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Thesis:

The effect of macroprudential policies on bank risk: The case of eurozone banks

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This thesis is devoted to my sister, Olga.

Abstract

This thesis deals with the effectiveness of macroprudential policy on bank risk for Eurozone banks. It gives an overview of macroprudential policy and examines its impact on risk-taking behavior of (Eurozone) banks. Macroprudential policy is expressed both as an aggregate index and it is also divided into sub-indexes. Furthermore, the riskiness of banking institutions is evaluated by using the so-called CAMELS variables. The empirical analysis is conducted at bank level by using panel pooled OLS. The sample consists of 41 commercial, savings and cooperative banks headquartered in Eurozone member states from 2011 till 2017. The main finding of the thesis is that macroprudential instruments do have the power to reduce bank risk and improve financial stability. The effects are greater for banks headquartered in a country that the market considers safe.

Keywords: Macroprudential policy, Macroprudential Instruments, Macroprudential supervision, Macroprudential tools, Bank Risk, Eurozone, CAMELS, Cerutti's Database, Z-score, Financial- institution related instruments, Borrower-related instruments, Country risk.

Περίληψη

Η παρούσα μεταπτυχιακή εργασία πραγματεύεται την αποτελεσματικότητα της μακροπροληπτικής πολιτικής πάνω στον κίνδυνο των τραπεζών που εδρεύουν σε κράτη-μέλη της Ευρωζώνης. Η μακροπροληπτική πολιτική μελετάται με δύο τρόπους. Πρώτον, ως ένας συγκεντρωτικός δείκτης που περιλαμβάνει τον αριθμό των εν λόγω πολιτικών που ασκούνται σε μια χώρα κατά τη διάρκεια ενός έτους . Δεύτερον, οι μακροπροληπτικές πολιτικές χωρίζονται σε δυο κατηγορίες (σε μέτρα που στοχεύουν στον δανειζόμενο και σε μέτρα που στοχεύουν στο χρηματοπιστωτικό ίδρυμα) και μελετάται ποιά από τις δυο κατηγορίες έχει μεγαλύτερη επίδραση στον τραπεζικό κίνδυνο. Επίσης, η επικινδυνότητα των τραπεζικών ιδρυμάτων εξετάζεται υπό το πρίσμα των μεταβλητών τύπου CAMELS. Η εμπειρική ανάλυση γίνεται σε επίπεδο τράπεζας και η μεθοδολογία που χρησιμοποιείται είναι πάνελ OLS. Το δείγμα αποτελείται από 41 εμπορικές, αποταμιευτικές και συνεταιριστικές τράπεζες που βρίσκονται στην Ευρωζώνη για την περίοδο 2011-2017. Το κύριο εύρημα της εργασίας είναι ότι η χρήση μακροπροληπτικών εργαλείων μπορεί να μειώσει την έκθεση των τραπεζών στον συνολικό κίνδυνο και να βελτιώσει την χρηματοπιστωτική σταθερότητα. Τέλος, η αποτελεσματικότητα των εν λόγω εργαλείων ενισχύεται όταν η τράπεζα βρίσκεται σε μια χώρα που η αγορά αξιολογεί ως ασφαλή.

Λέξεις- κλειδιά: Μακροπροληπτική πολιτική, Μακροπροληπτική εποπτεία, Μακροπροληπτικά εργαλεία, Τραπεζικός κίνδυνος, Ευρωζώνη, CAMELS, Cerutti's Database, Z-Score, Μέτρα που στοχεύουν στον δανειζόμενο, Μέτρα που στοχεύουν στο χρηματοπιστωτικό ίδρυμα, Κίνδυνος χώρας

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Introduction

The markets globalization , capital flows liberalization and the development of complex financial products created bank risks which are impossible to be evaluated by using traditional risk measures-i.e. balance sheet ratios. In addition, the lack of adequate risk management practices to address systemic risk proved detrimental for the financial system. In many countries, deregulation- the process of removing or reducing state regulations- deteriorated the risk-taking bank behavior. Such practices have steadily raised instability in the financial system and raised the interest of regulators to take action by developing measures which would address to the financial system as a whole. The measures in question were named macroprudential policy.

The term macroprudential policy refers to all the actions, measures and policies that regulatory authorities take in order to reduce the systemic risk of the financial system and to maintain its stability. This term firstly appeared in the late 70's when one of the biggest concerns that regulatory authorities had, was the rapid credit expansion to developing countries and the potential negative impact on financial stability . However, macroprudential policy was widely spread after the global financial crisis of 2007 which was a result of the overconfidence that market participants showed to the self-adjusting ability of the market, which encouraged them to take risky actions and underestimate such risk because of the long-lasted economic bloom. As far as the regulatory context is concerned , at that point of time it was structured on a purely microprudential basis because of the general belief that keeping each financial institution (eg a bank) safe would ensure safety in that financial system as was whole. Beyond dispute, the crisis of 2007 demonstrated the deficiency of the existing regulatory context as well as the need for the adoption of a common policy , which would take into account the market's players actions as a whole (macroprudential policy) rather than individuals.

As such, the direct goal of macroprudential policy is to maintain the financial stability and diminish the systemic risk which comes from the procyclical behavior of the financial institutions . The intermediate goal is the avoidance of the macroeconomic costs associated with the financial instability. Risk taking is defined ,in terms of macroprudential policy's ultimate goal , as " endogenous" because it is generated within the system and it depends on the bank institutions' collective behavior . As a result there is a great level of interdependence and exposure to risk among the financial institutions. As far the measurement of the systemic risk is concerned, it is conducted using balance sheet indicators, early warning indicators, indicators based on VaR and macro stress tests.

With regard to the macroprudential policy tools, most of them focus on the control of the bank capital. They are grouped into 4 categories: a) Rule-based macroprudential tools which act as built in stabilizers , e.g.: loan loss provisions, capital requirements/ capital surcharges, loan-to-value-ratios, risk management practices, b) Rule-based state dependent macroprudential tools , e.g.: contingent reversible , capital insurance, c) Discretionary tools, like supervisory review or warnings, quantitative adjustments to the various prudential tools, and d) tools based on quantitative restrictions.

Regarding to category d), Hanson et al. (2010) suggests the discrimination between relative and absolute values of the variables. He is in favor of an approach that gradually aims to increase capital for problem banks instead of raising capital ratio, because in this way the shrinkage of the asset side of the bank's balance sheet will be avoided and thus, procyclicality.

An alternative way to distinguish macroprudential tools is : a) those that measure the risk evolution within time (time series dimension), and b) those that measure risk which is dispersed into the financial system given a specific time point. In other words, those tools check the contribution of each financial system to systemic risk (cross sectional dimension).

The time series dimension tools address the procyclicality of the balance sheet's assets side of a bank. According to Kayshap and Stein (2004), supposing that a bank's demand in capital is of a procyclical nature, then raising capital in times of economic recession will affect the demand side of the credit cycle and thus, worsen the current state of an economy. An additional source of procyclicality, is the interaction of policies for evaluating collaterals and loan to value ratio. Another important procyclicality channel is loan loss provisions , which can impoverish banks' balance sheets and thus financial cycle. Third source of procyclicality is haircut and margining practices for financing securities and derivatives that are negotiated over the counter. In order to deal with procyclicality , there are tools that separate balance sheet items according to their maturity, eg. net stable funding ratio, liquidity cover ratio. Perotti et Suarez (2009,a,b, 2010) suggest that a bank should pay a "penalty" should it encounters liquidity risk.

Finally, macroprudential policy can be exercised as an stand alone policy or jointly with monetary policy, fiscal policy or microprudential policy in order to achieve the ultimate goal of financial stability. Monetary policy can affect financial stability in two ways: a) ex ante, by taking risk and short terms loans or loans in a foreign currency (Dell ' Arricia and Marquez, 2013, review) , b) ex post, by reducing loan supply as well as raising asset prices in order to induce externalities. Similarly, macroprudential policy can affect the supply side of the credit cycle which will have a direct impact on gross domestic product of an economy and thus, it can improve or worsen the business cycle. Fiscal policy matters because it can be a source of procyclicality which macroprudential policy aims to reduce. In particular, tax policies can affect systemic risk when tax and interest payments are not subject to be remitted or influence assets prices (De Mooij, 2011, Keen and De Mooij, 2012). Additionally , Pigouvian taxes can cause negative externalities (IMF, 2010). In general , taxes can not affect systemic risk, however they can affect macroprudential policy implying that macroprudential and fiscal agencies must cooperate in order to ensure soundness of the financial system. Last but not least, not only is macroprudential policy not always aligned with microprudential policy but there can be controversies between them(Osinki, Seal and Hoogduin, 2013, Angelini, Nocoletti-Altimari and Visco, 2012). For instance, during harsh times , macroprudential policy suggests loosening of regulatory requirements because they impede credit provision or they contribute to fire-sale assets effects. In contrast, microprudential policy may maintain or tighten regulatory requirements in order to protect each bank's depositors and investors.

Consequently, policies need to be properly chosen and carefully adjusted according to country and financial system characteristics in order to maximize the efficiency.

The purpose of this thesis is to examine the relationship between macroprudential policy and bank risk. The thesis is structured as follows: Chapter 1 is an introduction to financial system and the type of risks associated with banks. Basel Accords concerning the measures addressed to bank risks are also mentioned. Chapter 2 is dedicated to macroprudential policy and its mission, tools, origins and evolution. The chapter ends with the description of macroprudential policy in European Union. Chapter 3 refers to the literature review regarding macroprudential policy. Chapter 4 is devoted to the empirical analysis and it is separated into two parts. The first part refers to bank risk analysis with CAMELS indicators. The second part is the core analysis of macroprudential policy and bank risk. The chapter closes with conclusions and suggestions for future research.

Chapter 1: Financial System and Bank risks

1.1 The role of the financial system

In the last two decades, the financial system has radically changed. Globalization of capital and money markets has increased competition internationally whereas new markets have been developed. However, the risk associated with financial institutions activities has also been augmented. In this chapter we will refer briefly to the financial system as well as the risks that banks deal with.

Beyond dispute, banking institutions are the heart of the financial system in an economy. The financial system is a set of markets for financial products and instruments where individuals and institutions are trading and regulatory authorities are monitoring such operations . As far as the economic units are concerned, these are enterprises, households and banks which participate in the banking market as well as in the stock market and they trade loans , stocks and bonds. The purpose of the financial system is to allocate efficiently financial sources between market participants and to contribute on promoting welfare in the economy. Usually what financial institutions do is to source capital from surplus units in the economy (e.g. enterprises) and give it in form of loans to deficit units in the economy such as households .

The financial system has two financing forms: direct form and indirect form. In case of direct financing , surplus units (lenders) lend capital directly to deficit units (borrowers) without the existence of a financial intermediary. The deficit unit takes the money and the surplus unit will receive a payment over the capital borrowed, which is called interest. Though its simplicity , direct financing has the following problems:

- Information asymmetry
- High cost of managing information
- Lack of specialized knowledge and know-how
- Inconsistency of loan supply and demand, related to the amount and time horizon
- Insolvency risk

The simplest form of direct financing is the direct private placement of financial claims consisted of dealers who own securities and are willing to trade , brokers who buy and sell securities on behalf of their clients and investment banks which help borrowers to invest this capital on a secure investment.

As far as the indirect form is concerned, there is a financial intermediary who mediate between the surplus and deficit units in the economy. Financial intermediaries are commercial banks, insurance companies, savings banks, investment companies, leasing companies and factoring companies. The main advantage of indirect financing over direct is that financial intermediaries create demands for depositors and liabilities for borrowers which are more attractive to them.

Therefore, the economic system could not function without financial institutions. Extracting the definition from Investopedia, a financial institution (FI) is a company involved

in the business of dealing with financial and monetary transactions, such as deposits, loans, investments and currency exchange. Generally, three major types of financial institutions exist:

1. Depository institutions that accept and administrate deposits and make loans, including banks, credit unions, trust companies, and mortgage loan companies;
2. Contractual institutions such as insurance companies and pension funds
3. Investment companies, i.e. investment banks, underwriters, brokerage firms.

1.2 Risks associated with banking activity

The purpose of financial institutions is to increase the return on equity for the shareholders by making investments and taking over risk. High (or low) -profitable investments are associated with higher (lower) level of risk and vise versa. The probability of a financial institution to incur financial losses because of an unexpected event is called "risk". There are many sources of bank risk. The most important are :

i. Liquidity risk
ii. Market risk
iii. Foreign exchange risk
iv. Interest rate risk
v. Operational risk
vi. Credit risk
vii. Law risk
viii. country risk
ix. Solvency risk

i. Liquidity risk

For banks, liquidity risk may appear when depositors massively withdraw money from their bank accounts. In accounting terms the liability side of a bank's balance sheet is reduced. Because of the fact that asset side must equal liability side, banks are obliged to liquidate assets to restore balance. However, this is easier said than done. When a bank is obliged to rebalance its balance sheet , it occurs a liquidation cost which may be not able to retrieve. In turn, banks wish to hold liquid assets to address the increased need of depositors for cash. In extreme cases, a liquidity risk can cause a bank to default if it does not hold enough cash to cover the excessive depositors demand. A bank can manage a potential massive cash withdrawal by purchasing liquidity or storing liquidity.

ii. Market Risk

Market risk is the possibility of a financial institution experiencing losses due to factors that affect the overall performance of the financial markets in which is involved. It is also called "systemic risk," and it cannot be diversified, although there are techniques to be hedged.

Sources of market risk are recessions, political turmoil, interest rate changes, natural disasters and terrorist attacks.

iii. Foreign exchange risk

Foreign exchange risk refers to the change of an investment's value due to changes in the value of two different currencies. Changes in foreign exchange have both a direct and a indirect effect on banks. An example of a direct effect is when a bank holds liabilities in foreign currency (eg. a foreign currency loan) and a revaluation occurs, then its obligation in domestic currency is augmented . In turn, devaluation of domestic currency benefits those who have claims in foreign currency and damages those who have liabilities. On the other hand, credit risk, liquidity risk, interest rate risk, market risk and country risk may have an indirect effect on foreign exchange. For example, a bank with no foreign currency exposure is maybe subject to credit risk if it has granted loans to enterprises exposed to foreign exchange risk. In addition, expectations for changes in foreign exchange may cause a devaluation for domestic currency which will in turn cause a change in domestic interest rates.

iv. Interest rate risk

The interest rate risk, refers to the chance that investments will suffer as the result of unexpected interest rate changes. In case of a fixed-rate loan , banks are incurring losses because such loans are an important income source for them. Usually banks try to hedge this type of risk using derivatives with same maturity. In case of floated-rate loan , interest rate risk is transformed into credit risk as the adverse change in rates will affect borrowers who they will have difficulties in repaying interest and capital.

v. Operational risk

Operational risk refers to losses which may incur because of inadequate corporate governance systems. Such risk is due to human errors , mistaken managerial decisions or miscommunication between shareholders and management. Usually, lack of preventive action for such behaviors is the main source of operational risk . An important kind of operational risk is technological risk, that is the risk that occurs when technological investments do not produce the expected cost savings.

vi. Credit risk

One of the basic functions of banks is to provide loans to individuals and businesses. These loans can be either long-term or short-term. Because bank capital , when granting a loan, is bound, banks charge an interest rate over the principal capital. The rate in question includes the bank cost for tying down its capitals plus the risk of non repayment of loan.

Credit risk is the risk of default on a debt which may rise from a borrower failing to make required payments. As such, financial institutions must control and collect information regarding borrowers in order to diminish credit risk.

vii. Legal risks

Legal risks refer to damage or any loss incurred to a financial institution due to non conformity. Examples of legal risks are: unexecuted contracts, negotiating power abuse of financial institutions and over-valuation of investment or savings products, promotion of financial products and services whose terms have not been clarified to clients and non transparency in valuating financial products in financial markets. Legal risk is extremely difficult to be quantified and its confrontation depends on the bank's legal department.

viii. Country risk

Country risk refers to changes in the economy that may adversely affect profits or assets' value in a country. Country risk is an alternative type of credit risk which rises when financial institutions are owners of bonds and loans granted to enterprises headquartered in another country. For example, when a domestic enterprise cannot repay its loan, a bank has the right to resort to courts and assert its claims. However , this is not applicable when the bank has lent a foreign enterprise whose government forbids debt repayment because of foreign exchange inadequacy or due to political reasons.

ix. Solvency risk

Solvency risk arises when a financial institution cannot meet maturing obligations as they become due for full value, even if it may be able to settle at some time in the future or after disposal of its assets.

1.3 Basel regulatory framework

The financial crisis in the '80s had a severe impact on the value of bank capital and lead the whole banking system in a global financial instability. Market liberalization, the complexity of financial products as well as the increased competition rendered the existence of a international regulatory framework necessary to empower financial stability.

Basel Committee on Banking Supervision (BCBS) was established in 1974 by the central banks' principals consisting "G10" . Conferences take place 4 times per annum. BCBS consist of central banks' representatives as well as other banking authorities coming from the following states: USA, Germany, Japan, France, Great Britain, Canada, Italy, Spain, Netherlands, Suisse, Sweden, Belgium, Luxembourg. BCBS is not a supranational regulatory authority but a forum without legal power which operates under the auspices of Bank of International Settlements located in Basel. BCBS aims at extending the institutional framework at a international level to ensure that not only would no financial institution escape from regulation but also banks would abide by generally accepted rules to promote transparency and fairness of competition activities.

Basel regulatory framework evolves by incorporating new rules every time banking system goes through a severe crisis. So far three Basel Accords have been released. The first Basel Accord, known as Basel I, was released in 1988 and focused on the capital adequacy of banks and other financial institutions. The second Basel Accord, named Revised Capital Framework but better known as Basel II, was an update of the original accord. In the wake of the Lehman Brothers collapse of 2008 and the issuing global financial crisis, the BCBS decided to review and reinforce the Basel Accords. July 2010, an agreement was attained regarding the total design of the capital and liquidity reform package. This agreement is known as Basel III and it has been implemented gradually beginning in January 2013. It is expected to be completed by January 1, 2019.

1.3.1 Basel Accord I

Starting from Basel I, significance was given in capital requirements. From a regulatory point of view, capital constitutes the last line of defense that a credit institution has for absorbing potential losses when reserves have been exhausted and risk management is inadequate to protect the interests of depositors. Therefore, capital is distinguished into different scales (Tiers) depending on:

- To whom it will be given reimbursement priority if a financial institution goes bankruptcy.
- Bank's ability to absorb losses generated within a financial year or in case of bankruptcy or liquidation of the firm.
- The degree of permanence of capital (defined of undefined) which ensures its availability during crises.
- The ability of passing through the cost of capital into the following financial years.

Capital requirements were defined after taking into account credit risk as well as market risk , which was the reason of banks' failure in '70s. Basel I mainly focused on the minimum equity level which a bank should maintain with regards to credit risk of its loan portfolio. The ratio was defined at 8%. for banks and 10% for factoring companies.

$$\text{Capital Adequacy Ratio(CAR)} = \frac{Tier\ I+Tier\ II}{Risk\ weighted\ assets} \geq 8\%$$

$$\text{Tier 1 ratio} = \frac{Shareholder\ funds+perpetual\ non\ cumulative\ preference\ shares}{Risk\ weighted\ assets+off\ balance\ sheet\ risks} \geq 4\%$$

Basel Accord I was based on four pillars. The first one, known as "Constituents of Capital", defines the percentage of capital that each bank must maintain as reserves . Tier 1 includes all cash and cash equivalents whilst Tier 2 contains the so called hybrid capital , that is to say cash came from liquidation of tangible assets .The second pillar is called "Risk Weighting " and concerns the evaluation of risky assets .The third pillar , called "A Target Standard Ratio", is a merge of the two pillars whereas the fourth one , named " Transitional and Implementing Arrangements" is aimed at central banks of member-states to create a strong regulatory framework which will ensure the implementation of Basel Accord.

1.3.2 Basel Accord II

The continuing financial instability and financial crises happened in the 90's induced Basel Committee to revise and complement Basel I . In 1999 the Committee released a " Revised Framework on International Convergence of Capital Measurements and Capital Standards" which was renamed Basel II. However the implementation of the new reforms were meant to begin in 2004. In the European Union, Directive 2006/48 EU embodied the transition from Basel Accord I to II by setting the targets of institutional framework of capital adequacy:

- To maintain and boost market discipline in order to pursue financial stability at a international level.
- To blunt inequalities regarding the conditions of international competition , by setting uniform processes for capital regulation .
- To impose minimum capital requirements for covering bank risks to prevent bankruptcy.

Basel Accord II is based on three main pillars: minimum capital requirements, supervisory control and market discipline.

1. Pillar I: Capital requirements regarding credit risk, counterpart risk, market risk and operational risk are set.

2. Pillar II: It determines the capital adequacy evaluation process . It complements Pillar I since the latter includes the calculation procedures for capital requirements.

3. Pillar III: It boosts market discipline through publishing specific quantitative and qualitative data- quarterly, semester, annual- related with capital adequacy as well as risk management practices.

1.3.3 Basel Accord III

In an attempt to respond to the global financial crisis (GFC), in 2008, Basel Committee on Banking Supervision presented a renewed framework consisting of regulations and directives regarding the capital adequacy of financial institutions. Consultations, recommendations as well as regulations released by BCBS in July 2009 comprise Basel III. Somehow, Basel III is a improved version of Basel II and not a new agreement. Changes made in Basel III are of a prudential nature in both micro and macro level aiming at resolving both risks generated within the bank and the financial system as a whole. The purpose of the new measures implemented are : a) to improve the ability of banking sector to absorb losses in case of a crisis , b) to boost risk management practices , c) to improve transparency in the financial system.

According to Basel III:

i. Consistency and transparency regarding capital structure is increased:

   a. Tier 1 is now consisted of common equity and retained earnings .
   b. Tier 2 components (reserves, general provisions, hybrid capital, collaterals etc) are harmonized.
   c. Tier 3 (loan loss reserves etc) is abolished.
   d. A capital conservation buffer including common equity of 2.5% of risk-weighted assets sets the total common equity standard to 7%. Constraints on a bank's discretionary distributions will be implemented when it falls into the buffer range.
   e. A countercyclical buffer ranging from 0–2.5% including common equity will be applicable when credit growth is judged to result in an inadmissible build-up of systemic risk.

ii. Capital adequacy regulatory framework regarding risk coverage is fortified

   a. Capital requirements for trading books are increased in order to cover risks associated with complex financial products.

b. Capital requirements for trading positions (eg derivatives) are also augmented .
c. Over-the-counter derivatives are moved to clearing houses.

iii. A new simplified ratio of capital dependence is introduced which will play a complementary role in the existing framework . This ratio aims to:

a. Set minimum leverage ratios in banking sector. Leverage ratio is calculated by dividing Tier 1 capital by the bank's average total consolidated assets (sum of the exposures of all assets and non-balance sheet items). The banks are expected to maintain a leverage ratio in excess of 3%.
b. Contribute on limiting the impact of inconsistencies generated by risk calculation methods which take into account the aggregate of capital requirements of a bank.

iv. A new set of measures boosting capital requirements for handling potential bank distress is introduced.
v. A minimum liquidity standard is determined at international level regarding banks with international activities. The standard is called Liquidity Coverage Ratio. In practice this ratio shows the ability of a financial institution to cover capital outflows under extreme conditions for one month.
vi. In upturns, banks are obliged to store higher level of reserve requirements which they can use in the "bad " timed of the economy to reduce procyclicality and fire sales assets effect.
vii. In the long-term, structural Net Stable Funding Ratio (NSFR) is plotted to address liquidity mismatches. It covers the balance sheet and gives motivations for banks to utilize solid funding sources.

Chapter 2: An overview of macroprudential policy

2.1 The role of macroprudential policy

Broadly speaking, macroprudential policy needs to ensure financial stability , however, there is no widely accepted definition of financial stability. Two view- groups are distinguished. The first one defines financial stability in terms of resistance of the financial system to external shocks (e.g. Allen and Wood, 2006) whereas the second one emphasizes the endogenous nature of credit crises. The latter describes financial stability in terms of sponginess to shocks within the financial system or the weakness of banking institutions to respond to normal-sized shocks let alone large shocks (Borio and Drehman, 2009a).

