the test, we have included sub-scenarios with interest hikes of (a) 98bps; and (b) 200bps. These interest rate hikes are aligned with EBA's tests. 98bps is a result of Spain's long term interest rate hike if the U.S. interest rates were to increase by 250bps. 200bps was the hike used by IRRBB in their 2017 sensitivity analysis of stress test interest rate risk. In all of the scenarios we have assumed under-provisioning, as explained previously.[23] Even though the scenarios are theoretical and simplified, the impacts on the banks are very apparent.

The post-shock capital levels are affected by the impacts from:

- Increase in interest rates
- Increase in NPLs
- Increase in provisioning
- Exchange rate change

The tables below (10-15) shows the results of the stress tester 3.0.

[23] See Appendix XX for the individual provision rates

Table 10: Key results of IMF Stress Tester 3.0 - Banco Popular

Scenario	Pre-shock CAR	Post-shock CAR	Pre-shock CET1	Post-shock CET1	Increase in NPL
1a	*13,15%*	**5,71%****	*12,13%*	**4,63%**	1,90%
1b	*13,15%*	**4,29%****	*12,13%*	**3,20%****	1,90%
2a	*13,15%*	**7,01%****	*12,13%*	**5,94%**	0,60%
2b	*13,15%*	**5,60%****	*12,13%*	**4,53%**	0,60%
3a	*13,15%*	**6,63%****	*12,13%*	**5,55%**	0,99%
3b	*13,15%*	**5,22%****	*12,13%*	**4,14%****	0,99%

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
The pre-shock ratios are transitional, not fully phased.
Numbers in bold are below the regulatory requirement
*** Represent a level below Pillar 1 capital requirement without any buffers*

Table 11: Key results of IMF Stress Tester 3.0 – Banco Santander

Scenario	Pre-shock CAR	Post-shock CAR	Pre-shock CET1	Post-shock CET1	Increase in NPL
1a	*14,68%*	12,49%	*12,53%*	10,33%	0,30%
1b	*14,68%*	10,83%	*12,53%*	8,67%	0,30%
2a	*14,68%*	12,59%	*12,53%*	10,44%	0,18%
2b	*14,68%*	10,93%	*12,53%*	8,78%	0,18%
3a	*14,68%*	11,78%	*12,53%*	9,60%	1,10%
3b	*14,68%*	**10,10%**	*12,53%*	7,93%	1,10%

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
The pre-shock ratios are transitional, not fully phased.
Numbers in bold are below the regulatory requirement
*** Represent a level below Pillar 1 capital requirement without any buffers*

Table 12: Key results of IMF Stress Tester 3.0 – Criteria Caixa

Scenario	Pre-shock CAR	Post-shock CAR	Pre-shock CET1	Post-shock CET1	Increase in NPL
1a	*14,50%*	11,84%	*13,05%*	10,00%	0,57%
1b	*14,50%*	**8,85%**	*13,05%*	7,40%	0,57%
2a	*14,50%*	11,69%	*13,05%*	10,24%	0,32%
2b	*14,50%*	**9,09%**	*13,05%*	7,64%	0,32%
3a	*14,50%*	**11,00%**	*13,05%*	9,54%	1,09%
3b	*14,50%*	**8,38%**	*13,05%*	6,92%	1,09%

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
The pre-shock ratios are transitional, not fully phased.
Numbers in bold are below the regulatory requirement
*** Represent a level below Pillar 1 capital requirement without any buffers*

Table 13: Key results of IMF Stress Tester 3.0 – Bankia

Scenario	Pre-shock CAR	Post-shock CAR	Pre-shock CET1	Post-shock CET1	Increase in NPL
1a	*16,42%*	12,63%	*15,08%*	11,16%	0,88%
1b	*16,42%*	**9,77%**	*15,08%*	8,30%	0,88%
2a	*16,42%*	12,22%	*15,08%*	10,74%	1,34%
2b	*16,42%*	**9,35%**	*15,08%*	7,87%	1,34%
3a	*16,42%*	12,34%	*15,08%*	10,86%	1,20%
3b	*16,42%*	**9,47%**	*15,08%*	8,00%	1,20%

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
The pre-shock ratios are transitional, not fully phased.
Numbers in bold are below the regulatory requirement
*** Represent a level below Pillar 1 capital requirement without any buffers*

Table 14: Key results of IMF Stress Tester 3.0 – Banco Bilbao Vizcaya Argentaria

Scenario	Pre-shock CAR	Post-shock CAR	Pre-shock CET1	Post-shock CET1	Increase in NPL
1a	*15,14%*	13,58%	*12,18%*	10,60%	0,31%
1b	*15,14%*	12,47%	*12,18%*	9,50%	0,31%
2a	*15,14%*	13,45%	*12,18%*	10,47%	0,46%
2b	*15,14%*	12,34%	*12,18%*	9,37%	0,46%
3a	*15,14%*	12,86%	*12,18%*	9,86%	1,14%
3b	*15,14%*	11,75%	*12,18%*	8,75%	1,14%

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
The pre-shock ratios are transitional, not fully phased.
Numbers in bold are below the regulatory requirement
*** Represent a level below Pillar 1 capital requirement without any buffers*

Table 15: Key results of IMF Stress Tester 3.0 – Banco de Sabadell

Scenario	Pre-shock CAR	Post-shock CAR	Pre-shock CET1	Post-shock CET1	Increase in NPL
1a	*13,77%*	**9,03%**	*12,00%*	7,19%	0,70%
1b	*13,77%*	**8,35%**	*12,00%*	6,51%	0,70%
2a	*13,77%*	**8,91%**	*12,00%*	7,07%	0,82%
2b	*13,77%*	**8,23%**	*12,00%*	6,39%	0,82%
3a	*13,77%*	**8,71%**	*12,00%*	6,87%	1,03%
3b	*13,77%*	**8,03%**	*12,00%*	6,18%	1,03%

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
The pre-shock ratios are transitional, not fully phased.
Numbers in bold are below the regulatory requirement
*** Represent a level below Pillar 1 capital requirement without any buffers*

We quickly observe how largely affected the smaller banks are compared to the bigger ones. Banco Bilbao is the only bank not to go below Basel III requirements under any circumstances, due to their initially high Tier 1 capital levels. Banco Santander also demonstrates a resilience towards the shocks, only ending up below the CAR-minimum in the large exposure environment with the largest interest rate hike. This is coherent to the 2016 EBA Stress Testing exercise where they demonstrated similar results from their strong capital bases. Furthermore, Banco Popular is the only bank failing on the CET1 ratio requirement, while both Popular and Banco de Sabadell fails on the CAR ratio in every scenario tested, due to their lower total regulatory capital base. However, both of the banks have Tier 1 capital above 6% which is the minimum requirement. It is noted that Criteria Caixa have great exposures to their largest counterparties as they struggle both with the capital adequacy ratio and a significant increase in non-performing loans under scenario 3 a and b – large exposure default. This scenario has the greatest impact on the non-performing loans for all of the banks in both of the interest rate hike cases. However, Banco Popular's levels of NPLs to RWAs are severly increased in scenario 1 (a and b). The impact on their level of NPL is up to 160 basis points larger than its peers, which shows a clear sign of sensitivity in assets quality.

6.5.1.1 The performance of Banco Popular

Looking at the performance of Banco Popular in particular, we are interested to see if its sudden default in 2017 could have been predicted in 2016 and how sensitivity can be detected in its capital ratios. As discussed in part 4 and 6.3.1, the authorities were aware of Popular's situation, as being one of the poorest performers of the 2016 EBA stress test. In the IMF test, Popular is the worst performing bank on an overall level. Shock 1, *increase in NPLs*, affect Banco Popular harder than its peers, with an increase of 1,90% of its total risk weighted assets. This is a result of its additional provisions, where the provisions needed for this shock was relatively high for Popular. Also, since the assumption made was based on a proportional increase in NPL, from an NPL shock, Popular would have relatively high levels of NPLs compared to its peers due to its initial possession of NPLs. It is clear that Popular's capital levels are very sensitive to the shocks as it plummets in most of the situations (i.e. scenario 1b, CAR decreases by 8,86%). It is also clear from the small difference between the capital ratios that Popular's Tier 2 capital is slim, as well as it reported additional tier 1 capital of zero (Banco Popular, 2016).

However, it is not only capital that takes the hit. The risk weighted assets are affected by increase in provisioning and increase in NPLs (for all scenarios), as can be expected from their definition and

nature. As we remember from the discussion in part 4 in this paper, the RWAs have been a problem for Popular even before any implied crisis scenario due to its inability to get rid of NPLs, which caused slow burning pressure on its capital ratios.

