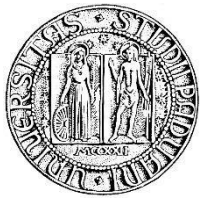

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Stress test results and the effects on bank's performance: Italian Listed Banks case

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Introduction

The following paper prosecutes to investigate on the effectiveness of Supervisory Authorities instruments; in other word, Stress Tests results, periodically issued by EBA, influence financial institutions and the goal is to test the validity of these on banks' performance. I will analyze the listed banks, especially, taking in consideration the main Italian listed banks and, therefore, how the Stress Test results affect the equity returns, the credit risk and the systematic risk; the sample counts 12 banks and these are chosen in function of the similar activity carried out. The paper covers the 2010-2016 period by looking at the 5 EBA issuance since October 2009. This has been done through a model of data containing observations of multiple phenomena obtained over time periods for the same banks and this gives the possibility to quantify the strength of the relationship between explained variables and the bank's equity returns. The explanatory variables taken in consideration are *economic bank-specific variables* such as Beta, Interest Margin, Tier 1, ROA, NPLs and *macro-economic variables* such as Unemployment and Inflation. The model will be preceded by its descriptive analysis and followed by all its supporting tests to better identify the obtained estimates. The two models applied are regressed two times; firstly, a model considering all 12 banks of the sample; secondly, a model considering just 10 banks which passed stress tests threshold over years (excluding, therefore, Banca Carige and Banca Monte dei Paschi di Siena) to capture the variations in terms of significance of variables coefficients. The thesis is composed of 5 main chapters, (i) the *Introduction of the theme* with the presentation of the principal supervisory institutions, the scenario analysis, the supervisory instruments and how these are simulated in the reality; (ii) the *Literature progresses, by* the first steps in measuring the credit risk and stress test literature reviews occurred over years, up to the actual financial environment together along with supervisory tools with the aim to add something to the existing literature; (iii) the *Empirical analysis* with the impact on banks' equity returns prices made by the explanatory variables on which stress tests act through the application of two approaches, *Pooled OLS* and *Bootstrap model*; (iv) the *Conclusion* with a recap of discovered results of the analysis and further hypothesis of future works on the same theme; (v) *References* will all sources of data utilized for the accomplishment of the thesis.

Contents

Table of Figures

1. European supervisory system

1.1. Banking supervisory activity

The European system set up for the supervision is under the control of the following three authorities: The European Securities and Markets Authorities (ESMA), the European Banking Authority (EBA) and the European Insurance and Occupational Pensions Authority (EIOPA). Although the final institutional architecture has not reached yet, the European Central Bank (ECB) has a central position in financial regulation with a future increase up to obtain further supervisory responsibilities. The process for banking supervision can be envisaged as a cycle in which regulation and supervisory policies provide the foundation for the development of supervisory methodologies and standards, which in turn underpin day-to-day supervisory activities. Bank supervisors monitor cyclical and structural developments in the banking sectors of the euro area and the EU as a whole, as well as other financial sectors. By impacting systemic risks on the stability of the EU financial system and its degree of resilience they use quantitative and other related tools to ensure effective and consistent prudential regulation and supervision across the European banking sector.

1.2. The Supervisory Review and Evaluation Process (SREP)

Supervisors regularly assess and measure the risk for each bank. This core activity is called the Supervisory Review and Evaluation Process, or SREP. Specifically, the SREP shows where a bank stands in terms of capital requirements and the way it deals with risks. In this decision, which the supervisor sends to the bank at the end of the process, key objectives are set to address the identified issues. The bank, then, must "correct" these within a specific time.

The SREP give supervisor a harmonised set of tools to examine a bank's risk profile from four different point of view, which are: *Business model* (supervisors assess the sustainability of each bank's set-up, in other words, whether it has a wide array of activities or whether it focuses on only a few lines of business), *Governance and risk management* (supervisors look into a bank's organisational structure by monitoring its management bodies and checking whether risks are being managed properly, *Risk to capital* (supervisor analyse whether a bank has a sufficient safety net to absorb losses arising, for example, from cyber-attack (nowadays, more and more frequently) on the bank's IT system, a sharp fall in oil prices and so on, *Risk to liquidity and*

funding (supervisors check a bank's ability to cover ad hoc cash needs, for example, in times of economic uncertainty when depositors may withdraw much more money than usual).

This SREP is used once a year and the decision is tailored to each bank's individual profile. In general, every bank as to comply with legal requirements that layout the minimum amount of capital it must hold; this is often referred to as "Pillar 1". The supervisor may ask the bank to hold additional capital and/or set qualitative requirements and this is referred to as "Pillar 2". The latter could refer to the bank's governance structure or its management.

Competent authorities are expected to take the following steps depending on the release of the stress test results. They discuss the quantitative impact of the so well-known *stress test* with the institution and understand the extent to which credible management actions may offset some of the impact of the adverse scenario. As the EU-wide stress test is conducted on the assumption of a static balance sheet, the assessment take, often, into account, some natural dynamics in the balance sheet, based on existing strategic and capital planning. Competent authorities assess the net impact of the stress test on the institution's forward looking capital plans and its capacity to meet applicable own funds requirements, although previously published TSCRs are not directly relevant as they are updated during 2016. Moreover, a wide range of potential actions may result, including the TSCR where the stress test reveals an imminent risk to the solvency of the institution; or using the qualitative outcomes to inform the SREP assessments in areas such as risk management; or identifying hidden concentrations. More generally however, authorities consider the requesting changes to the institution's capital plan (e.g. potential restrictions on dividend) or strategy and/or the setting capital guidance, above the combined buffer requirement. In cases where capital guidance is provided, that guidance will not be included in calculations of the Maximum Distributable Amount[1], but competent authorities would expect banks to meet that guidance except when explicitly agreed, for example in sever adverse economic conditions and if this does not happen remedial tools will be used.

1.2.1. What does this mean for the banks?

Each bank is different and this depends on the focus of it; some prefers the traditional commercial banking, while others look after other companies' financial assets. Again, some are exposed

[1] Member States shall prohibit any institution that meets the combined buffer requirement from making a distribution of its profit in connection with Common Equity Tier 1 ("CET1") capital to an extent that would decrease its CET1 capital to a level where the combined buffer requirement is no longer met (Article 141(1) of the Capital Requirement Directive (CRD IV). The purpose of such limitation is to ensure that the distribution of profits does not jeopardise the capital position of the credit institution. In addition, Article 141 CRD IV provides that institutions which fail to meet their combined buffer requirement must calculate, according to a pre-defined regulatory formula, the maximum amount they are allowed to pay in the form of dividends (on CET1 instruments), discretionary coupons (on Additional Tier 1 ("AT1") instruments) or through the creation of new obligations to pay bonuses and pensions rights. This amount is called the **Maximum Distributable Amount ("MDA")**.

to one specific factor whereas others spread their activities more widely across different segments. Supervisors from the ECB and the national supervisors, together in the Joint Supervisory Teams, consider a bank's potential impact on the financial system, its riskiness and its status, i.e. whether it is a parent entity, subsidiary or individual institution. In the most extreme case, the supervisor may not just require to hold more capital or to sell certain portfolios of loans but it might ask a bank to change its management or to adapt its business strategy to become more profitable.

The novelty of SREP (first introduced in 2004 with the Basel II accords set by the Basel Committee) under the SSM[2] is that since early 2015 one common methodology and one common timeline are being applied to all significant banks in the euro area.

1.3. ECB - Comprehensive Assessment

The ECB, together with the other central banks of the Euro-system and the European system of Central Banks, aims to maintain price stability, i.e. to safeguard the value of the euro. Price stability is essential for economic growth and job creation. Furthermore, it identifies and assess risks through a macro stress-testing framework and network analysis to investigate in a forward-looking manner the resilience of the banking sector to macroeconomic and financial developments. The regulation of financial institutions, above descripted, forms the foundation for macro-prudential policy. In pursuing its primary objective, the maintenance of price stability, the ECB undertakes the necessary economic and monetary analyses and adopts and implements appropriate policies. Moreover, it aims to strengthen the shared identities within a framework of clearly defined roles and responsibilities for all participants. To this end, the ECB attach importance to credibility and accountability by pursuing an effective communication and keeping abreast of the transformation and developments affecting money and financial markets. Within the Euro-system and the Single Supervisory Mechanism, it measures the supervisory framework against the highest international standards and combines the best of the national approaches to build a best practise framework for banking supervision across the participating member states. This mechanism is agile and risk-based, involving judgment and, as previously mentioned, forward-looking critical assessment. It, also, takes into account both the probability of a failure of institutions or an institution and the impact that such failure may have on financial

[2] Single Supervisory Mechanism

stability. The supervisory practises of the SSM follow two principles: firstly, the proportionality, tailoring the intensity of supervision to the systemic importance and risk profile of the supervised banks; secondly, the timely, that is the time of the supervisory action and through an effective monitoring of a credit institution's response.

The ECB, together with the national supervisors carries out Comprehensive Assessments, namely financial health checks of the "*significant banks*" it supervises directly. It assists in developing prudential requirements for significant and less significant banks, covering issues such as risk management practices, capital and liquidity levels and remuneration policies and practices. This help to ensure that the banks are adequately capitalized and can withstand possible financial shocks. Comprehensive Assessments are conducted either regularly (an initial health check of banks that have been recently classified as significant) or on an ad hoc (an assessment prompted by exceptional circumstances) basis. They pursue three main objectives: *Transparency* (enhance the quality of information available on the condition of banks); *Repair* (identify problems and implement necessary corrective actions); *Confidence building* (assure all stakeholder that banks are fundamentally sound and trustworthy. According to the methodology, the assessment often comprises two main pillars: an asset quality review (AQR) in order to enhance the transparency of bank exposures including the adequacy of asset and collateral valuation and related provisions; a stress test to verify the resilience of bank's balance sheets, performed in close cooperation with the European Banking Authority.

Overall, it is important to understand what makes a bank significant. Firstly, the ECB can decide at any time to classify a bank as significant to ensure that high supervisory standards are applied consistently and the criteria are the following: Size (the total value of its assets exceeds €30 billion); Economic importance (the value for the specific country or the EU economy as a whole); Cross-border activities (the total value of its assets exceed €5 billion and the ratio of its cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities is above 20%; Direct public financial assistance (it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility).

The ECB reviews and strengthens its methodologies and standards as it is possible to see looking at the latest results and policies implemented. It plans its activities through a two-step process, strategic and operational planning. Moreover, it used the experience gained from their implementation when planning supervisory activities for the forthcoming cycle based on the participation in international standard-setting bodies and European authorities, lessons learnt during day-to-day supervision and performance of quality assurance checks.

1.4. EBA – Stress Test

Finally, the European Banking Authority, as well as the main institution involved in the creation of a Rulebook in banking whose objective is to provide a single set of harmonized prudential rules for financial institutions. The EBA's activity has, among the others, to contribute to strengthening supervisory convergence, which range from the definition of guidelines and best practices, active participation in colleges of supervisors and organization of dedicated training, the performance of peer reviews and other EBA independent assessments aimed at evaluating the degree of convergence. This task needs to be executed to high standards to ensure that regulatory and supervisory rules are implemented equally across all Member States. Convergent supervisory is, indeed, fundamental to achieve consistent outcomes and a truly level playing field, which are the basis of the single market. Enhanced cooperation between supervisory authorities both at European and country level is crucial to improve the supervision cross-border banking groups. Colleges are the vehicles through which supervisory activities are implemented and coordinated. The role of EBA in this, is to promote and monitor the efficient, effective and consistent functioning of colleges with legal requirements through its policy work, that is technical standards on the functioning of colleges and their crucial tasks.
Going to what I will discuss at a later time throughout the paper, the EBA's task from an operational point of view, is to identify and analyses trends, potential risks and vulnerabilities stemming from the micro-prudential level, across borders and sectors with the aim of ensuring the orderly functioning and integrity of financial markets and the stability of the financial system in the EU. This activity, in details, collects, stores and manages data to perform risk analysis and stress tests for the purpose of market economic analyses as well as impact assessments of potential market developments.

1.5. European directives - The new supervisory framework

The new supervisory framework, illustrated above, is developed by the BCBS[3] and known as "Basel III". The EBA has been monitoring and assessing the impact of the Basel III rules on a sample of banks since June 2011 whose participation in the monitoring exercise is voluntary.
Data are only reported on an aggregate basis and the exercise assesses many aspects such as: changes to banks capital ratios; level of capital shortfall including capital surcharges; impact

[3] Basel Committee on Banking Supervision

on capital ratios and shortfall, resulting from changes in the definition of capital stemming from the new standard, referred to as common equity Tier 1 (CET 1); impact on capital ratios and shortfall, resulting from changes in the calculation or RWA stemming from capital, securitisation, trading book and counterparty credit risk requirements; impact from the implementation of the capital conservation buffer; the adequacy of leverage ratio; the adequacy of two liquidity standards, the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR).

1.6. CRR and CRD IV

From a juridical point of view, there have been many progresses seen as a necessity after the, still present, financial crisis. Since December 2010, The European Commission has envisaged EU legislative action to approximate and reinforce sanctioning regimes in the financial. The package adopted by Council and Parliament published in the Official Journal on 27 June 2013 builds on lessons learnt form the recent crisis which have shown that losses in the financial sector can be extremely large when a downturn is preceded by a period of excessive credit growth. This has been as a reaction to vulnerabilities in the regulation and supervision of the banking system at European and global level. Banks entered into the crisis with capital of insufficient quantity and quality and, in order to safeguard the stability, governments had to provide a revision of the Capital Requirements.

First, the crisis revealed an absolute necessity of enforcing the cooperation of monetary, fiscal and supervisory authorities across the globe. Secondly, some institutions in the financial system appeared to be resilient and ready to absorb even enormous market shocks whereas other institutions appeared to be unable to protect themselves. The crucial and resulting differences between the two were found in the quality and the level of the capital base, the availability of the capital base, liquidity management and the effectiveness of their internal and corporate governance. This brought the amending of Basel III Agreement by replacing the CRD with a new regulatory framework including a Regulation (CRR) and a Directive (CRD IV). Thirdly, one of the reason that justifies the Commission's legislative proposal is the number of banks which needed the intervention of the state in order to stay afloat. The knowledge that banks could have been resolved would have changed the balance of power between public authorities and banks; the former would have had more tools at their disposition that just the public purse and the bail-out option, and the latter not being able to enjoy the best of all worlds: privatize gains and socialize losses. This puts a dent on bank's risk appetite.

Moreover, an important matter is to understand why the existing rules not stop the crisis from happening. The financial crisis has unveiled several shortcomings of Basel II and necessitated unprecedented levels of public support with the aim to rebuild stability in the financial system. Among these, it is worth to mention the capital that was not loss-absorbing, failing liquidity management, inadequate group wide risk management and insufficient governance. Basel III proposes many objectives to make banks stronger, such as a better and more capital, more balanced liquidity, leverage back stop, capital requirements for derivatives (counter party risk) and capital buffers but it is useful to verify what Europe is adding to this agreement within the EU. The most fundamental change is the transition from an uni-dimensional world in which capital is the only prudential reference, to multi-dimensional regulation and supervision based on capital, liquidity and leverage ratio in order to cover the whole balance sheet of the banks.