An alternative view of the goal of macroprudential policy is as controlling the risk of episodes spread within the financial system which could have significant macroeconomic costs (Borio and Drehmann, 2009a). However, microprudential policy aims to control the risk within the financial institutions. In that sense, macroprudential policy is closely correlated with microprudential policy. In this context, Borio (2003) suggested the following stylized characterisation of the different nature of the two perspectives:

Table 2.1

Macro- versus microprudential perspectives

	Macroprudential	**Microprudential**
Proximate objective	limit financial system-wide distress	limit distress of individual institutions
Ultimate objective	avoid macroeconomic costs linked to financial instability	consumer (investor/depositor) protection
Characterisation of Risk	"endogenous" (dependent on collective behavior)	"exogenous" (independent of individual agents' behavior)
Correlations and common exposures across institutions	Important	Irrelevant
Calibration of prudential controls	in terms of system-wide risk; top-down	in terms of risks of individual institutions; bottom-up

Source: Borio (2003).

Perotti and Suarez (2009a) supported the view of macroprudential policy as an obstruction to banks' strategies causing systemic risk. Hanson et al (2010) observe that microprudential regulation press banks to internalize losses on their assets in order to reduce the negative externalities caused and to protect deposit insurance funds.. According to them, macroprudential policy aims at controlling the social costs of a generalized

reduction of assets in the financial system. They recognize the primary reasons for the balance sheet overshrinkage which are credit crunches and assets' fire-sale and they also put an emphasis on the amplitude of macroprudential regulation which should transgress deposit-taking institutions.

2.1.1 Financial stability

Allen and Wood (2006) claim that the term “financial stability” (as an independent objective from price stability) was first used in 1994 by the Bank of England. Both the definition of "financial stability" and its measurement have been the subject of extensive debate. One way of defining financial stability is to define it conversely, that is to state a definition for financial instability and financial crises (Mishkin(1999)). Another way is to define financial stability through the primary functions of the financial system: efficient allocation of capital, facilitation of saving-investment processes and sustainable intermediation (see Haldane et al. (2004) and Deutsche Bundesbank (2003)).

According to European Central Bank, financial stability is defined as " a situation where the financial system - which is composed of intermediary financial mechanisms, financial markets and financial markets infrastructures- can overcome shocks and any false correction of financial imbalances. As such, the probability of creating a severe imbalance in the financial intermediation process is diminished which could weaken the flow of deposits into profitable investment opportunities"(ECB, 2011).

Regarding the assessment of financial stability of the banking sector, Goodhart (2006) describes it as an not at all easy task due to cross-border spillovers, emergence of shadow banking which is related with normal banks, and the financial vulnerabilities in the non financial sector.

According to Borio and Drehmann (2009), in order to address financial (in)stability, three analytical dimensions must be taken into consideration. Firstly, which is the driving force behind financial instability. It can be either self-fulfilling prophecies (eg. a random effect which causes panic in depositors and they rush to withdraw their money from the bank) or fundamentals (eg. a steadily increasing economic uncertainty caused by banks' risk-behavior which leads depositors to withdraw their money). Secondly, which is the source of financial crises. It can be attributed either to a endogenous cycle or a exogenous shock. It is true that financial system can influence economic system and vice versa. The reason why is because during economic growth financial institutions and investors indulge in riskier investments and build up financial imbalances. When an unexpected (or exogenous) shock happens, for example a shift in exchange rate preferences, it triggers the accumulated financial imbalances and a financial crisis erupts. As such, taking into consideration the endogenous-cycle is of great importance when designing a global financial system (Hannoun, 2010). Third, which are the transmission channels causing financial instability. There is a general belief that (direct) systemic risk which is an outcome of banks failure disseminates in the financial system (the so-called domino effect). This state is boosted by the interdependence between financial institutions both domestically and

abroad. On the other hand, (indirect) systemic risk is generated by simultaneous shocks in the economy. The indirect systemic risk stems from various reasons such as banks holding similar, correlated assets (Acharya , 2009).

2.1.2 Systemic Risk

As mentioned earlier, the notion of financial stability is often discussed in terms of the concept of systemic risk and its sources. Systemic risk is the inability of a financial institution to serve its due obligations which can cause other financial institutions or enterprises not to serve their own obligations, when these obligations become due. Therefore, the risk of domino effect arises because of the insolvency transmission , mainly in the payments system framework and securities settlement framework (fundamentally endogenous risk). According to this view, risk is fundamentally endogenous, and reflects the mutual interaction between the financial system and the real economy that results in overextension in booms, and which in turn sows the seeds of the subsequent downturn and financial strains. We notice that risk builds up over time (during the boom) and then materializes as the imbalances unwind in the downturn.

2.2 Chronology of the term " macroprudential"

After the global financial crisis (GFC) it became obvious that the existing financial regulatory framework was not sufficient for ensuring the stability of the financial system as a whole (Borio ,2003). Therefore the microprudential approach promoting protection at bank level should be reconsidered and replaced by a regulatory scheme which would ensure systemically safeness. Such scheme is called macroprudential policy and has become a mandate for both policymakers and Central Banks' agents.

The term " macroprudential" has become popular after the global financial crisis of 2007. However, it is difficult to identify when it was firstly used. According to BIS records its first appearance was in an international context in 1979, at a meeting of the Cooke Committee (the forerunner of the present Basel Committee on Banking Supervision, BCBS). The core subject of the meeting was the rapid credit expansion in developing countries as well as the contingent negative impact on the financial stability.

On 1986, macroprudential term appears in a public report highlighting several vulnerabilities such as regulatory arbitrage, the underpricing of risk on new instruments, the overestimation of their liquidity, the opaqueness of risk resulting from interconnections in the financial system, the danger of risk concentrations, the overloading of payment and settlement systems, reflecting a sharply higher volume of transactions, the potential for increased market volatility, and stronger growth in overall debt (Clement, 2010).

By the late 1990s, the term “macroprudential” is starting to be used outside central banking circles too, with Asian financial crisis in 1997 being the main trigger. The main policy follow-up contained the development of better statistics to assess financial system vulnerabilities, so-called “macroprudential indicators” (MPIs) (IMF (2000)). These were subsequently integrated into the Financial Sector Assessment Programs (FSAPs), aimed at performing thorough assessments of such vulnerabilities.

In 2000, the General Manager of the BIS, delivered a speech at the International Conference of Banking Supervisor stating the two distinguishing features of the macroprudential approach: a) the cost limitation of financial distress in terms of output (the macroeconomy) and b) the recognition that aggregate risk was dependent on the collective behavior of financial institutions (“endogenous”).

In turn, the macroprudential approach appeared to have two dimensions, pointing to distinct policy implications. One was how risk evolved over time, with special reference to the financial cycle that is, the mutually reinforcing processes between the financial system and the real economy (later termed the “time dimension”). This became also known as the “procyclicality” of the financial system (Borio et al., 2001). Addressing this issue called for the prudential framework to induce a build-up of buffers in blooming times so that they could be sourced in bad times and thereby would act as stabilizers. The second dimension was how risk was distributed within the financial system at any point in time (later termed the “cross-sectional dimension”). The focus here was on institutions exposed in the same manner within the financial system and the interrelations between them. A calibration of prudential tools with respect to the systemic significance of individual institutions (i.e. their contribution to overall risk), was necessary. For example, institutions whose failure was more disruptive for the system as a whole would be subject to tighter standards(Borio et al., 2001).

Following the crisis, however, the cross-sectional dimension became important, mainly as a result of concerns over systemically significant institutions and the associated “too big to fail” problem. Finally, the usage of the term in the public sphere is to be employed for almost every policy designed to address systemic risk or concerns that lie between the macroeconomy and financial stability, no matter which tools are used.

2.3 Macroprudential policy goals (intermediates and ultimate)

The **ultimate** goal of macroprudential supervision is to guard stability in the financial system as a whole while boosting its resilience and diminishing systemic risk in order to achieve economic growth. The ultimate goal of macroprudential supervision is supported by intermediary targets of macroprudential policy, which are highlighted by transparency and accountability. The intermediary targets are defined after the assessment of the subjacent market weaknesses and the particular characteristics of a country's financial system which can be a source of systemic risk.

The **intermediary** targets of macroprudential policy are the following:

1. **Limiting and preventing excessive credit growth and leverage**

Beyond dispute, most of the economic crises are related with excessive credit growth. During the boom phase of the business cycle, banks underestimate the risk related with credit expansion. Therefore, they tend to grant too many loans without really checking the repayment abilities of the borrower. As all banking institutions within the financial system of a given country act like that and as the economy enters the downside phase of the business cycle, a credit crisis will arise and it will worsen the current state of the economy. As a result , banks will be unwilling to grant loans in the real sector of the economy whereas they will lose money because existing borrowers will delay payments given the tough economic conditions. Consequently, the liquidity in the market will reach at very low levels and a liquidity crisis will follow.

As far as the financial institution is concerned, it will address to alternative financing sources (capital markets, for example) in order to cover the borrowing cost as well as their financial obligations. In addition they will sell their assets immediately (fire -sale assets) leading in the shrinkage of asset-side of their balance sheet as well as their equity. Therefore the leverage ratio, which is equal to debt / equity, will substantially increase causing a blow in its reputation and solvency.

2. **Limiting and preventing excessive asset side- liability side maturity mismatch as well as liquidity deficiency**

As Saunders notes in his book: "Financial Institutions Management: A Risk Management Approach ", one of the main functions of the financial institutions is that they act as assets convertors by purchasing financial liabilities such as stocks, bonds which are issued by enterprises and are called Primary Securities. Moreover, financial institutions finance those liabilities by selling financial claims to households-investors in the form of deposits, security contracts etc, which are called secondary securities.

Consequently, the asset-side maturity is different from the liability- side of a bank's balance sheet. In fact, banks wish to create liabilities of short-term maturity whereas they fund assets of long-term maturity, leading to a maturity mismatch. To offset the maturity mismatch risk, they coordinate the cash inflows with cash outflows by matching the maturity

of income generated by assets with the maturity of interest regarding liabilities. However, according to Saunders " maturity matching is not necessarily harmonized with the assets' conversion because those two functions cannot be executed simultaneously" . Finally, the maturity match offsets the interest risk approximately because of two factors: the duration gap and the capability of financing assets and liabilities through equity.

3. **Limiting the direct and indirect concentration of financial exposures**

Financial institutions are often tempted by the over performance noticed in assets such as entrepreneurial loans and loans to other banks which make them ignore safety which is offered by a differentiated portfolio. Because of the fact that the performance of the assets in question are very sensitive for any price fluctuations , banks are exposed to profitability risk.

4. **Limiting irrational decisions in order to diminish moral hazard and negative impacts on financial system**

This kind of risk is a result of some mechanisms in the financial system which lead to the adoption of irrational behavior as well as to accumulation of systemic risk. For example, financial institutions which are characterized as " too big to fail" can be a source of frustration for regulatory authorities as the resolution procedure may have a negative impact on the fiscal budget and consequently in real economy.

5. **Enhancing financial systems' infrastructure**

There is an attempt to diminish the contagion disperse in the financial system by timely recognizing and minimizing structural risks which may put in danger financial market's infrastructure

2.4 Macroprudential instruments

As mentioned earlier, macroprudential policy aims to maintain stability in the financial system as a whole. In order for this goal to be achieved , it is necessary that systemic risk diminishes. But first, we need to define system risk. Systemic risk is the unavoidable risk which can influence the value of any security or portfolios of securities invested either in domestic or foreign markets. According to IMF (2010), there are 4 groups of systemic risk:

1. Risks which are generated from excessive credit growth and credit driven asset inflation
2. Risks which are due to excessive leverage and deleverage
3. Systemic liquidity risk
4. Risks which are related to fluctuate capital flows, including lending in foreign currency

Supervisory authorities make use of either purely macroprudential tools or "borrow" tools typically belonging to another type of policy (eg. monetary) to address systemic risk. Therefore, it is necessary to mention that the literature on specific macroprudential instruments can be categorized in various – in part overlapping – ways. Taken from BIS(2008), the following table provides an example of a taxonomy of macroprudential tools.

Table 2.2

Macroprudential instruments

1. Risk measurement methodologies	**Examples**
By banks	Risk measures calibrated through the cycle or to the cyclical trough
By supervisors	Cyclical conditionality in supervisory ratings of firms; Develop measures of systemic vulnerability (e.g. commonality of exposures and risk profiles, intensity of inter-firm linkages) as basis for calibration of prudential tools; Communication of official assessments of systemic vulnerability and outcomes of macro stress tests;
2. Financial reporting	
Accounting standards	Use of less procyclical accounting standards; dynamic provisions
Prudential filters	Adjust accounting figures as a basis for calibration of prudential tools; Prudential provisions as add-on to capital; smoothing via moving averages of such measures; time-varying target for provisions or for maximum provision rate
Disclosures	Disclosures of various types of risk (e.g. credit, liquidity), and of uncertainty about risk estimates and valuations in financial reports or disclosures
3. Regulatory capital	
Pillar 1	Systemic capital surcharge; Reduce sensitivity of regulatory capital requirements to current point in the cycle and with respect to movements in measured risk; Introduce cycle-dependent multiplier to the point-in-time capital figure; Increased regulatory capital requirements for particular exposure types (higher risk weights than on the basis of Basel II, for macroprudential reasons)
Pillar 2	Link of supervisory review to state of the cycle
4. Funding liquidity standards	Cyclically-dependent funding liquidity requirements; Concentration limits; FX lending restrictions; FX reserve requirements; currency mismatch limits; open FX position limits
5. Collateral arrangements	Time-varying Loan-to-value (LTV) ratios; Conservative maximum loan-to-value ratios and

	valuation methodologies for collateral; Limit extension of credit based on increases in asset values; Through-the-cycle margining
6. Risk concentration limits	Quantitative limits to growth of individual types of exposures; (Time-varying) interest rate surcharges to particular types of loans
7. Compensation schemes	Guidelines linking performance-related pay to ex ante longer-horizon measures of risk; back-loading of pay-offs; Use of supervisory review process for enforcement
8. Profit distribution restrictions	Limit dividend payments in good times to help build up capital buffers in bad times
9. Insurance mechanisms	Contingent capital infusions; Pre-funded systemic risk insurance schemes financed by levy related to bank asset growth beyond certain allowance; Pre-funded deposit insurance with premia sensitive to macro (systemic risk) in addition to micro (institution specific) parameters
10. Managing failure and resolution	Exit management policy conditional on systemic strength; Trigger points for supervisory intervention stricter in booms than in periods of systemic distress
Source: Adapted from BIS (2008).	

Some of the above mentioned tools are addressed to cross sectional dimension of financial stability - i.e. reducing risk within individual institutions- whilst other are addressed to combat procyclicality- i.e to reduce the interaction between financial system and real economy which amplifies the magnitude of a financial crisis.

An alternative distinction of macroprudential instruments refers to the target that such tools are addressed. The distinction in question- also adopted in this thesis- is : credit-related measures, liquidity-related measures and capital-related measures

1) Credit-related measures

<u>Caps on the loan-to-value (LTV) ratio</u>

Caps on LTV restrict the size of loan relative to the value of the underlying collateral. The LTV limit generally applies at the time of the loan origination and includes also down-payment requirements. The calibration of LTV can also take into account factors other than the value of the collateral[1].

[1] The definition is extracted from Budnik, K. and Kleibl, J. (2018) 'Macroprudential regulation in the European Union in 1995-2014: introducing a new data set on policy actions of a macroprudential nature' , *European Central Bank*, Working Paper Series No 2123

This tool is used for limiting and preventing excessive credit growth and leverage as well as direct and indirect concentration of exposures. A high LTV illustrates that the lender's coverage against collateral value reduction is small.

Debt (service)-to-income – D(S)TI ratio

DTI ratio is a prudential tool which records the percentage of income which is used for interest and depreciation payments and it is related with the time dimension of systemic risk. This ratio is useful for quantifying the effect that payment of household's debt has on their budget constraint (Piraeus Bank, 2015). It can be used as a standalone policy or jointly with other tools. In the first case, it ensures quality of asset side components. In contrast, when used together with LTV ratio, it impedes household's ability to borrow money from banks.

DSTI limits restrict the size of total debt service payments (including interest rate payments) to a fixed multiple of household income or, in some cases, to a fixed multiple of household income less household expenditure. The subcategory includes also criteria based on stress-testing factors such as interest rate risk and foreign exchange risks which impact maximum household indebtedness level.

Caps on foreign currency lending

A foreign-currency loan is a credit agreement where the credit is denominated in a currency other than that in which the consumer receives the income or holds the assets from which the credit is to be repaid; or the credit is denominated in a currency other than that of the member state in which the consumer is resident.

A foreign currency loan is a source of exchange risk for the borrower which is transformed into credit risk for the lender. Should the exposure in both foreign exchange risk and credit risk is large , then it can become systemic and threaten financial stability. In order to avoid that, caps (or higher risk weights , deposit demands etc) on foreign currency loan are imposed.

Ceilings on credit growth

A ceiling can be imposed either on the sum of bank lending or on the credit expansion in a particular sector. In the first case, this measure contributes in mitigating credit/asset price cycle and, therefore, is related with the time dimension of systemic risk. In the second case, however, imposing a ceiling in a specific sector, such as residential market, reduces inflation pressures in the asset side of a bank's balance sheet or limits risk exposure and , therefore, is related with the cross sectional dimension of systemic risk (IMF, 2010).

2) Liquidity-related measures

Limits on net open currency positions/ currency mismatch

Financial institutions often sell and purchase foreign exchange currency to increase their assets (eg. lending or making deposits in foreign currency) . The difference between balance assets and liabilities in foreign currency is the net open position. It is , therefore, a measure of foreign exchange risk.

Limits on net open currency positions/currency mismatch reduces banks' foreign exchange risk exposure as well as the externalities being caused due to banks' behavior. Large movements in foreign exchange rates may be a source of credit risk especially for those banks who have received foreign exchange loans without hedging their position (IMF, 2010).

Consequently, the net open position for each currency is defined as the result of summing the following (negative or positive) components:

- Net spot position, which equals to total assets (before subtracting loan loss provisions) minus liabilities (including interest) in foreign currency.

- Net forward positions, which equals to receivables minus payables of foreign exchange transactions, currency futures, principal of currency swap which are not included in the spot position.

- Irrevocable guarantees

Limits on maturity mismatch

A maturity mismatch occurs when a financial institution mismatches its balance sheet by having more short term liabilities than short term assets, as well as owing more assets than liabilities for medium and long term obligations. Limits on maturity mismatch is a prudential tool which sets a limit in duration gap - a source of systemic risk. In a liquidity crisis, financial institutions are not able to serve their short-term liabilities because of the different maturity of the balance sheet's items. Therefore, banks are forced to liquidate their assets immediately (fire sales of assets) in order to receive income and are subject to a fire sales cost which is transmitted in the financial system (IMF, 2010).

Reserve requirements

The reserve requirement is regulation imposed by Central Bank, which sets the minimum amount of reserves that a commercial bank must held. In other words it is a particular percentage of the amount of deposit liabilities the commercial bank owes to its customers.

It is a monetary policy tool which is addressed to systemic risk in two ways: First, reserve requirements affects directly credit growth by reducing credit/asset price cycle, which is

related with the time dimension of systemic risk. Second, reserve requirements provide a liquidity cushion which can be used in a liquidity crisis (IMF, 2010).

3) Capital-related measures

Countercyclical/ time-varying capital requirements or buffer CCyB

A capital buffer is mandatory capital that financial institutions are obliged to hold in addition to other minimum capital requirements. This measure was introduced in the Basel III regulatory reform and aims to reduce the procyclicality of lending .

In other words, it ensures that banking sector capital requirements take into consideration the macro-financial environment in which banks operate. They contribute in preventing financial institutions from taking excessive risk during the "good" times of the economy. In downturns, the regime should reduce the hazard that the credit supply will be less by regulatory capital requirements that could underestimate the performance of the real economy resulting in additional credit losses in the banking system (www.bis.org)

According to Bank of Greece, " The countercyclical capital buffer ratio is set to 0%-2,5% (exceeding 2,5% in extreme situations) and it is expressed as a percentage of the credit risk exposure for all the financial institutions within a country".

Time-varying/dynamic provisioning

Time-varying/dynamic provisioning is a way to make balance sheet provisions using performing loans during the upward phase of the business cycle. Those predictions aims to reduce the pro-cyclicality of the financial system during the downswing of the business cycle.

In particular, policy designers adjust time-varying/dynamic provisioning in a way that it acts countercyclically on bank lending. Finally, time-varying/dynamic provisioning increases during the upward phase of the business cycle in order to reduce credit growth and diminishes during the downward phase of the business cycle to support bank lending (IMF, 2010).

Restrictions on profit distribution

It is a prudential rule aiming at ensuring banks' capital adequacy. Since undistributed profits are added to bank capital, restrictions on profit distributions have an counter-cyclical effect on bank lending.

Factors affecting the choice of macroprudential instruments

a. Economic and financial growth

Emerging markets were largely using macroprudential tools before the onset of global financial crisis in 2007. In these countries financial markets are shallow and financial sector takes over only a small percentage of the total economic activity. Therefore, there is a great need for dealing with market failures and reducing liquidity risk by using liquidity- related measures (IMF, 2010).

Developed economies also use macroprudential tool after the global financial crisis in 2007. The financial system is rather developed in those countries and with a large degree of financial growth , therefore macroprudential tools that are used are of credit and liquidity nature (IMF, 2010).

b. Foreign exchange rate regime

Countries with fixed exchange rate system tend to use macroprudential tools more than countries with flexible exchange rate system since a fixed exchange rate policy limits the space for interest rate policy. In those countries , credit growth is related with capital inflows as banks tend to borrow in foreign currency. Countries with fixed exchange rate system use credit related measures to address excessive credit growth since interest rate policy is limited, as well as liquidity-related measures to administrate risks caused by external borrowing.

c. Type of shocks

As far as emerging markets are concerned , capital inflows are considered as a shock causing a great impact in financial system given the small size of the economy. For Eastern European Countries, capital inflows is considered as a shock and credit-related measures are imposed in order to reduce this impact. On the other hand, Latin America's countries use liquidity related measures (eg. limits on NOP) to limit capital inflows.

2.5 Interaction with other policies

In general, different economic policies are distinguished according to their goals, their instruments, and the authorities who control the instruments and are responsible for achieving the goals. For example, monetary policy is geared towards price stability and maximum employment, their tools are interest rates and money supply and it is being conducted by the central banks. Fiscal policy also aims to maintain inflation and achieve maximum level of employment through fiscal budget and the people in charge of its implementation are the government. Consequently, there is considerable interaction between the policies which must be taken into account in order to promote efficiency of the economic policy. In spite of this interaction, normally monetary and fiscal policies are conducted separately, with each policy taking the conduct and effects of the other policy into account (Svensson, 2018) .

By the same token, macroprudential policies interact with monetary, microprudential, fiscal, as well as competition policies to achieve price stability and maximum employment. In this context macroprudential policy, as other polices, can be motivated by the need to correct for externalities been brought about by other policies. Due to international dimension of macroprudential policy , international spillovers may exist which can overlap capital flow management (CFM) policies(Claessens, 2014) .

The following figure shows the interdependence between macroprudential policy and a range of policies in the context of financial stability and discuss the strength of this interactions which may vary across countries.

Figure 2.1: The relationship between macroprudential and other policies

Source: IMF staff

2.5.1 Monetary policy

As far as monetary policy is concerned, under flexible inflation targeting, there are two goals, price stability and accomplishing maximum employment. Price stability is achieved by stabilizing inflation around the inflation target whereas full employment expressed at the maximum sustainable employment rate is achieved through efficient resource allocation in the long run.

The instruments of monetary policy are the interest rate and communication. Communication regards the release of forecasts of the target variables, like inflation and unemployment, and forward guidance, such as announcing a policy-rate path, that is, a forecast for the policy rate. During a crisis, the set of instruments of monetary policy includes balance-sheet policies, for example large-scale asset purchases (quantitative easing), fixed-rate lending at longer maturities, and foreign-exchange interventions and exchange-rate floors. Monetary policy is being conducted by the central bank (Svensson, 2011).