It is interesting to see Popular's result so close to its resolution. It is clear that they struggled for a while, with increasing levels of NPLs and their negative impacts on risk weighted assets which ate up their capital levels. It comes off clearly from the test that the bank would struggle in any scenario or a combination of all scenarios with capital levels almost wiped out. The results clearly demonstrate the sensitivity of Popular's capital levels in 2016 and reveal their issues. While hanging above the minimum ratios in 2017, they were obviously not stable. It would have been very interesting to test the liquidity levels of the bank at the same time, but unfortunately, data limitations and underdeveloped models made this difficult.

6.5.2 IMF Test: The Breaking Point method

While not reaching the record NPL levels of Greece and Cyprys, Spain is still a country that continues to hold relatively high levels of NPLs, especially when compared to the Nordics. In December 2017, Spain held a NPL ratio of 7,8% (as comparison, the historical high of Denmark during the financial crisis was 6%). Spain's all time high was reached in 2013 with a NPL ratio of 13,6% (CEIC, 2018). In table 16. we see a summary of the results when our sample is put through the breaking-point test with increasing shocks, with NPLs increasing by a percentage (of current NPLs) at each stage. The data for the benchmark situation can be found in Appendix A13. The test reveals interesting results: Banco Popular's CAR falls below the regulatory limit between 10% and 20%, while Banco Santander and BBVA are solvent until 100% and only go below the limit between 100% and 150%. We have argued Banco Popular's main problem to have been the quality of its assets and the adverse impact the asset deterioration had on its solvency stance via its impact on risk-weighted assets. From this simple test, we see that the results support the asset quality argument. It is clear that once pressure is put on the NPLs, the solvency position quickly deteriorates. While there are differences between banks, with both Bankia and Sabadell falling insolvent between 40% and 50%, Popular is still clearly the worst performer.

Table 16: Key results of IMF: The Breaking Point method

Increase in NPLs (%)	Banco Popular CAR	Banco Santander CAR	Criteria Caixa CAR	BFA Bankia CAR	BBVA CAR	Banco de Sabadell CAR
10%	*11,40%*	*15,50%*	*14,80%*	*15,51%*	*15,71%*	*14,20%*
20%	**8,30%**	*15,00%*	*13,93%*	*14,11%*	*15,20%*	*13,24%*
30%	***5,30%***	*14,64%*	*13,00%*	*12,71%*	*14,72%*	*12,00%*
40%	***2,30%***	*14,11%*	*12,00 %*	*11,33%*	*14,20%*	*10,92%*
50%	***-0,72%***	*13,60%*	*11,11%*	***10,00%***	*13,71%*	***9,80%***
60%	***-3,74%***	*13,10%*	*10,23%*	***8,62%***	*13,20%*	***8,72%***
70%	***-6,70%***	*12,74%*	***9,32%***	***7,20%***	*12,70%*	***7,60%***
80%	***-9,76%***	*12,24%*	***8,41%***	***5,84%***	*12,21%*	***6,42%***
90%	***-12,74%***	*11,73%*	***7,40%***	***4,41%***	*11,73%*	***5,33%***
100%	***-15,71%***	*11,22%*	***6,50%***	***3,10%***	*11,23%*	***4,21%***
150%	***-30,80%***	***8,80%***	***1,92%***	***-3,82%***	***8,70%***	***-1,40%***

Note: All of the reported numbers are ratios to total pre-shock risk weighted assets.
Numbers in bold are below the regulatory requirement

While the test is very simplistic, it serves as a good confirmation to our earlier results from the stress tester 3.0, where we have seen Popular's that Popular's solvency levels take the worst hits in the case of increasing NPLs and interest rate hikes. The breaking point confirms both our previous test results and the discussion in part 4: Banco Popular is especially vulnerable to NPL shocks due to underprovisioning

6.6 Discussion: Can stress testing be effective in revealing instabilities in financial institutions?

In the previous sub-sections, a sample of Spanish banks were tested for their resilience in stressed scenarios, to see how key capital ratios reacted. They were tested on a range of different scenarios, some more complex and significant than others. In real life, the scenarios can be similar and different to what is tested, or a combination of many.

The purpose of this exercise was to conduct stress tests on banks while keeping it simple and at the same time realistic. One of the advantages of the IMF stress tester, as mentioned earlier, is the

transparency of the exercise. The six banks are all subject to the same shocks, and the test is conducted using aggregated public data, making them directly comparable. Furthermore, the assumptions made are based on what was used in the 2016 EBA stress test, which makes the two test results theoretically comparable. One should remember here that, as mentioned previously, we have intentionally used data from the end of 2016 for the purpose of observing test results and key ratios of Banco Popular the year before its failure. We acknowledge that this decision limits our ability to directly compare our results with the EBA results (which were based on 2015 data). We argue, however, that for the purpose of this thesis it is more relevant to follow the development of key indicators right before Popular's failure, even though comparative power to the EBA test is reduced. We suggest a topic for future research could focus on re-creating this test with the numbers of the same year.

The IMF is a simplified model, and it relies on many assumptions. The results would naturally be improved quality-wise and be more indicative if the data needed was available. Some of the scenarios are also rather severe and might be harsher than a setting in the real world. When interpreting the results, we base our analysis upon capital levels discussed and presented in section 5. It was clear from the IMF stress testing that Banco Popular failed the regulatory requirements in all scenarios, and if the scenarios were even harsher, their capital would most likely be wiped out. However, they did not fail[24] completely in the EBA stress tests. One can thus argue that even though they managed to stay above regulatory requirements, they might have failed on an internal level, or levels set by their supervisory colleges. Essentially, under Pillar 1, the enhanced minimum capital and liquidity requirements are determined, which is what we are basing our analysis on – i.e. minimum CET1 ratio of 7% and minimum CAR ratio of 10,5%[25] However, under Pillar 2, the risk management and supervision pillar, additional requirements might be imposed by the National Supervisory Authority (Banco de España), which are not disclosed to the public. In addition, there might be internal models and calculations that are used to monitor financial stability. Being one of the worst performers of the 2016 EBA stress test, one would assume that Banco Popular was under strict supervision with additional internal requirements. However, this is a speculation we cannot confirm with credible sources.

Based on the findings in the previous sub-section it is clear that the key regulatory ratios can act as early warning signals under stressed scenarios, which adds to the findings of section 5. Based on the

[24] Referring to our reported regulatory levels, not EBA, as they did not fail or pass banks.
[25] Depending on individual buffers. Please see table 5 for specific requirements.

EBA stress test results as well as the IMF stress tester, both the CAR and the CET1 ratio takes a hit. In certain adverse scenarios, Banco Popular have a CAR of 5% lower than the requirement, which serves as a signal of severe capital difficulties. On that note, findings showed that five of the six tested banks need to shore up their capital levels in order to weather *all* of the potential shocks with levels above the Basel III requirement. Based on the performance of Popular, we wanted to see how much capital the bank would have needed to be able to weather the shocks, based on the mildest and the hardest scenarios,[26] as shown in table 17. Assuming that the amount of capital lost in the stressed scenarios is the same as if the banks were holding more capital pre-shock, we can calculate how much capital they would need to hold pre-shock, and compare to the results found in table 10-15. Previous findings (Li et al. 2016) show that a greater level of capital than the minimum capital adequacy requirement of 8% (10,5% fully phased in) is optimal for the banks and their efficiency. We agree with these findings, and believe there should be institution specific capital levels set above the regulatory requirements. The only banks with adequate capital levels in the mentioned scenarios was Banco Santander and Banco Bilbao V. A. However, the exact capital adequacy levels will not be investigated further, as it is not the scope of this paper, but from our results one could recommend to have levels between results from column 3 and 4.

Table 17: Pre-shock capital levels needed to meet Basel III requirements post shock.

	(1) Basel III CAR requirement	**(2) CAR as reported**	**(3) CAR needed pre-shock (2a)**	**(4) CAR needed pre-shock (1b)**
Banco Popular Español S.A.	10,5%	13,15%	16,64%	19,36%
Banco Santander S.A.	10,75%	14,68%	12,84%	14,60%
Criteria Caixa, S.A.U.	10,56%	14,50%	13,37%	16,21%
Bankia S.A.	10,56%	16,42%	15,54%	17,94%
Banco Bilbao Vizcaya Argentaria S.A.	10,75%	15,14%	12,44%	13,42%
Banco de Sabadell S.A.	10,5%	13,77%	15,36%	15,92%

[26] For Banco Popular, the mildest scenario was 2a, and the hardest was 1b.

As discussed in section 6.3.1, it became clear from the 2016 EBA stress test that Banca Monte dei Paschi di Siena flunked the test with more than worrying results. Following the EBA publication, BMPS announced that it had secured underwriters for a turnaround plan to sell 9,2 billion euros in bad loans and raise capital with 5 billion euros(CNBC, 2016). We can therefore conclude that stress test results can certainly portray a bank's health and serve as a predictor of potential distress. We would, however, like to add a word of caution to this statement and emphasise that our viewpoint is backward looking, that is, we study the ratios of a bank that we know has failed. Further research is required to ascertain the specific levels of capital after which the probability of distress significantly increases.