In addition to Basel III implementation, the package introduces a number of important changes to the banking regulatory framework, both in the directive and in the Regulation. Within the Directive it touches topics as the remuneration in which the variable component shall not exceed 100% (except under certain conditions) of the fixed component of the total remuneration of material risk takers. CRDIV strengthens the requirements with regard to corporate governance arrangements, processes and introduces new rules and improved transparency regarding the activities of banks and investment funds aimed at increasing the effectiveness of risk oversight by Boards improving and ensuring effective monitoring by supervisors of risk governance. Within the Directive, the package created a Single Rule Book, a set of harmonised prudential rules that banks must respect throughout the EU by ensuring an international level playing field. The timeline and implementation of CRR and CRDIV and how it relates to the timelines and implementation in other G20 countries is crucial. All institutions are required to apply the new rules form the 1 January 2014 with a full implementation which is supposed to be on 1 January 2019, in line with international commitments. As Basel III aims to achieve that objective, the EU well knows the possibility where other jurisdictions do not faithfully implement the new Basel agreement. In the longer term, it is clearly beneficial as market participants benefit forma stable, safe and sound financial system. Even though the longer term is fundamental, there may be areas where an international level playing field is more important also in the short run (e.g. the new elements of Basel III). The Commission is therefore closely monitoring the consistent implementation of the pillars of the new agreement across the globe. Regarding to the sanctioning regimes, national sanctioning regimes currently in place for key violations of the CRD are divergent and not always appropriate to ensure effective enforcement. Certain important sanctioning powers are not available to all national authorities and sanctions are not published on a systematic basis. Furthermore, in some Member States the levels of administrative pecuniary

sanctions (fines) are too low and, thus, insufficiently deterrent; in the same way, sanctions cannot be imposed on both credit institutions and individuals responsible for violations. This situation may result, therefore, in a lack of compliance with the EU rules by creating distortions of competition in the Internal Market and have a negative impact on financial supervision. Finally, the commission as guardian of the Treaty, through EBA and an extensive and continuous dialogue with all major stakeholders, will monitor as above said how the Member States implement the changes to the Capital Requirements Directive. The consequences of the application of the legislative proposal regarding sanctioning regime will be evaluated on the basis of two main indicators, that are firstly, the number of violations detected and the number of sanctions applied and, secondly, the practice of the national competent authorities in the application of sanctions.

As regards corporate governance, the delivery of the expected benefits of new provisions should take time to be realised and degree of that will be depend on how credit institutions implement the new requirements.

1.7. The European Bail-in tool

The new bail-in tool in the EU bank resolution toolkit is an important step forward to safeguard stability in Europe, notably in relation to mitigation moral hazard and other problems inherent in a strong reliance on bailouts. This important feature highlights salient characteristics of the new requirements and then presents a multi-layered network model of banks' bail-inable securities that could help in gauging potential contagion risk and identifying mitigating measures to avoid systemic implications. The bail-in enables the resolution authority to write down and/or convert into equity the claims of a broad range of creditors according to a predefined creditor hierarchy; it contributes to reducing the burden on taxpayers when resolving large, systemic financial institutions and mitigates some of the moral hazard incentives associated with too-big-too fail institutions. The European bail-in too will, by design, affect other financial institutions that hold bail-inable securities of the bank being resolved. Losses incurred by those institutions may in turn impair their own viability and could therefore have consequences for the wider financial system. These potential second round effects need to be assessed by the relevant authorities in a timely manner.

The network model is provided to assess the size of the potential direct contagion channels due to securities cross-holding in the network and can also simulate how a bail-in at one bank lead

to the rewiring of links within the banking sector, which may give guidance to regulators on the effects of a bail-in on bank's interconnectedness. The aim is, therefore, identify situation where bail-in may entail financial stability risks and enables authorities to take ex ante mitigating measures to reduce the direct contagion risk. In addition, the tool could help inform policy decisions about the adequacy of capital levels in the system, the need for possible restrictions on bail-inable debt cross-holdings by banks and the minimum requirements for own funds and eligible liabilities (MREL) level to be set on a case-by-case basis by the SRM.

This ensures that the scope of the bail-in tool is as wide as possible, subjecting creditors to market discipline and contributing to an adequate loss-absorption capacity. The SRM Regulation, as above said, prescribes all liabilities which can be bail-inable; all liabilities are possible unless they are specifically excluded, such as secured or collateralised liabilities, including covered bonds. Moreover, in order to protect deposits guaranteed by deposit guarantee schemes and reduce the risk of systemic contagion, the bail-in excludes covered deposits and interbank liabilities with an original maturity of less than seven days. Resolution authorities may use the bail-in tool provided that three conditions for resolution are met, namely that: (i) the bank is assessed by the supervisor or resolution authority to be failing or likely to fail; (ii) there is no reasonable prospect that nay alternative private sector or supervisory measures would prevent the failure within a reasonable time frame; and (iii) a resolution action is necessary from a public interest point of view.

1.8. Stress Test – Scenario analysis

In order to ensure the orderly functioning and integrity of financial markets and the stability of the financial system in the EU, the EBA is mandated to execute the EU-wide stress test exercise. The EBA Regulation give the Authority powers to initiate and coordinate these tests, in cooperation with the European Systemic Risk Board (ESRB). The aim of such tests is to assess the resilience of financial institution to adverse market developments, as well as to contribute to the overall assessment of systemic risk in the EU financial system and the tests are conducted in a bottom-up fashion, using consistent methodologies, scenarios and key assumptions developed in cooperation with the ESRB, the ECB and European Commission (EC).

The Stress Test exercise is followed by an additional Transparency Exercise conducted by EBA's board of supervisors to give the market a prompt and coherent disclosure statement regarding capital composition and risk weighted assets (RWAs) of the main European banks.

This is combined by a detailed bank-by-bank statement concerning the credit risk exposure, market risk, sovereign risk and securitization process. The aim is to identify any material differences in RWA outcomes to understand the sources of such differences and to formulate the necessary policy solutions to enhance supervisory convergence. Following the EBA's stress test and recapitalisation exercise, it analyses why there are significant differences in the denominator of the capital ratios and material differences in banks' regulatory parameters. The data regarding the 2016 EU-wide stress has been published on July 29th 2016 whereas the latest 2015 EU-wide transparency exercise shows improvements in the resilience of the EU banking sector and progresses made on the recapitalisation of EU banks started during the previous years. The data is published at the highest level of consolidation and covers around 70% of total EU banking assets for the reference dates of 31 December 2014 and 30 June 2015.

1.9. The recent EU-wide stress testing exercise – key methodological changes

The 2016 EU-wide stress testing exercise requires banks to use the outcome of the adverse macro-financial scenario for variables such as GDP, inflation, unemployment, asset prices and interest rates in order to estimate the potential adverse impact on profit generation and capital. Some example of historical scenarios and crisis triggers are shown in the following table (Figure 1).

***Figure 1**: Some examples of historical scenarios and crisis triggers*

1973	First oil crisis – increase of oil prices by OPEC
1979	Second oil crisis – cut of Iranian oil supply
1987	Black Monday – stock market crash in the US
1991	Gulf war – oil price increase
1992	European Monetary System crisis – speculation against weaker currencies
1995	Tequila crisis – Mexican current account deficit
1997	East Asian crisis – US dollar peg cutting
1998	LTCM – LTCM collapse
2001	September 11 – terrorist attacks in the US
2007–08	Sub-prime mortgages crisis – rise in home foreclosures

Source: *Quagliariello,Mario, ed. Stress-testing the banking system: methodologies and applications. Cambridge University Press, 2009*

A scenario offers an internally consistent representation of the impact of the simultaneous change in a group of risk factors. This raises the issue of the plausibility of the shock, i.e., of the probability that can be attached to the joint movement of the risk factors. The results of

stress tests might be disregarded by the decision-maker if the scenarios upon which they are based are considered highly implausible. When sufficiently long time series of data are available (e.g. for market risk) and modelling techniques are relatively simple (e.g., for a single factor sensitivity analysis), an option is to derive the probability of the scenario looking at the past patterns of volatility and correlation.[4]

The recent exercise covers three years, that is from the first quarter of 2016, when the shocks are assumed to materialise, up to the end of 2018. In 2016, no pass-fail threshold has been included as the objective is to use the stress test as a supervisory tool, whose results will be discussed with individual banks in the SREP process. The objective of EBA's 2011 and 2014 stress tests were to identify possible capital shortfall and require immediate recapitalisation actions. However, after five years of continuous capital raising in the EU banking sector, with average CET1 ratios above 13%, the crisis type of stress test appears to be less relevant. This is why, instead of a 'capital now' approach, supervisors have decided to use the result of the stress test to assess banks' forward looking capital planning. Thus, although no hurdle rates or capital thresholds are defined for the purpose of the exercise, CAs will use stress the results as an input to the SREP.

The 2016 EU-wide stress test is one crucial piece of information, as above said, in the SREP process in 2016 and it is important to understand how these feed into the process. The results of the test allow CAs to assess bank's ability to meet applicable minimum and additional own funds requirements under the stress conditions against the common scenarios and assumption. Furthermore, the stress test results are a solid ground for a discussion with individual banks to better understand relevant management actions and how their capital planning may be affected by the stress and ensure that the banks will be above the applicable capital requirements. In other words, this means, firstly, that supervisors assess any credible management actions and other changes in the bank that would in practice impact the results. Then, they assess the potential impact of the stress on the banks and decide what the appropriate supervisor response is. Such a response could take the form of dividend restrictions or setting capital guidance which acts as a monitoring metric and not a binding requirement and is not relevant for the determination of the Maximum Distributable Amount.

The key methodological changes compared to the previous exercise are, therefore, rather similar to those of the 2024 exercise. Some improvements have been included for both refining the previous methodology, based on prior experience, and addressing new relevant risks. In this

[4] Quagliariello, Mario, ed. Stress-testing the banking system: methodologies and applications. Cambridge University Press, 2009.

regard, a methodology to estimate conduct risk-related losses is now included. Additionally, a more precise treatment of FX lending risk and hedging, together with a refinement of the net interest income (NII) methodology, were also introduced.

There are four main systemic risks which are identified by the ESRB and are represented as the most material threats to the stability of the EU financial sector and these are:

- An abrupt reversal of compressed global risk premium, amplified by low secondary market liquidity;
- Weak profitability prospects for banks and insurers in a low nominal growth environment, in the middle of incomplete balance sheet adjustments;
- Rising of debt sustainability concern in the public and non-financial private sectors, in the middle of low nominal growth;
- Prospective stress in a rapidly growing shadow banking sector, amplified by spillover and liquidity risk.

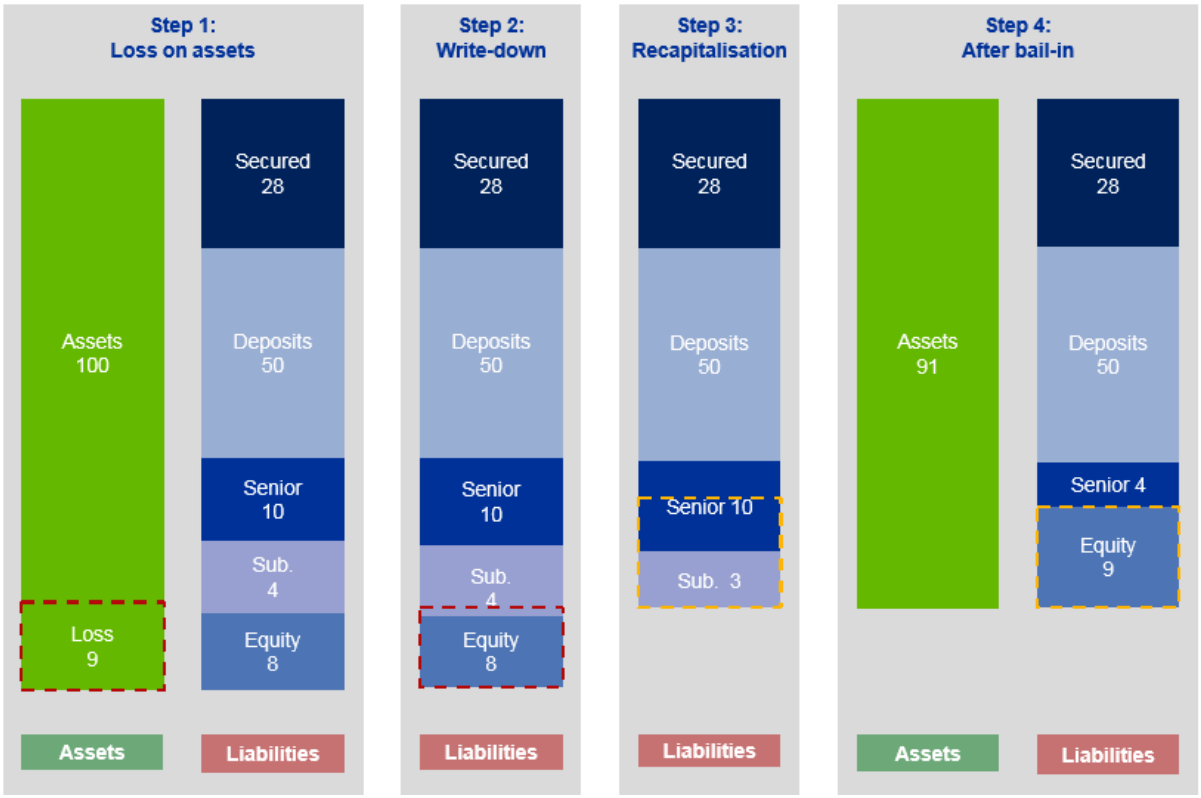
In the adverse scenario, the first systemic risk, assessed to be the most significant of the four, materializes through a change in investor preferences in the developed financial markets and in the United States with an increasing aversion to hold long-term fixed income securities. This lead people to induce a portfolio reallocation toward short-term instruments which causes a rise in US long-term risk-free interest rates and risk premium across all financial asset classes. The first systemic risk acts as a trigger for the vulnerability connected to the remaining three sources of risk and this often lead to a weakening of domestic demand, a decline in prices and a widening of sovereign credit spreads as well as to a sell-off by the shadow banking phenomena that would amplify the shocks to financial asset prices in the EU.