Moreover , macroprudential policy contributes on the task of monetary policy addressing adverse financial shocks by setting a minimum of capital buffers, putting a cap on lending criteria such as loan-to-value and debt-to-service, or limiting the foreign exchange transactions. Examples of averse financial shocks are the zero lower bond, the risk of massive capital outflows from small open economies due to cuts in interest rates etc.

However, in the real world policies do not operate perfectly. This could be due to the fact that a policy is often subject to political pressures and time inconsistency issues. As such, conducting both policies may need to be done in a way that one policy complements the other. This complimentarity in policies explains the strong interest of central banks for pursuing an amplified macroprudential policy through the establishment of macroprudential frameworks. Of course, any coordination between monetary and macroprudential policy as well as other policies must be taken into such framework while keeping the established independence and credibility of monetary policy (IMF, 2013).

2.5.2 Fiscal policy

In the aftermath of the GFC, concerns were raised of fiscal policy absenteeism as a post-crisis measure alongside prudential policies, e.g. macroprudential instruments. The concerns are mainly associated with the design of fiscal policy failure to consider financial cycles and having a more financial stable focal point (BIS, 2017). Fragile financial systems have adversely impacted the balance sheets of banks' sovereign debt holdings and reduces the scope for fiscal authorities to implement countercyclical policies (Bordo and Meissner, 2016).

Therefore, appropriate fiscal and structural policies are critical to reduce the likelihood of macroeconomic shocks. The build-up of systemic risk can be driven strongly by macroeconomic imbalances—internal or external—and distortions that affect the composition of output (IMF, 2013).

A strand of fiscal policy is tax policy. Taxes can have an effect on the prices of assets. As future tax liabilities are capitalized, in principle, setting taxes during a boom can make bubbles less likely. On the other hand, future tax reduction announcements regarding returns on assets can augment the prices of assets, especially during downturns. For example, countries have used tax measures to support residential prices by taking away stamp duties on housing transactions or stretching mortgage interest relief. However these measures can be proved wrong as they may introduce further distortions and finally increase price volatility (IMF,2013). In turn, pigovian taxes and levies could address directly systemic externalities. In this context the International Monetary Fund strongly recommended the creation of a pigovian tax called "Financial Stability Contribution" (FSC) in order to discourage leverage and wholesale funding and simultaneously serve as a financing link of a credible and effective resolving mechanism. FSC could be levied either at a flat rate or varied to reflect individual institutions' contributions to systemic risk and changes in overall risk over time.

All in all, tax policies can contribute to systemic risk by encouraging leverage, or influencing asset prices which are biases to be corrected by macroprudential authorities . While macroprudential policymakers cannot be in control of fiscal and structural policies, they can help analyze the underlying macroeconomic risks and imbalances, and inform the policy makers that are in a position to take appropriate action because fiscal policy in the aggregate matters as it can be a source of procyclicality.

2.5.3 Microprudential policy

Microprudential regulation aims to ensure the safety of individual banking institutions. It examines the responses of an individual bank to exogenous risks. Its main drawback is that it largely ignores the systemic importance of individual institutions in terms of its size, complexity, extent of leverage and interconnectedness with the rest of the financial system (Ekpu, 2016).

On the other hand, the objective of a macroprudential policy is to address systemic risk - a result of financial distress which can cause the collapse of all or a major part of the financial system. Juxtaposing microprudential and macroprudential approach, the former's objective is to protect consumers (investors and depositors) who have claims on financial institutions, while the latter's is to avoid output losses or reduce the negative externalities from financial system failure (Ekpu, 2016) .

All in all, macroprudential policy is based on microprudential regulation and supervision. Most often, microprudential objectives will be harmonized with macroprudential policies, but conflicts may arise (IMF, 2013). This is mostly clear in downturns when a macroprudential perspective may loosen macroprudential tools while the microprudential perspective may tighten requirements to protect depositors or investors. For example, microprudential authorities may call for increasing capital ratios in

bad times, while macroprudential authorities will be concerned that this leads to excessive deleveraging with adverse effects on the economy. In good times, conflict of interests are less likely to happen, however, the macroprudential approach will impose greater prudence.

2.5.4 Competition Policies

Competitive processes within the financial sector can create incentives for excessive risk-taking, leading to tensions between competition and financial stability . It is well-known that, in general, competition is likely to result in more cost-effective production of goods and services and higher efficiency (Ratnovski, 2013). However, competitive procedures within the financial sector can also raise systemic risk. This can create tensions between the objectives of competition authorities and those of the macroprudential policymaker, in particular when the macroprudential authority is concerned about the build-up of risk over time.

Mergers between financial intermediaries have the potential to create institutions that are "too big to fail." On the other hand, the creation of large and complex financial institutions due to acquisitions and mergers may prove be "too difficult to resolve." Consequently ,macroprudential authorities are strongly interested in controlling the procedure of mergers and takeovers between financial institutions or taking preventive action to break-up financial institutions, to increase resolvability (IMF, 2013).

To sum up, competition policy for the financial sector requires a macroprudential approach. One way of assuring that the interaction between competition and systemic risk is taken into consideration is to convey existing powers of competition policy, including licensing, take-over control and break-up powers to the prudential authorities. Another is to make sure that mechanisms of coordination and consultation between the prudential and competition authorities are strong and to insert financial stability as a secondary objective of the latter. Finally, where there is a distinction between the micro-and macroprudential authorities, the macroprudential body should be in charge of the design as well as the application of these policies.

2.6 Macroprudential policy in the European Union

In the euro area, the institutional framework includes various authorities charged with a macroprudential proxy at a county level, and the ECB with specific macroprudential competence at the Banking Union level. The ECB acts as a supervisor in the banking sector of the Eurozone and the EU as a whole, to control for vulnerabilities and resilience of the financial system. It accomplishes these tasks together with the other central banks of the EMU and the European System of Central Banks. In other words, macroprudential policies are imposed at a country level, but within a system of central supervision. In this context, macroprudential policies are grouped into two categories. The first one includes those based

on member states legislation whereas the second one contains those stemming from regulatory initiatives at EU level. For example, lending standards restriction policy as expressed by caps on loan-to-value(LTV) and liquidity requirements policy as set by net stable funding ratio(NFSR) are of a national preference. In turn, regular adjustment of exposure limits, CAR's and minimum capital requirements have been dictated by Basel I Accords and Standards as well as by the 1992 Directive on the Monitoring and Control of Large Exposure of Credit Institutions. It needs to be mentioned that 94% of the policy actions are legally binding -meaning that sanctions of monetary nature as well as activity restriction is imposed- whereas 6% are recommendations with no important sanctions.

The nature of a policy in the European Union can be either microprudential or macroprudential. Examples of the former are : a) minimum capital requirements- which are widely used- and b) large exposure limits whilst of the latter are: a) addressing general and sectoral credit growth, b) bank and household leverage, c) developments in asset prices and foreign currencies, d) exposure concentration, e) interconnectedness, f) maturity mismatches on banks' balance sheets and g) resilience of the financial system as a whole. In order to define one policy tool as macroprudential , three criteria need to be met. First, the tool in question must encompass systemic risk and be introduced by EU's Capital Requirements Regulation and Capital Requirements Directive IV (CCR/CRDIV). These include a set of capital buffers (countercyclical capital buffers, buffers for systemically important institutions, and systemic risk buffers) , sectoral risk weights, liquidity requirements (liquidity coverage ratio and net stable funding requirements) and large exposure limits. In this context, there also are tools imposed at a national level which are considered macroprudential by the legislative authority.

Secondly, the tool can be either (micro) prudential or monetary, however, aiming at macroprudential purposes. An example of microprudential measure is loan-loss provisioning, of monetary policy nature is marginal reserve requirements and of fiscal nature is taxes on financial institutions and activities.

Thirdly, prudential tools with structure and transmission channels similar to macroprudential instruments and at the same time have a system-wide impact. For example, minimum capital requirements.

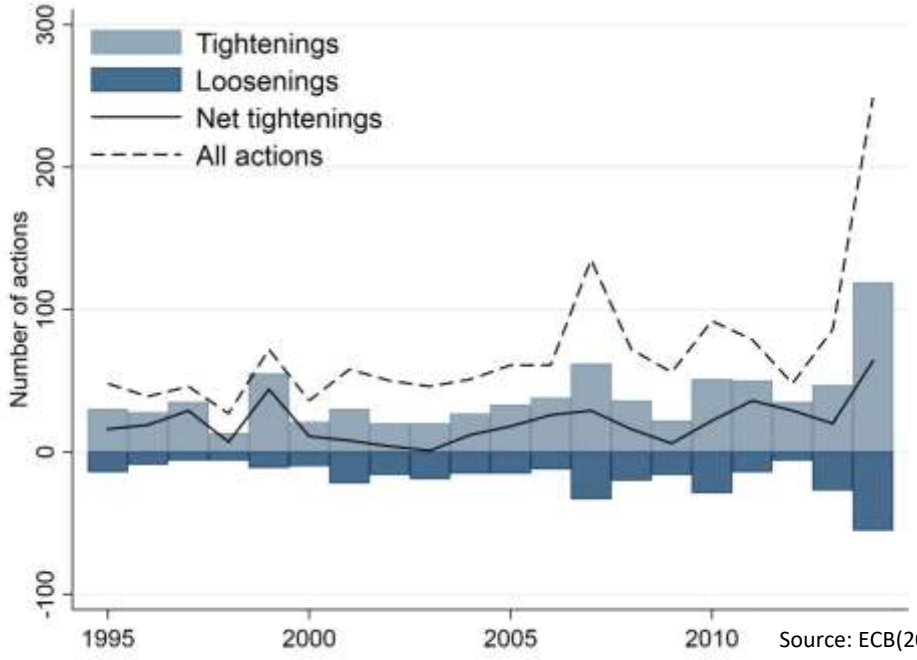
Policy actions within the EU were focused primarily in mitigating the concentration of exposure and secondary in enhancing the resilience of the financial system. To achieve that, most of the policy actions included tightening of measures (60% of policy actions between 1995-2015). Moderately tightened policy stance was imposed on loan-loss provisioning and lending standard restrictions whereas strongly tightened policy was implemented on capital buffers, liquidity requirements , minimum capital requirements and limits on large exposures.

The global financial crisis (GFC) was a benchmark for the reconsideration of the importance of macroprudential policy for addressing the procyclicality of financial system. In the pre-crisis period (1995-2007) limits on excessive credit growth were used to address procyclicality whereas in the post crisis period (2008-2014) capital buffers and liquidity requirements with an explicit countercyclical design . However, it became obvious that the aforementioned tools were not sufficient for combating procyclicality and this lead to the

introduction of countercyclical capital buffer as a direct measure of procyclicality in the new macroprudential policy framework.

Macroprudential policies in the European Union may follow common trends because of the fact that financial cycles are correlated across countries or as a result of common EU directives and regulations. These trends are examined in the light of tightening and loosening policy actions for different macroprudential instruments at the aggregate EU level over time which are illustrated in the following figure. The chart brings together the information for all categories of policy actions of a macroprudential nature. The light blue bars point out the number of tightening policy actions, while the dark blue bars denote the number of loosening policy actions. The solid line supplies a simple measure of policy stance by showing the net number of tightening policy actions (i.e. tightening actions minus loosening actions). Moreover, the dashed line reports the total number of actions, which also includes actions with an ambiguous impact

Figure 2.2 Evolution of macroprudential policy stance in the EU between 1995 and 2014



Source: ECB(2018)

In the mid-90's we notice a gradual tightening of macroprudential policy stance in the EU which somehow reflects the late phasing in of the Basel I Accord via adoption of the relevant EU directives in several EU jurisdictions. From 2000 until 2005 it was a period of moderate adjustments meaning that there was loosening of policy actions across countries which canceled out the effect of the existing tightened measures . From 2005 until 2007 - during the upswing of the financial cycle- another policy tightening was implemented but again it was cancelled out by the loosening polices imposed from 2007 until the outbreak of the global financial crisis (GFC) in 2008. In 2010 onwards there is again a notable tightening of macroprudential policies aiming at augmenting the resilience of banking sectors and

which was at the zenith in the significant tightening observed in 2014 as a result of the introduction of CRR/CRDIV package.

As mentioned earlier the implementation of macroprudential policy is not the same for all countries within the European Union. Besides some obligatory regulations for all state-members, macroprudential policy is mainly exercised by the national authorities. To depict the differences in the intensity of macroprudential policy actions across countries we use the following figure. It reports the number of activated instruments of a macroprudential nature for each country until 2014. As we notice there is a significant variation in the intensity with which EU countries have utilized macroprudential tools. Specifically, GR, BG, CR, CY, SL, PL, LV, IE, SK and HU activated more than 30 policy instruments until 2014 , whilst the CZ, ES, DE, DK, the UK and IT[2] activated less than 15 instruments. Consequently, new country member entries from 2004 onwards have been on average much more active users of macroprudential tools than existing member states. This is likely related to the fact that some of these countries experienced a financial crisis during the 1990s (e.g. the CZ or HU), and almost all of them faced post-transition challenges such as high volatility of macroeconomic and credit aggregates, occasional outflows of capital (or a risks), sudden changes in exchange rates or risks associated with high dollarization of the economy.

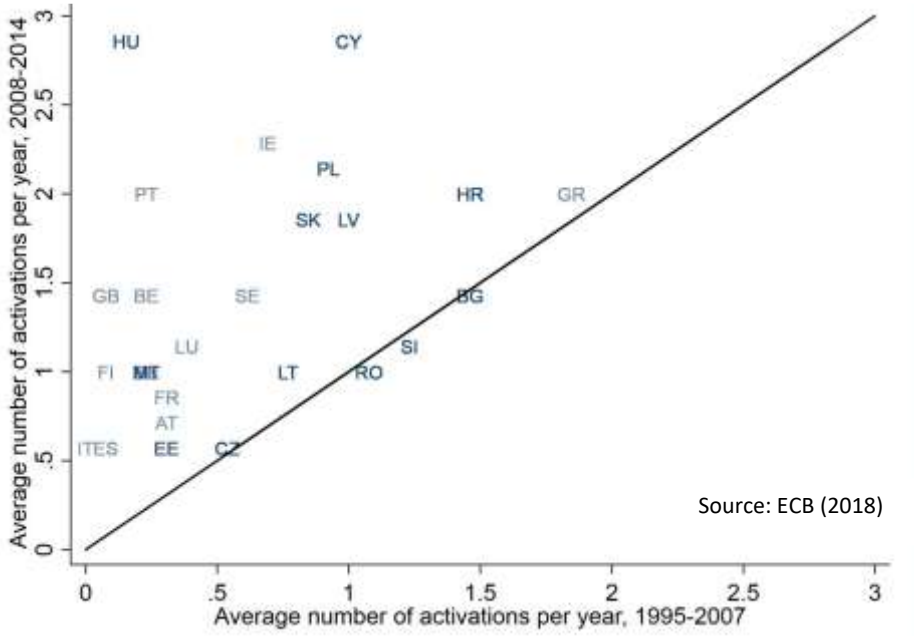
Figure 2.3 Number of activated policies of a macroprudential nature across EU member states until 2014

The next figure adds a time dimension to this comparison by plotting the average number of activated instruments per year during the pre-crisis period (1995-2007) against the average number of activated instruments per year during the post-crisis period (2008-2014). Countries lying below the 45^{o} line put into effect more policies prior to the crisis , whereas countries above the line activated relatively more policies between 2008 and 2014. It is clearly demonstrated that most countries activated a significantly higher number of

[2] GR: Greece, BG: Bulgaria, CR: Croatia, CY: Cyprus, SL: Slovenia, PL: Poland, LV: Latvia, IE: Ireland , SK: Slovakia, HU: Hungary , ES: Spain, DE: Denmark, DK: Denmark, UK: United Kingdom, IT: Italy , CZ: Czech Republic . A full list of European union's country codes is presented in Appendix

policies of a macroprudential nature per year during and following the crisis than prior to the crisis. This holds in particular for countries whose financial sectors were relatively strongly affected by the crisis e.g. CY, HU, IE and PT[3]. However, BU, CZ, GR,RO deviated from this trend as they were almost equally active in setting macroprudential policies during both periods. Especially Greece inserted a very high number of macroprudential measures both prior to the crisis, comprising a significant number of credit growth limits and lending standards restrictions, and following the crisis.

Figure 2.4 Average number of activated policies per year across EU member states during 1995-2007 and during 2008-2014



Source: ECB (2018)

One of the main purposes of macroprudential tools is to address systemic risk. One source of systemic risk may be credit growth especially when becoming excessive. Credit growth can be gauged by the year-on-year percentage in the stock of bank loans to the private sector. With regard to mortgage loans, the faster they expand the higher the risk of an asset bubble. This is due to the fact that excessive residential loans lead to a rapid increase in house prices.

In order to control credit growth, macroprudential authorities activated new tools or adjusted the existing ones. When new tools were activated such as new minimum capital requirements, capital buffers and new loan-loss-provisioning standards they indeed had a negative impact [4]on credit growth for households and enterprises. On the other hand, new sectoral risk weights did not seem to affect credit growth. Moreover, in countries where credit growth was on average lower after a policy change, it started to drop already a year prior to the entering into force of a measure, which could be due to possible announcement

[3] PT: Portugal, RO: Romania

[4] For the full analysis see European Semester: Thematic factsheet – Banking sector and financial stability – 2017

effects. Regarding the adjustment of existing tools , loan-to-value, loan-to-income, debt-to-income or debt-to-service-to income limits and other lending standards restrictions provided sufficient evidence of their effectiveness in mitigating credit growth. Finally, the tightening of maturity mismatches seems also to reduce credit growth.

Chapter 3: Literature Review

In the last decade, hundreds of empirical studies have been carried out regarding macroprudential policy and its effects on the economy. Because of the multidimensional nature of macroprudential policy, it would be a bias to mention only studies focused on bank risk which is the topic treated by this thesis. In this chapter I examine empirical studies concerning , besides bank risk, economic growth, market risk, residential market and income inequality.

Frost and Van Stralen (2017), examine the relationship between macroprudential policy and Gini coefficient and how they affect market income inequality and net income inequality. They run panel regression of 69 countries over the period 2000-2013. They use data from Standardized World Income inequality Database (SWIID) (2016) regarding the macroeconomic indicators and from Cerutti et al. (2017, a) regarding macroprudential indicators. Given that there are substantial differences for the definition of income distribution as well as its sampling and frequency , the authors use SWIID database because it distinguishes market income inequality measured as a Gini coefficient of income prior to government's redistribution policies and net income inequality after redistribution. In other words, SWIID database disentangles market outcomes from final disposable income inequality. As far fas macroprudential index database is concerned, authors make use of Cerutti's database (CCL) which converts the General Macroprudential Policy Index data into an annual panel for 119 countries.

They run two panel regressions using as dependent variable Gini coefficient for market income measure and net income measure. As independent variable they use a lagged Macroprudential index , a vector of lagged control variables and country and year fixed effects. Specifically, the MaP indicators from CCL are dummy variables that take value 1: if a particular measure is used, 0: otherwise. The Macroprudential measures taken into account in the panel regression are: concentration limits, countercyclical and fx reserve requirements, interbank exposure limits, loan-to-value(LTV) and debt-to-income (DTI) limits, dynamic loan loss provisioning and countercyclical capital buffers . Concentration limits prevent banks from building up large exposures to specific borrowers whereas interbank exposure limits, countercyclical and fx reserve requirements reduce bank interconnectedness and connected lending. LTV an DTI limits constrict the borrowing ability of borrowers without extensive income or collateral. Dynamic loan loss provisioning may restrict dividends of banks during periods of high profitability, which could impact the income position of bank shareholders.

As far as control variables are concerned, they include: i) trade openness as measured by the ratio of exports and exports to GDP, ii) capital account openness , iii) domestic credit to GDP, iv) the ratio of the info and communications technology (ICT) capital stock to GDP, v) human capital as measured by the average years of schooling in the population, vi)government expenditure on cash transfers and subsidies; vii) unemployment rate, vii) dummy for banking crisis, which takes value 1 : if a banking crisis happened; 0 otherwise.

They found that market inequality has a positive relationship with concentration limits, reserve requirements and interbank exposure limits. Although there is a positive relationship between market inequality and loan-to-value and debt-to-income limits, it is not statistically significant. On the other hand, market inequality is negatively correlated with leverage ratio requirements and limits on FX lending, meaning that if one of those two indexes is increased, then market inequality will decrease. There is a negative relationship between dynamic loan loss provisioning and financial sector levies, though insignificant. Moreover, the dummy banking crisis variable seems to play an important role as in countries that have experience a banking crisis in the last 5 years, market inequality was increased.

As far as income inequality is concerned , it is positively correlated with concentration limits, loan-to-value and debt-to-service limits. In contrast, interbank exposure limits and reserve requirements are not statistically significant anymore. With regard to banking crises, they maintain their positive coefficient when examining income inequality too.

Should we compare the two models, the relationship between MaPs and net inequality is stronger than MaPS and market inequality. Moreover, borrower based instruments, such as loan-to-value and debt-to-income limits seem to have a positive relationship with income inequality. This has a ring of truth to it, because LTV and DTI limits on mortgages can impede a household's purchasing ability to buy a house. In general, MaPs improve credit market and asset price developments over the financial circle, resulting in worsening wealth redistribution. However, MaPs they do diminish financial stability risks caused by international capital flows.

To check if the results above are robust, the authors run another panel regression where they use as dependent variable income shares and as independent variable the change in macroprudential policy expressed as a dummy. They also found that there is a positive relationship between income shares and interbank exposure limits, loan-to-value and reserve requirements.

All in all, there is positive relationship between some of macroprudential measures and market and income inequality. Especially for countries that use interbank exposure limits, concentration limits and countercyclical reserve requirements , it seems that Gini coefficient for both market and net inequality will increase in the next year. For emerging and developing countries, limits on FX lending and leverage ratio affects negatively net and market inequality. For countries that use loan-to-value and debt-to-income , Gini coefficient for net income increases, however, these results are not statistically significant.

The purpose of the article" Macroprudential Policy: What instruments and how to use them?" (2011) written by Lim, Columba, Costa, Kongsamut, Otani, Saiyid, Wezel and Xu is to evaluate the effectiveness of macroprudential tools in reducing systemic risk over time and across institutions and markets. Their research is a stepping stone to international debate on how to make macroprudential policy operational. Actually, they verify the conditions under which macroprudential policy appears to have a significant impact or not.

Their dataset consists of 49 countries -both emerging and developed- for the period 2000-2010 and they use a panel regression to analyze the impact of macroprudential instruments on four measures of systemic risk: credit growth, systemic liquidity, leverage and capital flows. In particular eight macroprudential tools are inserted as dummies to see if they restrict procyclicality of credit growth and leverage, that is their tendency to reinforce the business cycle. Namely , these tools are: caps on the LTV, caps on the DTI, caps on foreign currency lending, ceilings on credit or credit growth, reserve requirements, countercyclical/time-varying capital requirements, time varying/dynamic provisioning and restrictions on profit distributions. In addition they use the correlations between GDP growth and credit growth and leverage to examine if the stage of the business cycle affects the effectiveness of macroprudential tools. By the same token, they take into account common exposures between financial institutions as it is a factor which can influence the rest two dependent variables they investigate, liquidity and capital flows. Common exposure is measured by the following proxies, limits on net open position and limits on maturity mismatch. Moreover, they include dummies for the degree of economic development, the type of exchange regime and the size of the financial sector to check for the efficacy of macroprudential tools across countries.

However, the specification of the panel regression addressed several challenging issues, which are demonstrated below:

1. How to isolate the impact of macroprudential instruments on the specified target when different policies are also addressing at the same target simultaneously.

- Solution: For monetary policy, interest rate was introduced and for fiscal policy, GDP growth was used as a proxy. The reason why they used GDP growth instead of fiscal deficit is because of the latter is highly correlated with interest rate and it would introduce multicollinearity in their model.