7. Discussion

7.1 The changed resolution framework

In this thesis we have witnessed the evolution of the European banking union and the birth of the new European resolution framework, most importantly, the role of the SRB and the implications of the BRRD to the resolution process of Banco Popular. The resolution was conducted with two main tools available to the SRB: the bail-in method and a sale of business.

In order for us to evaluate the process as a whole, it is important to differentiate the effects to different stakeholders: depositors, shareholders, bondholders and the public.

The bail-in is by design meant to preserve public funds and taxpayer money and act upon the market discipline argument: investors take the gain, thus they should also bear the risk. A prediction outlined by Avgouleas and Goodhart (2015), which certainly was achieved in this case: no government guarantees were given and no contributions were needed from the SRF either. Similarly, depositors were saved from participating in the bail-in. Meanwhile bondholders and shareholders lost a combined amount of $4,82 billion (Reuters, 2017) and have been filing lawsuits against the SRB ever since. So, what is the lesson here?

First, it needs to be acknowledged that the resolution decision and process demonstrated the type of prompt and rapid actions that are needed in the SRB in order to make the power of BRRD efficient. A great deal of the scepticism surrounding the banking union and SRB previously was based on the assumption that a large organisation with such broad cross-border responsibilities and powers would never work efficiently or respond to national level banking distress fast enough. The case of Banco Popular has demonstrated that the pipeline can indeed work fast, and it will need to continue to do so in order for it to enforce the BRRD efficiently in the future.

On another note, the criticism surrounding the case of Banco Popular needs to be taken on board and evaluated appropriately to draw lessons for the future. Most importantly, we feel it is necessary to stress the lack of transparency in the process. The obscurity surrounding the pre-resolution valuation of Banco Popular and the refusal by the SRB to make it public to the investors is an issue which we feel may harm the credibility of the SRB. Such actions have the potential to build unneeded conflicts of interests between the resolution authorities (both national and SRB) and the bondholders and shareholders of an institution. While it has been acknowledged in literature that transparency and openness sometimes comes with the cost of efficiency when enforcing regulations (Leino, 2017; Cygan, 2013), we argue that in the long run, a level of transparency in the resolution process – and in

the aftermath of it – is needed to ascertain credibility and trust within the banking union and improve accountability of the SRB and the SSM. An additional concern that we would like to raise is that while public interest is promoted directly by saving the taxpayers money, an indirect threat to financial stability may arise from writing off bondholders. We share the concerns of Schoemaker (2015), that the quest for public interest may end up overlooking the indirect shocks when other financial institutions are hit after debt write-offs. While the effects were mild in the case of Banco Popular, it is an area that must be monitored carefully with each resolution decision.

7.2 What does the stress testing tell us?

The second part of this paper looked into the key indicators that came as a result of stronger supervision and regulatory requirement after the financial crisis of 2008-2009. In order to have an in-depth understanding of these indicators and their functionality for the financial system as a whole, a stress testing exercise was conducted. Mainly, the results of a stress test evaluate whether a financial institution holds enough capital to withstand unfavourable and stressed scenarios. During the financial crisis, questions rose about the adequate levels of capital and liquidity of banks in order to support risky activities. In the unwinding of the financial crisis, the regulatory capital levels were found to be insufficient for the prevailing volatile conditions, and thus banks and regulators alike faced the challenge of regaining the public's trust. The broad-based supervisory stress testing was introduced as a response and with the objective of providing clarity and transparency to the public.

The process of stress testing in the EU developed through the European Banking Authority and it evolved during the last years, moving away from a pass and fail threshold and rather using the tests as guidelines for further development of regulatory frameworks. This can be a weakness of the stress testing exercise, as the pass and fail threshold gave the investors and the public a better indication of the health of the ratios in question. In addition, when falling below the public capital requirements, banks were incentivised to raise capital. Being one of the largest banks in Spain, Banco Popular has been included in the EBA stress tests for all of the four conducted exercises since 2010. Passing the test in 2014, Banco Popular ended up being one of the poorest performers under the 2016 exercise, even though it had reported capital levels well above the regulatory requirement for the actual scenario. It is worth questioning how the capital levels are adequate to weather adverse scenarios, as well as how the results of stress tests are used (or if they are used at all) as early warning signals of financial distress. In our test we look back and attempt to identify signals of Popular's distress and ascertain whether the stress test conducted reveals the underlying reasons for the failure.

Being one of the poorest performers, it is assumable that Popular was under closer supervision by the authorities due to sensitive capital ratios under stressed scenarios. Using 2016 data in the IMF stress tester 3.0, it is again confirmed that the capital levels of Popular were indeed fragile and would decline rapidly in the case of an external shock. These results can hence be interpreted as early warning signals of capital instability, and the need for stronger supervision. As discussed in section 6.6, under the confidential Pillar 2 management, Popular might have been subjected to additional requirements, and hence performed even worse than what is led to believe by the public results.

A key question we want to pose here is why some banks perform better than others in stressed scenarios even when the sample starting point capital levels are similar and above the regulatory requirements. Banco Popular starts with a capital levels that are above minimum requirements, but will their responses to shock reveal fragility? It turns out that they do: in the IMF Stress tester 3.0, Banco Popular ends up with capital levels below the minimum requirements in all scenarios.

When we shock the sample of banks, the size of impact on the capital level of Banco Popular from increases in provisions, NPLs and interest rates is significantly higher than the other banks relative to its initial capital position. Banco Popular is severely hit by the need to make new provisions, which comes from the first shock, under-provisioning. This shock is applied in all scenarios, to all banks with the same assumed provision rates on their pass loans, special mention loans, substandard loans, doubtful loans and loss loans. However, in most scenarios, Banco Santander, Banco Bilbao and Criteria Caixa does not even need to make any provisions, as their provisions held already covers their new provision needs following the shock. Banco Popular on the other hand severely decreases its capital levels due to increased provisioning. The IMF stress test therefore shows how Popular did not have sufficient provision levels.

Furthermore, as we observed the sensitivity of Banco Popular' ratios under the EBA stress test as well, we question and dig deeper into what drives these results. The EBA exercise is based on more complex calculations as the IMF test is very simplified.

Based on our existing knowledge of capital ratios and the case of Banco Popular, we argue that an important part of a bank's health that is overlooked in the stress testing exercises; the asset quality. As we have discussed in the previous sections of this paper, a crucial factor that drove Popular's solvency deterioration was the weight from bad assets. This argument is supported by the sensitivity of Popular's capital levels when compared to other banks. It is then rather puzzling that the build-up of a bank's assets is not discussed or presented in the published stress testing documents by EBA. We

find this questionable, as the capital levels in stressed scenarios crucially depend on this quality. The Supervisory Entity of Banco Popular also failed to address the issue of a growing non-performing assets (NPA) portfolio amounting to € 37 billion, with a coverage ratio of only 45%. Even with extraordinary provisions booked and impairments of € 17 billion in the first quarter of 2017, they were not able to achieve any reductions in NPAs.

While EBA does conduct a transparency exercise, the extent of which asset quality affects the banks and its solvency levels could be covered better. A suggestion could be to have a complementary asset quality report for all the banks involved in the stress testing exercise, to better evaluate their capital adequacy with respect to the riskiness of their assets in adverse scenarios and use the results as early warning signals for potential solvency.

While we have argued strongly for improved transparency in asset quality and stress testing in general, it is important to note that it can come with a cost of a negative signalling effect of raising capital after stress testing results are revealed. Published capital levels under stressed scenarios act as important information and signals for the authorities, the banks and to some extent the public. While capital injections can aid a bank facing a weakened solvency situation and poor stress test results (and sometimes is demanded by authorities), such actions can send a worrying signal to the public, and the press. This can furthermore affect the reputation of the banks, and stock prices can fall, deposits can be withdrawn and the bank can end up worse off than before the exercise was conducted - as happened in the case of Banco Popular. Popular's capital injections were widely recognised in the press and eventually lead to an outflow of deposits and the liquidity crunch that was the end of Popular. The events also have theoretical support: a research by Alves, Mendes & Pereira Da Silva (2015) confirms this, indicating how publication of stress test results have a negative impact on the stock prices of riskier financial institutions. However, considering the case with the best of our knowledge, we argue that improved transparency from institutional and national levels can ultimately lead to improved supervision and more accurate stress testing results.

7.3 Regulations to come

7.3.1 Basel IV

Basel IV presents an interesting topic for future discussions and holds many specifications and add-ons to the current Basel III accord. No official outline has been published by the Basel Committee yet, and thus we will have to remain in somewhat of a speculative level.