To assess at which capital level a bank would be considered to failing or likely to fail, a benchmark is needed for the network model. In the simulation exercise, the benchmark level of capital is assumed to be common equity Tier 1 (CET1) of 7%. EU legislation does not provide for quantitative thresholds to determine whether a bank is failing. Instead, this determination is left to the supervisor or resolution authority. According to EBA Guidelines, the supervisor should firstly base its determination of whether or not these failing or likely to fail conditions are met on the outcomes of the SREP, including a comprehensive assessment of both qualitative and quantitative elements reflecting the bank's capital and liquidity positions and other requirements for authorization to continue. Among different solutions, one possible threshold would be a CET1 ratio of 4.5%, reflecting that buffers and other capital to meet Pillar 1 and Pillar 2 requirements are decreased badly. Another more conservative assumption would be that a bank is determined to be failing or likely to fail when a bank has used up its buffers and for instance

half of its Pillar 2 capital add-on, suggesting that branches of Pillar 2 requirements may be grounds for a withdrawal of authorization and thus a failing or likely to fail assessment.

To better understand how this works, an example shown below will represent a case of loss absorption and recapitalization after a bail-in. First of all, a bank experiences a loss of nine units on its assets side and, as a consequence, breaches the assumed threshold triggering a bail-in. In a second step, its liabilities side is therefore written down to absorb the losses (in this example, the entire equity and part of the subordinated debt is lost). In a third step, the bank will be recapitalized to 10.5% CET1. This requires, indeed, new equity of nine units: the entire subordinated debt and a fraction of the senior unsecured debt need to be bailed in. Finally, the final step illustrated the balance sheet of the bank after the bail-in (Figure 2).

***Figure 2**: Stylised example of loss absorption and recapitalisation after a bail-in*



***Source**: Systemic implications of the European bail-in tool: a multi-layered network analysis*

The decision on the capital level will be based on qualitative criteria and expert judgement as the EU legal texts do no stipulate a specific level of recapitalization. Criteria for the target level for the latter are detailed by EBA Regulatory Technical Standards (RTS). These prescribe that resolution authorities should aim to set a level of minimum requirement for own funds and

eligible liabilities (MRELs) sufficient to ensure that in the future, following a bail-in, the institution can: (i) absorb losses sufficient to exhaust capital requirements and buffers; (ii) satisfy capital requirements applicable after the implementation of the preferred resolution strategy; and (iii) match average capitalisation levels for a defined peer group in order to restore market confidence.

To prevent the usage of bail-in tool, a multi-layered network approach is established to monitoring contagion risk in relation to bail-in. each of the four layers in the multi-layered network represents the securities cross-holding of a specific seniority of the largest Single Supervisory Mechanism (SSM) banking groups. This is constructed based on proprietary ECB data covering the securities holdings of the 26 largest euro area banking groups and the corresponding liability structure is derived using supervisory data. The network is based on two micro-financial datasets, that is the Securities Holdings Statistics (SHS) and the Centralized Securities Database (CSDB). From the first dataset, it is possible to identify all the cross-holding of debt securities and quoted shares among the sample of 26 banking groups. In addition, by combining SHS data with the second dataset it is possible to retrieve information on the type of debt and the seniority, which in turn permits to accurately assess the exposure of individual banking groups to bail-inable instruments issued by other banking groups. Based on these, four securities cross-holding network differentiated by the seniority of the security are built, for equity, subordinated debt, senior unsecured debt and secured debt.

1.10. How is this assessed and simulated during the Stress Test?

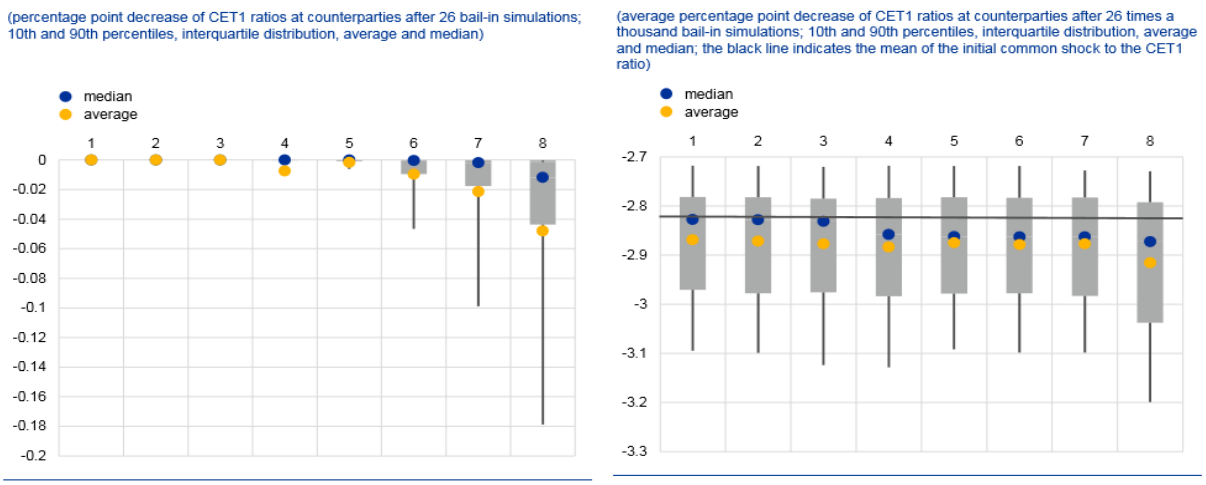
In the baseline scenario, a bank is hit by an idiosyncratic shock amounting to 5% of total assets. This loss is deducted from the bank's external assets and if the loss results in a breach of the assumed 7% CET1 resolution threshold, a bail-in is simulated. With the aim to absorb the loss, equity and debt will be written down in accordance with the creditor hierarchy; then, the bank will be recapitalized to 10.5% CET1[5] in order to reach the required level of capital. To analyze the direct contagion effects, if one or several other banks in the network go below the threshold of 7% CET1 after the initial bail-in, these banks will also be bailed in and the direct contagion cascade continues as long as there are banks breaching the resolution and bail-in threshold. According to the adverse scenario, it simulates a bail-in in an already weakened financial system; firstly all banks are subject to a macroeconomic shock affecting their current CET1 levels; secondly the weakened system is subjected to the baseline scenario, where one bank at a time

[5] The 10.5% is based on the average SREP CET1 requirements of significant institutions, which are around 9.9%.

is hit by a 5% shock and is bailed in. this system is repeated for a thousand draws of the macroeconomic shock, and therefore thousand times for each of the 26 banks. Fundamental is, therefore, the necessity to be resilient for the banking system from the bail-in of a significant institution. The two scenarios are useful for illustrating how resilient the banking system is to direct contagion when a significant institution is put into resolution and its debt is bailed in. By applying the model, it is straightforward to calculate the effects on other financial institutions holding bail-inable debt of the institution although individual bank-level results are not shown for confidentiality reasons. The charts below are generated looking at the bank-level results which are sorted in ascending order and the banks were then grouped into groups of at least three, which in turn yielded eight banks clusters for which the average results are displayed. In the baseline scenario of an idiosyncratic bail-in, the impact on the equity ratios of the counterparties of a bailed-in bank is very small, even though in most cases senior unsecured creditors are hit. Focusing, firstly, on the baseline scenario, the chart shows the decline in CET1 ratios across groups of the 25 other banks in the sample in the case of a bail-in of an individual significant institution. Instead, under the adverse scenario, the contagion effects of the bail-in on the other bank's CET1 capital are overall very limited, in a few cases contained but still non-negligible effect are observed. In detail, the limited effect is mostly due to the low levels of securities cross-holdings among the 26 banks. The analysis shows that in all cases subordinated creditors are affected, especially the senior unsecured creditors where losses range is between zero and 40% while the senior unsecured layer is exhausted and the bail-in hits the deposit layer.

Banks are not only connected via securities cross-holdings but also through interbank market. The latter is incorporated as a potential additional direct contagion channel in a particular set up and it is also subject to bail-in. With the aim to perform a comprehensive analysis of the potential for direct contagion after a bail-in, the baseline scenario is run in a set-up where nominal interbank exposures are added to the securities cross-holdings network. All information on banks' interbank lending and borrowing was extracted from the ECB supervisory data. In the adverse scenario, the bail-in of a bank has a somewhat stronger impact on its counterparties in the network. In addition to a common shock, the banking sector as a whole is already in a weakened solvency position, with an average decline of 2.8% in the CET1 ratios at the counterparties of the bank under resolution. The simulation of the baseline scenario in the weakened system results in a stronger decline in the CET1 ratio at counterparties (on average around 8 basis points) compared with the simulation of the baseline scenario without a prior common shock (on average 1-2 basis points).

***Figure 3**: Decrease in CET1 ratios in the baseline (left-side) and adverse (right-side) scenario*



***Source**: ECB (Securities Holdings Statistics and supervisory data).*

Furthermore, in the adverse scenario, some heterogeneity is observed across banks in terms of the immediate bail-in effects on the rest of the banks CET1 ratios. The loss absorption capacity mostly resides with holder of bail-inable bank debt outside the network of the 26 largest SSM banking groups. On average, senior unsecured debt securities issued by a bank within the network and held within the network as a percentage of the total nominal amount of securities issued by that banks in the senior unsecured layer amounts to only 5%. For subordinated debt, the average ratio is 0.6% and for equity cross-holdings the average ratio is 2%.

Therefore, the potential for contagion lies mostly outside the network of 26 banks and from the simulations and analysis performed three are the main findings. First, resolution authorities will need to continue to ensure the current low level of interbank cross-holdings of bank bail-inable debt in the network as they appear to prevent contagion. Second, the composition and level of loss-absorbing capacity should be set for each bank on a case-by-case basis. Third, the loss absorption capacity mostly resides with holder of bail-inable bank debt outside the network of the 26 largest SSM banking groups. Finally, it should be highlighted that the presented results are likely to underestimate the contagion risk and this because of the possibility of cases where two or more banking groups are bailed in simultaneously or, again, where any confidence-driven and second-round indirect contagion effects that are likely to occur in this context are not captured.

1.11. Does the stress test scenario remain relevant in light of the EU membership referendum in the UK?

The recent EU-wide stress is based on a general macroeconomic downturn scenario, as above mentioned, over a three-year horizon. While the scenario is linked to a specific trigger, the stress impact is driven by the severity of the overall shock over three years. Any given significant shock will cause a recession which would translate into bank losses. Thus, even after the outcome of the EU referendum in the UK, the three-year shock remains relevant as an analytical tool to understand what happen to banks balance sheets if an economic downturn is preceded by an economic shock.

The GDP shock assumed in the scenario for the EU-wide stress test is more severe than the currently available forecasts of the impact of the UK decision.

1.12. Stress Test: Is the methodology enough critics?

In many ways, Stress Test are the best macroprudential tool we have for reducing the frequency and severity of financial crisis but to be effective, they must to be truly stressful. The tempest must be the financial equivalent of a severe hurricane, not just a tropical storm[6]. To better analyze the methodology let's summarize the published results in which the EBA concludes that, except for Deutsche Bank, all of the largest European institutions meet the 3% leverage ratio requirement throughout the three-year simulated stress test episode. And, at 2.96% even Deutsche Bank comes close. However, a capital-asset ratio of 3% probably could be not sufficient to avoid runs in a crisis and there are many reasons why being skeptical about this. By comparing the EBA stress test scenario to those used by the bank of England and the Federal Reserve, it is possible to see differences. Firstly, in their assumptions about equity market performance, in the EBA's adverse scenario, European equity prices drop by only a bit more than 25$ whereas in contrast, the Bank of England assumes that U.K. and U.S. equity markets both fall by more than 40% and the Federal Reserve's severe scenario builds in a 51% crash in the Dow Jones Industrial Average. The U.K. and U.S. tests are both consistent with a fall of more than 40% in global equities that actually occurred with the recent financial crisis in 2008. The European test seems to be weaker. Moreover, the fundamental economic assumptions reveal a

[6] Cecchetti, Stephen G., Kermit L. Schoenholtz, and James Fackler. Money, banking, and financial markets. Vol. 4. McGraw-Hill/Irwin, 2006.

similar pattern. The EBA assumes that, in 2018, euro-area real GDP will be 6.8% below their baseline projection; this assumption is slightly more stressful than the Bank of England's scenario for the euro area but generally less aggressive than either the actual 2007-2010 history or the path assumed for the euro area in the Federal Reserve's 2016 Comprehensive Capital Analysis and Review (CCAR) test. As a matter of process, one would think that coordination and cooperation on development of these scenarios is critical to the accuracy and credibility of the results but one of the fundamental principle is that the resilience of the global financial system ensures that financial difficulties in one jurisdiction do not spillover into other.

1.13. Dexia Case

Doubts about the resilience of these tests are based, for example, on Dexia case experience. On July 2011, the EBA published the result of Stress test on 90 banks across 21 countries in the EU, covering around 65% of the banking industry. Eight failed. Sixteen were border line with core tier one capital ratios – a key measure of financial strengths – of between 5% and 6%. The Test have proved to be meaningless even quicker than they were in 2010 when Ireland's banks were given a clean bill of health, only to be bailed out four month later. In July 2011, the EBA has been reckoning that the capital shortfall of the banks that failed was just €2.5bn.[7] at that time, the markets reckon that the hole is more like €300bn.

Dexia was created in the late 90's when Credit Local de France merged with Credit Communal de Belgique. It had had provide finance for spending on schools, public transport, street lighting and other locally controlled budgets. Through a retail branch network in Belgium and a private banking unit in Luxembourg, it had the aim to strengthen the business ahead of the euro's launch in 1999. A first bailout happened in 2008 when the collapse of the US investment bank Lehman Brothers caused lenders worldwide to become wary of lending to each other. The necessity to provide a $5bn credible line to a subsidiary puts Dexia itself in an impossible situation because it relied on being able to take out short-term loans to finance the longer term credit it offered public authorities. Moreover, the Eurozone debt crisis has had a huge impact because of the 3.4bn euros of exposure to Greek government bonds together to billions of euros of exposure to sovereign debt issued by Italy, Spain, Portugal and other troubled Eurozone economies. In spite of all this, Dexia passed July's banking stress test carried out by the EBA. This happened because the bank had a core tier one capital ratio of 10.3%.[8] The troubled institution

[7] Jill Treanor, "How did Europe's bank stress tests give Dexia a clean bill of health?", The guardian.
[8] Kelion, Leo. "How Dexia was caught out by the Eurozone debt crisis." (2013).

has made efforts to clear its balance sheet of risky assets but the key catalyst has been its freeze of access to market short-term liquidity.

Dexia case matters the financial theory. Firstly, it put extra pressure on Belgium and France's finances with the attempt made to guarantee Dexia's loans; secondly, the stress test' failure to show Dexia's vulnerability call into question how many other European lenders are at risk making clear how supervision and monitoring activities are fundamental for the financial environment in order to avoid further contagion among the institutions.

2. LITERATURE REVIEW

2.1. Related studies and Contribution

This paper tries to contribute to the existing literature on the topic of how stress test affects banks' performance. It analyses, for the Italian listed banks, the usefulness and benefits to conduct these exercises and to disclosure their results. The contribution tries to give an overall view of the European situation by taking into account the most relevant variables firstly linked to market returns and all latest events occurred. As such, it observes Brexit, as ratified by the referendum on June 23rd, the 2016 EU-wide stress test results published by EBA on July 29th. All of these are important because of the consequences transmitted into banks equity returns. Moreover, it will show a comparison, firstly in the Italian banking scenario, and then, on how every single variable evolved over the time window.