2. How to adjust the general effect of such instruments in the context of country-specific characteristics.

- Solution: They use dummy variables to control for the type of exchange rate regime, size for financial sector and degree of economic development. In addition the panel regressions' fixed effects takes into consideration other unobserved country-specific characteristics.

3. How to avoid estimation biases to ensure a correct quantification of the outcome of macroprudential instruments.

- Solution: This is addressed by employing the System Generalized Method of Moments, which is used for panel data with endogenous explanatory variables.

Moving on to the general results of the regression , it seems that the degree of economic development, the type of exchange rate regime and the size of the financial sector does not have an impact on the efficacy of the instruments. In other words, they have a statistically insignificant coefficient. When the dependent variable is credit growth (yoy change in inflation -adjusted claims on the private sector) , five out of ten macroprudential dummies have a negative coefficient which is also statistically significant. Namely, these are: caps on the LTV, caps on the DTI, ceilings on credit growth, reserve requirements, time-varying/dynamic provisioning. This points out that these tools may lower the correlation between credit growth and GDP growth.

As far as systemic liquidity is concerned , credit expansion funded from sources other than deposits ($\frac{credit}{expansion}$) is used as a proxy for wholesale funding in the estimation of the efficacy of limits on maturity mismatch. The reason why the latter is considered as a source of systemic risk over countries. It seems that limits on maturity mismatch do have an impact on dependent variable as its coefficient is statistically significant.

With regards to leverage ($\frac{assets}{equity}$) , six out of ten tools have a statistically significant coefficient. These tools are caps on DTI, ceilings on credit growth, reserve requirements, caps on foreign currency lending, countercyclical/time varying capital requirements and time-varying/ dynamic provisioning. In other words, capital related measures are expected to reduce procyclicality of leverage.

Finally, capital flows and currency inflation- proxied by ($\frac{foreign\ liabilities}{foreign\ assets}$) - seems to be affected negatively by limits net open positions. In particular, the results suggest that for every $ of foreign assets held, the foreign liabilities of countries with this instrument are 15% less than those without it.

In addition, they suggest some country-specific circumstances -such as the quality of supervision, the phase of the credit cycle, the extent to which circumvention and arbitrage are possible, as well as the ability of authorities to take coordinated policy actions to limit circumvention - which may influence the effectiveness of the instruments and should be taken into account.

All in all, they reach the following conclusions : Regarding credit growth or asset price inflation, credit-related instruments may be useful. Of these, LTV and DTI caps can be kept in place, adjusted counter cyclically or targeted at specific sources of risk. Concerning liquidity risk, liquidity-related instruments such as limits on mismatch may be used, or limits on the net foreign currency position if the liquidity risk derives from foreign currency funding. In turn, capital related instruments may be suitable for dealing with risks arising from excessive leverage. In case that the aforementioned hazards derive because of capital inflows, all three types of measures can be used.

Claessens, Ghosh and Mihet (2014) study the effect of macroprudential policies over mitigating financial system vulnerabilities. The article starts on the premise that bank exposure towards risk is inherently procyclical and towards the "good" times of the economy bank is expanding which drives up the assets price as well as collaterals price, resulting in increasing loans to households and enterprises. In order for banks to support the increased lending , they raise capital either domestically or from abroad. Therefore their liabilities also increase. However, during the "bad" times of the economy banks' risk increases which leads to capital leakages and the bank fire sales their assets in order to receive income. Moreover a big part of the granted loans become non performing and thus compressing banks' profitability. As a result, banks become more vulnerable to shocks because of the loans regarding asset side and deposits regarding liability side.

Are macroprudential measures effective in reducing the procyclicality of their balance sheet shrinkage and thus systemic risk? In order to answer this question, they examine a sample of 18.000 observations regarding 2820 banks in 48 developed countries and emerging markets over the period 2000-2010. Of the 2820 banks, 1650 banks are in 23 developed countries and 1120 in 25 emerging markets. Data are from datastream and bankscope. They run a Generalized Method of Moments (GMM) regression to correct for the bias in the coefficients because of endogeneity. They use as dependent variable asset growth. In terms of right-hand side variables, they use a lagged dependent variable and they control for individual bank conditions by including a vector $Z_{i,t-1}$ which consists of a bank's leverage and liquidity (ratio of loans to deposits) positions in the previous year. To control for macroeconomic developments and policies, they include a vector $X_{c,t-1}$ of (lagged) variables. They also include year-fixed effects, to control for any (remaining) time-varying effects, such as changes in global economic or financial conditions (as well as US dollars inflation), and individual country-fixed effects, to control for any time-invariant country circumstances. In terms of the policy variables of interest, in the base regression the matrix $MaPP_{j,c,t}$ is our set of dummy variables that take the value of 1 during years in which a (group of) policy instrument j is used in country c and zero otherwise. Countries that never use any instrument are thus included, with values of zero for all instruments. The author distinguishes macroprudential policy instruments into 4 categories:

- Borrower based measures (LTV, DTI[5])
- Financial institutions' asset (CG, FC) [6], and liabilities-based measures (RR[7])
- Financial institutions' buffer based measures (DP, CTC,PRD)[8]
- Other measures [9](countercyclical provisioning, countercyclical capital, restrictions on profits distribution, restrictions on treatment of profits in regulatory capital)

[5] caps on loan-to-value, debt-to-income

[6] limits on credit growth and foreign currency

[7] reserve requirements

[8] dynamic provisioning, countercyclical requirements, limits on profit distribution

[9] The category Other contains some macro-prudential policies not classified as well as some macro-prudential policies whose observance was coded independently, with the latter possibly overlapping to some degree with the other policies already classified.

They also include interactions terms such as $MaPP_{j,c,t} * \Delta Y_{i,c,t-1}$, which is the interaction between the specific policy and the respective lagged bank risk variable, calculated as a matrix.

They found that macroprudential policy tools such as LTV, DTI, CG limits, FC and RR are negatively associated with assets growth. In turn, buffer-oriented measures (countercyclical capital requirements, dynamic provisioning, limits on profit distributions) do not have an impact on asset growth in a statistically significant way. The group of Other policies also has the expected negative sign and it is statistically significant.

Higher GDP growth is most often significantly associated with higher asset growth but asset growth is generally lower in downswings. Interaction of policies with the phase of cycle show cycle show that macro-prudential policies are somewhat more effective in booms than they are in busts.

All in all, when they differentiate the effectiveness of policies in reducing vulnerabilities according by the state of the economy, they validate that many help decrease risks during upswings. In shrinkage phases, nevertheless, most macroprudential tools appear to be less effective in retaining financial intermediation. This is reasonable given that many macroprudential policies aim to reduce vulnerabilities, while only some are more oriented towards the construction of buffers. Yet, some tools which assist the construction of buffers in good times generally do not aid to provide cushions that relieve crunches during downswings. As such, macro-prudential tools may be less auspicious to moderate adverse occurrences.

Altunbas, Binici and Gambacorta (2017) examine the effectiveness of macroprudential policies on bank risk, exploiting the cross-sectional dimension among countries. The paper in question complements existing empirical evidence on the effectiveness of macroprudential policies, for example Claessens (2015). The authors consider bank risk to be systemic risk which is by nature endogenous. By using macroprudential tools, policymakers aim at restricting bank risk-taking and the probability of the occurrence of a financial crisis. The authors check and evaluate how macroprudential tools impact specific measures of bank risk, such as the expected default frequency (EDF)[10] and the Z-score, using data for 3.177 banks in 61 countries over the period 1990-2012. Herein is quoted the baseline empirical model they investigate:

$$\Delta Risk_{i,k,y} = a\Delta Risk_{i,k,t-1} + b\Delta EDF\_NF_{k,t} + \gamma MP_{k,t} + \psi MC_{k,t} + \lambda BSC_{i,k,t-1} + \delta MP_{k,i} * BSC_{i,k,t-1} + \theta_i + \kappa_{k,t} + \varepsilon_{i,k,t}$$

where:

$\Delta Risk_{i,k,t-1}$ *is the annual change of the risk measure for bank i headquartered in country k, in year t, regressed on its own lag*

[10] EDF stands for Expected Default Frequency and is a measure of the probability that a firm will default over a specified period of time (typically one year). "Default" is defined as failure to make scheduled principal or interest payments. Z-score is an indicator of the probability of default which relies on balance sheet variables

$\Delta EDF\_NF_{k,t}$ *is the EDF change for the non-financial sector in country k . This variable aims at filtering out the effects of changes in the market price or risk due to the business cycle.*

$MP_{k,t}$ *indicates the change in the macroprudential tool*

$MC_{k,t}$ *is a vector of macroeconomic characteristics*

$BSC_{i,k,t-1}$ *is a vector of bank specific characteristics*

$MP_{k,i} * BSC_{i,k,t-1}$ *which is an interaction term between macroprudential indicator and bank specific characteristics*

θ_i *is a time invariant bank fixed effects*

$\kappa_{k,t}$ *is a dummy variable that takes value of 1 if a banking crisis happened; 0 otherwise*

As far as bank specific characteristics are concerned , these are bank size, proxied by the logarithm of a bank's total assets (SIZE), the liquidity ratio (LIQ) , capital to asset ratio (CAP) and share of deposits over total liabilities (DEP). The first three indicators isolate loan supply from monetary and macroprudential shocks and control for "too big to fail" considerations. The fourth indicator is a measure of a bank's strength against market movements. The author also distinguishes the banks into "high-risk" bank and "low-risk" bank. A "high-risk" bank is less strongly capitalized whereas a "low -risk" bank make relatively more loans than high-risk banks and are more efficient. Also bank profitability, measured by return on assets (ROA) is higher and more stable for low-risk banks. The bank data are pooled from BankScope, a commercial database maintained by Fitch and Bureau van Dijk.

As far as the macroeconomic characteristics are concerned, there are the difference between the real interest rate and the natural rate (DIFF, a measure for monetary policy stance) and the growth rate of nominal GDP (ΔGDP).

Moreover, special attention should be paid to macroprudential index which is actually an index that the authors constructed by using existing macroprudential index databases. The steps are the following: First they considered a dummy variable which is an aggregate index for evaluating the overall effectiveness of macroprudential tools when more than one measure is activated. This dummy takes +1 if a given macroprudential tool was tightened and -1 if it was eased, leaving zero elsewhere. They apply this for each macroprudential measure. Then they sum up all the different dummies for the various macrprudential tools , meaning that possible values are 3 and -3 or even 0.

Second they distinguished the macroprudential toolkit according to the following five categories : a) capital-based instruments, b) liquidity-based instruments, c)asset-side instruments, d) reserve requirements and e) currency requirements. The first two categories have as main objective to enhance the financial sector's resilience. Examples of such tools are countercyclical capital requirements, leverage restrictions, general or dynamic provisioning and the establishment of liquidity requirements. The last three categories are aimed at dampening the credit cycle. Examples of such tools are changes in reserve requirements, variations in limits on foreign currency mismatches, cyclical adjustments to loan-loss provisioning and margins or haircuts.

Finally they spited the changes in macroprudential tools into easing and tightening cases. The dummy MP_easing(MP_tighening) takes a value of 1 if the macroprudential tool was eased(tightened) in a given year and zero otherwise.

Back to the empirical model, Generalised Method of Moments (GMM) panel methodology by Blundell and Bond (1998) is used in order to obtain consistent estimates of the relationship between macroprudential policy and bank risk. This methodology is quite handy because it takes into account endogeneity issues as well as heterogeneity of the data which is caused by unobservable factors affecting individual banks. Moreover, the residuals have been checked for serial autocorrelation of order two (AR(2))and instruments have been checked for validity (Hansen test).

Their findings are presented as follows: MP's coefficient has a statistically significant negative sign , which means that it has a negative effect on bank risk. In other words, should we use macroprudential instruments, a tightening of such measure will reduce bank risk. Also their findings suggest that the effect is higher for weakly capitalized banks than for strongly capitalized ones, which they do have better access to markets for non-reservable liabilities (eg. certificate of deposits). On the other hand, should we use macroprudential instruments, a loosening of such measure will augment bank risk. Remember that the results are in accordance with the findings of Claessens, Ghosh and Mihet (2014). Regarding the interaction term between macroprudential tools and bank specific characteristics (MP Index *BSC index), it seems that it has a stronger effect on weakly-capitalized banks , smaller with low liquidity buffers and fewer deposits. We reach the conclusion that banks that are small , weakly capitalized and with a low proportion of deposit funding react more strongly to macroprudential shocks. This makes sense given that in real word small and less capitalized banks face difficulties and costs in raising non-secured deposits and consequently they take over higher risk by definition. As such, macroprudential measures will largely affect their risk-taking capacity.

As far as EDF_NF is concerned, it seems to have the expected positive sign because the higher the expectation for a business to go bankruptcy , the higher the expectation for a bank to go bankruptcy . Regarding DIFF variable, it shows a negative sign which means that a loosening in monetary policy will increase bank risk and , therefore , the probability of default for a bank. Moving on to the phase of the business cycle, as it is demonstrated by the change in nominal GDP (ΔGDP), it seems that an increase of ΔGDP reduces the risks that bank face as measured by Z-score as dependent variable.

To conclude with, capital-based instruments and liquidity-based instruments which are aimed at improving financial sector's resilience perform better in combating bank risk in comparison to those aimed at dampening the credit cycle. Moreover, reserve requirements perform better when tightened than loosened. However, this is not the case for currency requirements which do better when loosened.

Lastly , the authors checked for robustness of the results to the presence of possible heterogeneity in the effectiveness of macroprudential tools caused by different stages of

economic and financial developments across countries. In order to conduct this check, they divided the sample (3,177 banks and 20,870 observations) between advanced economies (2,286 banks and 15,144 observations) and EMEs (891 banks and 5,756 observations). in both groups of countries, macroprudential policies have a significant impact on banks' risk-taking. Moreover, the average effect of a macroprudential policy tightening, distinguishing those tools aimed at dampening the cycle (Cyclical) from those whose main objective is to enhance the financial sector's resilience (Resilience). On average, macroprudential tightening reduces the probability of a bank's default by 0.35% and the effect is higher in advanced economies (-0.47%) than in EMEs (-0.15%).

The purpose of the article " How good is the market as assessing bank fragility? A horse race between different indicators" (2002) by Paola Bongini, Luc Laeven and Giovanni Majnoni is to identify the ability of forecasting financial distress at a specific point in time and over time. To achieve that an empirical research is being conducted regarding the performance of three sets of indicators of bank fragility. Particularly, these indicators are : balance sheet, stock market prices and credit ratings. The data set is taken from publicly available information regarding individual banks who are active in the East Asian countries during the years 1996-1998 . The policy questions that are being asked is: To what extent can market signals of bank fragility be relied upon?

Actually, there is the general perception that market summarizes the information dispersed among market participants (semi strong form) but sometimes this information is too costly to be obtained. Consequently , the market's information power can be different among countries. In order to check this empirically , the policy question takes the following form: Do market possess the ability to effectively process the available information and send signals which are informative and have a discipline effect on market participants? Consequently, in order to answer this question the following banking performance indicators are used:

1. Balance sheet indicator , which is based on banks' accounting data

This indicator is used to predict the failure of individual banks. It is focused on the early identification of institutions that are facing financial difficulties. Therefore it acts as an " early warning system[11]".

In order to construct the indicator they did the following:

a) Firstly they construct a dummy from ex post information on bank distress which takes value 1 should the bank fails, and 0 otherwise

b) Use CAMEL type indicators(Capital adequacy, Asset quality, Management quality, Earnings, Liquidity) to summarize the given info into one dummy which will take value 1 should a bank's CAMEL ratio is worse than that of 75% of the sample, and 0 otherwise

[11] For an in-depth analysis of early warning systems, see Sahajwala , R., and Van den Bergh, P., Supervisory risk assessment and early warning systems , 2000, BIS

The higher the value of the balance sheet indicator, the higher the perceived bank's risk.

2. Implicit cost of deposit insurance of an individual bank. Laeven (1999) has proven that this cost is positively correlated with bank risk and can be used as a probability measure of bank distress.

This indicator is an implementation of Merton's model (1977) suggested by Ron and Verma (1986). Merton models the deposit insurance as a put option on the value of bank's assets. The key assumptions of the model are: Bank's asset values follow Geometric Brownian motion and all bank debt is insured.

As such the deposit insurance per $ of deposits can be modeled as follows:

$$g = \Phi(\sigma - h) - \frac{V}{D}\Phi(-h) \;\; where\; h = \frac{\ln(\frac{D}{V}) + \frac{\sigma^2}{2}}{\sigma}$$

V is the bank's asset value V
g is the value of the deposit insurance guarantee per $ of insured deposit
σ is the instantaneous expected standard deviation of asset returns
Φ is the cumulative normal distribution function
D is the face value of bank's debt

3. Credit ratings for banks

In general, an improvement in the credit rating of a bank is considered that it reduces the probability of financial distress as measured by the observable historical default frequencies computed over long spans of time. The analysis is limited to the most commonly available category of ratings namely those related to long-term foreign currency deposits.

To sum up, when looked from a cross section perspective, it appears that an ex post determined set of balance sheet indicators, integrated with information about the size of the bank and country-specific variables has some power in discriminating strong and weak banks. Moreover, neither listed or rated banks where on average safer than non-rated or non-listed banks. The reason why is probably because that market discipline had been counteracted by forbearance practices related to the "too big to fail" problem.

On the other hand, when looked from a dynamic perspective , stock market based indicators proved to incorporate faster new sources of information than the other two. This is because balance sheet indicators cannot be altered more frequently than the information releases, usually in an annual basis, while implicit deposit insurance premiums seemed to precede credit ratings with an average semester lag.

Overall, there is no apparent evidence on the sample being rated that market has discipling effects. Moreover none of the three indicators has strong predictive power in forecasting bank distress , after controlling for both the effect of macroeconomic factors and for bank's size. Also, implicit deposit insurance risk premiums showed on average a more timely adjustment than credit rating grades, although public's reaction in both cases seems

to be delayed and extreme. However, when there is extreme volatility , deposit insurance premiums are driven by the variability of the underlying assets.

Chapter 4: Data and Variable description

In the previous chapters we discussed about macroprudential policy and its origins as well as its targets and mission. We also discussed about macroprudential tools and the evolution of macroprudential policy in the European Union. We deployed existing literature regarding the effects of macroprudential policy on various sectors of the economy. Now , we move on to the empirical part of this thesis. The purpose of this thesis is to study the effect that macroprudential policies have on risk regarding banks headquartered in a member state of Eurozone. The reason why I opted for the bank sector is because it is the heart of the financial system of a country and it contributes in economic growth by boosting domestic demand. As such I wish to check if the imposition of macroprudential tools on a banking institution affects the amount of risk that it takes over and therefore their effectiveness on financing dynamic sectors of the economy. To end with, I selected the region of Eurozone because it involves a group of countries which although they share the same currency and monetary policy, they face different economic conditions and are in a different development stage.

My empirical investigation is based on the articles by Altunbas, Binici and Gambacorta (2017)[12] and Bongini, Laeven and Majnoni (2002) [13]. My attempt hereby is to combine macroprudential tools with CAMELS indicators and examine what happens at bank-level risk. When a bank adopts macroprudential instruments, will the level of risk it takes be increased, decreased or remain unaffected ?

As such, the empirical investigation is divided into two parts. The first part is focused on analyzing the CAMELS . My attempt is to reproduce part of the methodology described in Bongini's, Laeven's and Majnoni's article and apply the results I took in order to distinguish the banks from my sample into risk level categories. In particular, I used the analysis presented in chapter 3.1. Balance sheet indicators and combined it with the standard risk-weights which accompany each CAMELS variable, obtained from Saunder's and Conrnett's book Financial institutions Management: A Risk Management. The analysis is presented in chapter 4.3.

The second part of my research (Chapter 4.4) is dedicated on the core subject of this thesis. I use the annual change of Z-score as the dependent variable- following Altunbas, Binici and Gambacorta (2017). As far as the explanatory variables are concerned, I use CAMELS ,as factors that affect bank risk , real GDP growth and country credit risk as country-specific variables and the aggregate macroprudential index. Being inspired by the empirical investigation of the authors in question, I conducted an additional regression where-instead of the aggregate macroprudential index- I inserted two independent variables concerning borrower-targeted measures and financial-targeted measures in order to see

[12] Macroprudential policy and bank risk

[13] How good is the market as assessing bank fragility? A horse race between different indicators

which group of measures has a greater direct effect on bank risk. The dataset for the macroprudential instruments is extracted from Cerrutti's database so I follow the distinction given by Cerruti.

The chapter is divided as follows: In Section 1 the data sources are presented whilst in Section 2 the dependent and independent variables are presented and analyzed. In Section 3 CAMELS variables are analyzed whereas in Section 4 the empirical analysis based on panel regressions is presented. Section 5 draws conclusions and suggests next steps for further research and analysis.

4.1 Data

4.1.1 Bank Data

My main source for the bank balance sheet data is Bankscope , a commercial database maintained by Fitch and Bureau van Dijk. The advantage of this database is that it standardizes balance sheet statements to adjust for variations in accounting and auditing conventions so that they are comparable. The reason why I chose it is because it specializes in providing information only for financial institutions. The main disadvantage of this database is that it contains information from 2011 onwards, so the year range of the sample it is automatically limited to 7 years, that is from 2011-2017.

The data gathered consist of active commercial banks, savings banks and cooperative banks because the three of them are of a making-profit nature and also function in a similar way. Central banks were excluded from my search due to the fact that they are institutions which conduct monetary policy by managing a state's currency, money supply, and interest rates and therefore they act differently from the above mentioned banks which operate to make profits. All the banks included are also listed in the local exchange because such banks abide by the international financial reporting standards and are comparable. However, the presence of too large or too small banks-in terms of market capitalization- in the sample could introduce a bias in the results.

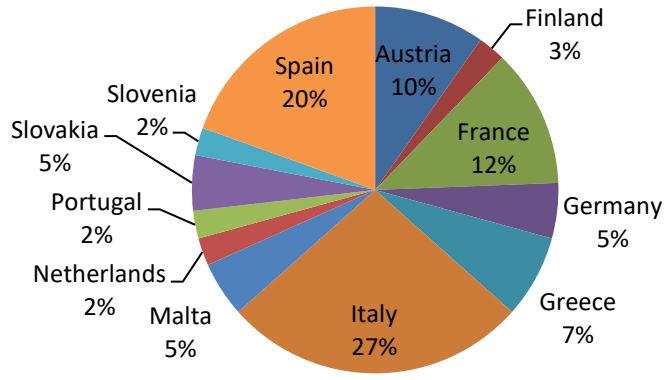
Consequently, I set a minimum of current market capitalization of 500.000.000,00 Euros in order to exclude banks of low market capitalization because such banks are riskier by nature (they have low liquidity) and their common stocks can be attacked by speculators. Therefore, only highly capitalized banks are included in the sample. The last search step was to opt for the world region, where I chose for Eurozone. From the 19 countries which are member-states of the Eurozone, my search returned results for 12 countries, specifically for Austria, Finland, France, Germany, Greece, Italy, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. The total number of the banks satisfying the aforementioned criteria are 41 and they are illustrated in the table below:

[Insert table 4.1]

Although the analysis will be at a bank level , it is highly recommended that we see how these banks are distributed across countries. The sample consists of 41 banks of which 4 of them are from Austria, 1 is from Finland, 5 are from France, 2 are from Germany, 3 are from Greece, 11 are from Italy, 2 are from Malta, 1 is from Netherlands, 1 is from

Portugal, 2 are from Slovakia, 1 is from Slovenia and 8 are from Spain. In the following figure we see how these banks are distributed across countries as a percentage of the sample.