PwC (2018) and McKinsey (2017) have outlined some of the expected changes in their studies including a fundamental review of the trading book and a corresponding market risk RWA increase by 80% and IRB market risk RWA increase by 40% for international banks and 25% for regional bank. A new IRB RWA floor is also expected to change to 75%. For the largest banks in Europe, the change in RWA is expected to increase from €1 trillion to €2,5 trillion, or capital increase from 13% to 22%, and will mean significant impacts to European banks and their capital management. The changes are largely driven by the BCBS concern of variability and large differences in calculating capital for similar levels of risk, especially credit risk (Capgemini Consulting, 2017).

Given the discussion in this paper and our observations of the role of RWA in the case of Banco Popular, we find that the new focus on RWA in Basel IV is both warranted and needed. As has been argued throughout this thesis, the emphasis has been on the nominator side of the solvency equation for too long and the regulatory focus needs to be shifted to the denominator now. An option making the bank disclosure of RWA more comprehensive and thus making it the risk-evaluation easier for external parties is also being considered.

However, there is still a lot of uncertainty of the final effects Basel IV will have, and it remains to be seen how large the required capital increase will actually be. Banks have expressed their concerns that a large capital increase and restrictions on IRB modelling will result in disproportional capital impact, and assets with lower underlying risk will be hit the most. Consequently, countries that are predicted to be most affected are countries with a high concentration on low-default risk loans, such as Ireland, Sweden and Denmark (McKinsey & Company, 2017).

7.3.2 Liquidity Stress Testing

Liquidity is undoubtedly one of the key reasons for financial distress: without sufficient liquidity: as elaborated in the beginning of this paper, the nature of banking activities involves the matching of assets and liabilities of different maturities, and in the case where the liquidity dries up, this matching is no longer feasible. Such was the case of Banco Popular, and many other institutions before it.

Given its importance to financial health, it remains to be one of the most underdeveloped sides of banking regulations, with the Basel III ratio LCR being in the early stages of implementation and NSFR only entering the mandatory requirements framework as of January 2018. As these ratios become more used in banking regulations, we hope to see new developments in liquidity stress testing as well. Jobst, Ong & Schmieder (2017) stated in their paper that whilst liquidity is undoubtedly

harder to quantify and its interconnections are more difficult to predict than for solvency, stress testing for it in a credible and detailed way is a crucial step that needs to be taken in the future. As the ILAAP assessments submitted in 2016 failed to meet the standards of the ECB and they have stated to put a greater emphasis on the harmonisation of liquidity risk management practices on the future and ensuring business appropriate liquidity strategies (KPMG, 2016b).

The preparation of this thesis has made it clear for us that there is a significant lack of data and strategies to address the issue of liquidity. An interesting point for further study on Banco Popular is the testing of its liquidity position right before its failure and lessons we can draw from that.

8. Conclusion

This thesis has taken us from the first Basel accords in 1988 to the failure of Banco Popular in 2017. We have investigated the evolution of banking regulations in the EU, taking a special focus on the transition from publicly funded bailouts to the new resolution framework defined in the BRRD. In chapters 2 and 3 we have introduced the theoretical background behind banking regulations and the issue of moral hazard that has been the driving factor in establishing a harmonised resolution framework in the EU. We see that the regulatory responses reflect directly the experiences from the financial crisis.

Chapter 4 introduced the case of Banco Popular, which we use as a practical case throughout the thesis to support our theoretical discussion. We have an introduction to the case and the build-up of their difficulties: namely, their increasing and persistent levels of NPLs. We then critically evaluate the resolution process and the SRB's enforcement of BRRD in the case of Popular and identify key strengths and weaknesses. We find that the new resolution framework in the banking union has successfully shifted the weight of bank failures to its shareholders and creditors and taken an important step in dealing with the issue of moral hazard in the banking sector. We identify the main weakness of the framework to be the level of obscurity in the entity valuation stage which we argue reduces the credibility and accountability of both the SRB and the BRRD. While we also acknowledge the rapid response to have been a crucial and important element in the case of Popular and emphasise that the process needs to remain as efficient in the future, we argue that it should not be at the cost of transparency.

After exploring the resolution process of Popular, we go beyond and question whether its struggles could have been detected earlier through key regulatory ratios, and that further measures could be taken to avoid a failure. From chapter 5 we find that the historical levels of CAR, CET1 and the leverage ratio do not significantly differentiate between a group of Spanish peer banks and Popular. Furthermore, we conclude that the liquidity ratios (LCR and NSFR) have potential for indicating bank health, but based on our case will not be useful early-warning signals by themselves. The best results we observe come from an academic ratio NPACR introduced by Chernykh & Cole (2015) which signals Popular's underperformance from the peer group already in 2013. We conclude that in order to use the regulatory ratios as early-warning signals, we must observe their reactions under stress, hence, we move into chapter 6 where we dive into stress testing. First, we study the European Banking

Authority stress tests of 2016 and see that while Popular was one of the weakest participants, it succeeded in remaining above the minimum regulatory requirements, and was significantly stronger that the worst performer of the test, namely Italy's Monte Paschi. To further understand the underlying sensitivity of capital ratios under stressed scenarios, as well as evaluating Popular's health months before its failure, we conduct an IMF stress test on our Spanish sample of banks using 2016 figures. Given the underdevelopment of the liquidity ratios, we focus on the solvency ratios of CAR and CET1. We find that Popular underperforms in every scenario and has the most severe reactions when we pose an increase of NPLs by 25% with a 200bps interest rate hike or a failure of three largest failures with the same interest rate increase. Both of these scenarios cause Popular's CET1 ratio to fall below 4,5%, which is the regulatory pillar I requirement, without any capital buffers. Our results confirm that Popular's underlying issues with NPLs are apparent in its solvency ratios; however, a shock scenario is required to reveal their true fragility. We therefore conclude that the regulatory ratios can be used as early-warning signals for financial distress, but only if they are subject to frequent evaluation and testing. In addition, we believe that a more transparent asset quality review as a complimentary document to stress tests is important for the overall evaluation of a bank's health. We find that the failure of Banco Popular to get rid of bad quality assets in their balance sheet turned out to play a significant role when they started to experience capital shortfalls.

Based on this thesis and our findings we have come up with the following recommendations:

As we have established in our discussion, the case of Banco Popular highlighted the importance of swift decision-making which cross-country institutions so often lack. The banking union and the SRB demonstrated the ability for agile implementation of resolution tools in the case of Banco Popular. This efficiency in actions should be maintained in all the future cases to come.

While acknowledging the rather successful implementation of the bail-in tool, we also conclude the case of Banco Popular to highlight some weaknesses in the resolution process. Mainly, the lack of transparency of the valuation of Banco Popular. We believe that making the valuation process transparent to key stakeholder such as bondholders and shareholders will improve the credibility and accountability of the SRB in the long run, and minimize costs associated with legal disputes.

The second point of view from which we have studied the failure of Banco Popular is in the form of a stress test conducted with 2016 figures. From the results and the following discussions, we have picked out the following recommendations: firstly, we suggest a complementary asset quality review to be mandatory with each stress test conducted to account for the part that RWA and asset quality

play in banks' required capital levels. This report is currently not conducted every year, and as seen in the case of Banco Popular, a deeper understanding of the underlying asset quality is important as it can result in swift changes.

Finally, we would recommend the return of pass and fail thresholds for stress tests (namely EBA), to convey a clearer picture of a financial institution's health to investors and the public. This is likely to incentivise banks to hold higher levels of capital, which we have concluded to be necessary for our sample of banks.

Having clearly promoted our findings and views, we conclude this investigation of the resolution of Banco Popular. We have reached tangible recommendations for future resolution processes involving the BRRD. Furthermore, we have made recommendations for stress testing practices which we hope will improve early detection of financial distress in the future. To these words, we hereby conclude our thesis.