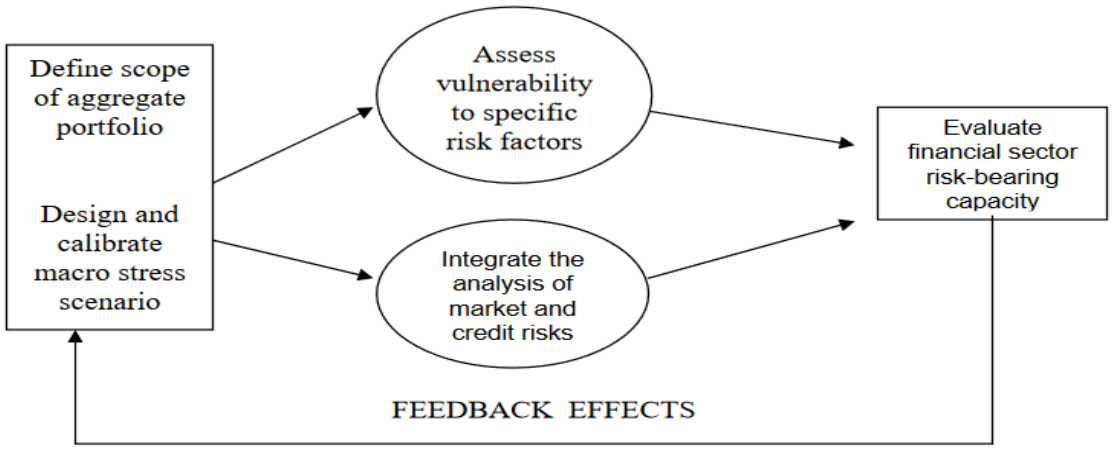
2.2. The beginning of "stress testing literature"

This chapter is related to different strands of macro stress testing literature. Starting with the work of Thomas C. Wilson (1997), which demonstrated the necessity to measure the credit risk, as additional support of the transactional control in adverse economic conditions, emerged scientific works treating the stress tests fee ability, in various different bank systems, in order to see the way in which they can absorb shocks and continue their activity in a sustainable and robust manner. Several studies examine whether bank opacity differs from that of non-financial firms in "normal" time.

At this regard, a key step in macro stress-testing is that of selecting the relevant financial institution when assessing the risk exposure of the financial system. Should the analysis be restricted to large institutions relevant for systemic stability or should it also include, for example, foreign banks, non-banks, insurance companies or pension funds? How to deal with financial conglomerates? Furthermore, which asset classes within any give financial institution should be included in the stress-banking books? These are all questions put in place by Marco Sorge (2004). Defining the relevant portfolio for macro stress-testing depends partly on the nature of risks to be analyzed and partly on data availability and this becomes of primarily importance. In fact, portfolios are in continuous evolution over time according to the specific investment and hedging strategies of individual institutions and the actual exposure on any single credit obligation may

follow per-determined loan disbursement and repayment profiles or be characterized by an a priori uncertain drawing pattern (e.g. lines of credit) as the following graph shows.

***Figure 4**: Overview of macro stress-testing*



***Source**: Sorge, 2004 p.2*

Indeed, there are several elements involved in the design of any stress scenario including the choice of the type of risks to analyze (market, credit, interest rate, liquidity, etc..), whether single or multiple risk factors are to be shocked, what parameter(s) to shock (prices, volatilities, correlations), by how much (based on historical or hypothetical scenarios) and over what time horizon. The analysis of a wide range of risks factors enhances the predictive power of the stress-test at the cost, however, of an increased computational burden and similarly, simulating a comprehensive scenario include multiple shocks allows more realistic predictions than focusing on ad-hoc sensitivities of single parameters. A key decision is how to calibrate the size of the shocks to use for stress-testing; they can be calibrated to the largest past movements in the relevant risk variables over a certain horizon or, alternatively, in a more quantitative way and with sufficient data, it is possible to estimate the joint empirical distribution of past deviations from trend of the relevant risk variables and use its quantiles for the simulation of the stress scenarios.

The necessity to measure the financial institution's credit risk comes into the world because of the belief that banks hold substantial private information. The main purpose of bank examinations is to acquire some of this information which, in turns, can be done by identifying three types of information effects: (i) the net auditing effect of verifying the bank's books, (ii) the regulatory discipline effect of changing regulatory treatment and (iii) the private information effect of revealing information about bank condition (Berger and Davies, 1998). The role of

information acquisition of bank regulators is important for the recognition and possible control of bank risk. This role is also consistent with the modern theory of banking under which banks hold a substantial amount of private information about their loan customers, and by implication according to the well-known "economies of scale", private information about their own conditions. One important consideration in choosing how much of the risk-bearing and associated monitoring responsibility should rest with government versus private-sector agents depends upon the quality of the information available to the two groups. If the examination process give regulators a substantial informational advantage, this would tend to favor regulatory discipline, all else equal, while a private-sector informational advantage would tend to favor market discipline. Through the event study methodology, the analysis found that the only strong effect is that examination downgrades appear to reveal unfavorable private information about condition. It is, therefore, important to capture in the simulated scenario the second-round effect on any other economics variable that might be affected by the original shock (for example, a sever oil sock is likely to affect GDP as well as inflation, interest rates, etc.) and this can be done by two main methodological approaches: *a "piecewise approach"* that evaluates the vulnerability of the financial sector to single risk factors, by forecasting several "financial soundness indicators" (such as non-performing loans, capital ratios and exposure to exchange rate or interest rates risks) under various macroeconomic stress scenarios; *an "integrated approach"* combining the analysis of the sensitivity of the financial system to multiple risk factors into a single estimate of the probability distribution of aggregate losses that could materialize under any given stress scenario. Both approaches have made significant improvements over time but Sorge's thesis rests on the need to pay closer attention to the correlation of risks and risk measures over time and across institution, to the lengths of the time horizon used for simulation and to the potential instability of all reduce-form parameter estimates because of feedback effects.

2.3. The financial environment and actual supervisory tools

Started, firstly, with the demonstration of the necessity to measure the credit risk and, secondly, with the understanding of what type of financial institution and kind of risk should be included in the stress test, then, a step forward has been done with the analysis of the approach through which better estimate and capture the simulated scenario. Over time many studies have been conducted regarding European supervisory and how stress tests assess the impact of an adverse macroeconomics scenario on the profitability and capitalization of a large number of banks and

another strand of macro stress testing literature could be identified exactly in this and in several contributions.

One of the first analysis which studied the market reaction and the implications for bank transparency to the disclosure of supervisory actions is John.S Jordan, Joe Peek and Eric Rosengren paper (2000). They examined the stock market reaction to announcements of formal supervisory actions and found that, firstly, the variation in the quality and timeliness of disclosure by U.S. banks explains much of the variation in the market's reactions and, secondly, that these announcements can cause spillover effects. However, rather than representing contagion, these spillover effects are consistent with enhanced transparency. Only banks in the same region as the announcing bank, with similar exposures, are affected. Thus, enhanced disclosure can improve the allocation of resources in the banking system.

In the EU where the concept was, and still is, matter of concern, raised different theories and thoughts during the crisis, especially in Germany's entire banking industry which had joined forces to resist any compulsory recapitalization of banks with the aim to resist European moves to impose higher requirements across the board. Furthermore, the country's five banking association has wondered if any risk assessment of European banks should be based on the current concept of capital requirements, and should not anticipate the Basel III rules that were only supposed to come into effect few years later (Bryant, 2011).

Another important proof, on the same way to what this paper wants to demonstrate later on, is the Petrella and Resti's analysis (2013). Here the paper demonstrated how the supervisors, by making the outcome public as attempt to curb bank opaqueness, should help investors distinguish between sound and weak institutions and restore confidence on the market. Furthermore, in order to assess whether stress tests produce valuable information to market participant, this analysis investigates the price changes experienced by European banks after the release of the 2011 stress test results. It is effectively important identify the scenario for the supervisors even at the cost to provide a truly "stressed" environment (e.g. scenarios involving the default of one or more sovereign entities), as they might scare investors or simply be politically unpalatable; but if downturn scenarios are perceived as too mild by investors, the stress test results may simply be ignored by the market. Moreover, if macroeconomics conditions in the following months deteriorate more than anticipated by the "stressed" assumptions (possibly leading to the failure of one or more banks which had passed the test), this dents the supervisors' credibility and may lead to greater market uncertainty. Banks, as well, agreed that if too many detail on balance sheet composition are made public, this could damage business confidentiality and give rise to legal risks. Also, other market participant could gain insights into one bank's risk profile,

e.g. by estimating the amount of needed financial hedgers and using this information to carry out arbitrage strategies on the CDS market.

Again, doubts about the accuracy with which outside investors can assess a banking firm's value have been analyzed even some years before, by Flannery et al. (2010). These are the motivation why many government intervene in the banking market and the financial crisis has reinforced concerns about the possibility that banks are unusually opaque. The paper examines the trading characteristics of bank share over the period from January 1990 through September 2009. As results, bank shares trading exhibit sharply different feature before vs. during the crisis. Until mid-2007, large banking firms appear to be no more opaque than a set of control firms, and smaller banks are, at most, slightly more opaque. During the crisis, however, both large and small banking firms exhibit a sharp increase in opacity, consistent with the policy interventions implemented at the time. Although portfolio composition is significantly related to market microstructure variables, no specific asset category(s) stand out as particularly important in determining bank opacity. However, market participant apparently became unsure about the composition and exposures of some financial institutions' portfolio and the true economic value of some assets in those portfolios. This solvency uncertainty led investors to lose confidence in the banking system up to the point that even financial institutions themselves were reluctant to lend to each other, as evidenced by the sever dislocation in the interbank funding market. All these reasons led policy maker, therefore, to be concerned about credit flows being disrupted by the substantial amount of impaired assets clogging banking firm's balance sheet. One of the obstacle to removing impaired assets from banking firm' balance sheets was the substantial disagreement between insiders and outsiders about the economic value of those impaired assets. Moreover, this kind of information asymmetry could lead outside investor to undervalue the banking firm's equity in a pooling equilibrium, making it expensive for the banking firm to raise capital and exacerbating the underinvestment problem (Myers and Majluf, 1984).

Related to the same strand above described, the Ellahie analysis (2012) investigates the capital market consequences of government stress testing of banks in the European Union during the global financial crisis of 2007-2012. Theory suggests that the announcement of imminent publics disclosure, as well as subsequent disclosure, can induce changes in *information asymmetry* (defined as information differences across investors) and *information uncertainty* (defined as ambiguity about the implications of information for value). Through the analysis, it is highlighted that compared with propensity score matched control firm, stress test announcements do not significantly affect measures of information asymmetry or information uncertainty for tested banks. Again, upon disclosure of 2011 test results, information asymmetry declines for

tested banks while information uncertainty increases indicating either imprecision of revealed information or worsening sovereign credit crisis. Moreover, the document put in evidence that the detailed credit "Exposure at Default" disclosures in the 2011 test results had directional information content for measures of information asymmetry, information uncertainty, credit spread and equity prices. This evidence suggests a role for transparent government stress test in improving the information environment in capital markets during crises thanks to the effort of government regulation in trying to mitigate potential bank opaqueness by requiring detailed periodic disclosure to publics investors. The analysis contributes to prior political economy literature by (i) providing timely empirical evidence on the usefulness of centralized stress testing of banks as a government intervention mechanism and (ii) giving answers to debates about the appropriated mechanism to monitor the systemic and contagion risk of financial institutions through the disclosure of transparent information and the enactment of a better regulation.

A similar investigation has been done on the US banking stress tests. It analyses the effects of the announcement and the disclosure of the clarification, methodology and outcomes on banks' equity prices, CDS[9], systematic risk and systemic risk during the 2009-2013 period. Bank supervisors expect banks to hold sufficient capital to cover losses under adverse economic conditions and stress testing has become an important tool for banks supervisors to achieve that goal. In stress tests the implications for individual banks' financial positions under several macroeconomic scenarios are examined taking the bank's exposures and business models into account. Stress tests have several characteristics. First, they are forward looking. Second, they generally put high weight on highly adverse scenarios, thereby providing supervisors with information about tail risks. Third, common scenarios are applied to banks so that stress tests can provide more consistent supervisory standards across banks. Finally, unlike traditional supervisory exams that generally are kept confidential, the results of banks stress tests are frequently publicly disclosed in order to restore confidence and reduce market uncertainty. Indeed, it is widely believed that stress test conducted in the US have provided valuable information to the market. This paper added to the existing literature in four ways; first, the examination of the effects of all post-crisis stress tests in the US. Second, in contrast to most previous research, the analysis is not confined to the effects of stress tests on equity returns and CDS spreads but also considers the impact of stress test on banks betas. Betas capture systematics risk based on the co-movement of returns with the overall market and are therefore particularly relevant for understanding the effects of stress tests. Third whether the change in betas is due to changes in individual bank risk, or due to changes in systemic risk. Finally, the investigation does not only consider the

[9] Credit Default Swap

impact of the publication of the stress test outcomes, but also examine other disclosure events, such as the announcement of the stress test and the disclosure of the methodology to be used, as these may also provide information. The latter is a point well analyzed even by other works (Petrella and Resti, 2013), on which particular focus has been paid.

Another strand of related literature examines to what extent supervisory information should be disclosed. Speaking of this, an analysis of costs and benefits is done by Goldstein and Sapra (2014). They argued that while stress tests uncover unique information to outsiders – because banks operate in second-best environments with multiple imperfections – there are potential endogenous costs associated with such disclosure and this for many reasons. First, disclosure might interfere with the operation of the interbank market, and the risk sharing provided in this market. Second, while disclosure might improve price efficiency and hence market discipline, it might also induce sub-optimal behavior in banks. Third, disclosure might induce ex post market externalities that lead to excessive and inefficient reaction to public news. Fourth, disclosure might also reduce traders' incentives to gather information, which reduce market discipline because it hampers the ability of supervisors to learn from market data for their regulatory actions. Many proponents of disclosure of stress-test results have linked the severity of the recent financial crisis to bank opacity and the thesis of the analysis stands on that many banks took on excessive risks that were not adequately disclosed so that such risks could not be properly priced by the market. Disclosure of stress-test results informs outsider whether banks are sufficiently capitalized to absorb negative shocks, thereby enhancing market discipline. Such market discipline, in turn, would have prevented insiders from engaging in excessive ex ante risk taking behavior that may have contributed to the recent financial crisis. Greater transparency of a bank's risks would have also allowed banking regulators to better monitor the banks and allowed them to intervene early enough to take corrective actions by recapitalizing weak or insolvent banks. Unfortunately, by the time regulators intervened, it was too late as there was a widespread panic because the market could not distinguish a solvent bank form an insolvent bank and such panic brought the fallen of whole financial system. Therefore, as we see, there are many legs to stand on the belief, that by disclosing stress-test results and information is beneficial, and, investors would see their confidence restored and such a boost in investor confidence would, in turn, positively influence the real economy. This would promote financial stability although bank-specific inefficiencies that, most of the time, are object of possible minimization through a proper understanding of their sources to better inform the debate and guide regulators in both designing costs and handling the disclosure.