Figure 4.1 Distribution of bank sample across countries



Source: Author

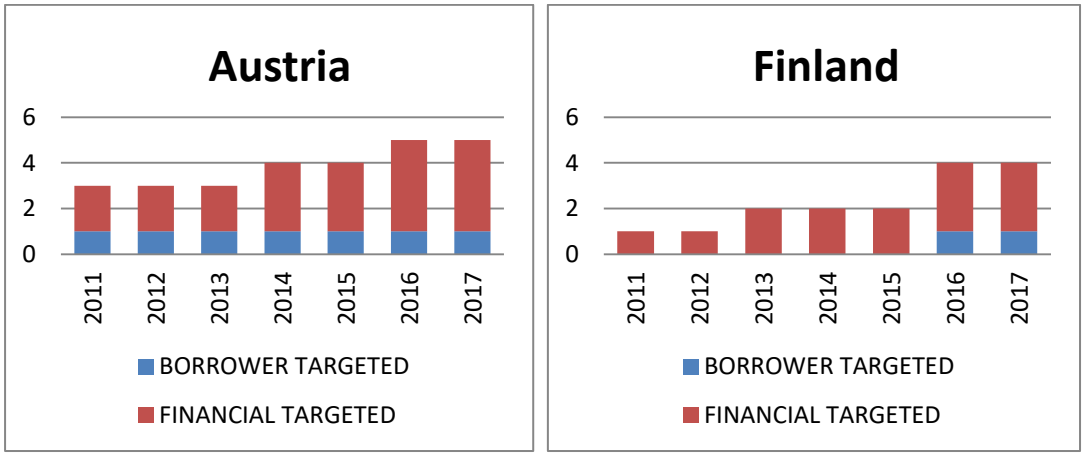
As we notice, the vast majority of the banks are Italian (27%), followed by Spanish banks (20%) and French ones (12%). Slovenia, Portugal and Netherlands share the same percentage of banks in the sample which is the lowest one and accounts for 2%. Increased by 1%, finish banks are in the lowest positions too . Between the two extremes, Austrian banks hold 10% of the total sample whereas Greek banks hold 7% . Finally Germany and Slovenia are in the same place with their banks taking over 5% of the sample. The sample mix seems quite interesting given that over 50% of the banks are from the so-called "European South" (Spain, Italy, Greece, Portugal) whereas banks located in industrialized countries such as Germany, France and Austria account for less than 30% of the sample. Empirically, we know that the state of the economy affects banking activity in a country and thus risk taking behavior so I have included two variables in the model in order to take into account this variability, real GDP growth and Country Risk. Real GDP is a measure of economic activity defined as the value of all goods and services produced less the value of any goods or services used in their creation-in constant prices. The calculation of the annual growth rate of real GDP volume is intended to allow comparisons of the dynamics of economic development both over time and between economies of different sizes. In turn, Country risk refers to the risk of making an investment or borrowing from a country, generated from swifts in the business activity that may have an adverse impact on profits or the value of assets in the country. Country risk includes all the factors that affect a state such as security, political stability, government effectiveness, the legal environment, macroeconomic risks, foreign trade, labour markets, financial risks, fiscal policy and the state of local infrastructure.

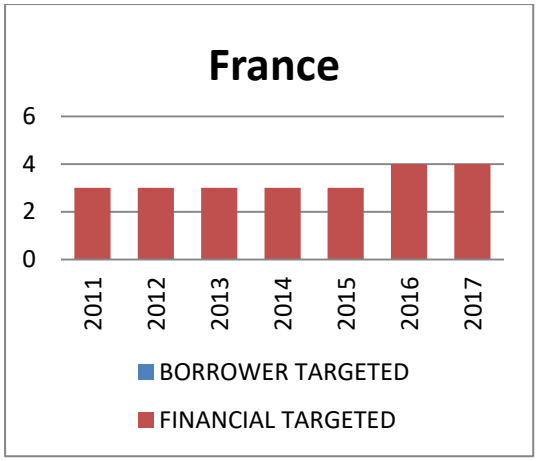
4.1.2 Macroprudential Tools

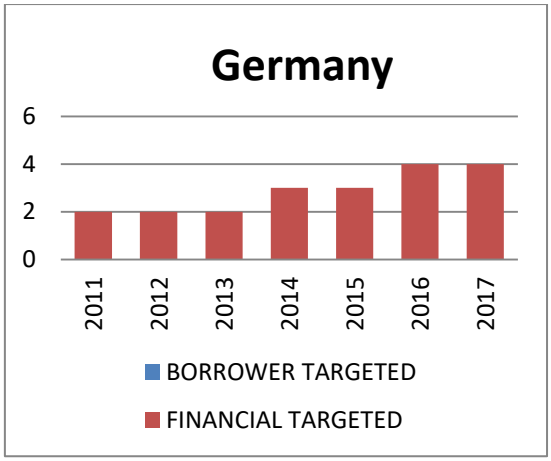
The data on macroprudential policy across countries have until now been even more sparse, but have recently seen substantial development. Via the IMF's Global Macroprudential Policy Instruments (GMPI) survey several new databases have emerged with broad coverage and high frequency of macroprudential instruments across countries.

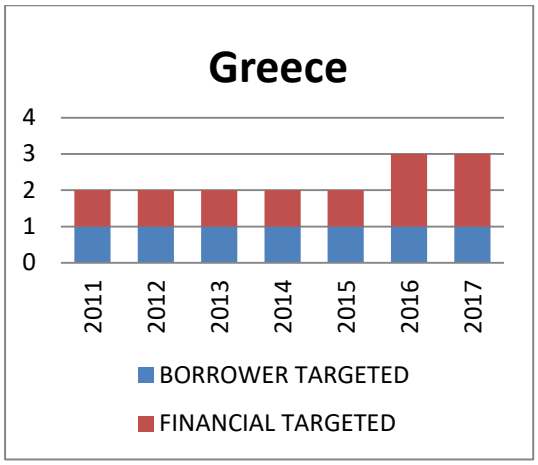
The one I use here is by Cerutti et al (2017a) which converts the GMPI data into an annual panel for 119 countries. They cover 12 types of macroprudential policy instruments, which are also subdivided into borrower-based measures, such as loan-to-value (LTV) and debt-to-income (DTI) limits , and financial institution-based measures, which comprise most other tools (e.g. countercyclical capital buffers and dynamic provisioning, capital surcharges on systemically important financial institutions, levies or taxes on specific assets or (non-core) liabilities, etc.).

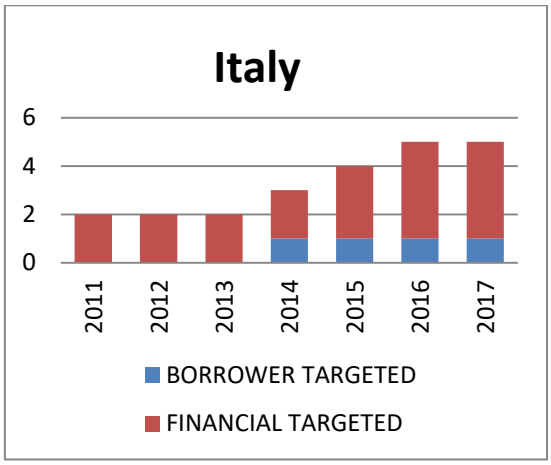
The following figures illustrate the number of macroprudential tools that countries use from 2011 until 2017 as well as the category they belong. Each bar represents the number of macroprudential tools that a country uses in total in a yearly basis. In the horizontal axis we see the years and in the vertical axis we see the total number of macroprudential tools used. (Almost) each bar is divided in two colors, the blue which is in the bottom and the red color which is on top. The blue color represents the tools which are borrower targeted whereas red color pertains to financial targeted ones. Where the blue part stops we are informed for the number of borrower based tools that are used and this is the starting point of the red part which shows us the number of financial based tools. For example, in 2011 Austria used in total three macroprudential tools, of which only one was aiming at borrower's side and the other two were aiming at financial institution's side. The former includes debt-to-income ratio and loan-to-value ratio caps whilst the latter contains time-varying/dynamic loan-loss provisioning, general countercyclical capital buffer/requirement ,leverage ratio, capital surcharges on SIFIs, limits on interbank exposures, concentration limits, limits on foreign currency loans, limits on domestic currency loans, levy/tax on financial institutions, loan-to-value ratio caps, FX and/or countercyclical reserve requirements.




France
6
4
2
0
2011
2012
2013
2014
2015
2016
2017
BORROWER TARGETED
FINANCIAL TARGETED


Germany
6
4
2
0
2011
2012
2013
2014
2015
2016
2017
BORROWER TARGETED
FINANCIAL TARGETED


Greece
4
3
2
1
0
2011
2012
2013
2014
2015
2016
2017
BORROWER TARGETED
FINANCIAL TARGETED


Italy
6
4
2
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2011
2012
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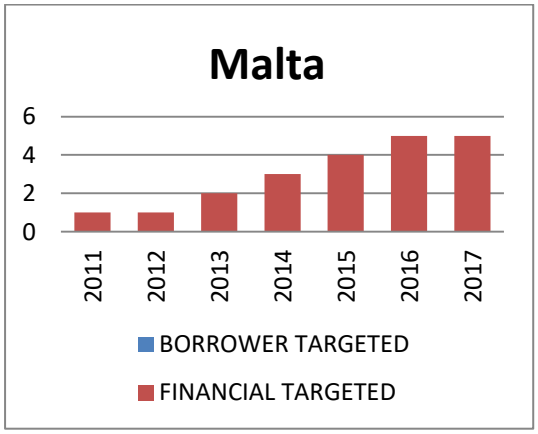
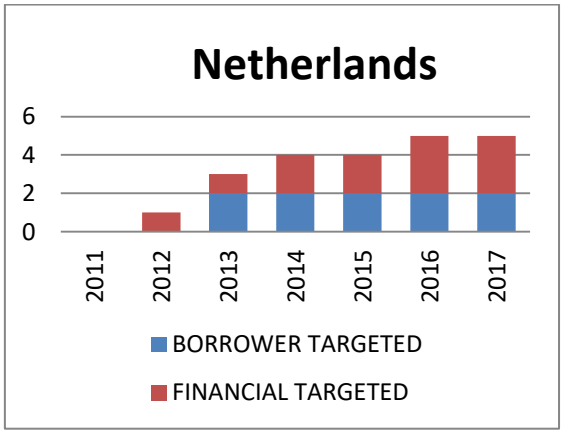
2016
2017
BORROWER TARGETED
FINANCIAL TARGETED


Malta
6
4
2
0
2011
2012
2013
2014
2015
2016
2017
BORROWER TARGETED
FINANCIAL TARGETED


Netherlands
6
4
2
0
2011
2012
2013
2014
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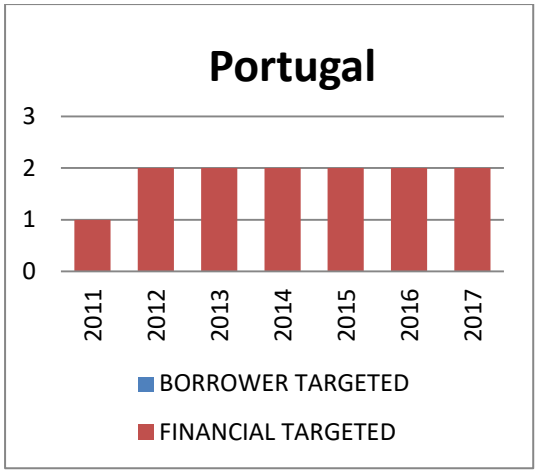
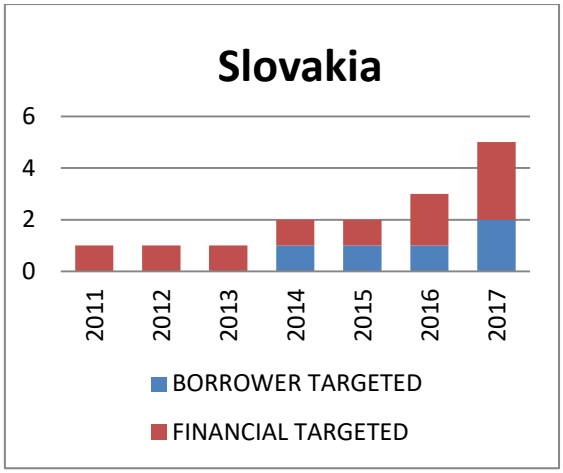
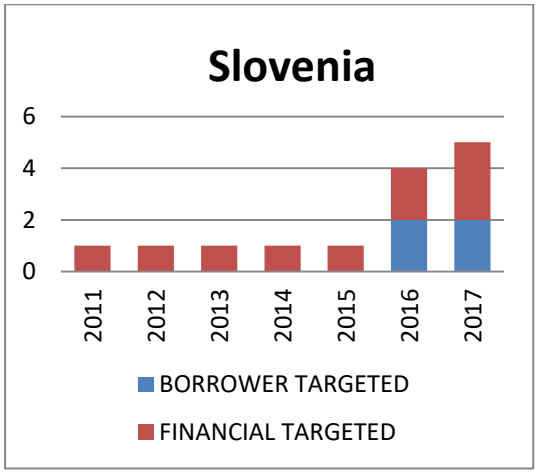
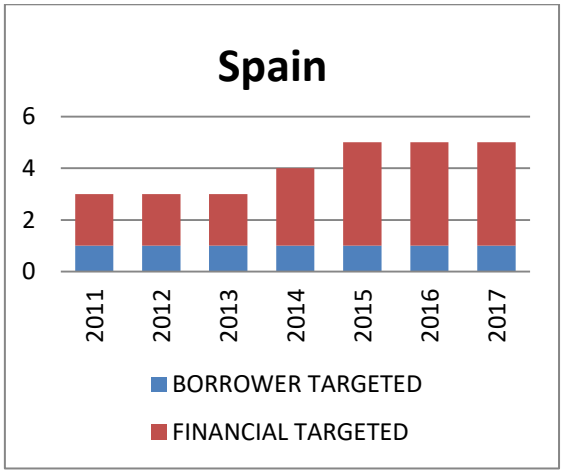
2016
2017
BORROWER TARGETED
FINANCIAL TARGETED









As we notice the use of macroprudential instruments has been augmented over time for all the countries in the sample. Each county does not use more than 5 instruments per year whereas the Netherlands is the only country which started to use macroprudential tools since 2012. The policy mix varies over time and is different for each country. However, for 4 countries (France, Germany, Malta, Portugal) the use of macroprudential tools is limited to those aimed at financial institutions. Finland and Slovenia introduced the use of borrower targeted tools in 2016 , the Netherlands in 2013 and Slovakia in 2014. It is woth-noting that when banks started to adopt macroprudential tools, the crises in the banking sector were eliminated for all countries in the sample, meaning that such tools do have the power to correct the irrational behavior of banks. The table in question is presented in Appendix.

4.2 Description of the Variable

The examination of a possible relationship between bank risk and macroprudential instruments is conducted by using panel OLS regression, contrary to Altunbas, Binici and Gambacorta (2017), who use Generalized Method of Moments to combat endogeneity

issues. The endogeneity issues stems from the fact that , in principle, the situation of the banking sector could also affect on macroprudential policy decisions. They use GMM as proposed by Blundell and Bond[14]. The reason why I did not follow their method is because GMM is a class of estimators that include OLS and 2SLS. As such, under the assumption that all regressors are exogenous, OLS[15] is an efficient GMM estimator.

The dependent and independent variables which are used in the model are presented below[16]. The dependent variable and some of the independent ones are generally used in the empirical literrature.

4.2.1 Dependent Variable

Z-score (annual change)

The Z-score can be summarised as Z=(k+ROA)/σROA, where k is equity capital as percent of assets, ROA is the average after tax return as a percent of assets, and σROA is the 5-year rolling standard deviation[17] of the after-tax return on assets, as a proxy for return volatility. The Z-score counts the number of standard deviations a return realisation has to decline to exhaust equity, assuming that bank returns are distributed normally. A higher Z-score implies a lower probability of insolvency risk. For reasons of simplification, I use the annual change of Z-score without changing its interpretation.

4.2.2 Independent Variables

CAMELS

"CAMELS" model is very effective and accurate tool which is used to measure and evaluate performance and risk in banking industries. The CAMELS stands for Capital adequacy, Asset quality, Management, Earning and Liquidity and Sensitivity. The variables below stand for each one of CAMELS acronym. CAMELS technique is analyzed in the section 4.3 .

Total Capital Ratio (TCR%)

This ratio is the total capital adequacy ratio under the Basel rules. It measures Tier1+Tier2 capital which includes subordinated debt, hybrid capital, loan loss reserves as a percentage of risk weighted assets and off balance sheet risks. This ratio should be at least 8%.

[14] In the Arellano–Bond method, first difference of the regression equation are taken to eliminate the fixed effects. Then, deeper lags of the dependent variable are used as instruments for differenced lags of the dependent variable (which are endogenous).

[15] See Baum, Schaffer and Stillman(2002)' Instrumental variables and GMM: Estimation and testing' pg.10

[16] The variables definition are extracted from the Bankscope's variables definition.

[17] Rolling Standard Deviation is a statistical measurement of market volatility. It makes no predictions of market direction, but it may serve as a confirming indicator. To calculate the 5-year rolling standard deviation I sourced data from 2005-2010 from Datastream,- a global financial and macroeconomic data platform -and combined them with data obtained from Bankscope for 20011-2017.

Non-performing loans to total gross loans (NPLs %)

This is a measure of total loans which are doubtful. The lower this figure is the better the assets quality. This ratio shows the quality of a bank's loan portfolio .

Net Interest Margin (NIM%)

Net interest margin (NIM) is calculated by subtracting the interest income generated by financial institutions from the amount of interest paid out to their lenders (eg. deposits), and divide it by the (interest-earning) assets. It is a measure of the efficacy of a financial institution's investment decisions. A positive net interest margin shows that the financial institution has invested its funds efficiently whereas a negative return implies that the bank or investment firm has not made a profitable investment.

Return on Avg Equity (RoaE %)

The return on equity is a measure of the return on shareholder funds. The higher the ratio the better the financial position of the bank is. However, attention should be paid when putting too much weight on this ratio as it may be an indication of an over leveraged balance sheet.

Liquid assets to short-term liabilities(LIQUID %)

It is a deposit run off ratio which looks at what percentage of customer and short term funds could be met if they were withdrawn suddenly. Therefore it is an solvency indicator. The higher this percentage the more liquid the bank is and less vulnerable to a classic run on the bank.

Interbank ratio(INTER%)

This is money loaned to other banks divided by money borrowed from other banks. . It measures the sensitivity of bank activity related with other banks- i.e. the exposure of each bank towards the domestic banking system. If the ratio is greater than 100 then it denotes that the bank is net placer rather than borrower of funds in the market place, and therefore more liquid.

Macroeconomic Indicators

Macroeconomic indicators are economic statistics which are released tactical by government agencies and private organizations. These indicators give insight into the economic performance of a particular country or region, and therefore can have a great affect on investment decisions.

Real GDP growth (rGDP growth%)

Given than our data concern banks in countries with different economic structure, it is highly recommended that we use the real GDP growth for each country as an additional independent variable. The data are taken from Eurostat.

Country Risk (CR)

By the same token, I use a variable for country risk to distinguish between risky and non risky countries. The country risk data are drawn from the Economic Intelligence Unit s which is an organization that provides forecasting and advisory services to assist entrepreneurs, financiers and government officials. The EIU provides country, industry and risk analyses based on the work, research and insights of a worldwide network of economic, political and business experts. Because of the fact that the country risk rating is expressed as qualitative variable that takes values from AAA-BBB, I transformed this data into a dummy variable which takes value 1 if a country has a rating of A and above-therefore it is non risky- and 0 otherwise .

Macroprudential Indicators

Macroprudential indicators comprise both aggregated microprudential indicators of the health of individual financial institutions, and macroeconomic variables associated with financial system soundness. The indicators that are the focus of this paper are quantitative variables.

Macroprudential Index (MPI)

It is a dummy variable that sums the macroprudential instruments that each country uses within a year. As previously mentioned, the data are taken from Cerutti, Claessens, Laeven (2017) macroprudential policy dataset (2018 update). Going deeper with my analysis I also used the distinction between borrower based measures **(BORROWER)** and financial institutions based measures **(FINANCIAL)** in order to see which type of instruments has a greater effect on bank risk.

An overview of the dependent an independent variables is given in the following table.

Table 4.3 - Summary of variables		
Variables	**Name**	**Description**
(Y) Dependent	Z-score (annual change)	Z-score is an alternative risk measure extracted from balance sheet data. It shows the number of standard deviations needed to eliminate Equity. The greater Z-score is the less likely is a bank to go bankruptcy
(X's) Independents		
CAMELS		
Capital Adequacy	Total Capital Ratio (**TCR%**)	The Total Capital Ratio (TCR) is a measure of a bank's available capital expressed as a percentage of a bank's risk-weighted credit exposures. It is also known as capital-to-risk weighted assets ratio (CAR) and it is used to protect depositors and promote the stability and efficiency of financial systems around the world.
Asset quality	Non-performing loans to total gross loans (**NPLs %**)	It shows the percentage of loans that are have not been remitted for a period of at least 90 days for commercial banking loans and 180 days for consumer loans. The greater the ratio is, the worse off the bank is.
Management	Net Interest Margin (**NIM%**)	This ratio is the net interest income expressed as a percentage of earning assets. The higher this figure the cheaper the funding or the higher the margin the bank is commanding. Higher margins and profitability are desirable as long as the asset quality is being maintained.
Earnings and profi tability	Return on Avg Equity (**RoaE %**)	Return on equity (ROE) is a measure of financial performance calculated by dividing net income by shareholders' equity. Because shareholders' equity is equal to a company's assets minus its debt, ROE could be thought of as the return on net assets.
Liquidity	Liquid assets to short-term liabilities(**LIQUID %**)	This ratio indicates the liquidity risk of a bank because the less the cash to cover its short term liabilities, the more vulnerable it is in case of a liquidity crisis. The higher the ratio is, the better off the bank will be.
Sensitivity to market risk[18]	Interbank ratio(**INTER%**)	It measures the sensitivity of bank activity related with other banks that is the exposure of the each bank towards the domestic banking system.
Macroeconomic Indicators		
Economic Development	Real GDP growth (**rGDP growth%**)	The real economic growth rate measures economic growth in relation to gross domestic product (GDP) from one period to another and adjusted for inflation. The higher the real GDP growth ratio is, the better the economy performs.
Country risk	Country Risk (**CR**)	In particular, country risk denotes the risk that a foreign government will default on its bonds or other financial commitments. In a broader sense, country risk is the degree to which political and economic turmoil affect the securities of issuers doing business in a particular country. Here CR is denoted as a dummy that takes value 1 if a country is non risky and 0 otherwise
Macroprudential Indicators		

[18] A proper measure of sensitivity to market risk is VaR. It estimates how much a set of investments might lose (with a given probability), given normal market conditions, in a set time period such as a day. However, this info was not available for all banks included in the sample so I used Interbank ratio instead. In some way Interbank ratio measures the exposure of the bank towards the banking system.

Cumulative	Macroprudential Index (**MPI**)	Takes values of 1 when a country uses one specific macroprudential instrument in a year , otherwise 0. The maximum value that this index can take is 12. The same token in applied in the macroprudential sub-indexes. For Borrower-based measures the maximum value is 2 whereas for Financial - based measures is 10.
Borrower based	**BORROWER**	Takes values from 0 to 2
Financial based	**FINANCIAL**	Takes values from 0 to 10

Source :Author

4.3 An empirical analysis of bank risk using CAMELS rating system

Performance of financial institutions is gauged by using blend of financial ratio analysis, benchmarking, measuring performance against budget (Avkiran, 1995). In accounting terms, performance of financial institutions regards the capacity in producing sustainable profits (Rozanni & A. Rahman, 2013). They need a way to evaluate performance and consider some important financial ratios and find the strengths and weaknesses.

Traditional method of applying financial ratios to evaluate bank's state of performance has been long practiced, with practitioners using CAMELS rating to measure their banks' performance. CAMELS rating is used by bank's management to evaluate financial health and performance (Rozanni & A. Rahman, 2013).

The Uniform Financial Institutions Rating System (UFIRS) was established in 1979 by the bank regulatory agencies . In 1988, the Basel Committee on Banking Supervision of the Bank of International Settlements suggested the use of CAMELS framework for assessing financial institutions (Dash & Das, 2009). CAMELS is an international system for bank risk assessment according to six factors (Datta, 2012): Capital adequacy, Asset quality, Management soundness, Earnings and profitability, and Liquidity and Sensitivity. In 1997, Sensitivity to market risk, was included in the CAMELS framework (Dash & Das, 2009, Gunsel, 2005).