Appendix

A1

Basel's Classification of risk weights of on-balance-sheet assets

Risk Weight	on-balance-sheet asset
0 %	(a) Cash (b) Claims on central governments and central banks denominated in national currency and funded in that currency (c) Other claims on OECD central governments and central banks (d) Claims collateralised by cash of OECD central-government securities or guaranteed by OECD central governments
20 %	(a) Claims on multilateral development banks (IBRD, IADB, AsDB, AfDB, EIB) and claims guaranteed by, or collateralised by securities issued by such banks (b) Claims on banks incorporated in the OECD and loans guaranteed by OECD incorporated banks (c) Claims on banks incorporated in countries outside the OECD with a residual maturity of up to one year and loans with a residual maturity of up to one year guaranteed by banks incorporated in countries outside the OECD (d) Claims on non-domestic OECD public-sector entities, excluding central government, and loans guaranteed by such entities (e) Cash items in process of collection
50 %	(a) Loans fully secured by mortgage on residential property that is or will be occupied by the borrower or that is rented
100 %	(a) Claims on the private sector (b) Claims on banks incorporated outside the OECD with a residual maturity of over one year (c) Claims on central governments outside the OECD (unless denominated in national currency - and funded in that currency - see above) (d) Claims on commercial companies owned by the public sector (e) Premises, plant and equipment and other fixed assets (f) Real estate and other investments (including non-consolidated investment participations in other companies) (g) Capital instruments issued by other banks (unless deducted from capital) (h) all other assets

Source: Adapted from Basle Committee on banking supervision – international convergence of capital measurement and capital standards, 1988: https://www.bis.org/publ/bcbs04a.pdf

A2

Pillars of Basel I, II and III

	Pillar I **Credit Risk, Market Risk, Operational Risk**	**Pillar II** **Supervisory Review**	**Pillar III** **Market Discipline**
Basel I	8% RWA of 4% tier 1 capital, 4% of tier 2 capital	Not Applicable	Not Applicable
Basel II	8% RWA, of which 2% needs to be CET1. Credit risk via standardized approach or IRB or advanced internal ratings based approach (AIRB).	Framework for residual risk (other risk categories such as concentration risk and systemic risk.	Disclosure of certain information to the public.
Basel III	8% RWA, of which min, 4,5% CET1, min. 6% tier 1, min 8% total (tier 1 + tier 2). Leverage ratio LCR NSFR Countercyclical buffer add (0-2,5% of CET1) Capital Conservation buffer (2,5% CET1) G-SIFI add on: 1-3% of RWA	Framework for residual risk (other risk categories such as concentration risk and systemic risk.	Disclosure of certain information to the public.

A3

Aid Approved to the Financial Sector in Europe 2008-2015 by country

In Billions €

	GDP	Capital Injection		Impaired Assets		Guarantees for liabilities		Other measures	
	2015	*Approved*	*Used*	*Approved*	*Used*	*Approved*	*Used*	*Approved*	*Used*
Belgium	410.4	23.3	20.8	28.2	2.8	275.8	46.8	20.5	0.0
Bulgaria	45.3	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0
Denmark	271.8	14.6	10.8	2.3	0.3	580.0	145.0	4.9	2.0
Germany	3,032.8	114.6	64.2	82.8	80.0	447.8	135.0	9.5	4.7
Ireland	255.8	91.6	62.8	57.2	2.6	376.0	284.3	40.7	0.9
Spain	1,075.6	174.3	61.9	139.9	32.9	200.0	72.0	30.0	19.3
Greece	175.7	59.6	46.6	0.0	0.0	93.0	62.3	8.0	6.9
France	2,181.1	29.2	25.0	4.7	1.2	319.8	92.7	8.7	0.0
Croatia	43.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Italy	1,642.4	25.8	11.8	0.4	0.0	80.0	85.7	0.0	0.0
Cyprus	17.6	3.5	3.5	0.0	0.0	6.0	2.8	0.0	0.0
Latvia	24.3	0.8	0.5	0.5	0.4	5.1	0.5	2.1	1.0
Lithuania	37.3	0.8	0.3	0.6	0.0	0.3	0.0	0.0	0.0
Luxembourg	51.2	2.5	2.6	0.0	0.0	4.5	3.8	0.3	0.1
Hungary	109.7	1.1	0.2	0.1	0.1	5.4	0.0	3.9	2.5
Netherlands	676.5	39.8	23.0	30.6	5.0	200.0	40.9	52.9	30.4
Austria	339.9	40.1	11.8	0.6	0.5	75.0	19.3	0.0	0.0
Portugal	179.5	34.8	15.3	4.4	3.1	28.2	16.6	6.1	3.8
Slovenia	38.6	4.5	3.6	3.7	0.3	12.0	2.2	0.0	0.0
Sweden	446.9	5.0	0.8	0.0	0.0	156.0	19.9	0.5	0.0
United Kingdom	2,580.1	114.6	100.1	248.1	40.4	364.5	158.2	39.9	33.3
EU	14,710.6	820.9	465.6	604.3	188.6	3,311.2	1,188.1	229.7	105.0

Source: Adaptation from Millaruelo & del Rio (2017). the cost of internvention in the financial sector since 2008 in the EU countries.
https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/ArticulosAnaliticos/2017/T2/files/beaa1702-art10e.pdf

Note: Excluding Finland, Slovakia, Malta, Romania, Poland, Czech Republci and Estonia due to minimum impact of state aid.

A4

Bank packages available in Denmark according to Finansiel Stabilitet

Bank Package I – Stability Package (2008-2010)	- Protection of all unsecured creditors and their claims against Danish banks. - All depositors covered. - Private Contingency Association provided a guarantee of DKK 10 billion to cover losses by the Finansiel Stabilitiet, incurred from the bank package.
Bank Package II – Credit Package (From 2009-2010)	- Banks and mortgage credit institutions could apply for State-guaranteed senior funding and hybrid capital injections. - Purpose was to ensure sufficient liquidity in the sector after the expiry of the general government guarantee under package 1. -
Bank Package III – Exit Package (From 2010)	- Changed the general government guarantee: unsecured creditors can no longer be sure to receive full coverage of their claims. - Practical operations continue as normal and the winding up of the institutions takes place over a weekend. - Haircuts posed on unsecured creditors and depositors above DKK 750,000. Guarantee fund for covered deposits. Distressed institutions closed over a weekend.
Bank Package IV – Consolidation Package (From 2011)	- Aims to incentivize institutions to partially or wholly acquire exposures from distressed institutions via a dowry from Finansiel Stabilitet. - Based on two models: Under model 1, viable banks takes over the entity with a dowry. Under model 2, a new established subsidiary of Finansiel Stabilitet takes over and receives a dowry from the guarantee fund.
Bank Package V – Development Package (From 2012)	- Improve access to financing for small- and medium sized businesses. - Better access to export financing and growth capital.

Source: Finansiel Stabilitet (2018),

A5

Classifications of Banco Popular's Capital Instruments

1. Tier 1 Instruments

Issuer	ISIN	Amount Standing	Number of Instruments
Banco Popular Espanol, S.A.	XS0979444402	€499,985,000	5,000
Banco Popular Espanol, S.A.	XS1189104356	€749,988,000	3,750
Popular Capital, S.A.	DE0009190702	€64,695,000	64,695
Popular Capital, S.A	DE000A0BDW10	€19,115,000	19,115
Popular Capital, S.A	XS02288613119	€5,400,000	108
Pastor Participaciones Preferentes, S.A.U.	XS225590362	€7,359,000	7,359

2. Tier 2 Instruments

Issuer	ISIN	Amount Standing	Number of Instruments
Banco Popular Espanol, S.A.	ES0213790001	€99,700,000	1,994
Banco Popular Espanol, S.A.	ES0213790019	€200,000,000	200,000
Banco Popular Espanol, S.A.	ES0213790027	€250,000,000	250,000
BPE Financiaciones, S.A:	XS0550098569	€91,700,000	1,834

3. Non-Listed Debt

Issuer	Identifier (for non-listed debt)	Amount Standing	Number of Instruments
Total Bankshares Corporation	Subordinated debt total bank 1	€10,978,957	12,000
Total Bankshares Corporation	Subordinated debt total bank 2	€10,978,957	12,000
Total Bankshares Corporation	Subordinated debt total bank 3	€10,978,957	12,000
Total Bankshares Corporation	Subordinated debt total bank 4	€10,978,957	12,000

Source: Adapted from FROB report, 2017. http://www.frob.es/en/Lists/Contenidos/Attachments/419/ProyectodeAcuerdoreducido_EN_v1.pdf

A6

Stock of HQLA – full list of the different levels

Stock of HQLA	**Factor**
A. Level 1 assets:	
• Coins and bank notes • Qualifying marketable securities from sovereigns, central banks, PSEs, and multilateral development banks • Qualifying central bank reserves • Domestic sovereign or central bank debt for non-0% risk-weighted sovereigns	100%
B. Level 2 assets (maximum of 40% of HQLA):	
Level 2A assets	
• Sovereign, central bank, multilateral development banks, and PSE assets qualifying for 20% risk weighting • Qualifying corporate debt securities rated AA- or higher • Qualifying covered bonds rated AA- or higher	85%
Level 2B assets (maximum of 15% of HQLA)	
Qualifying RMBS • Qualifying corporate debt securities rated between A+ and BBB- • Qualifying common equity shares	75% 50% 50%

Source: BCBS (2013b)

A7

A7.1
Components of the available stable funding categories

Table A7.1 below summarises the components of each of the ASF categories and the associated maximum ASF factor to be applied in calculating an institution's total amount of available stable funding under the standard.