How much capital and liquidity does a bank need to support its risk by taking activities? During the recent (and still ongoing, especially for Italian banks with their well-known huge quantity of NPLs) financial crisis, answers to this question using standard approaches, e.g. regulatory capital ratios, were not longer credible and thus broad-based supervisory stress testing became the new tool. Bank balance sheets are notoriously opaque and are susceptible to asset substitution (easy swapping of high risk for low risk assets), so stress tests, tailored to the situation at hand, can provide clarity by openly disclosing details of the results and approaches taken, allowing trust to be regained. With that trust re-established, the cost-benefit of stress testing disclosure may tip away from bank-specific toward more aggregated information. Schuermann (2013) answers to this question before mentioned through laying out a framework for the stress testing of banks: why it is useful and why it has become such a popular tool for the regulatory community during the recent financial crisis. In detail, he provides an analysis from the design to the execution of stress testing and how should one handle their disclosure either in crisis or "normal" times. He identifies three kinds of capital and liquidity: (i) the capital/liquidity you have; (ii) the capital/liquidity you need (to support your business activities); and (iii) the capital/liquidity the regulators think that you need. Stress testing, regulatory capital/liquidity and bank-internal (so called "economic capital/liquidity") model all seek to do the same thing: to assess the amount of capital and liquidity needed to support the business activities of the financial institution. Capital adequacy addresses the right side of the balance sheet (net worth), and liquidity the left side. Yet to the question of what is the capital you need vs. the capital you have, in each case the answer came out wrong because neither firm-internal (economic) nor regulatory capital and liquidity models can guarantee failure prevention; indeed, that is not their purpose as every firm accepts some probability of failure, sized by its risk appetite. But the defaults and the cascading of these came out with a resulting deep skepticism of stated capital adequacy by the market, forced regulators to turn to other tools for assessing, in a credible way, the capital adequacy of banks. That tool turned out be stress testing. A successful macro-prudential stress testing program, particularly in a crisis, has at least two components: first, a credible assessment of the capital strengths of the tested institution to size the capital "hole" that needs to be filled, and second a credible way of filling that hole. As before mentioned a default occurred even when a financial institution passed the test few months earlier (Dexia case in the EU). The results of 2011 EBA stress test of 90 banks in 21 countries were at first blush similarly mild as the previous year's. Eight banks were required to raise a total of only €2.5bn. However, the degree of disclosure was much more extensive than before and importantly, all bank level results were available to be downloaded to enable market analysts to easily impose their own loss rate assumptions. In this way, the "official" results were no longer so final: analysts could

(and did) easily apply their own sovereign haircuts on al exposures and thus test the solvency of any of the 90 institutions themselves.

An important issue is the stress testing design. Chosen to measure the credit risk, the type of institution and the approach through which compute the analysis, the most fundamental choice in stress testing design is the risk appetite of the authorities: how severe and how long should the stress scenario be; and what is the post-stress hurdle. Over years different ratios changed; for instance, the 2009 SCAP[10] in the U.S. presented a two-year scenario with a post-stress hurdle of 4% Tier 1 common capital. The 2012 bottom-up Spanish stress test used a three-year scenario with a post-stress hurdle of 6% core Tier 1 capital, suggesting a lower risk appetite by the Spanish authorities than the American. With the risk appetite established, one of the principal challenges faced by both the supervisors and the firms in designing stress scenarios is coherence and the real difficulty is in specifying a coherent joint outcome of all the relevant risk factors. For example, not all exchange rates can depreciate at once; some have to appreciate. A high inflation scenario needs to account for likely monetary policy responses, such as an increase in the policy interest rate as Janett Yellen, the Federal Reserve president, did two time in three months up to 1% in 2017 and, Mario Draghi will probably do at the end of Quantitative Easing program (end of 2017 or first months of 2018). However, all supervisory stress tests to date have imposed the same scenario on all banks. Naturally, any scenario may be especially severe for some banks and much less so for others, depending on the business mix and geographic footprint. This one-size-fits-all approach is analogous to the problem of regulatory vs. internal economics capital models: the former by design is the same for all banks, while the latter, being bespoke to a given bank, directly takes account of the particular business mix of that bank. This problem of same or custom-made stress scenario becomes especially acute when it is necessary to move from crisis times, when there may be less debate about what a relevant adverse scenario might look like, to "normal" times. At this regard, the US CCAR[11] program, in operation since 2011, recognized this problem and asks banks to submit results using their own scenarios (baseline and stress) in addition to results under the common supervisory stress scenario. This represented an important step forward from the 2009 SCAP: by asking banks to develop their own stress scenario(s), which was to reveal the particular sensitivities and vulnerabilities of their portfolio and business mix, supervisors could learn from the

[10] The Supervisory Capital Assessment (SCAP) - It allowed supervisors to measure how much of an additional capital buffer, if any, each institution would need to establish today to ensure that it would have sufficient capital if the economy weakens more than expected. https://www.federalrserve.gov/newsevents/press/bcreg/bcreg20090507a1.pdf

[11] The Comprehensive Capital Analysis and Review (CCAR) – it is an intensive assessment of the capital adequacy of large, complex U.S. bank holding companies (BHCs), and of the practices these BHCs use to assess their capital needs. https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20170203a4.pdf

banks about what they thought to be the high-risk scenarios. This is useful not just for micro-prudential supervision but also for macro-prudential supervision by allowing for the possibility of learning about common risks across banks hitherto undiscovered or under-emphasized and thanks to this dual approach, supervisors could directly compare results across banks from the common scenario without sacrificing risk-discovery. Most of studies so far analyzed conclude that stress tests produce valuable information for market participant and can play a role in mitigating both bank opacity and risk overflowing. At the same time, Goldestein and Sapra (2012) and Schuerman (2013) conclude that it is fundamental the extent to which supervisory information should be disclosed because it may not always be optimal.

The final related strand of literature examines how stress test can be used to set capital ratios, limit capital distributions, and set-up resolution regimes in case of financial distress (BCBS, 2012). Because of these and their related benefits, there has been a significant increase in the use of supervisory stress tests in recent years. In fact, all countries indicated that they conduct some form of supervisory stress test. The review found that the two most common areas for supervisory follow-up were improving governance processes for stress testing and use of additional (in particular, more severe) scenarios. Many countries either regularly or occasionally imposed requirements to improve data or model validation processes. The least common supervisory follow-up actions indicated in the responses was to require the banks to review or change limits or exposures (less than half of the countries reported taking this actions regularly). Another principle encourages supervisors to consider the results of stress tests in assessing capital adequacy and in setting prudential buffers for capital and liquidity. A large majority of countries indicated that they sometimes or regularly impose capital or liquidity requirements as a result of stress testing deficiencies. This use of stress scenarios for setting liquidity requirements has appeared to be fairly well established, particularly as countries worked toward the implementation of Basel III liquidity framework, which is based on stressed cash flows. Use of stress tests for setting minimum capital requirements, determining explicit capital buffers or for limiting capital distributions by banks is a more recent development that was not extensively considered in the principles and, thus, was not a key focus of the review. While use of stress tests to set formal minimum capital requirements is not common, use of standard supervisory stress scenarios as a benchmarking tool is increasingly prevalent. Other countries took the view that stress test results are just one factor in assessing how much capital is needed to offset the risk of unexpected losses and, at the beginning, it was one of several tools in assessing capital adequacy and there was a reluctance to place primary reliance on stress test scenarios outcomes. Most countries used to utilize both risk specialist and generalist supervisors in reviewing stress testing practices at banks. At the same time, some countries noted that where stress testing is

allocated to a separate unit, it could be more difficult to ensure that stress testing is embedded within routine supervision and that stress test outcomes are understood and used by the generalist supervisors. Moreover, the more advanced countries, noted a general lack of specialized stress testing resources. Indeed, some countries realized that prioritization of supervisory work is a major issue as key individual involved often have other responsibilities. There has been a significant increase in the use of supervisory stress test. As a result, progress in this area can be considered more advanced generally than some other aspects of the principles. Many countries conduct both bank-run and supervisors-run stress tests on an annual basis. This can involve the supervisory authority running the same scenario using supervisors or public data in order to benchmark banks' results from the bank-run stress test. Some countries run both regional and country-specific stress tests. The overall assessment and challenge of the reasonableness of banks' stress tests scenarios and outputs is a difficult area for supervision. In many countries, the models, assumptions and approaches used are evolving, and banks are at varying degrees of sophistication. At a general level, the review found a range of supervisory methods for challenging the scope and results of banks' stress tests and scenarios. The most widely used method was to compare outputs with historical experience, such as a past severe recession. However, in countries with little history of financial crisis, this approach may be more difficult. Instead, a number of countries conducted their own parallel stress tests on banks financial data to benchmark results produced by banks or placed high reliance on reasonableness checks based on supervisors' understanding of portfolios. Peer comparisons were very useful in countries facilitate this by requiring banks to report the results of their stress tests in a standardized manner, and, many countries also placed moderate to high reliance on bank's own internal model validation reporting. This has been done by auditors or consultants through independent reviews even if, most of the countries involved, indicated they did not rely at all on dependent review of stress testing results as part of their supervision activities. Again, another trend is that supervisory authorities were more actively reviewing scenarios chosen by the banks in their internal stress testing and, for example, the banks' ICAAP.

Stress testing is, nowadays, increasingly part of the publics debates on the strength and transparency of supervision; this because of the period of severe crisis experienced by during 2007-2009 and the many of the factors that have contributed to the turmoil, such as loose monetary policy or intense competition. A key novel element in the recent crisis, however, is represented by the various ways through which banks have transferred credit risk in the financial system. Nijskens and Wagner (2011) reported this, highlighted how banks traditionally shed only few risks from their balance sheets, such as through loan sales or credit guarantees and finally, how in recent years, however, banks have dramatically increased their risk transfer activities. For

one, they have done this by using credit derivatives, mostly in the form of CDS[12] and through the securitization of assets (particularly noteworthy are the CLOs[13]). The severity and the widespread nature of the recent crisis indicated that these risk transfer activities have increased the risks in at least some parts of the financial system. After all, the main rationale behind credit risk transfer is that it allows fragile financial institution to move risks to less fragile institutions and to diversify away concentrated exposures. It was for these reasons that regulators initially endorsed actions for the overall stability assessment of the new credit risk transfer activities. Standard measures of bank risk commonly used by regulators, such as the amount of risk-weighted assets, fail to capture this. In fact, due to the diversification presumably achieved by CRT, banks have could lower their capital requirements, allowing them to extend their lending and thus contributing to the current turmoil. The results showed that in a word characterized by an active transfer of credit risk in the financial system, effective regulation should pay more attention to a bank's contribution to systemic risk, rather than to its individual risk. In other words, an increase in the bank's beta is due to a higher correlation between banks and not due to higher bank volatility. As a result, an interesting implication for an effective regulation of these institutions is that market seems to have been aware of the greater risk these banks are posing; this is because the banks experienced a substantial increase in their beta well before the onset of the crisis. The failure of traditional risk measures to spot the higher systemic risk at CRT banks, the results highlighted together with stress tests and their disclosure warrant a greater future role for using market-based information for financial regulation.

Supervisory authorities have regular discussion with banking industry risk officers or hold occasional seminars, workshops or roundtables with banks to exchange experiences on stress testing methodologies and use of results. This has resulted in publications of local industry guidance based on the Committee's principles. Furthermore, some supervisors also have a formal process for coordinating with other official organizations within their country. In some cases, a formal committee of regulators and other authorities (including the central bank) discusses systemic vulnerabilities and provides input into stress testing programs and the scenarios to be tested. Several other supervisors coordinate with their central bank in conducting a quantitative macroeconomic stress test, including consideration of potential systemic issues that may be caused by banks' management reactions to a common stress scenario. Regional-level coordinating bodies have also become increasingly important.

[12] The markets for CDS have grown tremendously since their inception in 1996, with outstanding volume estimated at around US $10 trln before the start of the crisis

[13] *Collateralized Loan Obligations*, instruments through which banks transfer pools of loan from their balance sheets. This new technique allowed banks to shed commercial loans (typically the most informational sensitive form of lending) on a large scale

Finally, the review has highlighted a number of different supervisory approaches that appear to have been more effective and are reflective of more advanced progress. At this regard, one of the most effective tools has been the significantly heightened focus on industry-wide supervisory stress tests. Many countries found that this process has helped to focus on common expectations, provided a structured approach for dialogue on better stress testing practices and identified gaps in banks' stress testing infrastructure. By challenging the loss results reported by banks on the prescribed scenarios, supervisors have motivated banks to justify their results and hence improve their internal assessment of key risk areas. In contrast, there was some evidence that countries that have only conducted supervisory stress tests or supervisory review of stress testing practices without leveraging these two aspects together have not made as much progress in implementing the principles. A formal self-assessment process conducted in some countries helped banks on identifying where their practices are consistent with the principles and where gaps exist in stress testing programs. This is why open dialogue with banks has also seen as a key element of an effective supervisory program; annual meeting with banks can include discussion of risk developments and best practices in stress testing that effectively create incentives for banks to strengthen their own practices. Another approach highlighted by some countries was to engage in dialogue on scenario selection, dynamics of models, reporting templates and data capabilities, and overall robustness of the stress test at the highest level of bank management. Moreover, several countries have issued publications describing observed good practices arising from benchmarking or initial implementation reviews of the principles; this type of guidance allows banks to benchmark themselves against their local peers. Therefore, banks, and to some extent regulators, are increasingly using stress testing as a means of communicating their risk profiles to the market. However, disclosure requirements and practices vary considerably by country. Many countries now publish aggregate summaries of stress tests results in their regular financial stability reports, and in some cases outcomes for individual banks. The latter do the same as practice of their financial results.

2.4. Future plans

Most supervisory authorities described future enhancements to their stress testing supervision programs. Those countries in the early phases of maturity are planning to issue, finalize, or update rules on stress testing and to commence review and assessment of stress testing practices. Some of them are also conducting supervisory stress tests for the first time. In the light of

what happened during the still present financial crisis, those supervisory authorities in intermediate to advanced stages of maturity plan to focus on deepening their current on-site and off-site review programs, with the aim of better assessing how stress test outcomes are used in bank decision-making and risk appetite setting.

Indeed, stress testing results increased their reliability over years but are also expected to have even greater impact on contingency planning including recovery and resolution. Additional supervisory work is planned for identifying and assessing how banks are integrating stress tests results in the development of risk appetite and overall risk management. Some supervisors will also use horizontal reviews across multiple banks to assess these areas as well as to benchmark banks' internal stress test scenarios and assumptions. Greater focus on the use of stress test outputs in assessing capital adequacy and liquidity was evident in a few countries, such as Italy and generalizing all southern European countries, with some also planning more explicit consideration of stress test outcomes in setting capital buffers.