According to Christopoulos G.A and Ntokas G.I. (2012)[19], the rating scale of CAMELS lies between 1 and 5. **One** is the **highest score** which reflects optimality in bank performance as well as adequacy in risk management mechanisms which correspond to the size and complexity of the bank institution. **Bank** is **characterized** as **STRONG**. **Two** is the **second highest score** which represents satisfactory performance and risk management practices consistent for safe and sound operations. **Bank** comes **under SATISFACTORY category**. A **score of three** indicates that bank's performance is flawed to some degree and is of supervisory concern. **Bank** is **described** as **FAIR**. **Four** is **the second worst rating score** and reflects poor performance that is of serious supervisory concern. **Bank** is **classified as MARGINAL**. **Five** corresponds to **the lowest rating possible** and it is considered as an

[19] Topics on theory of banking and finance, pg. 239-240, Kritiki publications

indication of unsatisfactory performance that is critically deficient and in need of immediate remedial attention**. Bank** is **characterized** as **UNSATISFACTORY**[20].

The following table summarizes the information above. According to the score that the bank gets , it is classified into one of the five categories. In general, if a bank has an average score less than two it is considered to be a high-quality institution, while banks with scores greater than three are considered to be less-than-satisfactory establishments.

Table 4.4 CAMELS score range
1) 1.00–1.49 – "strong",
2) 1.50–2.49 – "satisfactory",
3) 2.50–3.49 – "fair",
4) 3.50–4.49 – "marginal",
5) 4.50–5.00 – "unsatisfactory". Source: Hyz and Gikas(2015) [21]

Because of the fact that CAMELS are correlated with risk at bank level, I considered of high importance to conduct an preliminary analysis of the variables in question before proceeding with the regression. What I did here was to calculate CAMELS ratio for each bank and classify them into five categories depending on the sum they scored. I calculated the average for each camels variable for the period 2011-2017 .The analysis is at a cross-sectional level[22]. The summary statistics are presented in the table below.

The methodology I used to compute camels rating score is based on the article by Bongini, Laeven and Majnoni (2002)[23] who " transform each CAMEL indicator in a dummy variable that takes value 1 if the bank's CAMEL S ratio is worse than that of 75% of all the sampled banks, and 0 otherwise". The lines highlighted in yellow shows the observation which is on the 75% of the total sample. So for the banks that have TCR% less than 13,168% , NIM% less than 1,32%, LIQUID% less than 9,188%, RoaE% less than 1,653% and INTER% less than 76,96% get a value of 1, otherwise 0. By the same token banks with NPL% more than 12,022% will get a value of 1, otherwise 0.

[20] Ekpu, V., Micro-prudential Vs Macro-prudential Approaches to Financial Regulation and Supervision, 2016, pg.20-21

[21] Camels and Greek Banking Sector Performance during the Crisis- An analysis of the Evidence (2015), pg.32

[22] A diagrammatic illustration of CAMELS for each bank can be found in Appendix

[23] Bogning, P., Laeven, L., Majnoni, G., How good is the market as assessing bank fragility? A horse race between different indicators,2002, pg. 1015, Journal of Banking & Finance ,26,1011-1028

Table 4.5 Summary statistics of CAMELS variables						
	TCR%	NPL%	NIM%	RoaE%	LIQUID%	INTER%
Lowest Value	5,914	1,042	0,551	-82,416	4,057	4,221
1st quartile	13,168	3,941	1,320	1,653	9,189	19,792
Median	14,391	6,147	1,584	5,985	11,957	39,779
3rd quartile	15,918	12,022	2,208	8,935	33,077	76,961
Maximum Value	21,657	39,344	3,499	32,038	92,708	311,308
Average	14,290	9,906	1,822	3,035	24,267	60,666
Standard deviation	2,830	9,197	0,736	19,125	22,754	65,288
Source: Author						

I multiply the value of each dummy with the weight of each CAMELS indicator, as defined by *Federal Deposit Insurance Corporation.* Extracted from Saunders (2017) [24], the following table illustrates the weights of CAMELS components.

Table 4.6	
Camels Component	**Weight**
Capital Adequacy	25%
Asset Quality	20%
Management	25%
Earnings	10%
Liquidity	10%
Sensitivity to market risk	10%
Source: FDIC, Federal Register, February 25,2011, www.fdic.gov	

The next step is to sum the 5 weighted dummies in order to create a balance sheet indicator that summing from 0 to 1, instead of 1 to 5 and having a score range of 0,2 for each category instead of 0,5. However, nothing changes in the interpretation of the number. The higher the value of the balance sheet indicator, the higher the bank's perceived risk.

4.3.1 Results

The results of the CAMELS rating score are presented in the figure below. As we see, from the 41 banks 13 (or 31,7 %) are described as STRONG, meaning that they caught a score less than 0,2 . These banks are the safest ones. Additionally, the vast majority of the banks accounting for 48,8% in the sample , are described as SATISFACTORY, with a score ranging between 0,2 and 0,39. Banks which their result is between 0,4 and 0,59 are characterized as FAIR, and they are 6 in total (or 14,6%). On the other hand, MARGINAL banks are those who got a score between 0,6- 0,79 and are only 1 out of 41 (2,4%). Only 1

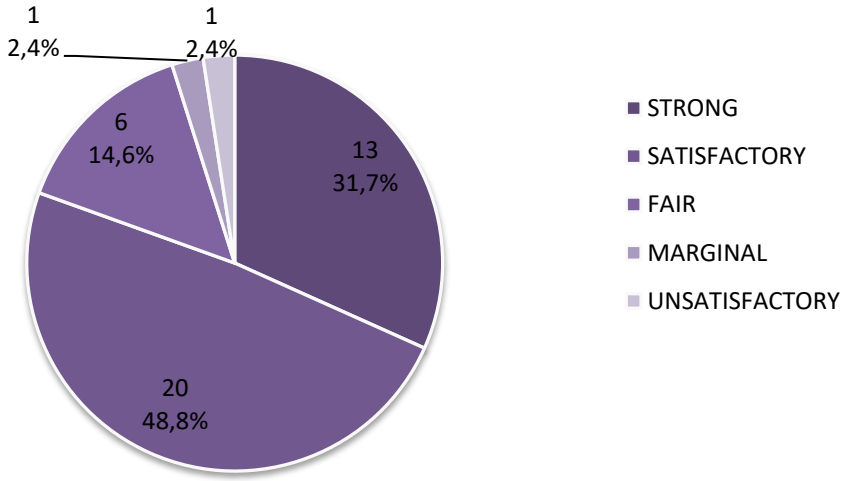
[24] Saunders, A., Cornett M.M., Financial Institutions Management: A risk management approach, 2014, McGraw Hill Education.

bank (2,4%) got a score higher than 0, 8 meaning that it is the riskiest ones described as UNSATISFACTORY bank.

It is quite encouraging that the number of "good" banks or those categorized as STRONG-SATISFACTORY are 33 (20+13) and the "bad" banks (rest of categories) are 9 although I expected them to be less. Given that when selecting for bank data I set a lower bound of 500.000.000,00 euros for market capitalization, in order to include big banks which by default are considered to be safer, the result I got now seems a contradiction in terms. Consequently, a high market capitalization itself cannot ensure the safety of a bank and must be taken into account with several other factors as well, for example CAMELS, in order to have a precise view of the bank's perceived risk. However it does give us a good hunch . Given that a somewhat more than half of the banks come from South Europe (Spain, Portugal Italy, Greece) the number of "bad banks" causes no impression. A larger share of capitalization due to loan loss reserves- which is most probably the case in Spanish, Greek, Portugal and Italian banks- is likely associated with more risky assets and can therefore be expected to increase the probability of distress (Bongini, 2010). However, what it is indeed surprising is that some of banks belonging in an industrialized country such as France were considered as "bad" banks and vice versa (for example the Italian bank Credito Emiliano SpA is a STRONG bank whereas the whilst the French Natxis bank is considered a FAIR bank). (See Table 4.7 in Appendix for the full list of banks). On the other hand we get a confirmation that our sample is representative, meaning that it accurately represents the population and the results can be confidently generalized.

Bearing these in mind, we move on to the core section of chapter 4 where the effectiveness of macroprudential tools as well as CAMEL variables have on bank risk is being investigated.

Figure 4.2 Distribution of banks according to their CAMEL characterization



4.4 The effect of macroprudential policy on bank risk

As mentioned earlier, the purpose of this study is to investigate the relationship between macroprudential tools and bank risk . Altunbas, Binici and Gambacorta (2017) use listed banks operating in both advanced economies and EMEs over the period 1990-2012. They found that macroprudential tools – both those focusing on dampening the cycle (loan to value ratios, reserve and currency requirements) and those specifically designed to enhance banks' resilience (capital requirements) – have a significant impact on bank risk. They measure bank risk with the expected default frequency (EDF) and the annual change of Z-score . The calculation of the EDF indicator demands bank issuance of equity on the stock market, whilst the Z-score is an indicator of the probability of default which sources information from balance sheet variables. In this study , I use Z-score to measure bank risk.

The empirical model is given by the following equation. The model estimated is a panel pooled OLS model. The sample consists of 41 banks headquartered in member-states of Eurozone for the years 2011-2017. The following table summarizes the variables, the expected sign and the reasoning . The summary statistics of the variables are presented in table 4.9 in Appendix.

Table 4.8 Summary of the variables, its expected sign and reasoning

Empirical model	$\Delta Risk_{i,k,t} = constant + a\Delta Risk_{i,k,t-1} + bTCR\%_{i,k,t-1} + \gamma \text{NPLs } \%_{i,k,t-1} + \psi \text{NIM}\%_{i,k,t-1} + \lambda \text{RoaE } \%_{i,k,t-1} + \delta \text{LIQUID } \%_{i,k,t-1} + \text{INTER}\%_{i,k,t-1} + \theta \text{rGDP growth}\%_{k,t} + \kappa \text{CR}_{k,t} + \nu MPI_{k,t} + \varepsilon_{i,k,t}$	
Name	Expected sign	Reasoning
TCR%	+	TCR is expected to increase Z-score because when a bank meets its TCR requirements it is protected against credit risk and therefore the probability of going bankruptcy decreases.
NPLs %	-	It is clear that a bank with NPLs has lower revenues which result in a lower RoA / RoE . Therefore NPLs have a negative impact on a bank's net position and increase the probability of default as expressed with a low Z-score.
NIM%	+	An increase in the net interest margin reflects an increase in profitability and therefore lowers bank risk which is expressed with an increase in Z-score
RoaE %	+	It is obvious that the higher the RoE is the safer the bank is. Consequently, an increase in RoE will also increase Z-score.
LIQUID %	+	An increase in liquidity over short-term liabilities is possible to cause a increase in Z-score because liquid assets may reduce borrowing costs and consequently augment net income.
INTER%	+/-	If a bank is a net placer it has granted more loans to other banks than the deposits accepted from other banks . It means that it anticipates a positive interest income which decreases bank risk. On the other hand the more loans it grants the riskier it becomes because its asset portfolio increases. In turn, if the bank is a borrower then it possibly expects a negative interest income and therefore its level of risk increases. Consequently this variable can have either a positive or a negative impact on bank risk which is not known beforehand.
rGDP growth%	+	An increase in real GDP growth will increase borrowers' income and therefore decrease the likelihood of missing loan payments. Therefore banks' revenues will increase causing an decrease in the probability of default and therefore an increase in Z-score.
CR	+	Given that the dummy of country risk takes the value 1 if a country is non risky this implies that the sign of the coefficient must be positive to denote an increase in Z-score and reduction of bank risk.
MPI BORROWER FINANCIAL	+	Given that the purpose of macroprudential instruments is either to increase directly the financial sector's resilience or dampening the cycle as an intermediate target, the sign of the coefficient must be positive by default.

Source: Author

In order to check that the variables above were the appropriate ones for the model, several tests were conducted. Firstly , I checked if each variable is stationary by using the Levin – Lin – Chu unit root test for panels. If a time series has a unit root (i.e. it is not stationary) it shows a systematic pattern that is unpredictable. Therefore it is undesirable the variables in question follow a unit root process. All of the variables were proved to be stationary and therefore, I can proceed with the next test. The results of the test are presented in Table 4.10 in Appendix.

Secondly, I checked for possible multicollinearity among the dependent and independent variables. Existence of multicollinearity violates one of the basic assumption of multiple regression and creates problem in the estimation of the coefficients. The results of the correlation matrix are illustrated in the table below. From the correlation matrix it turns out that there is no multicollinearity because none of the correlations are above 0,75 [25] in absolute value. Please be noted that I get results of no multicollinearity either when I replace MPI with BORROWER and FINANCIAL sub indexes. The results are presented in table 4.11(b) in Appendix.

Table 4.11 (a) Correlation matrix of regression I

Variables	Zscore	TCR	NPLs	NIM	RoaE	LIQUID	INTER	rGDPgrowth	CR	MPI
Zscore	1	0,2392	-0,3574	-0,0734	0,0825	0,15	-0,051	0,2151	0,3352	0,2695
TCR		1	-0,1928	-0,0665	0,1422	-0,0557	0,1332	0,2309	0,385	0,1859
NPLs			1	0,4243	-0,0983	0,3306	-0,1977	-0,09	-0,4494	-0,1153
NIM				1	0,0548	0,4911	-0,0907	0,0134	-0,1226	-0,183
RoaE					1	0,0515	0,0707	0,0343	0,0703	0,0399
LIQUID						1	-0,2089	0,0941	-0,2253	-0,006
INTER							1	0,0517	0,3618	-0,0162
rGDPgrowth								1	0,0636	0,4345
CR									1	-0,0757
MPI										1

Source: Author

The model estimation to be used is Pooled OLS including Newey– West (HAC) method to correct for any heteroscedasticity in the regression. The regression results are presented in the table below. The first regression (I) concerns the effect of the aggregate macroprudential index on bank risk (MPI) whereas the second one (II) includes the two categories of macroprudential index , FINANCIAL and BORROWER, in order to see which of the two types of measures has a greater impact on bank risk. It should be noted that CAMEL-type variables are introduced as lagged variables because the data come from banks' balance sheets released in a yearly basis. Therefore in order to estimate the bank risk at year t, we must use data released in the year t-1. In this way we also avoid possible

[25] https://eclass.aueb.gr/modules/document/file.php/ODE360/%CE%A3%CE%97%CE%9C%CE%95%CE%99%CE%A9%CE%A3%CE%95%CE%99%CE%A3/%CE%9F%CE%99%CE%9A%CE%9F%CE%9D%CE%9F%CE%9C%CE%95%CE%A4%CE%A1%CE%99%CE%91-6.%20%CE%A0%CE%9F%CE%9B%CE%A5%CE%A3%CE%A5%CE%93%CE%93%CE%A1%CE%91%CE%9C%CE%9C%CE%99%CE%9A%CE%9F%CE%A4%CE%97%CE%A4%CE%91.pdf

autocorrelation in residuals. The Durbin Watson test [26] which checks for this phenomenon has a value of more than 1,5 in each regression meaning that indeed there is no serial autocorrelation in residuals of order 1. To end with, the adjusted R square tells us the percentage of variance of the dependent variable explained by the independent variables. In both regressions the independent variables introduced explain 71,1 % of the alterability of the annual change in Z-score.

Table 4.12: Panel regression results

	Dependent Variable: Annual change of the Z-score					
	(I)				(II)	
	Coeff		t-statistic	Coeff		t-statistic
const	−20,546	**	−2,136	−23,633	**	−2,059
TCR_1	0,260		0,619	0,328		0,805
NPLs_1	−0,322	**	−2,686	−0,3269	***	−2,758
NIM_1	4,166	*	1,905	4,838	*	1,953
RoaE_1	0,008		1,352	0,010		1,434
LIQUID_1	0,052		0,787	0,059		0,855
INTER_1	−0,0341	**	−2,454	−0,037	**	−2,644
rGDPgrowth	−0,133		−0,0840	−0,273		−0,1625
CR	12,642	**	2,197	12,364	**	2,178
MPI	4,763	***	2,979	BORROWER	2,926	0,950
Zscore_1	-0,765	***	-8,170	FINANCIAL	5,563	** 2,606
				Zscore_1	-0,758	*** -7,811
Sample Period	2011-2017			2011-2017		
Observations	226			226		
Adjusted R^2	0,711			0,710		
D-W test	1,543			1,540		

Notes: The database is composed of 41 banks headquartered in 12 member states of the Eurozone. Robust standard errors are reported. The symbols *,** , and *** represent significance levels of 10%,5%, and 1% respectively.

Source: Author

In the first regression, the lagged variable of TCR has the expected positive sign but the results are not statistically significant. This does not change in the second regression either. The lagged value of NPL in regression (I) has a negative effect on the annual change of Z-score and therefore bank risk and it is statistically important at 5% level. Should the ratio of non-performing loans to gross loans increases by 1%, Z-Score will decrease by 0,32% on average ceteris paribus. Note that a decrease in Z-score automatically means an increase in bank risk. In regression (II) , the coefficient of NPL has almost the same negative impact on Z-score but its statistical significance is greater now(1%). The lagged value of NIM has the anticipated positive sign and it is statically significant at 10% level in both regressions. It is

[26] Extracted from lecture notes of the course Financial Econometrics ,MSc in Finance and Banking Management, Department of Finance and Banking Management, University of Piraeus

worth noting that the coefficient of NIM has the second highest value in regression (I), something that does not happen in regression II. However , the coefficient of NIM is higher in the second regression than in the first one. If the Net Interest Margin increases by 1% Z-score will increase on average by 4,83% (against 4,166% in regression I) ceteris paribus. Although the coefficient of lagged Return on average Equity has a positive impact on Z-score, it is not statically significant and therefore we cannot generalize the result in question. Moving on to LIQUID_1 variable it seems that it has a positive but not significant influence on Z-score in both regressions. On the other hand, the lagged value of INTER has a negative impact on Z-score which is statistically significant at 5% level for both regressions. Should the INTER increases by 1% the annual change in the risk perceived by the bank will increase on average by 0,0341% ceteris paribus. The negative impact of INTER on Z-score in regression II is slightly higher than in regression I.

Moving on to macroeconomic indicators, realGDP growth seems to have a negative impact on annual change on Z-score but not statistically significant. The negative sign of the coefficient of rGDP may cause us impression because normally we would expect economic development to benefit bank performance and therefore bank risk. Indeed a higher level of production leads to an increase in income and therefore borrowers are able to remit the loan payments. On the other hand, banks are tempted to grant loans even though to potential lenders who do not comply with the lending criteria. This flexibility from bank's side in granting loans throughout the development stage of the economy is an important source of risk for them. In both regression the aforementioned bank activity is captured by the negative sign accompanying the coefficient of rGDP. One second possible explanation could be that the majority of banks in our sample is headquartered in Southern European countries , where the growth of real GDP was negative for two years and banks are in a stabilization process. Consequently it is fair to assume that the negative economic development of these countries affected the sign of the coefficient. Again, the results are not statistically significant means that we cannot generalize the results and draw conclusions.

The next macroeconomic indicator, Country Risk (CR) has the highest coefficient in both regressions with a level of significance at 5%. The sign of the coefficient is positive as expected. This means that banks which are headquartered in non risky countries (i.e. the dummy variable has a value of 1) are on average 12,62% safer than those headquartered in a risky country ceteris paribus.

Last but not least, the core variable of my study, MPI seems to have the expected positive impact on Z-score. As mentioned earlier, MPI is a dummy which sums up the macroprudential tools used in each country annually. Therefore the adoption of one additional macroprudential tool (no matter if it is borrower based or financial institution based) will increase on average the change in z-score by 4,76% or, alternatively, decrease the bank risk by the same percentage, ceteris paribus. The imposition of macroprudential instruments is indeed effective towards the reduction of bank risk generally as the statistically significance level is the strongest reported (1%). Therefore by no means could we doubt the importance of such variable in regression I.

In regression II, I wanted to check which category of macroprudential instruments has a greater effect on Z-score. In this regression I follow Cerutti et al (2017a) which distinguish two categories of macroprudential instruments: those that are aimed at borrowers such as debt-to-income ratio and loan-to-value ratio caps and those aimed at financial institutions such as time-varying/dynamic loan-loss provisioning , general countercyclical capital buffer/requirement , leverage ratio, capital surcharges on SIFIs[27], limits on interbank exposures, concentration limits, limits on foreign currency loans, limits on domestic currency loans, levy/tax on financial institutions, FX and/or countercyclical reserve requirements. The results of regression II revealed that only measures aimed at financial institution have a significant positive impact on Z-score. In particular, the use of an additional financial aimed instrument is expected to increase the annual change in Z-score by 5,56% on average. In other words, the adoption of an extra macroprudential instrument of this specific category, will reduce the bank's perceived risk by the same percentage on average ceteris paribus. The effectiveness of such tools is confirmed by the level of significance which is 5%.

Although the financial based instruments were proved to be effective in mitigating bank risk, the borrowers based instruments seemed to have no such effect. Even though the coefficient has the expected positive sign, its value of 2,92% does not make it statistically important at any level of significance. However, this result is aligned with my remarks made on a previous chapter regarding the use of macroprudential tools in countries included in the sample. Most of the countries used only financial institution targeted measures whereas the rest of them started to use borrower targeted measures later than 2011. Given that the time period of my sample is 2011-2017 , the result revealed by the regression seems reasonable. It is worth noting that the effect of financial institution based measures on bank risk is greater than the effect of the aggregate MPI (MPI= 4,76 against FINANCIAL= 5,56) but with a lower level of statistical significance (MPI *** against FINANCIAL **).

The level of bank risk at time t (or the annual change in Z-score) is also explained by the lagged value of itself which has a negative sign and it is statistically significant at a 1% level in both regressions. Also the constant is statistically significant at a 5% level but has a negative sign in both regressions. However the constant has a greater negative value in regression II than in I. This means that if all independent variables were statistically insignificant there are factors included in the constant which would decrease Z-score (and therefore increase bank risk) by 20,54% on average in regression I and by 23,63% on average in regression II.

Juxtaposing the results above with those from Altunbas, Binici and Gambacorta (2017) ,we find that they agree to some extent. In particular, the variables MPI and the lagged Z-score have the same sign and are statistically significant. In their study all the dependent variables all statistically significant. Moreover, the variable of real GDP growth is positive whereas in the present study it has a negative sign. The reason why is probably

[27] A systemically important financial institution (SIFI) is a financial institution whose failure might cause a crisis in the financial system. According to EBA, SIFIs included in the sample are Deutsche Bank, Commerzbank BNP Paribas, Crédit Agricole, Société Générale , UniCredit SpA, Intesa Sanpaolo, ABN AMRO ,Banco Bilbao Vizcaya Argentaria , Banco Santander , Caixabank, Banco de Sabadell.

because of the much larger sample they have which also takes into account emerging markets.

4.5 Conclusions

Macroprudential policy came to the fore the last twelve years, after the outburst of the global financial crisis (GFC) in 2007. Therefore there is little theoretical background to guide the implementation of macroprudential policy and the right policy mix between macroprudential, monetary and fiscal policies. However, significant empirical investigation has been deployed so far which has enlightened the path to an effective macroprudential policy towards stabilization of the financial system as a whole. Although reduction of systemic risk remains the core purpose of macroprudential policy, the impact of such policy in other economic aspects (eg. inequality) has been studied as well, giving this policy a broader economic dimension rather than merely focusing on improving financial sector. Beyond dispute, macroprudential policy is here to stay and this is confirmed by the hundreds of studies which examined it either as a standalone policy or blended with the rest of policies. Governmental agencies, policy-makers, private organizations, have managed to quantify the impact of macroprudential policy to address systemic risk vulnerabilities and take responsive action -either preventive or repressive.