ASF factor	Components of ASF category
100%	• Total regulatory capital • Other capital instruments and liabilities with effective residual maturity of one year or more
95%	• Stable non-maturity (demand) deposits and term deposits with residual maturity of less than one year provided by retail and SME customers
90%	• Less stable non-maturity deposits and term deposits with residual maturity of less than one year provided by retail and SME customers
50%	• Funding with residual maturity of less than one year provided by non-financial corporate customers • Operational deposits • Funding with residual maturity of less than one year from sovereigns, public sector entities (PSEs), and multilateral and national development banks • Other funding with residual maturity of not less than six months and less than one year not included in the above categories, including funding provided by central banks and financial institutions
0%	• All other liabilities and equity not included in above categories, including liabilities without a stated maturity • Derivatives payable net of derivatives receivable if payables are greater than receivables

A7.2
Components of the required stable funding categories

Table A7.2 summarises the specific types of assets to be assigned to each asset category and their associated RSF factor

RSF factor	Components of RSF category
0%	• Coins and banknotes • All central bank reserves • Unencumbered loans to banks subject to prudential supervision with residual maturities of less than six months
5%	• Unencumbered Level 1 assets, excluding coins, banknotes and central bank reserves
15%	• Unencumbered Level 2A assets
50%	• Unencumbered Level 2B assets • HQLA encumbered for a period of six months or more and less than one year • Loans to banks subject to prudential supervision with residual maturities six months or more and less than one year • Deposits held at other financial institutions for operational purposes • All other assets not included in the above categories with residual maturity of less than one year, including loans to non-bank financial institutions, loans to non-financial corporate clients, loans to retail and small business customers, and loans to sovereigns, central banks and PSEs
65%	• Unencumbered residential mortgages with a residual maturity of one year or more and with a risk weight of less than or equal to 35% • Other unencumbered loans not included in the above categories, excluding loans to financial institutions, with a residual maturity of one year or more and with a risk weight of less than or equal to 35% under the Standardised Approach
85%	• Other unencumbered performing loans with risk weights greater than 35% under the Standardised Approach and residual maturities of one year or more, excluding loans to financial institutions • Unencumbered securities that are not in default and do not qualify as HQLA including exchange-traded equities • Physical traded commodities, including gold
100%	• All assets that are encumbered for a period of one year or more • Derivatives receivable net of derivatives payable if receivables are greater than payables • All other assets not included in the above categories, including non-performing loans, loans to financial institutions with a residual maturity of one year or more, non-exchange-traded equities, fixed assets, pension assets, intangibles, deferred tax assets, retained interest,

A7.3

Table A5.3 summarises the off-balance sheet categories and associated RSF factors

RSF factor	RSF category
5% of the currently undrawn portion	Irrevocable and conditionally revocable credit and liquidity facilities to any client
National supervisors can specify the RSF factors based on their national circumstances.	Other contingent funding obligations, including products and instruments such as: • Unconditionally revocable credit and liquidity facilities; • Trade finance-related obligations (including guarantees and letters of credit); • Guarantees and letters of credit unrelated to trade finance obligations; and • Non-contractual obligations such as − potential requests for debt repurchases of the bank's own debt or that of related conduits, securities investment vehicles and other such financing facilities; − structured products where customers anticipate ready marketability, such as adjustable rate notes and variable rate demand notes (VRDNs); and − managed funds that are marketed with the objective of maintaining a stable value

A8

A8.1

Fully loaded ratios from the 2016 EBA Stress Test

Table A6.1: EBA Stress testing results Fully Loaded CET1 ratio

Bank	Actual values (31.12.15)	Baseline scenario (31.12.2018)	Adverse Scenario (31.12.2018)
Banco Popular	10,2%	13,5%	**6,6%**
Banco Santander	10,2%	13,2%	8,2%
Criteria Caixa	9,7%	11,0%	7,8%
Bankia	13,7%	14,4%	9,6%
Banco Bilbao Vizcaya Argentaria	10,3%	12,0%	8,2%
Banco de Sabadell	11,7%	12,8%	8,0%

Source: *http://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2016/results*

A8.2

Table A6.2: EBA Stress testing results Fully Loaded Leverage Ratio

Bank	Actual values (31.12.15)	Baseline scenario (31.12.2018)	Adverse Scenario (31.12.2018)
Banco Popular	5,68%	7,24%	3,99%
Banco Santander	4,73%	6,08%	3,97%
Criteria Caixa	5,32%	6,27%	4,58%
Bankia	5,53%	6,01%	3,87%
Banco Bilbao Vizcaya Argentaria	6,07%	7,02%	5,07%
Banco de Sabadell	4,85%	5,57%	3,40%

Source: *http://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2016/results*

A9

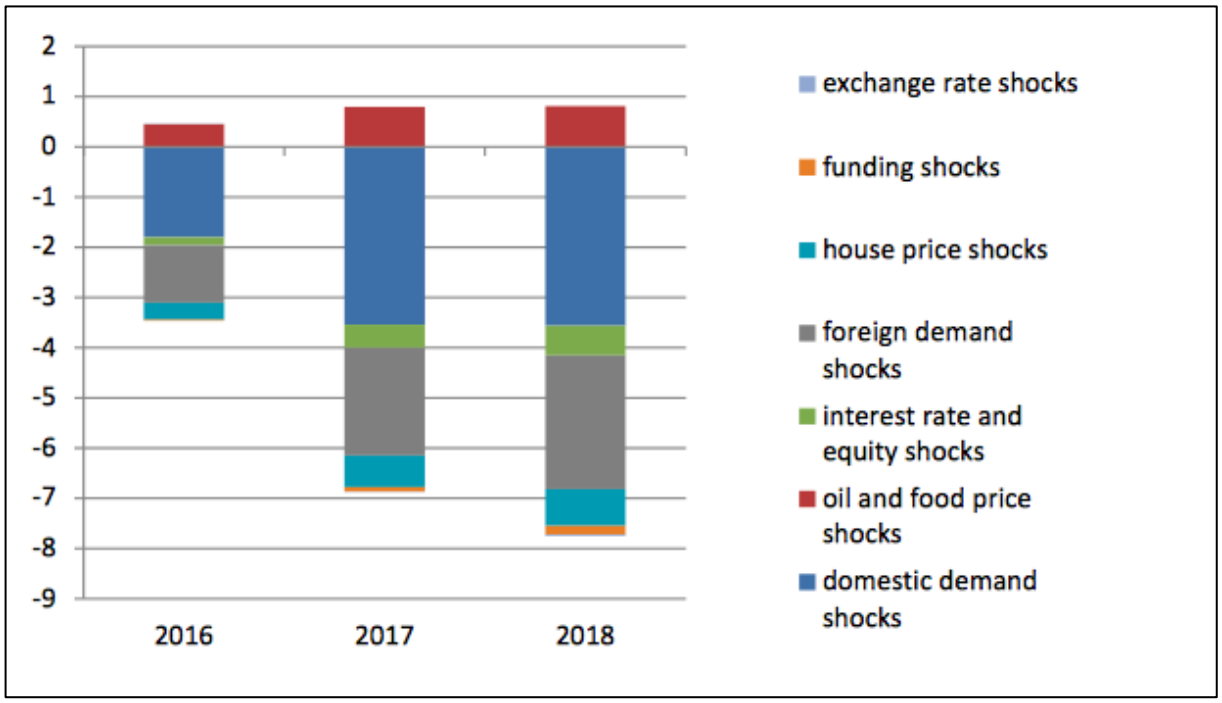
Main financial stability risks and assumed financial and economic shocks for EBA stress test

Source of risk	Financial and economic shocks
An abrupt reversal of compressed global risk premia, amplified by low secondary market liquidity	• Rising long-term interest rates and risk premia in the United States and other non-EU advanced economies • Global equity price shock • Increase in the VIX volatility index and spillover to emerging market economies • Foreign demand shocks in the EU via weaker world trade • Exchange rate shocks • Oil and commodity price shocks
Weak profitability prospects for banks and insurers in a low nominal growth environment, amid incomplete balance sheet adjustments	• Investment and consumption demand shocks in EU countries • Residential and commercial property price shocks in EU countries
Rising of debt sustainability concerns in the public and non-financial private sectors, amid low nominal growth	• Country-specific shocks to sovereign credit spreads • Shocks to corporate credit spreads
Prospective stress in a rapidly growing shadow banking sector, amplified by spillover and liquidity risk	• EU-wide uniform shock to interbank money market rates • Shocks to EU financial asset prices • Shocks to financing conditions in EU countries (via shocks to household nominal wealth and user cost of capital)

Source: *https://www.eba.europa.eu/documents/10180/1383302/2016+EU-wide+stress+test-Adverse+macro-financial+scenario.pdf*

A10

Contributions of individual adverse shocks to the deviation of real EU GDP from baseline (percentage points)



Source: *https://www.eba.europa.eu/documents/10180/1383302/2016+EU-wide+stress+test-Adverse+macro-financial+scenario.pdf*

A11
A11.1
Data used for the IMF Stress Tester 3.0.