The peer review focused on supervisory implementation. Nevertheless, it is interesting give an overall view on how these enhancements translated into standard operating procedure. So far, all countries reported significant progresses in stress testing capabilities at banks since publication of the principles. Authorities noted an overall improvement in the rigor and quality of stress testing and the quality of information presented in ICAAPs. Two of the main risk-specific stress testing, the market and liquidity risk, were found to be reasonably well developed. More recently, banks have focused increasingly on centralized, firm-wide stress testing that encompasses a broader range of risks, but many countries noted this area is still evolving. Banks have strengthened their resourcing, with some banks now having set dedicated stress testing units.

Therefore, banks are using a broader range of scenarios, including those that are more severe and complex, and are establishing stronger governance frameworks with clear lines of responsibility for stress testing. Thus, bank and countries are giving more importance to stress tests results in their decision processes even because of the improvements in data systems and abilities learned to adapt to news vulnerabilities and specifics scenarios. The level of documentation is also improved. Countries' responses to the review survey highlighted common areas of future improvements in bank stress testing practices, which are (i) *Integrating results into decision-making (*stress testing tools are still immature and some countries felt that in many cases the banks take a compliance-oriented approach in order to meet regulatory requirements); (ii) *Governance* (there is the necessity that banks need to have a better understanding of stress testing limitation, assumptions, and uncertainties by users of stress test results, including senior management and the board of directors); (iii) *Severity of scenarios* (supervisors in many countries remain concerned that banks' internal stress test scenarios do not plausibly reflect potential

severe scenarios and outcomes), (iv) *Data and IT infrastructure* (accumulation of sufficient data for modeling purposes is a challenge for banks in some countries and aggregation information across the bank remains an issue), (v) *Modeling issues* (multiple risk class impacts generally have not been modeled in a sophisticated manner, although some banks attempt to take into account correlations between risks. Incorporating feedback effects and system-wide interactions remains very difficult. Another technical area is the identification and aggregation of correlated risks and integrations between credit, market and liquidity risks).

The environment has provided a sound test of how countries put into practice the Committee's 2009 principles[14] for stress testing supervision (BCBS, 2009). There was clearly space for further progresses among the supervisory community in the supervision of stress testing. Many countries in the *early* to *intermediate* stages of implementation are working to finalize their prudential requirements for stress testing and implement regular review programs that cover enterprise-wide stress testing governance, capabilities and models. Even those countries considered to be in the advanced phase of implementation of the principles felt that there are many remaining challenges with respect to their own stress testing programs.

Authorities, step by step, are continuing with their efforts to embed the use of stress testing within their supervisory programs. In many cases, this requires additional resources and training for both generalist and specialist supervision staff. Stress testing infrastructure, including the ability to collect appropriate data, develop models and aggregate results, continues to evolve. Explicit consideration of stress test outcomes in assessing liquidity and market risk capital requirements is well established in supervisory frameworks. Stress testing has traditionally not featured as prominently in assessment of overall banks capital adequacy but practices are evolving in this area and currently significant improvements have been done.

The review, so far, has highlighted that there are different supervisory approaches and it is difficult to state which is the best and the most effective. A combination of supervisory stress tests together with involvement of generalist and specialist supervision staff in reviews of banks' stress testing practices at an enterprise-wide level often characterizes the more well developed supervisory programs.

Seen the implementation and analysis of Basel II principles, there is an interesting question to pose: *how can we integrate supervisory stress tests with the Basel III framework in a macroprudentially coherent and transparent manner*? These tables, below, show the arrengements

[14] Providing forward-looking assessments of risk, Overcoming limitations of models and historical data, Supporting internal and external communication, Feeding into capital and liquidity planning procedures, Informing the setting of banks' risk tolerance and facilitating the development of risk mitigation or contingency plans across a range of stressed conditions.

with all requirements up to 2019 by Basel Committee on Banking Supervision. An interesting point of views is how ratios and buffers increased over years, as a result of a better and greater supervision provided.

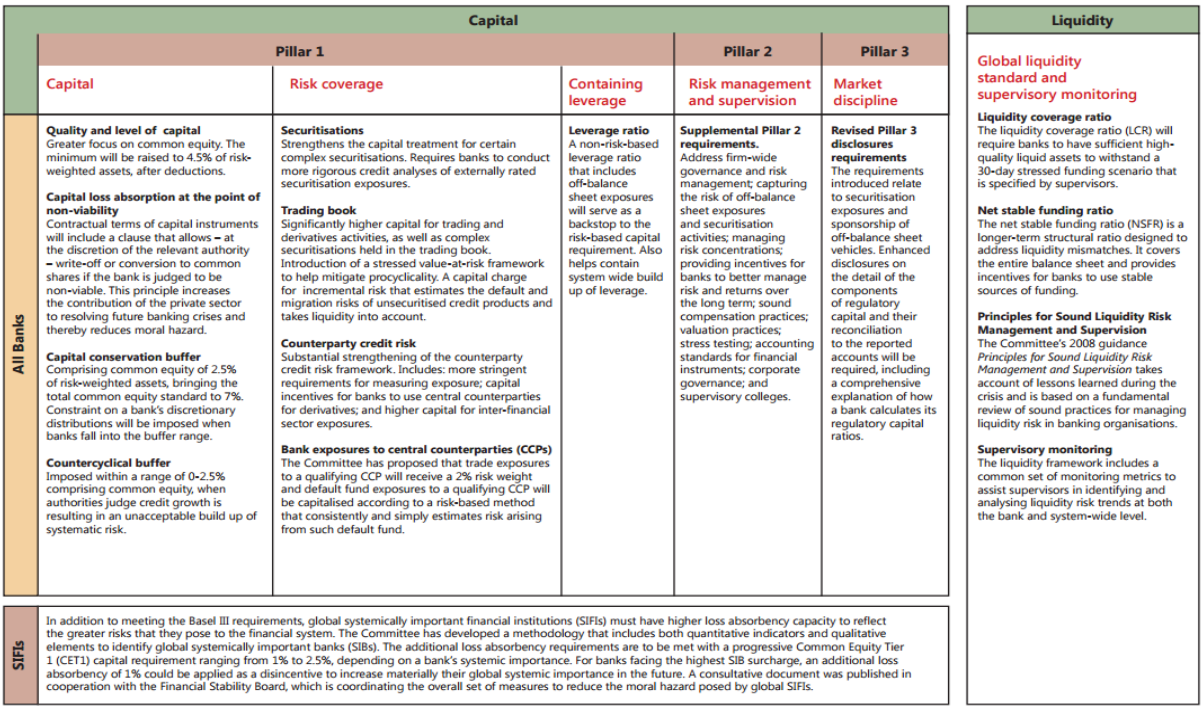
***Figure 5**: Basel III phase-in arrangements*

	Phases	2013	2014	2015	2016	2017	2018	2019
Capital	Leverage Ratio		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015				Migration to Pillar 1	
	Minimum Common Equity Capital Ratio	3.5%	4.0%	4.5%				**4.5%**
	Capital Conservation Buffer				0.625%	1.25%	1.875%	**2.5%**
	Minimum common equity plus capital conservation buffer	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	**7.0%**
	Phase-in of deductions from CET1*		20%	40%	60%	80%	100%	**100%**
	Minimum Tier 1 Capital	4.5%	5.5%	6.0%				**6.0%**
	Minimum Total Capital		8.0%					**8.0%**
	Minimum Total Capital plus conservation buffer		8.0%		8.625%	9.25%	9.875%	**10.5%**
	Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital		Phased out over 10 year horizon beginning 2013					
Liquidity	Liquidity coverage ratio – minimum requirement			60%	70%	80%	90%	**100%**
	Net stable funding ratio						Introduce minimum standard	

* Including amounts exceeding the limit for deferred tax assets (DTAs), mortgage servicing rights (MSRs) and financials.
– – transition periods

***Source**: Bank for International Settlements- International regulatory framework for banks*

***Figure 6**: Basel Committee on Banking Supervision reforms – Basel III*



***Source**: Bank for International Settlements- International regulatory framework for banks*

The reforms targets are essentially two; on a bank-level or micro-prudential, *regulations* which will help to raise the resilience of individual banking institutions to periods of stress; macro-prudential, *system wide risks* that can build up across the banking sector as well as the procyclical amplification of these risks over time. These two approaches to supervision are complementary as greater resilience at the individual bank level reduces the risk of system wide shocks. Back to previous question, Bruegel[15], through an event on late 2016, tried to answer to the question above by giving the opportunity to Anatoli Segura Velez (Economist, Financial Stability Research Directorate, Bank of Italy) to present his proposal on how to bridge the micro/macroprudential policies using supervisory stress tests in a macro-prudentially coherent framework. Presently, both the Basel III capital framework and the system-wide stress tests are used to assess banks' capital adequacy. The proposal is to introduce a bank-specific Stress Test Buffer as an additional capital requirement to the Pillar 1 of Basel III. In other words, by imposing the condition of procyclical severity to this buffer (increased during expansions and decreased during downturns), it is possible to ensure countercyclical macroprudential policy. Therefore, severity and specific attention to choices that are made under a constrained discretion approach based on macroeconomic scenarios. This combination between rules and discretion would counteract inaction bias from supervisors, enhancing predictability and transparency of policymaking. The stress tests currently used to assess the resilience of individual banks have, thus, the potential to be used to test whether the existing Capital Conservation and Countercyclical Capital buffers can withstand an adverse macroeconomic shock. On the contrary, a stress test buffer (STB) could be generated to absorb remaining losses. Part of banks' voluntary buffers could be channeled to cover additional capital requirements set by the STB, if necessary, avoiding capital shortfall. This would represent an attracting challenge because of its not easy at all implementation; this instrument entails several tasks and further work that would be done to provide a formal definition of a severity measure and of a rule to guide policy along the cycle, under a constrained discretion approach. In fact, while in the United States and the UK some of the features outlined above already exist, the jurisdiction in the Euro Area poses some difficulties to the operationalization of these measures. A second challenge would be the choice of the adequate cycle to which the stress test would be related (e.g. business cycle or credit cycle). Moreover, for the scenario design to be appropriate, it was recommended that each domestic cyclical position was also taken into account. Finally, a final remark is about the differences in

[15] Bruegel is a European, independent and non-doctrinal think tank devoted to policy research on international economic issues, based in Brussels. It started operations in 2005 and has rapidly acquired reference status in European economic policy debates http://bruegel.org/

objectives of stress testing in a macroprudential and micro-prudential frameworks, and the possible problems of credibility that could emerge when using the same instrument in both spheres. Economists and journalists, both from America and Europe, talked a lot recently about Basel 4 and how this new revision of the Basel Committee on Banking Supervision could change the implementation, the requirements and monitoring of the standards required. After a first "face-off" there was by one side Italian, French, German, Dutch and, more in general, northern Europe countries, against all big American colossus from the other side it is possible to see a stalemate situation. By a European point of view, the target is exactly the BCBS and the request rest on the possibility to stop immediately the new plan of reforms and, mainly, to not proceed in re-writing the rules regarding the counterparty risk assessment during a credit concession to companies. European banks strongly believe the credit reduction experienced by companies (and consequently damages to the economy) caused by the application of Basel 3 could become even worse and dangerous if the new revision will be approved. The perspective of new capital increases and of strong decrease of credit supply is more than concrete. On the other side, there are American banks which even outlined a legal action against the FED to stop the Stress Test exercises that, in their opinion, are run with opacity and they offer exchanges ways to speculate on credit and financial rights. Indeed, the new President of United Stated of America always approved a softening of banking industry rules; the latter could, however, be convenient for both, American and European banks.

The heart of the discussion rests on the Internal approaches, in other words, schemes through which banks assess their assets riskiness and the related reserves. Moreover, particular focus is pointed out on the *output floor* inclusion, which is a benefit limitation that internal models might generate in respect to standard ones. The regulatory request foresees that capital requests with internal rating based models do not be below the 60% (or, even 90%) of those generated per standard methods, whose schemes are undergoing updates. It is obvious that in case of new agreement, European banks will pay for that (potential impact for 50-200 billion plus additional on-going modifications for 600 billion) and a new credit tightening would be unavoidable.

Be strongly against this view of rules is quite common among European banks, especially German and Swedish; right away French and Dutch. Moreover, few words must be said on the Italian situation; always agreed with European banks before mentioned but with a critical situation. It could represent a risk and a strong penalization because of the less diffusion of internal rating based models. Although regulators would avoid a "relevant" increase of capital absorption, it is sufficient a low single digit increase in RWA of 5% to generate a not entirely insignificant impact on CET1. The "Il Sole 24 ore" reported this; moreover, a simulation made by an Equita analyst revealed how this could bring an increase up to 14% in RWA with a negative

impact on CET1 for -114/159 base points, that is the equivalent of 11/15 billion of capital. Unicredit would be the most impacted bank with potential negative blow around about 167/283 bases points. On the other side, as previously said, there are American banks. They have less fear of internal model introduction for two reasons; firstly, it is because the smaller effect of the real estate mortgages on portfolios, thanks to securitization process. Secondly, the Dodd-Frank Act; the American institutions already utilizes the most penalization method between the standard and advanced one to mitigate the riskiness of own credits. According to Bloomberg, five of the six biggest American banks (Goldman, BofA, Jp Morgan, Citi, Wells Fargo) would have no impacts in case of introduction of a new threshold (75%). This is why, in the Basel 4 battle, European banks are the ones could pay more and find themselves in trouble.

3. EMPIRICAL ANALYSIS – ITALIAN LISTED BANKS

3.1. Preface

In this section, I would like to present the basic behavioral, informational and institutional assumptions I am making throughout the empirical analysis. In detail, I will explicate the assumptions that are driving the results and how these are sensitive to changes in parameters.

Firstly, it follows an overall comparison at *European-level* as consequence of the recent disclosure of Stress Test results of July 29th, 2016 observing *changes* occurred over the last three years and *expectations* for both, baseline and adverse scenarios. This enables to better understand and evaluate the actual situation and how European countries are seen under a so-called "*EBA-view"*. It will take into account considerations about (i) shocks to long-term interest rates in EU countries; (ii) stock price shock; (iii) GDP growth; (iv) contributions of individual adverse shocks to deviation of real EU GDP from baseline scenario; (v) real GDP under the baseline and adverse scenarios in a historical perspective; (vi) HICP inflation, (vii) unemployment rate; (viii) residential property prices; (ix) prime commercial property prices. Then, the analysis points out to the focus of the paper, that is to estimate how Stress Tests affect Italian listed banks' performance through the description of data, methodology, period covered, limitation of data and the basic econometric specification used for the test.

3.2. EBA 2016 EU-wide bank stress testing exercise

The European Banking Authority (EBA) 2016 EU-wide stress testing exercise required banks to use the presented outcome of the adverse macro-financial scenario for variables such as GDP, inflation, unemployment, asset prices and interest rates to estimate the potential adverse impact on profit generation and capital. Each main financial stability risk has automatically its assumed financial and economic shocks. Specific macro-financial shocks that are assumed to materialize under each of the parts of the scenario are well observed and analyzed for each of the variables mentioned above.