In the present study, I examine the relationship between macroprudential policy and bank risk level. I also attempted to check how this relationship is affected under different categories of macroprudential instruments , financial based and borrower based. In addition, CAMELS type variables were included to address the six sources of risk that banks face, namely : capital risk, asset quality risk, management risk, profitability risk, liquidity risk and market risk. Country specific characteristics like real GDP growth and country risk were included too to take into account the heterogeneity in the data.

As far as the sample is concerned, 41 banks headquartered in 12 Eurozone countries were under study from 2011-2017. These countries were: Austria, Finland, France, Germany, Greece, Italy, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. From the descriptive statistics presented in section 4.1.2 the majority of countries use only financial based instruments whereas the rest of them use both financial-based and borrower-based instruments. The CAMELS analysis showed that the more macroprudential tools countries put into effect the less risky their banks are.

Based on the regressions conducted in section 4.4 I reached the conclusion that macroprudential instruments have a significant impact on bank risk. Bank risk was expressed in terms of annual change on Z-score and the relationship between macroprudential instruments and annual change in Z-score was positive. This means that an adoption of an extra macroprudential instrument will increase distance from bankruptcy -or lower the probability of bank default and therefore bank-level risk. The view that such tools do have the power to diminish system risk and contribute on maintaining financial stability is strongly supported. The same conclusions are drawn when sub-indexes of the aggregate macroprudential index are included in the regression. However, in this model, only financial based tools seem to have an effect on bank risk and it has to do with the data gathered.

Because of the fact that macroprudential policies are a relatively recent topic , there are many possible aspects to be investigated in the future. My suggestion would be to identify the effect of such policy on each type of loans which banks provide. In general, there are three main loan categories: mortgages, consumer and entrepreneurial. Given that the purpose of such policies is to address systemic risk, it would be interesting to see if there is also any direct effect on the loan portfolio of a bank. In any case it would be a step in deeper understanding the relationship between macroprudential policy and microprudential regulation. It is indeed important to make clear when prudential tools act as macroprudential ones so the coordination between prudential policies at micro and macro level can be improved.

References

Books

Christopoloulos, J. A. and Ntokas, J. (2012) *Topics on banking and finance issues*, 1st edition

Saunders, A. and Cornett, M.M. (2014) *Financial Institutions Management: A Risk Management Approach*, New York, 8th edition

Articles

Akinci, Ozge and Olmstead-Rumsey, Jane (2015) *'How Effective are Macroprudential Policies? An Empirical Investigation'* Federal Reserve, no. 1136.

Altunbas, Y. , Binici, M. and Gambacorta, L. (2017) 'Macroprudential policy and bank risk', *Bank for International Settlements*, No 646.

Arnold, B., Borio, C., Ellis, L. and Moshirian, F. (2012) 'Systemic risk, macroprudential policy frameworks, monitoring financial systems and the evolution of capital adequacy' *Journal of Banking and Finance*, No 36.

Arslan, Y. and Upper, C. ' Macroprudential frameworks: implementation and effectiveness', *Bank for International Settlements*, no94.

Bank of Cyprus (2005) ' Directive addressed banks regarding foreign exchange exposures'

Bank of Cyprus (2015) 'Policy strategy for linking the ultimate target of maintaining financial stability with the intermediate targets and tools of macroprudential policy and other related issues'

Basel Committee on Banking Supervision (2013) 'Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools', Banks for International Settlements.

Bistriceanu, G. (2014) 'Establishing the Financial Rating of the Banking System. A European Perspective', Journal of Economics and Business Research No. 2 , 2014, pp. 115-123.

Blundell-Wignall, A. and Roulet, C. (2014) ' Macro-prudential policy, bank systemic risk and capital controls', *OECD*, OECD Journal, Volume 2013/2.

Boar, C., Lombardo, G., Silva, L. (2017) 'What are the effects of macroprudential policies on macroeconomic performance?' *Bank for International Settlements.*

Bongini, P., Laeve, L. and Majnoni, G. (2002) ' How good is the market as assessing bank fragility? Ahorse race between different indicators', Journal of Bnaking and Finance 26 1011-1028.

Budnik, K. and Kleibl, J. (2018) 'Macroprudential regulation in the European Union in 1995-2014: introducing a new data set on policy actions of a macroprudential nature' , *European Central Bank*, Working Paper Series No 2123.

Cerutti, E., Claessens, S. and Laeven, L. (2015) 'The Use and Effectiveness of Macroprudential Policies: New Evidence', International Monetary Fund, WP/15/61.

Cerutti, E., Correa, R., Fiorentino, E., and Segalla, E. (2016) 'Changes in Prudential Policy Instruments–A New Cross-Country Database' *International Monetary Fund*, WP/16/110.

Chris McDonald (2015) 'When is macroprudential policy effective?', BIS Working Papers, No 496.

Claessens, S., (2014) 'An Overview of Macroprudential Policy Tools', *International Monetary Fund*, WP/14/214.

Claessens, S., Ghosh, R. S. and Mihet, R. (2014) *'Macro-Prudential Policies to Mitigate Financial System Vulnerabilities' ,* International Monetary Fund, WP/14/155.

Clement, P. (2010) 'The term "macroprudential": origins and evolution', *Bank for International Settlements*, BIS Quarterly Review.

Dash, M. and Das, 'A CAMELS Analysis of the Indian Banking Industr y' (July 14, 2009). Available at SSRN: https://ssrn.com/abstract=1666900

Ekpu, V. (2016) ' Micro-prudential Vs Macro-prudential Approaches to Financial Regulation and Supervision, *Aston University* , Conference Paper.

Evans, O., Leone, M.A., Gill, M. and Paul Hilbers (2000) ' Macroprudential Indicators of Financial System Soundness', *International Monetary Fund*, Occasional Paper 192.

Frost, J. and Van Stralen, R. (2017) ' Macroprudential policy and income inequality', Journal of International Money and Finance .

Galati, G. and Moessner, R. (2011) ' Macroprudential policy – a literature review', Bank for International Settlements, BIS Working Papers No 337.

Giese, J. Nelson, B., Tanaka, M., and Tarashev, N. (2013) 'How could macroprudential policy affect financial system resilience and credit? Lessons from the literature', *Bank of England*, No 21.

Hyz, A. and Gikas, G. (2015) ' Camels and the Greek banking sector performance during the crisis- An analysis and review of the evidence', ACTA UNIVERSITATIS LODZINSIS, FOLIA OECONOMICA 5 (316).

ICTF Member Reference (2017) ' Country Risk Reports' , The Economist Intelligence.

IMF (2013) 'Key Aspects of Macroprudential Policy'.

Jiménez, G. and Saurina, J. (2002) ' Loan Characteristics and Credit Risk', Bank of Spain Directorate-General of Regulation.

Kahou, M.E. and Lehar, A. (2015) ' Macroprudential policy: A review' , University of Calgary, SPP Research Papers Vol.8 Issue 34.

Laeven, L. and Valencia, F. (2018) 'Systemic Banking Crises Revisited', *International Monetary Fund*, Working Paper Series WP/18/206.

Laeven, L.A., Levine, R., 2008. Bank Governance, Regulation, and Risk Taking. NBER Working Paper No. 14113.

Lekkos, H., Leventakis, A. and Yannakidis, C. (2015),' When past decisions determine the future economic scenery: Debt to Income ratio for households and enterprises' *Bank of Piraeus,* Financial Analysis and Investment Strategy.

Liedorp, F.R, Medema, L., Koetter, M., Koning R.H., and Lelyveld I. (2010) ' Peer monitoring or contagion? Interbank market exposure and bank risk' , *De Nederlandsche Bank*, DNB Working Paper No.248 .

Lim, C., Columba, F. , Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel T., and Wu, X. (2011) 'Macroprudential Policy: What Instruments and How to Use Them?' *International Monetary Fund*, WP/11/328.

Monetary and Economic Department (2001) 'Marrying the macro and microprudential dimensions of financial stability', *Bank for International Settlements*, BIS Papers no.1.

Ratnovski, L. (2013) ' Liquidity and Transparency in Bank Risk Management' , *International Monetary Fund*, WP/13/16.

Rostami, M. (2015) 'Camels analysis in banking industry', *Global Journal of Engineering Science and Research Management.*

Rubio, M. (2018) ' National macroprudential policies in the euro area: Flexibility vs. supervision' , *Elsevier*, Economics Letters 170 (2018) 55–58.

Svensson, E. O. L., (2018) ' Monetary Policy and Macroprudential Policy: Different and Separate? ' , *Canadian Journal of Economics*

Websites

Wikipedia http://en.wikipedia.org

Investopedia https://www.investopedia.com/

International Monetary Fund https://www.imf.org/external/index.htm

Bank for International Settlements https://www.bis.org

World Bank https://www.worldbank.org/

Eurostat https://ec.europa.eu/eurostat

Cerrutti's Macroprudential Database http://www.eugeniocerutti.com/Research

European Bank Authority https://eba.europa.eu/

European Systemic Risk Board https://www.esrb.europa.eu/home/html/index.en.html

Appendix

Table 2.3 European Union Country Codes							
Austria	(AT)	Estonia	(EE)	Italy	(IT)	Portugal	(PT)
Belgium	(BE)	Finland	(FI)	Latvia	(LV)	Romania	(RO)
Bulgaria	(BG)	France	(FR)	Lithuania	(LT)	Slovakia	(SK)
Croatia	(HR)	Germany	(DE)	Luxembourg	(LU)	Slovenia	(SI)
Cyprus	(CY)	Greece	(GR)	Malta	(MT)	Spain	(ES)
Czechia	(CZ)	Hungary	(HU)	Netherlands	(NL)	Sweden	(SE)
Denmark	(DK)	Ireland	(IE)	Poland	(PL)	Great Britain	(GB)
Source: europa.eu							

Table 4.1 List of banks included in the sample	
	Bank Name
1.	Raiffeisen Bank International AG
2.	Oberbank AG
3.	Bank für Tirol und Vorarlberg AG-BTV (3 Banken Gruppe)
4.	BKS Bank AG
5.	Aktia Bank Plc
6.	BNP Paribas
7.	Crédit Agricole S.A.
8.	Société Générale SA
9.	Natixis SA
10.	Caisse régionale de crédit agricole mutuel de Paris et d'Ile-de-France SC-Crédit Agricole d'Ile-de-France
11.	Deutsche Bank AG
12.	Commerzbank AG
13.	National Bank of Greece SA
14.	Alpha Bank AE
15.	Eurobank Ergasias SA
16.	UniCredit SpA
17.	Intesa Sanpaolo
18.	Unione di Banche Italiane Scpa-UBI Banca
19.	BPER Banca S.P.A.
20.	Mediobanca SpA-MEDIOBANCA - Banca di Credito Finanziario Società per Azioni
21.	Banca Mediolanum SpA
22.	Banca Popolare di Sondrio Societa Cooperativa per Azioni
23.	Credito Emiliano SpA-CREDEM
24.	Banca Piccolo Credito Valtellinese-Credito Valtellinese Spa

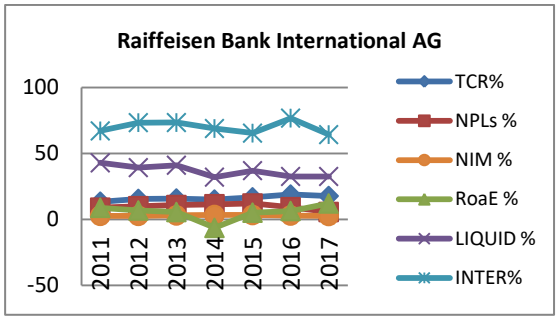
25.	Banca Ifis SpA
26.	Banca Generali SpA-Generbanca
27.	Bank of Valletta Plc
28.	HSBC Bank Malta Plc
29.	ABN AMRO Group N.V.
30.	Banco Comercial Português, SA-Millennium bcp
31.	Vseobecna Uverova Banka a.s.
32.	Tatra Banka a.s.
33.	NLB dd-Nova Ljubljanska Banka d.d.
34.	Banco Santander SA
35.	Banco Bilbao Vizcaya Argentaria SA-BBVA
36.	Caixabank, S.A.
37.	Banco de Sabadell SA
38.	Bankia, SA
39.	Bankinter SA
40.	Unicaja Banco SA
41.	Liberbank SA

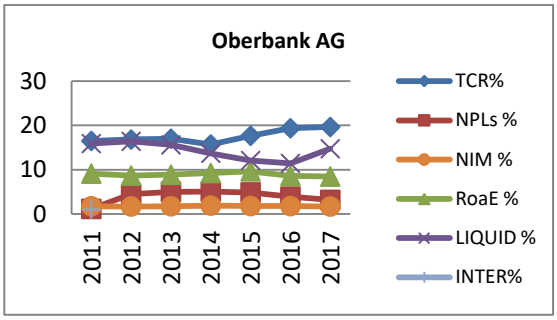
Table 4.2 Systemic banking crisis [28]

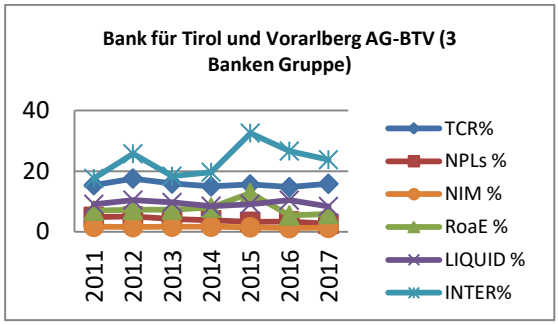
	2011	2012	2013	2014	2015	2016	2017
AUSTRIA	1	1	0	0	0	0	0
FINLAND	0	0	0	0	0	0	0
FRANCE	0	0	0	0	0	0	0
GERMANY	0	0	0	0	0	0	0
GREECE	1	1	0	0	0	0	0
ITALY	0	0	0	0	0	0	0
MALTA	0	0	0	0	0	0	0
NETHERLANDS	0	0	0	0	0	0	0
PORTUGAL	1	1	0	0	0	0	0
SLOVAKIA	0	0	0	0	0	0	0
SLOVENIA	1	1	0	0	0	0	0
SPAIN	1	1	0	0	0	0	0

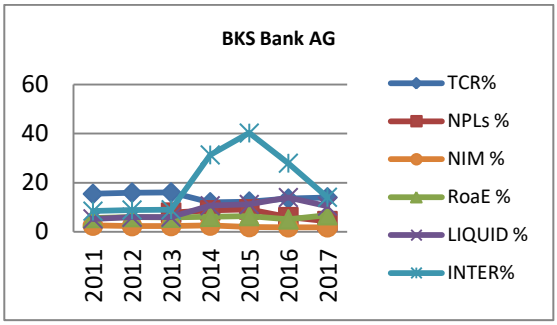
[28] The table is extracted from Laeven, L., Valencia, F., Systemic Banking Crises Database: An Update, 2012, IMF

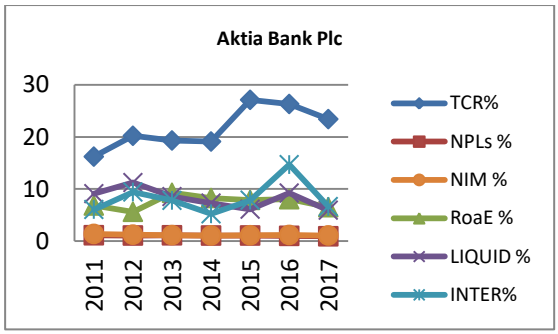
A diagrammatic illustration of CAMELS variables for each country

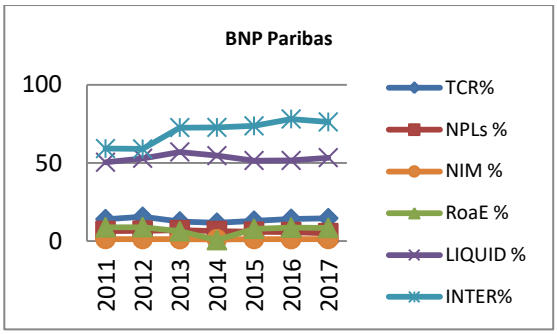


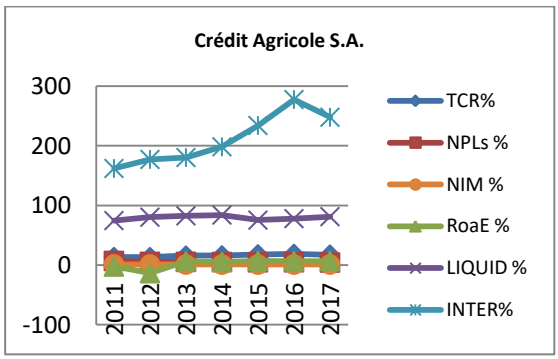


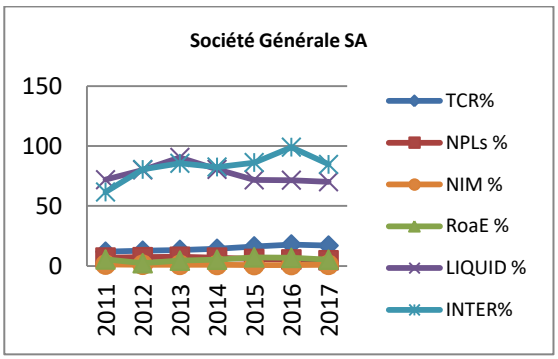


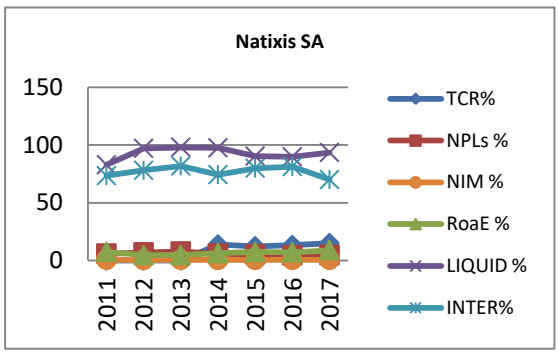


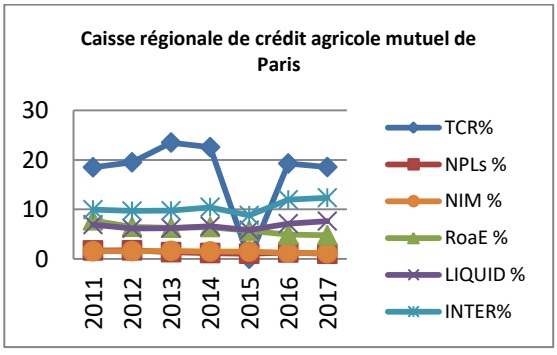


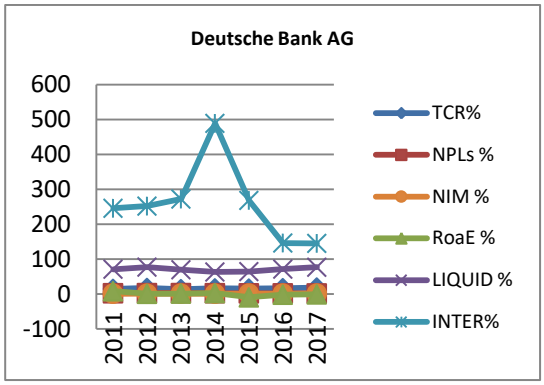


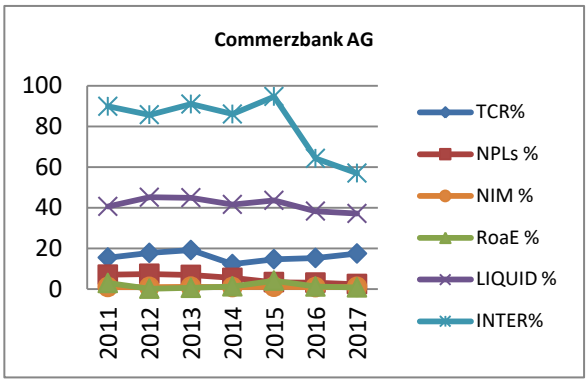


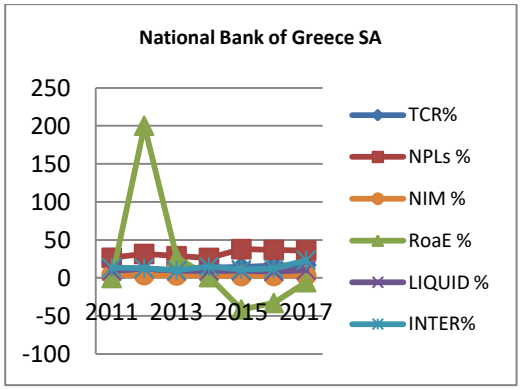


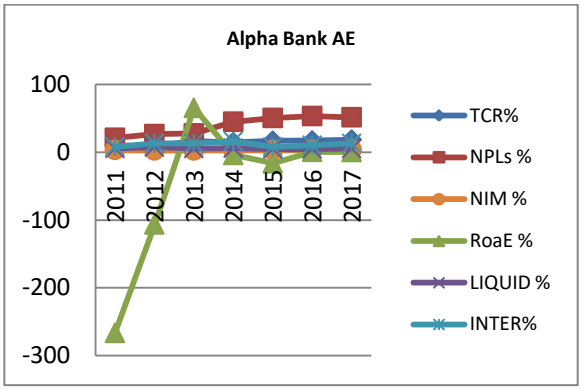


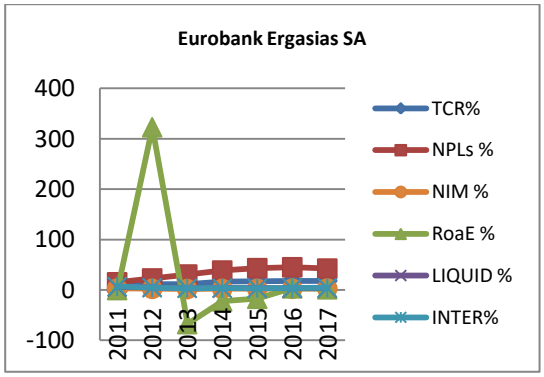


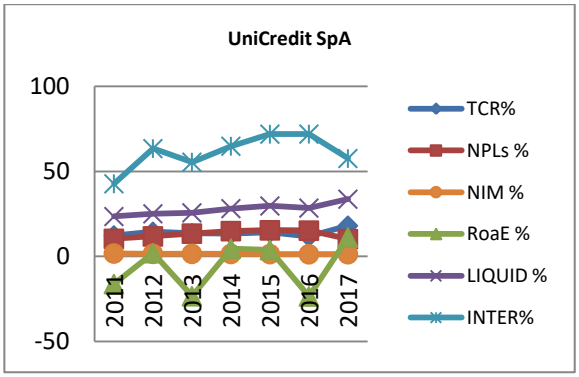

Deutsche Bank AG
600
500
400
300
200
100
0
-100
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

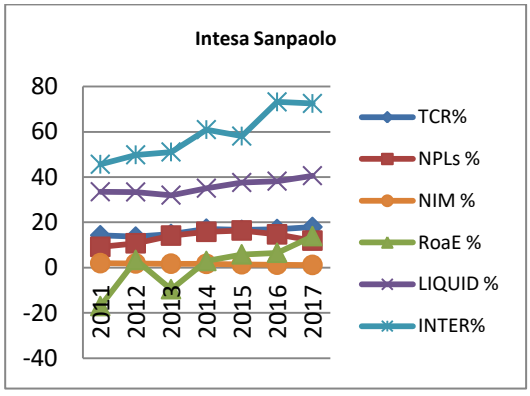

Commerzbank AG
100
80
60
40
20
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

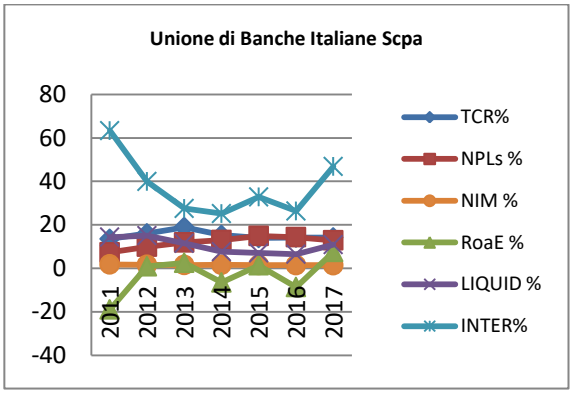

National Bank of Greece SA
250
200
150
100
50
0
-50
-100
2011
2013
2015
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