The table represents the data included for our sample of six banks to perform the IMF Stress Tester 3.0.
This data has been retrieved from Annual Reports (2016) for the respective banks, Pillar III disclosures and from public data-bases such as Orbis.
Some of the data on sectoral structure of lending, largest exposures, long term government bonds 1, net open foreign exchange data and interbank credit data had to be assumed as it is not reported. Some of these assumptions are not homogenous, as they are based on historical information about the individual banks, and therefore made at a very careful level, so that they can act as valid assumptions. *(assumptions are discussed in part 6 of the main document).*

	Banco Popular	Banco Santander	Criteria Caixa	Bankia	Banco Bilbao Vizcaya Argentaria	Banco de Sabadell
Table A1. Balance sheet and income statement data (simplified)						
Total assets	116.605.873	1.052.271.000	273.499.172	151.035.316	522.364.000	170.350.784
Cash and T-bills	3.278.808	104.427.000	13.553.691	2.853.756	48.911.000	11.688.250
Long-term government bonds	15.483.879	148.766.000	57.996.493	26.708.758	53.122.000	4.598.190
Total loans (net)	96.315.800	790.900.000	199.497.157	108.682.602	413.056.000	149.781.068
Other assets (net)	1.527.386	8.178.000	2.451.831	12.790.200	7.275.000	4.283.276
Total liabilities	116.605.873	1.052.271.000	273.499.172	151.035.316	522.364.000	170.350.784
Deposits	66.897.126	832.004.000	120.719.390	88.740.594	276.724.000	95.108.183
Demand deposits	28.818.043	657.970.000	78.276.896	49.967.953	123.601.000	59.817.975
Domestic currency	28.596.499	657.770.000	78.176.896	49.861.633	123.401.000	59.717.975
Foreign currency	221.544	200.000	100.000	106.320	200.000	100.000
Term deposits	38.079.083	174.034.000	42.442.494	38.772.641	153.123.000	35.290.208
Domestic currency	38.079.083	174.034.000	42.442.494	38.772.641	153.123.000	35.290.208
Foreign currency	0	0	0	0	0	0
Total capital (equity)	49.708.747	220.267.000	152.779.782	62.294.722	245.640.000	75.242.601
Common equity tier 1	7.808.140	73.708.859	20.414.618	11.605.956	47.370.000	10.332.360
Tier 1	7.808.140	73.708.859	20.414.618	11.516.952	50.083.000	10.332.360
Tier 2	655.167	12.628.041	2.258.084	687.222	8.810.000	1.519.237
Total tier capital	8.463.307	86.336.900	22.672.702	12.635.642	58.893.000	11.851.597
CET1 ratio as reported	0,1213	0,1253	0,1305	0,1508	0,1218	0,1200
CAR as reported	0,1315	0,1468	0,1450	0,1642	0,1514	0,1377

Net income ("after-tax profit")	-5.591.299	7.358.000	4.823.565	3.346.138	6.623.000	963.741
Net operating income (+)	-7.516.017	10.663.000	4.354.141	1.319.146	8.074.000	895.944
Net interest income (+)	2.096.588	31.089.000	3.870.508	2.198.846	17.060.000	3.837.762
Interest income (+)	2.929.747	31.089.000	704	2.198.846	27.708.000	3.837.762
Interest expense (-)	833.159	0	41.819	0	10.648.000	0
Noninterest income (+)	601.583	10.180.000	2.260.092	824.000	4.718.000	1.148.582
Provisions for loan losses (-)	9.953.803	9.518.000	658.000	155.700	913.000	1.427.100
Noninterest expense (-)	260.385	21.088.000	1.118.459	1.548.000	12.791.000	2.663.300
Securities gains/losses (+)	521.597	-23.000	789.795	2.359.742	248.000	371.365
Applicable income taxes (-)	-1.403.121	3.282.000	320.371	332.750	1.699.000	303.568
Extraordinary gains, net (+)	0	0	0	0	0	0

	Banco Popular	**Banco Santander**	**Criteria Caixa**	**Bankia**	**Banco Bilbao Vizcaya Argentaria**	**Banco de Sabadell**
Table A2. Other input data						
Capital adequacy calculation						
Regulatory capital	7.808.140	73.708.859	20.414.618	11.605.956	47.370.000	10.332.360
Risk weighted assets	64.372.232	588.088.000	156.412.406	76.959.314	388.951.000	86.069.980
Credit risk data						
Performing loans	78.233.222	777.255.000	190.086.421	99.289.695	402.583.000	140.436.357
Pass loans	78.233.222	777.255.000	190.086.421	99.289.695	402.583.000	140.436.357
Special mention loans	0	0	0	0	0	0
Non performing loans (NPLs), gross	19.601.578	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925
Substandard loans	0	0	0	0	0	0
Doubtful loans	19.601.578	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925
Loss loans	0	0	0	0	0	0
Provisions held	1.519.000	14.459.000	4.949.683	1.405.104	8.917.000	306.214
Collateral reported against:						
Substandard loans	0	0	0	0	0	0
Doubtful loans	10.439.000	11.926.000	27.608.671	9.183.159	50.540.000	4.985.990
Loss loans	0	0	0	0	0	0

Sectoral structure of lending						
Total loans	96.315.800	790.900.000	199.497.157	108.682.602	413.056.000	149.781.068
Agriculture	481.579	3.954.500	1.028.000	543.413	1.183.608	872.000
Manufacturing	1.926.316	12.970.935	7.048.000	807.469	8.261.120	7.374.000
Construction	784.878	11.529.720	8.732.000	10.723.835	8.253.265	2.252.000
Trade	4.623.158	13.259.178	7.968.000	9.436.493	19.826.688	8.309.000
Tourism incl. Transport	4.815.790	11.914.044	4.804.000	12.812.523	20.652.800	7.978.000
Credit institutions and insurance	9.631.580	79.090.000	19.949.716	10.868.260	52.686.542	8.927.000
Other	74.052.499	658.181.623	149.967.441	63.490.609	302.191.977	114.069.068
Nonperforming loans	19.601.578	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925
Agriculture	196.016	281.040	187.000	107.980	193.900	96.509
Manufacturing	588.047	843.120	486.000	323.940	581.700	289.528
Construction	3.008.671	4.215.600	2.409.000	1.619.702	2.908.500	1.447.639
Trade	784.063	1.124.160	648.000	431.920	775.600	386.037
Tourism	294.024	421.560	261.000	161.970	290.850	144.764
Credit institutions and insurance	137.211	196.728	100.523	75.586	135.730	67.556
Other	14.593.546	21.021.792	10.268.896	8.076.912	14.503.720	7.218.892

	Banco Popular	**Banco Santander**	**Criteria Caixa**	**Bankia**	**Banco Bilbao Vizcaya Argentaria**	**Banco de Sabadell**
Largest exposures						
#1	211.583	2.158.423	566.818	315.891	1.472.325	296.290
#2	211.583	2.158.423	566.818	305.104	1.471.675	296.290
#3	211.583	2.158.423	566.818	305.104	1.471.675	296.290
#4	211.583	2.158.423	566.818	305.104	1.471.675	296.290
#5	211.583	2.158.423	566.818	305.104	1.471.675	296.290
Interest rate risk data						
Total sensitive assets (by time to repricing)	82.460.000	260.511.000	7.220	30.869.669	159.209.000	39.302.940
< 3 months	40.715.000	112.927.000	6.199	12.727.174	91.618.000	21.802.041
3-6 months	19.937.000	79.938.000	1.021	8.231.993	27.359.000	15.623.359
6-12 months	21.808.000	67.646.000	0	9.910.502	40.232.000	1.877.540
Total sensitive liabilities (by time to repricing)	60.653.000	195.872.000	10.712	61.129.638	215.642.000	62.770.188
< 3 months	18.386.000	112.551.000	9.217	33.876.787	146.106.000	31.513.771
3-6 months	18.211.000	39.465.000	1.495	23.451.006	27.982.000	9.096.250
6-12 months	24.056.000	43.856.000	0	3.801.845	41.554.000	22.160.167