Concerning the calibration of the these shocks, the yields on long-term Treasury Securities United States are assumed to rise sharply, deviating by 250 basis point (bps) form the baseline by end-2016. The resulting increased investor risk aversion would affect the prices of European

fixed income instruments, and yields on ten-year German sovereign debt would increase by about 80 basis points over the same horizon. In addition, sovereign credit spreads in the euro area would widen as it reflects broadly the market assessment of individual sovereigns' vulnerabilities. Overall, long-term interest rates in the EU would be higher by 71 basis points in 2016, 80 basis point in 2017 and 68 basis points in 2018 as the following chart shows:

Figure 7: *Shocks to long-term interest rates in EU countries*

	Shocks (basis points)			Baseline (percentages)				Adverse (percentages)		
	2016	2017	2018	2015	2016	2017	2018	2016	2017	2018
Belgium	63	75	61	0.9	1.0	1.2	1.3	1.7	2.0	1.9
Bulgaria	64	83	69	2.4	2.4	2.6	2.7	3.1	3.5	3.4
Czech Republic	79	80	72	0.6	0.7	0.9	1.0	1.5	1.7	1.7
Denmark	56	67	53	0.7	1.0	1.3	1.3	1.6	1.9	1.9
Germany	44	67	53	0.5	0.7	0.9	1.0	1.2	1.6	1.5
Ireland	81	87	74	1.2	1.3	1.5	1.6	2.1	2.4	2.3
Greece	234	162	148	10.0	8.0	8.2	8.3	10.4	9.9	9.8
Spain	98	100	87	1.8	2.0	2.2	2.2	2.9	3.2	3.1
France	55	73	60	0.9	1.1	1.3	1.4	1.6	2.0	2.0
Croatia	65	82	68	3.5	4.0	4.2	4.2	4.6	5.0	4.9
Italy	107	102	89	1.7	1.8	2.0	2.1	2.9	3.0	3.0
Cyprus	68	71	58	4.6	4.1	4.3	4.4	4.8	5.1	5.0
Latvia	56	76	63	0.9	1.1	1.3	1.4	1.7	2.1	2.0
Lithuania	62	72	59	1.4	1.7	1.9	2.0	2.3	2.6	2.6
Luxembourg	52	72	59	0.4	0.5	0.7	0.8	1.0	1.4	1.4
Hungary	210	160	160	3.4	3.4	3.7	3.7	5.5	5.3	5.3
Malta	62	76	62	1.5	1.7	1.9	1.9	2.3	2.6	2.6
Netherlands	54	70	57	0.7	0.9	1.1	1.2	1.4	1.8	1.7
Austria	55	72	58	0.8	1.0	1.2	1.3	1.5	1.9	1.9
Poland	165	158	146	2.7	2.7	2.9	2.9	4.4	4.4	4.4
Portugal	121	111	97	2.4	2.5	2.7	2.8	3.8	3.9	3.8
Romania	119	124	115	3.5	3.8	4.0	4.1	5.0	5.2	5.2
Slovenia	95	100	86	1.7	1.9	2.1	2.2	2.9	3.1	3.0
Slovakia	60	76	63	0.9	0.9	1.1	1.2	1.5	1.9	1.8
Finland	52	70	57	0.7	1.0	1.2	1.2	1.5	1.9	1.8
Sweden	66	80	64	0.7	0.9	1.2	1.2	1.5	2.0	1.9
United Kingdom	50	59	47	1.8	1.9	2.1	2.1	2.4	2.7	2.6
Euro area	**70**	**81**	**68**	**1.2**	**1.4**	**1.6**	**1.6**	**2.1**	**2.4**	**2.3**
European Union	**71**	**80**	**68**	**1.3**	**1.5**	**1.7**	**1.7**	**2.2**	**2.5**	**2.4**

Source*: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

Generally, the increase in risk premium has effects well beyond fixed income markets. Global equity prices would decline by 36% by the end of 2016 with an annual average reduction in global stock prices that would amount to 22%. This is amplified, as previously said, by a sell-off by shadow banking entities and the EU stock prices would fall by 25% (on an annual basis) in comparison with the baseline scenario to about 16% in 2018 (Table 2.). Commodity as the oil prices also would be affected responding to financial shock and the expected weakening of global economic growth; it has been estimated a fall of about 48% in 2016 compared with the baseline projection of about 54 US dollars per barrel, standing at about 44% below baseline

levels in 2017 and 2018. Money market rates (three-month interbank offered rates) in all EU countries would rise by about 33 basis point compared with the baseline scenario in 2016 reflecting a much higher credit premium; the latter would decline to 23 basis point in 2017 and 6 basis point in 2018.

The worsening of financial condition caused by a reduction in the availability of funding from shadow banking entities would contribute to a contraction in economic activity. This is the reason why in all these estimation, it is assumed that banks would respond by tightening lending standards on loans to the private non-financial sector. This shock is represented by country-specific shock to the cost of corporate credit and loans to households, through an increase in the user cost of capital and a reduction in the financial wealth of households respectively. The corresponding impact on 2018 GDP is estimated to be limited to about 0.12%. Finally, swap rates would respond to the increase in money market rates and long-term government bond yields.

Figure 8: *Stock price shock*

	2016	2017	2018
Belgium	-25.5	-24.3	-16.1
Bulgaria	-10.3	-12.4	-8.2
Czech Republic	-23.3	-20.9	-13.9
Denmark	-20.4	-22.0	-14.6
Germany	-24.6	-25.6	-17.0
Estonia	-14.1	-16.9	-11.2
Ireland	-25.6	-25.0	-16.6
Greece	-26.4	-23.6	-15.7
Spain	-26.0	-24.9	-16.6
France	-28.0	-26.5	-17.6
Croatia	-12.1	-14.7	-9.7
Italy	-28.8	-25.3	-16.8
Cyprus	-21.4	-23.1	-15.4
Latvia	-10.0	-10.3	-6.8
Lithuania	-12.2	-15.2	-10.1
Luxembourg	-22.1	-20.7	-13.7
Hungary	-17.4	-19.9	-13.2
Malta	-11.2	-13.8	-9.2
Netherlands	-25.5	-25.5	-16.9
Austria	-30.5	-25.4	-16.9
Poland	-19.4	-19.9	-13.2
Portugal	-24.0	-20.3	-13.5
Romania	-18.6	-22.1	-14.7
Slovenia	-9.8	-12.1	-8.0
Slovakia	-11.4	-13.4	-8.9
Finland	-23.0	-25.4	-16.9
Sweden	-23.9	-24.7	-16.4
United Kingdom	-25.3	-24.6	-16.3
Euro area	**-26.2**	**-25.2**	**-16.7**
European Union	**-25.4**	**-24.7**	**-16.4**

Source*: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

In addition, the increased global uncertainty would reduce global economic growth, notably through confidence and financial spillovers to emerging market economies (EMEs), spanning all major emerging market regions (Asia, Latin America, emerging Europe). This, in turns, leads capital outflows from EMEs and, therefore, a reduction in emerging market asset prices causing domestic demand in these economies to suffer from both tighter financing condition and business and consumer confidence shocks. The consequence is the possible impact on the EU economies through trade channels, as foreign demand for EU exports that would be materially reduced. The global shocks are also assumed to negatively affect confidence; it results in country-specific reductions in private consumption and investment in all EU countries.

The exogenous shocks to house prices reflect the country-specific misalignment of house prices with regard to estimated fundamental levels and historical volatility of house prices. These shocks, which overall drive the house prices down by about 6%, are in addition to a common shock of about 7.5% affecting all EU countries.

***Figure 9**: GDP growth in EU countries*

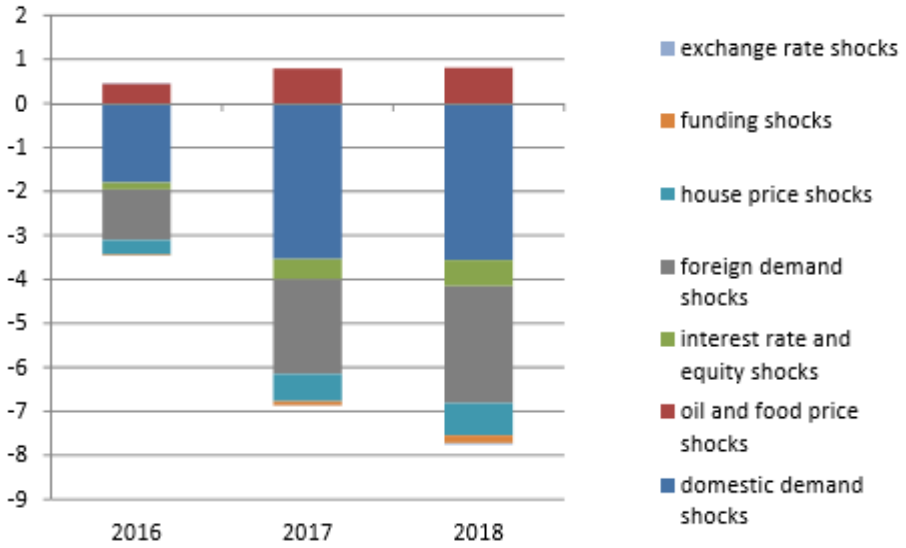
	Baseline growth rates (percentages)			Deviations (percentage points)			Adverse growth rates (percentages)			Level deviation 2018 (percentages)
	2016	2017	2018	2016	2017	2018	2016	2017	2018	
Belgium	1.3	1.7	1.6	-2.9	-4.0	-1.0	-1.6	-2.3	0.6	-7.6
Bulgaria	1.5	2.0	2.1	-2.9	-5.0	-2.1	-1.5	-3.0	0.0	-9.5
Czech Republic	2.4	2.7	1.8	-4.5	-5.1	-1.4	-2.1	-2.4	0.4	-10.4
Denmark	2.0	1.8	1.8	-4.1	-3.9	0.1	-2.1	-2.0	1.8	-7.6
Germany	1.9	1.9	1.6	-3.5	-3.0	-0.3	-1.6	-1.1	1.3	-6.6
Estonia	2.6	2.6	2.1	-5.5	-5.6	-1.1	-3.0	-3.0	1.0	-11.6
Ireland	4.5	3.5	3.6	-4.6	-4.6	-1.9	-0.1	-1.2	1.7	-10.4
Greece	-1.3	2.7	3.1	-4.4	-5.5	-1.5	-5.7	-2.8	1.6	-10.9
Spain	2.7	2.4	2.0	-2.0	-3.3	-1.8	0.6	-0.8	0.2	-6.7
France	1.4	1.7	1.6	-2.0	-2.7	-1.1	-0.6	-1.1	0.6	-5.6
Croatia	1.4	1.7	1.5	-5.3	-4.3	0.9	-3.9	-2.6	2.4	-8.4
Italy	1.5	1.4	1.7	-1.8	-2.6	-1.7	-0.4	-1.1	0.0	-5.9
Cyprus	1.5	2.0	2.2	-3.2	-3.2	-0.3	-1.7	-1.3	1.9	-6.5
Latvia	3.0	3.3	2.6	-5.0	-7.4	-3.7	-1.9	-4.1	-1.1	-14.8
Lithuania	2.6	3.4	1.7	-5.0	-4.9	0.9	-2.5	-1.5	2.6	-8.6
Luxembourg	3.2	3.0	3.3	-4.3	-3.6	-0.7	-1.1	-0.7	2.6	-8.2
Hungary	2.2	2.5	1.9	-1.7	-2.8	-0.5	0.5	-0.3	1.4	-4.8
Malta	3.6	3.1	2.7	-4.6	-4.6	0.2	-0.9	-1.5	2.9	-8.4
Netherlands	2.1	2.3	1.4	-3.0	-3.9	-1.9	-1.0	-1.6	-0.4	-8.4
Austria	1.5	1.4	1.3	-3.1	-3.7	-1.1	-1.7	-2.3	0.2	-7.6
Poland	3.5	3.5	3.0	-2.6	-4.0	-2.5	0.9	-0.5	0.5	-8.5
Portugal	1.7	1.8	1.6	-3.8	-4.4	-2.2	-2.1	-2.6	-0.6	-9.9
Romania	4.9	3.6	3.1	-7.1	-3.6	-1.1	-2.2	0.0	2.0	-11.0
Slovenia	1.9	2.5	1.3	-4.2	-4.4	-0.2	-2.3	-1.9	1.2	-8.4
Slovakia	2.8	3.3	4.0	-5.3	-7.3	-1.5	-2.5	-4.0	2.5	-13.1
Finland	0.7	1.1	1.6	-3.4	-5.3	0.1	-2.7	-4.1	1.6	-8.3
Sweden	2.8	2.7	2.0	-3.5	-6.1	-4.9	-0.7	-3.4	-2.9	-13.5
United Kingdom	2.4	2.2	1.2	-4.6	-2.9	0.4	-2.2	-0.7	1.6	-6.8
Euro Area	**1.8**	**1.9**	**1.7**	**-2.8**	**-3.2**	**-1.1**	**-1.0**	**-1.3**	**0.6**	**-6.8**
European Union	**2.0**	**2.1**	**1.7**	**-3.2**	**-3.3**	**-1.0**	**-1.2**	**-1.3**	**0.7**	**-7.1**

***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

As a combined result of the foreign demand shocks, financial shock and domestic demand shocks in the EU, the baseline scenario implies a deviation of EU GDP by 3.1% in 2016, 6.3% in 2017 and 7.1 in 2018%. The estimated EU real GDP growth rates under the adverse scenario over the same three years of the test amounts to -1.2%, -1.3% and +0.7% respectively.[16]

It is notable to show that the major part of the impact on GDP is driven by the domestic demand factors, that are the exogenously set reductions in consumption and investment, which collectively reduce EU real GDP by about 3.6% compared with the baseline by 2018 as the chart below shows. Moreover, the combined impact of interest rate, house price and stock price shocks is somewhat weaker and the positive contribution of lower commodity prices and weaker exchange rates to EU GDP moderates the negative deviation from the baseline by about 0.8%. In combination with a probable (according to the ECB and the Quantitative Easing adopted) lower headline inflation, the impact on nominal GDP would be particularly pronounced.