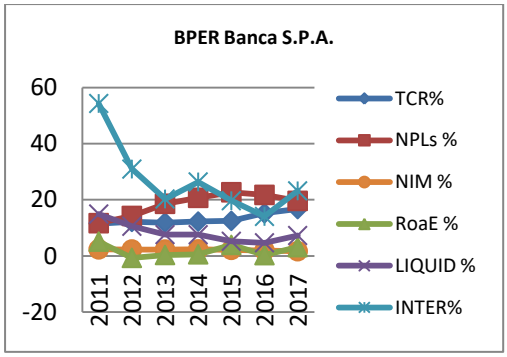

Alpha Bank AE
100
0
-100
-200
-300
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

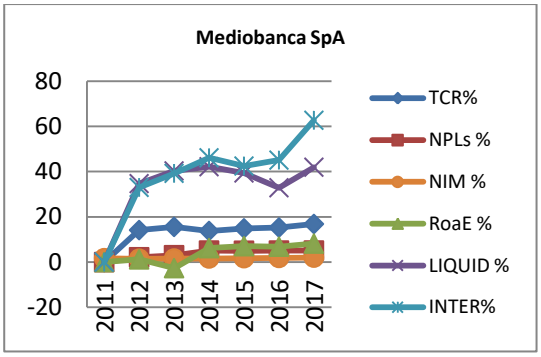

Eurobank Ergasias SA
400
300
200
100
0
-100
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

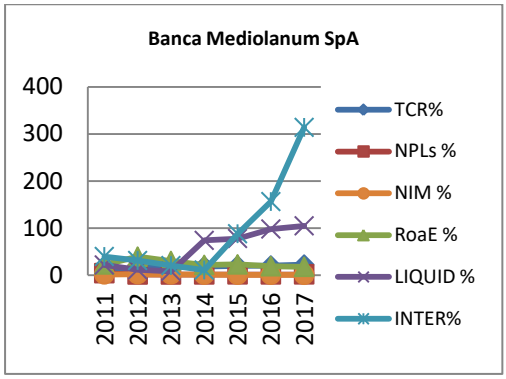

UniCredit SpA
100
50
0
-50
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

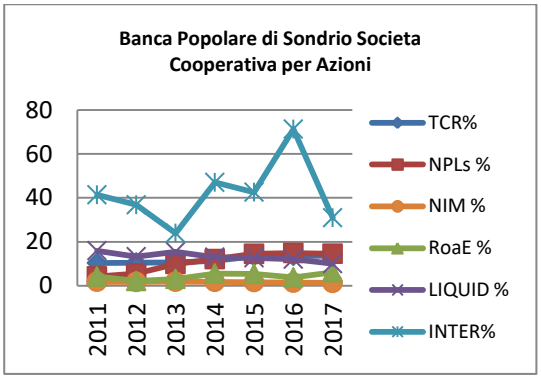

Intesa Sanpaolo
80
60
40
20
0
-20
-40
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

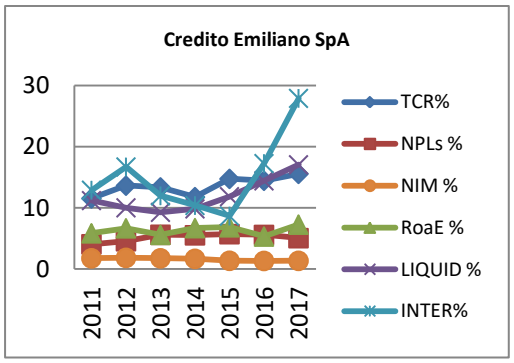

Unione di Banche Italiane Scpa
80
60
40
20
0
-20
-40
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

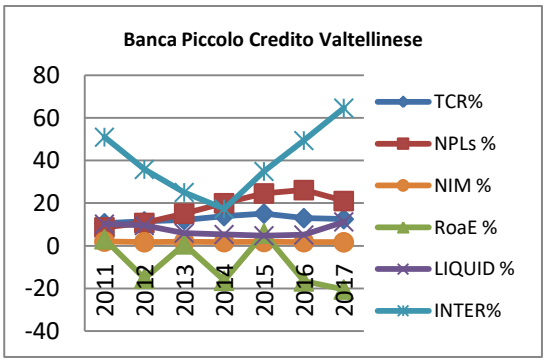

BPER Banca S.P.A.
60
40
20
0
-20
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

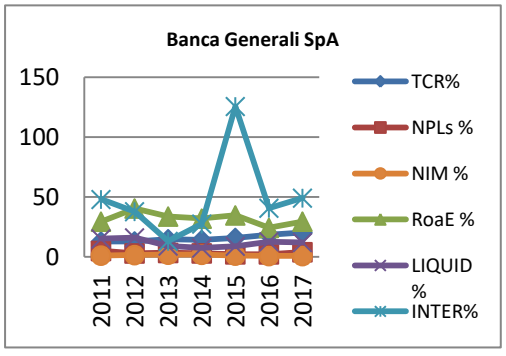

Mediobanca SpA
80
60
40
20
0
-20
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

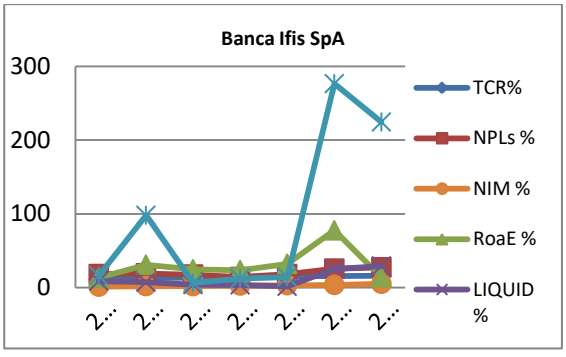

Banca Mediolanum SpA
400
300
200
100
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

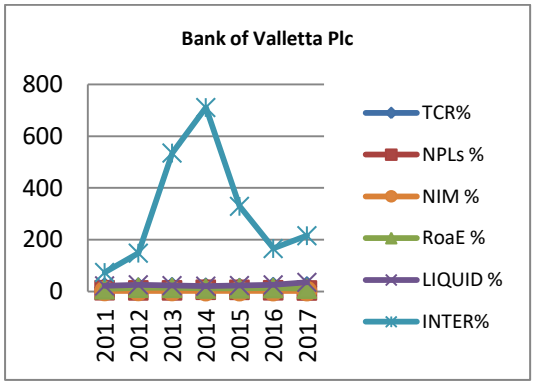

Banca Popolare di Sondrio Societa Cooperativa per Azioni
80
60
40
20
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

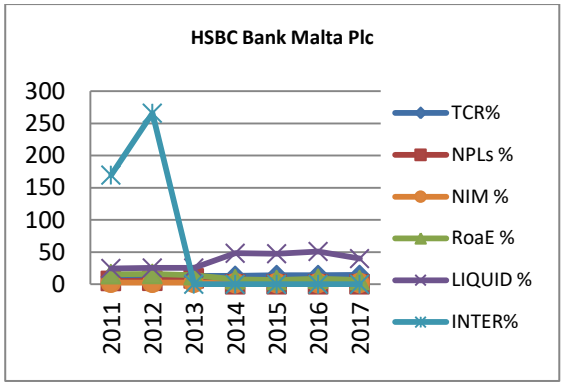

Credito Emiliano SpA
30
20
10
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

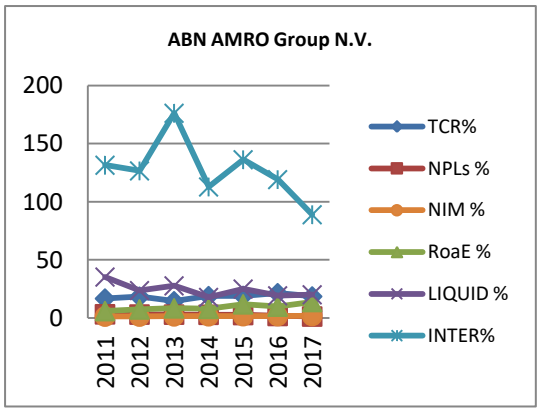

Banca Piccolo Credito Valtellinese
80
60
40
20
0
-20
-40
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

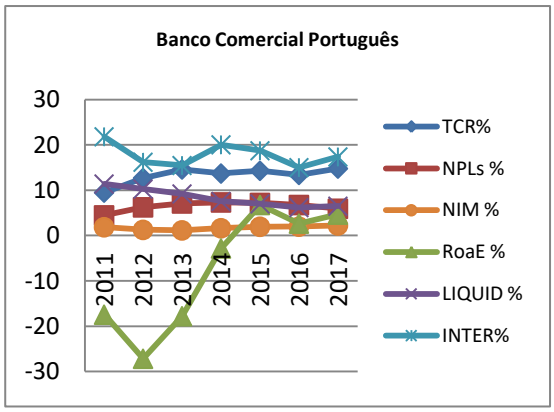

Banca Generali SpA
150
100
50
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

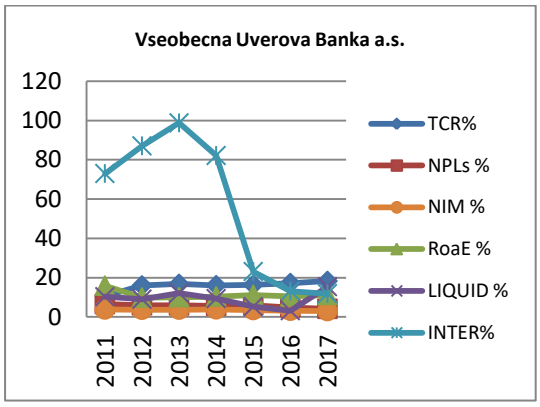

Banca Ifis SpA
300
200
100
0
TCR%
NPLs %
NIM %
RoaE %
LIQUID %

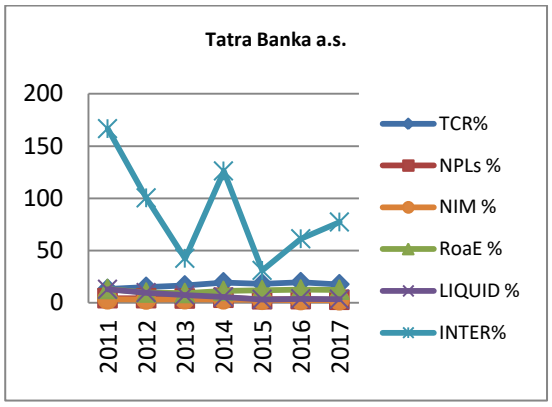

Bank of Valletta Plc
800
600
400
200
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

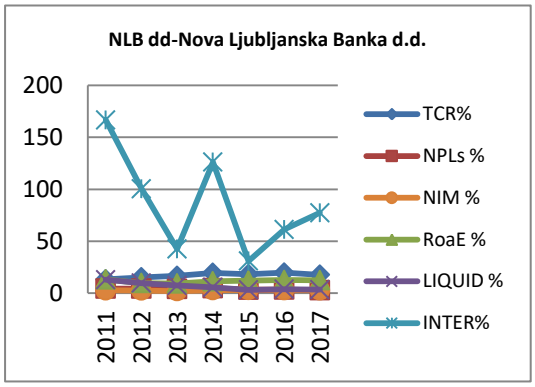

HSBC Bank Malta Plc
300
250
200
150
100
50
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

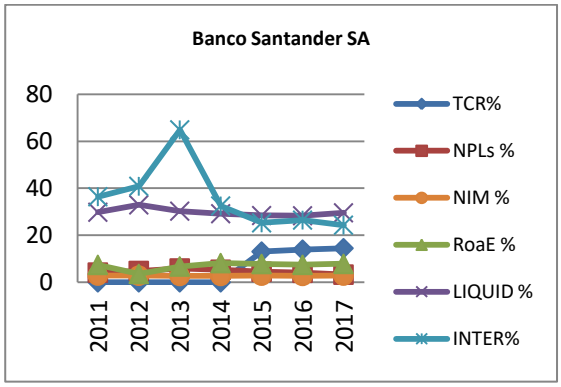

ABN AMRO Group N.V.
200
150
100
50
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

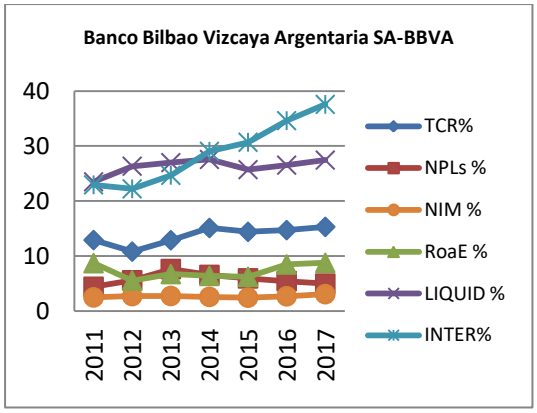

Banco Comercial Português
30
20
10
0
-10
-20
-30
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

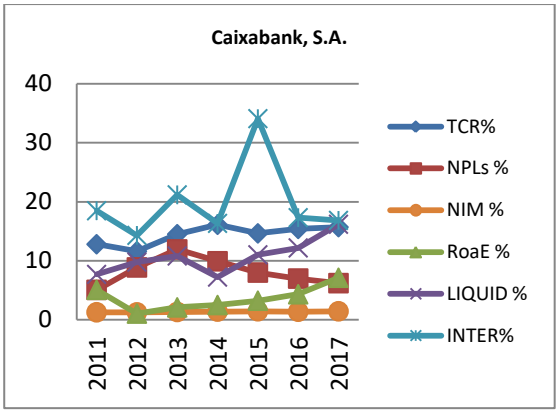

Vseobecna Uverova Banka a.s.
120
100
80
60
40
20
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

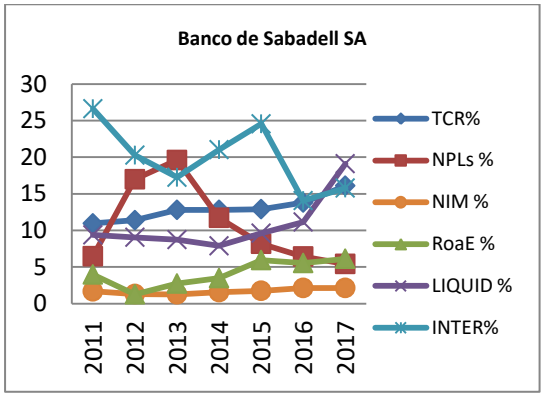

Tatra Banka a.s.
200
150
100
50
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

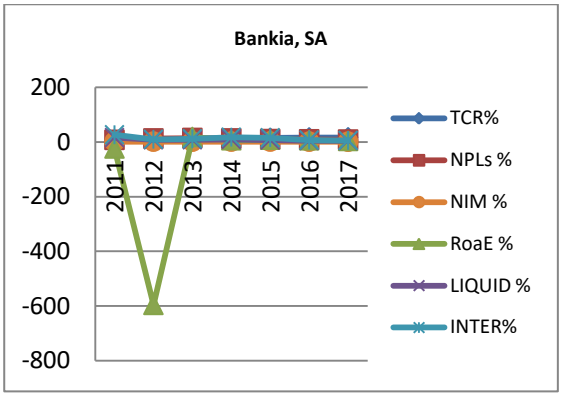

NLB dd-Nova Ljubljanska Banka d.d.
200
150
100
50
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

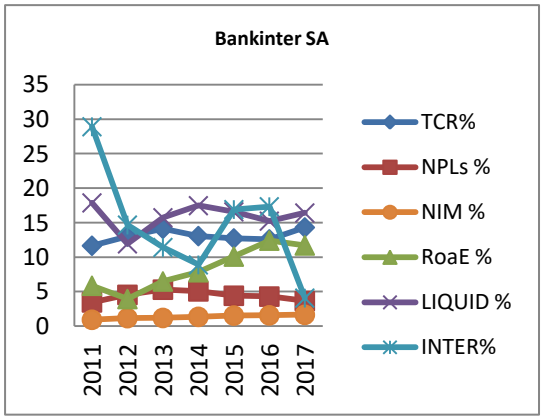

Banco Santander SA
80
60
40
20
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

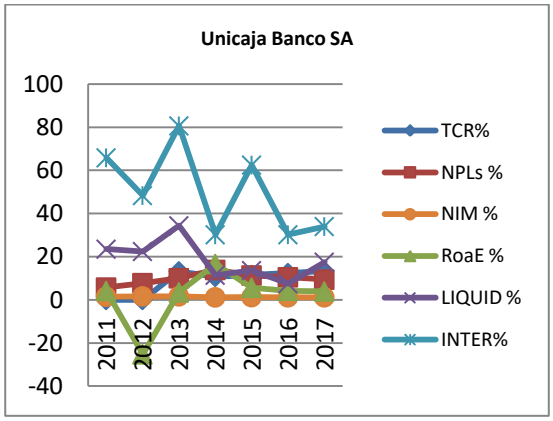

Banco Bilbao Vizcaya Argentaria SA-BBVA
40
30
20
10
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%


Caixabank, S.A.
40
30
20
10
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%


Banco de Sabadell SA
30
25
20
15
10
5
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%


Bankia, SA
200
0
-200
-400
-600
-800
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%


Bankinter SA
35
30
25
20
15
10
5
0
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%


Unicaja Banco SA
100
80
60
40
20
0
-20
-40
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

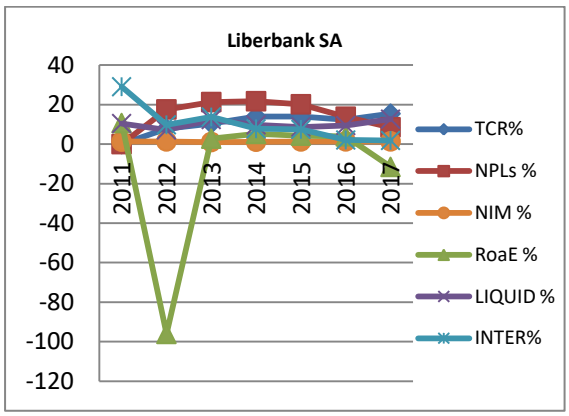

Liberbank SA
40
20
0
-20
-40
-60
-80
-100
-120
2011
2012
2013
2014
2015
2016
2017
TCR%
NPLs %
NIM %
RoaE %
LIQUID %
INTER%

Table 4.7		
List of banks according to CAMELS Categorization	**Country**	**Score**
STRONG		
Raiffeisen Bank International AG	AUSTRIA	0
Oberbank AG	AUSTRIA	0
Bank für Tirol und Vorarlberg AG-BTV (3 Banken Gruppe)	AUSTRIA	0
BKS Bank AG	AUSTRIA	0,1
Credito Emiliano SpA-CREDEM	ITALY	0,1
Banca Generali SpA-Generbanca	ITALY	0
Bank of Valletta Plc	MALTA	0
HSBC Bank Malta Plc	MALTA	0
ABN AMRO Group N.V.	NETHERLANDS	0
Vseobecna Uverova Banka a.s.	SLOVENIA	0
Tatra Banka a.s.	SLONAKIA	0,1
Banco Bilbao Vizcaya Argentaria SA-BBVA	SPAIN	0
Caixabank, S.A.	SPAIN	0
SATISFACTORY		
BNP Paribas	FRANCE	0,25
Crédit Agricole S.A.	FRANCE	0,25
Société Générale SA	FRANCE	0,25
Caisse régionale de crédit agricole mutuel de Paris et d'Ile-de-France SC-Crédit Agricole d'Ile-de-France	FRANCE	0,2
Deutsche Bank AG	GERMANY	0,35
Commerzbank AG	GERMANY	0,25
UniCredit SpA	ITALY	0,3
Intesa Sanpaolo	ITALY	0,3
Unione di Banche Italiane Scpa-UBI Banca	ITALY	0,3
BPER Banca S.P.A.	ITALY	0,3
Mediobanca SpA-MEDIOBANCA - Banca di Credito Finanziario Società per Azioni	ITALY	0,25
Banca Mediolanum SpA	ITALY	0,25
Banca Popolare di Sondrio Societa Cooperativa per Azioni	ITALY	0,25
Banca Ifis SpA	ITALY	0,2
Banco Comercial Português, SA-Millennium bcp	PORTUGAL	0,3
NLB dd-Nova Ljubljanska Banka d.d.	SLOVENIA	0,3
Banco Santander SA	SPAIN	0,25
Banco de Sabadell SA	SPAIN	0,25
Bankinter SA	SPAIN	0,35
Unicaja Banco SA	SPAIN	0,25
FAIR		
Aktia Bank Plc	FINLAND	0,45
Natixis SA	FRANCE	0,5
National Bank of Greece SA	GREECE	0,55
Alpha Bank AE	GREECE	0,5
Eurobank Ergasias SA	GREECE	0,4
Bankia, SA	SPAIN	0,55
MARGINAL		
Banca Piccolo Credito Valtellinese-Credito Valtellinese Spa	ITALY	0,65
UNSATISFACTORY		
Liberbank SA	SPAIN	0,9

Source: Author

Table 4.9 Summary Statistics						
	Average	Mean	Minimum	Maximum	Standard deviation	CV
Z-score	0,020933	0,14515	-21,897	4,4325	1,9587	93,571
TCR%	14,968	14,67	7,8	27,1	2,8825	0,19258
NPLs%	10,139	6,209	0,91	53,288	9,9914	0,98548
NIM%	1,8222	1,668	0,409	5,082	0,7916	0,43442
RoaE%	3,0675	6,246	-596,31	322,87	48,224	15,721
LIQUID%	70,739	74,199	24,365	98,966	19,168	0,27097
INTER%	61,958	34,004	1,824	711,01	82,318	82,318
rGDPgrowth	0,37026	0,011	-0,091	6,6	0,99712	2,693
CR	0,41463	0	0	1	0,49352	1,1903
MPI	3,2439	3	0	5	1,2189	0,37576
BORROWER	0,60976	1	0	2	0,54929	0,90084
FINANCIAL	2,6341	2	0	5	1,032	0,39177
Source:Author						

Table 4.10 Unit root Tests results [Levin-Lin-Chu panel unit root test]

H_0 : variable is non stationary [i.e. I(1)]
H_1 : variable is stationary [i.e. I(0)]

Variable	t-statistic	p-value	Accept/Reject null hypothesis	Result
Zscore	-25,404	0,0000	Reject	Stationarity
TCR	-110,841	0,0000	Reject	Stationarity
NPLs	-12,15	0,0000	Reject	Stationarity
NIM	-21,943	0,0000	Reject	Stationarity
LIQUID	-51,436	0,0000	Reject	Stationarity
INTER	-64,78	0,0000	Reject	Stationarity
rGDPgrowth	8,278	0,0000	Reject	Stationarity
MPI	-27,573	0,0000	Reject	Stationarity
FINANCIAL	-27,434	0,0000	Reject	Stationarity
BORROWER	-13,57	0,0000	Reject	Stationarity

Table 4.11(b) Correlation matrix of Regression II										
Variables	**Zscore**	**TCR**	**NPLs**	**NIM**	**RoaE**	**LIQUID**	**INTER**	**rGDPgrowth**	**BORROWER**	**FINANCIAL**
Zscore	1	0,0452	-0,3837	-0,0172	0,2052	0,0383	-0,1111	0,2163	0,0713	0,2061
TCR		1	-0,1371	-0,0353	0,2728	-0,1665	0,1845	0,1492	0,0632	-0,204
NPLs			1	-0,5172	-0,5349	0,358	-0,2821	-0,1647	0,1517	-0,4754
NIM				1	-0,15	0,5306	-0,2598	0,0084	0,3496	-0,5462
RoaE					1	0,0389	0,1868	0,1067	0,074	0,2312
LIQUID						1	-0,3012	0,1176	0,4033	-0,1811
INTER							1	0,0912	-0,2938	0,1929
rGDPgrowth								1	0,082	0,2588
BORROWER									1	-0,1148
FINANCIAL										1