Structure of the bond portfolio						
Long-term government bonds	15.483.879	148.766.000	57.996.493	26.708.758	53.122.000	4.598.190
Bond 1	0	0	0	0	0	0
Bond 2	15.483.879	148.766.000	57.996.493	26.708.758	53.122.000	4.598.190
Average duration of bonds held	6,8	6,8	6,8	6,8	6,8	6,8
Liquid assets	18.762.687	253.193.000	71.550.184	29.562.514	102.033.000	16.286.440
Short-term liabilities	28.818.043	657.970.000	78.276.896	49.967.953	123.601.000	59.817.975
o/w demand deposits	28.818.043	657.970.000	78.276.896	49.967.953	123.601.000	59.817.975
other	0	0	0	0	0	0
Exchange rate risk data						
Net open position	-233.212	4.209.084	-546.998	-302.071	2.089.456	340.702
Net US$ position	-58.303	1.052.271	-136.750	-75.518	522.364	85.175
Net pesos position	-58.303	1.052.271	-136.750	-75.518	522.364	85.175
Net GBP position	-58.303	1.052.271	-136.750	-75.518	522.364	85.175
Net positions in other curr.	-58.303	1.052.271	-136.750	-75.518	522.364	85.175
FX loans	4.302.624	491.282.000	3.280.000	898.244	224.682.000	66.107.000
Profits and ROAs over time						
Profit (2001-2016 average)	445.479	5.596.000	1.049.614	468.324	3.831.063	538.032
Profit (2001-2016 st. dev.)	1.548.733	2.488.949	974.552	1.723.889	4.619.232	541.578
St. dev of ROA (1996-2010)	0	0	0	0	0	0
Interbank credit data (credit of bank in the row to the bank in the column)						
Banco Popular	...	60.753	30.377	30.377	60.753	20.251
Banco Santander	3.543.197	...	10.629.591	10.629.591	42.518.364	3.543.197
Criteria Caixa	1.263	7.579	...	7.579	7.579	1.263
Bankia	178.878	1.073.266	1.073.266	...	1.073.266	178.878
Banco Bilbao	2.915.700	34.988.400	8.747.100	8.747.100	...	2.915.700
Banco de Sabadell	800.200	2.400.600	1.200.300	1.200.300	2.400.600	...

A11.2

Assumptions made for the IMF Stress Tester 3.0.

The following table represents the assumptions made for the parameters and variables used in the Stress Tester 3.0 tool. We have used different color codes in our assumption sheet.
Green denotes numerical assumption (parameters) of the stress test.
Blue denotes the assumed sizes of the shocks to risk factors. Below, it is indicated our assumed 25% of increase in NPLs, the sectoral shock, the three largest exposures defaulting, our assumed increase in interest rates (98 bps and 200 bps) and assumed exchange rate shock.
Unfortunately, the exchange rate risk data we needed was not available, so crucial assumptions had to be made regarding the FX positions of our sample of banks. We assumed 0,1% of total assets for each net currency position (US dollars, pesos and GBP) for the larger banks, Banco Santander and Banco Bilbao. For the smaller banks (Banco Popular, Criteria Caixa, Bankia, Banco de Sabadell), we assumed short FX positions of 0,05% for each net currency. This was based on the limited data available.

Credit Risk	
Shock 1. "Underprovisioning"	
Assumed provisioning rates (%)	
Pass loans	1
Special mention loans	3
Substandard loans	20
Doubtful loans	40
Loss loans	100
Assumed haircut on collateral (%)	0
Impact on RWA/impact on capital (%)	100
Shock 2. "Proportional increase in NPLs"	
Assumed increase in NPLs (%)	25
The increase is proportional to:	
existing NPLs (1=yes, 0=no)	1
existing performing loans (1=yes, 0=no)	0
Assumed provisioning of the new NPLs (%)	25
Impact on RWA/impact on capital (%)	100
Shock 3. "Sectoral shocks to NPLs"	
Assumed shocks (% of performing loans in the sector becoming NPLs)	
Agriculture	0
Manufacturing	0
Construction	0
Trade	10
Tourism	20
Non-bank financial institutions	0
Other	0
Assumed provisioning rate (%)	30
Change in RWA/change in capital	100
Shock 4. Large exposures	
Number of large exposures becoming NPLs	3
Assumed provisioning rate (%)	100

Interest Rate Risk

Parameters of bonds	Settlement	Maturity	Coupon	Yield	Frequency	Basis	Duration
Bond 1	31-12-2016	31-12-2018	8	9	2	1	1,89
Bond 2	31-12-2016	31-12-2020	8	10	2	1	6,84

Nominal interest rate: assumed change (percentage points)	2

Exchange Rate Risk

Assumed exchange rate change (%, + ...depreciation)	10
100 percent depreciation leads to x percent of FX loans becoming NPLs, x=	10,0
Provisioning rate on the additional NPLs	50

Scenarios

Which of the credit shocks (2,3,4) is considered for the scenario?	2
Assumed minimum CAR rule (%)	10,5

A11.3

Homogenous assumptions made for the Sectoral loans section

These assumptions are based on the position of Criteria Caixa, as they reported the data in need. Hence we have homogenous assumptions for the banks. They are relevant for the following banks:
Banco Popular, Banco Santander, Banco Bilbao V.A., Banco de Sabadell.

Nonperforming loans	**Assumptions (% of total NPLs)**
Agriculture	1%
Manufacturing	3%
Construction *(except BP)*	15%
Trade	4%
Tourism	1,50%
Credit institutions and insurance	0,07%

A12

Sensitivity analysis of large exposures

We have conducted a sensitivity analysis of the data input for large exposures. The purpose is to see how the banks are affected by the assumption made, and how accurate it seems to be.
The orignal assumption is that each large exposure constitutes 2,5% of eligible capital.
For simplistic reasons, we are assuming that the five exposures included in our test consitute their total number of large exposures (in reality they are expected to have many more).
We are interested in seing the effect on the capital levels when the exposures vary, as notices in the results that the banks are sensitive to this scenario.

We are testing using the same input for scenario 3a: Large exposure default with interest rate hike of 98 bps.
In the first test (table A7.4), each large exposure consitutes 1% of eligible capital.
In the second test (table A7.5), each large exposure constitutes 5% of eligible capital. This is based on the maximum level set by Basel III, where an institution can have a maximum total exposure of 25% of its eligible capital (BCBS, 2014b).

We find that the CET1 ratio show a sensitivity towards the levels of large exposure. It differs with an average of 1,03% with the highest level of exposure. However, our main goal is not to find the adequate capital levels, but to evaluate the use of early warning signals. Hence, the assumed rate of 2,5% of eligible capital seems reasonable, as Banco Popular is still not able to meet the regulatory requirement in any of the scenarios presented below.

Table A12.1
1%

	Banco Popular Español S.A.	**Banco Santander S.A.**	**Criteria Caixa, S.A.U.**	**Bankia S.A.**	**Banco Bilbao Vizcaya Argentaria S.A.**	**Banco de Sabadell S.A.**
Post-shock CET1	6,14%	10,20%	10,13%	11,31%	10,48%	7,47%
Difference from initial test	-0,59%	-0,60%	-0,59%	-0,63%	-0,62%	-0,60%

Table A12.2
5%

	Banco Popular Español S.A.	**Banco Santander S.A.**	**Criteria Caixa, S.A.U.**	**Bankia S.A.**	**Banco Bilbao Vizcaya Argentaria S.A.**	**Banco de Sabadell S.A.**
Post-shock CET1	4,56%	8,59%	8,53%	9,61%	8,81%	5,85%
Difference from initial test	1,00%	1,02%	1,01%	1,07%	1,05%	1,02%

A13

IMF Breaking Point Method - input

Baseline scenario for the breaking-point test to which shocks are introduced

Item	All Banks	Banco Popular	Banco Santander	Criteria Caixa	BFA Bankia	Banco Bilbao Vizcaya	Banco de Sabadell
Capital	188.544.083	8.463.307	86.336.900	22.672.702	12.204.174	58.867.000	11.851.597
RWA	1.275.996.683	64372232	588088000	156412406	78364045	388760000	86069980
CAR (in percent)	14,78	13,15	14,68	14,50	15,57	15,14	13,77
Total loans	1.639.461.624	97.595.078	805.359.000	204.446.840	110.087.706	421.973.000	150.087.282
Performing loans	1.547.447.338	78.233.222	777.255.000	190.086.421	99.289.695	402.583.000	140.436.357
Normal and pass loans	1.547.447.338	78.233.222	777.255.000	190.086.421	99.289.695	402.583.000	140.436.357
NPLs	92.014.286	19361856	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925
Doubtful loans	92.014.286	19361856	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925
NPL ratio (in percent)	5,6	19,84	3,49	7,02	9,81	4,60	6,43
Total provisions currently held 1/	107.488.759,4	20.144.188,22	35.876.550	16.261.283,21	11.790.907,95	23.415.830	11.055.288,57
Total provisions that should be held	107.488.759,38	20.144.188,22	35.876.550	16.261.283,21	11.790.907,95	23.415.830	11.055.288,57
General provision	15.474.473,38	782.332,22	7.772.550	1.900.864,21	992.896,95	4.025.830	1.404.363,57
against normal and pass loans	15.474.473,38	782.332,22	7.772.550	1.900.864,21	992.896,95	4.025.830	1.404.363,57
Specific provision	92.014.286	19.361.856	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925
against doubtful loans	92.014.286	19.361.856	28.104.000	14.360.419	10.798.011	19.390.000	9.650.925

Note: Based on a 1,0 provisioning rate for doubtful loans and 0,01 rate for normal and pass loans. All figures in thousands of euros

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