***Figure 10**: Contributions of individual adverse shocks to deviation of real EU GDP from baseline (percentage points)*

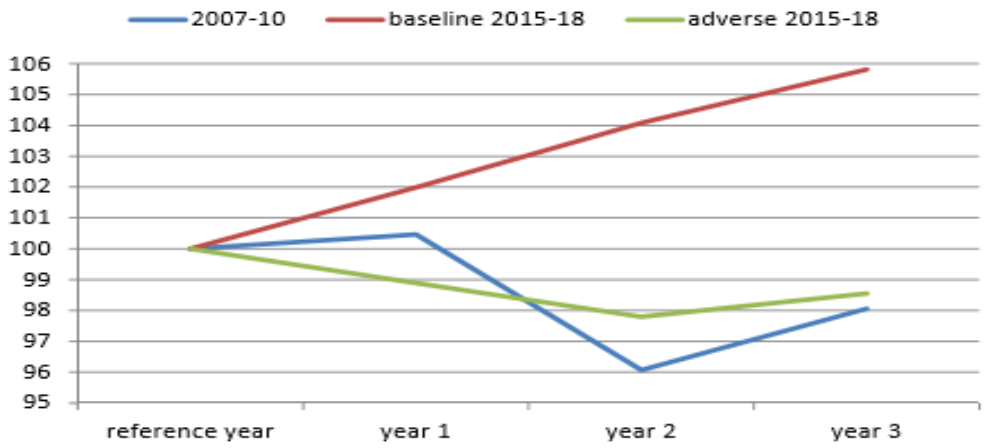


***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision website (2016)*

[16] NiGEM (a global econometric model maintained by the UK National Institute of Economic and Social Research), together with BVAR and GVAR (Bayesian and Global Vector Autoregressive) models, were used to estimate the impact of the scenario on non-EU economies and capture the trade spillovers from the rest of the world to the EU. Intra-EU trade channels are embedded in the stress test elasticities: a multi-country. EU-wide simulation tool based on impulse response functions (from European System of Central Banks – ESCB – central banks models). This tool is used to translate exogenous shock to domestic demand, house prices, financial asset prices, interest rates and foreign demand in individual EU countries into a consistent macro-financial scenario.

Another useful comparison is the historical perspective under the adverse scenario; there is a total reduction in EU GDP by 1.7% in 2018 from the 2015 level and this is slightly severe than the 2008/2010 period when the EU economy contracted by about 2.0% over three years. The recession considered under the adverse scenario is longer but shallower than the 2008-2010 events as figure 11 shows.

***Figure 11**: EU real GDP under the baseline and adverse scenarios in a historical perspective*



Note: Level of real GDP is normalized to 100 in the reference year

***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision website (2016)*

Again, let's see the HICP inflation in EU countries and how it evolves over years according the estimates. The Harmonized Index of Consumer Prices (HICP) inflation rate in the EU under the adverse scenario is well below the baseline scenario by -2.0 p.p. in 2016, -1.9 p.p. in 2017 and 2.1 p.p. in 2018. By taking in consideration an annual inflation rates of -0.2% in both following years of the test and a sharp reduction in energy and food commodity at the beginning of the year, the HICP inflation would reach -0.9% in 2016 and prices would fall slightly in 2017 and 2018. Going to the last year of the test, the 2018, the deviation is increasingly explained by the impact on prices of weaker aggregate demand, both domestic and foreign.

***Figure 12**: HICP inflation in EU countries*

	Baseline inflation rate (percentages)			Deviations (percentage points)			Adverse inflation rate (percentages)			Price level deviation 2018 (percentages)
	2016	2017	2018	2016	2017	2018	2016	2017	2018	
Belgium	1.7	1.5	1.5	-1.9	-3.2	-2.4	-0.2	-1.7	-0.9	-7.2
Bulgaria	0.7	1.1	1.8	-2.2	-1.7	-1.2	-1.5	-0.6	0.6	-5.0
Czech Republic	1.0	1.6	1.9	-0.7	-2.0	-4.3	0.2	-0.4	-2.4	-6.8
Denmark	1.5	1.9	2.1	-1.8	-1.3	-1.3	-0.3	0.6	0.8	-4.3
Germany	1.0	1.7	2.1	-2.4	-2.2	-2.6	-1.3	-0.5	-0.5	-6.8
Estonia	1.8	2.9	3.3	-3.7	-4.0	-3.0	-1.9	-1.1	0.2	-10.1
Ireland	1.4	1.6	1.5	-0.9	-1.6	-1.1	0.6	0.0	0.4	-3.5
Greece	1.0	0.9	1.0	-1.8	-4.0	-5.5	-0.8	-3.1	-4.5	-10.8
Spain	0.7	1.2	1.6	-2.6	-0.8	-0.6	-1.9	0.5	1.0	-3.9
France	0.9	1.3	1.6	-1.5	-0.8	-0.5	-0.5	0.5	1.0	-2.7
Croatia	0.9	1.7	2.2	0.7	-1.7	-2.8	1.6	0.0	-0.6	-3.7
Italy	1.0	1.9	2.8	-1.1	-1.7	-2.5	-0.1	0.3	0.3	-5.1
Cyprus	0.6	1.3	1.5	-3.0	-1.5	-1.4	-2.5	-0.2	0.1	-5.7
Latvia	1.4	2.1	2.0	-3.1	-4.7	-4.6	-1.7	-2.6	-2.6	-11.7
Lithuania	0.6	2.2	2.6	-1.9	-2.5	-1.9	-1.3	-0.3	0.7	-6.0
Luxembourg	1.7	1.7	1.7	-3.2	-0.7	-0.5	-1.5	1.0	1.2	-4.3
Hungary	1.9	2.5	2.4	-2.5	-0.8	-0.7	-0.6	1.8	1.6	-3.9
Malta	1.8	2.2	2.1	-1.8	-1.6	-3.3	0.1	0.6	-1.2	-6.4
Netherlands	1.2	1.5	1.7	-1.3	-0.9	-1.9	-0.1	0.6	-0.2	-4.0
Austria	1.8	2.0	2.1	-3.3	-0.9	-1.0	-1.5	1.1	1.1	-5.0
Poland	1.4	1.9	2.1	-1.1	-1.4	-3.5	0.2	0.5	-1.3	-5.8
Portugal	1.1	1.3	1.6	-2.4	-3.2	-2.6	-1.3	-1.9	-1.0	-7.9
Romania	-0.3	2.3	2.3	-2.2	-4.0	-5.4	-2.5	-1.7	-3.1	-10.9
Slovenia	0.8	1.4	1.3	-2.6	-3.5	-2.7	-1.8	-2.1	-1.4	-8.5
Slovakia	1.0	1.6	1.5	-1.9	-3.7	-4.9	-0.8	-2.2	-3.4	-10.0
Finland	0.6	1.5	2.4	-2.7	-3.7	-4.9	-2.1	-2.2	-2.6	-10.8
Sweden	1.5	1.7	1.8	-5.3	-2.0	-1.2	-3.9	-0.3	0.6	-8.2
United Kingdom	1.5	1.7	1.9	-2.0	-3.0	-3.0	-0.6	-1.3	-1.1	-7.7
Euro Area	**1.0**	**1.6**	**1.9**	**-1.9**	**-1.7**	**-1.9**	**-0.9**	**-0.1**	**0.1**	**-5.3**
European Union	**1.1**	**1.6**	**2.0**	**-2.0**	**-1.9**	**-2.1**	**-0.9**	**-0.2**	**-0.2**	**-5.8**

***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

One of adverse scenario's standard characteristics is a substantial increase in the EU unemployment rate instead of a slight reduction expected under the baseline scenario. According to the stress test this would reach 11.6% in 2018, which is almost 3.0% point than the baseline (figure 13). Residential property prices in the EU would fall and this happens because of the assumed exogenous shocks as well as their reaction to the general deterioration in the economic outlook.

Overall, EU residential property prices would stand about 21.3% below the baseline levels by 2018 (figure 14), having contracted by about 10.7% from the 2015 levels; the same is for commercial property prices which would deviate downwards form the levels consistent with the baseline economic projections.

***Figure 13**: Unemployment rate in EU countries*

	Baseline unemployment rate (percentages)			Deviations (percentage points)			Adverse unemployment rate (percentages)		
	2016	2017	2018	2016	2017	2018	2016	2017	2018
Belgium	8.4	7.9	7.7	0.4	2.3	4.2	8.8	10.2	11.9
Bulgaria	9.4	8.8	8.7	0.3	1.5	2.3	9.7	10.3	11.0
Czech Republic	5.0	4.8	4.9	0.4	1.2	1.4	5.4	6.0	6.3
Denmark	5.8	5.5	5.5	1.4	4.2	5.3	7.2	9.7	10.8
Germany	4.9	5.2	5.4	0.5	1.3	1.9	5.4	6.5	7.3
Estonia	6.5	7.6	7.8	1.7	4.8	5.0	8.2	12.4	12.8
Ireland	8.7	7.9	8.1	1.0	3.2	4.6	9.7	11.1	12.7
Greece	25.8	24.4	23.0	0.9	2.1	2.8	26.7	26.5	25.8
Spain	20.5	19.0	18.2	0.8	2.3	3.3	21.3	21.3	21.5
France	10.4	10.2	10.1	0.1	0.4	0.9	10.5	10.6	11.1
Croatia	15.6	14.7	13.8	1.0	3.1	4.0	16.6	17.8	17.8
Italy	11.8	11.6	11.3	0.3	1.2	2.2	12.1	12.8	13.5
Cyprus	14.5	13.2	11.9	0.8	2.1	2.6	15.3	15.3	14.5
Latvia	9.5	8.8	9.7	1.4	4.3	6.5	10.9	13.1	16.2
Lithuania	8.6	8.1	9.0	0.2	0.5	0.5	8.8	8.6	9.5
Luxembourg	5.8	5.8	5.9	0.1	0.6	1.2	5.9	6.4	7.1
Hungary	6.7	6.2	6.3	0.1	0.8	1.1	6.8	7.0	7.4
Malta	5.7	5.8	5.7	0.0	0.8	1.0	5.7	6.6	6.7
Netherlands	6.6	6.3	6.3	0.3	2.2	4.3	6.9	8.5	10.6
Austria	6.1	6.0	5.9	0.6	1.1	1.7	6.7	7.1	7.6
Poland	7.2	6.8	7.0	0.8	3.8	6.1	8.0	10.6	13.1
Portugal	11.7	10.8	11.0	0.7	2.5	4.2	12.4	13.3	15.2
Romania	6.6	6.5	6.5	0.8	1.6	1.7	7.4	8.1	8.2
Slovenia	9.2	8.7	8.3	1.6	3.3	4.6	10.8	12.0	12.9
Slovakia	10.5	9.6	9.7	0.9	3.1	4.6	11.4	12.7	14.3
Finland	9.5	9.4	9.1	1.1	1.4	1.4	10.6	10.8	10.5
Sweden	7.7	7.4	7.4	0.5	2.7	5.2	8.2	10.1	12.6
United Kingdom	5.4	5.5	5.7	2.1	3.5	3.9	7.5	9.0	9.6
Euro area	**10.6**	**10.3**	**10.1**	**0.4**	**1.4**	**2.3**	**11.0**	**11.7**	**12.4**
European Union	**9.2**	**8.9**	**8.9**	**0.7**	**1.9**	**2.8**	**9.9**	**10.8**	**11.6**

***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

***Figure 14:** Residential property prices in EU countries*

	Baseline inflation rate (percentages)			Deviations (percentage points)			Adverse inflation rate (percentages)			Price level deviation 2018 (percentages)
	2016	2017	2018	2016	2017	2018	2016	2017	2018	
Belgium	0.6	1.7	2.4	-10.7	-6.5	-4.5	-10.1	-4.8	-2.1	-20.0
Bulgaria	-1.4	-1.0	1.0	-9.7	-7.6	-7.0	-11.1	-8.6	-6.0	-22.5
Czech Republic	5.3	5.7	5.1	-15.3	-9.3	-3.6	-10.0	-3.6	1.4	-24.7
Denmark	4.9	4.8	5.0	-15.6	-9.0	-5.1	-10.7	-4.2	-0.1	-26.0
Germany	5.6	6.3	5.7	-10.9	-6.8	-4.3	-5.4	-0.5	1.4	-19.5
Estonia	6.0	5.0	4.5	-11.0	-13.9	-11.7	-5.0	-8.9	-7.2	-30.9
Ireland	8.7	6.3	7.0	-10.7	-7.3	-8.0	-2.0	-1.0	-1.0	-22.3
Greece	-2.3	3.6	0.8	-10.7	-8.0	-6.0	-13.0	-4.5	-5.2	-22.8
Spain	7.5	7.8	7.1	-13.0	-8.5	-6.4	-5.5	-0.7	0.6	-23.8
France	0.5	1.5	2.3	-9.1	-5.8	-3.8	-8.7	-4.3	-1.5	-17.4
Croatia	1.2	3.1	3.9	-9.1	-8.6	-9.4	-7.9	-5.4	-5.5	-24.1
Italy	2.0	4.1	5.9	-11.6	-6.2	-4.4	-9.6	-2.1	1.5	-20.2
Cyprus	3.4	5.0	4.5	-9.8	-5.7	-3.8	-6.4	-0.7	0.7	-17.6
Latvia	4.1	4.5	3.2	-10.8	-6.3	-5.2	-6.7	-1.9	-2.0	-20.0
Lithuania	2.9	7.7	5.8	-12.4	-14.3	-8.5	-9.5	-6.6	-2.7	-29.9
Luxembourg	5.8	5.7	7.3	-15.4	-11.7	-6.9	-9.6	-6.0	0.4	-28.9
Hungary	6.1	7.1	5.1	-11.3	-6.2	-3.8	-5.2	0.9	1.4	-18.9
Malta	9.7	8.6	6.2	-11.2	-11.6	-10.7	-1.4	-3.0	-4.5	-27.9
Netherlands	6.0	5.9	5.9	-9.9	-7.2	-7.4	-3.9	-1.3	-1.5	-21.4
Austria	2.3	2.9	3.2	-15.0	-8.9	-3.3	-12.7	-6.1	-0.1	-24.6
Poland	4.2	4.5	4.8	-10.0	-8.6	-13.6	-5.8	-4.1	-8.8	-27.8
Portugal	4.7	4.5	4.2	-12.0	-7.9	-5.4	-7.3	-3.4	-1.2	-22.4
Romania	3.7	6.9	6.6	-13.6	-14.0	-11.6	-9.9	-7.1	-5.0	-32.7
Slovenia	4.2	6.4	5.2	-11.9	-7.7	-5.4	-7.6	-1.3	-0.3	-22.1
Slovakia	4.7	6.7	7.4	-10.4	-10.7	-11.4	-5.7	-4.0	-4.0	-27.6
Finland	1.7	2.9	4.8	-12.3	-7.2	-0.5	-10.6	-4.3	4.3	-18.6
Sweden	4.8	3.6	2.6	-24.0	-16.3	-6.1	-19.2	-12.7	-3.5	-38.9
United Kingdom	4.5	3.9	2.0	-11.3	-7.1	-3.5	-6.8	-3.2	-1.5	-19.8
Euro Area	**3.7**	**4.6**	**4.9**	**-11.0**	**-6.9**	**-4.8**	**-7.3**	**-2.3**	**0.1**	**-20.2**
European Union	**3.9**	**4.5**	**4.3**	**-11.6**	**-7.4**	**-4.9**	**-7.7**	**-2.9**	**-0.6**	**-21.3**

***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

By 2018, commercial property prices would contract by about 15% from their 2015 levels, and stand about 23% below the baseline projections (figure 15).

***Figure 15**: Prime commercial property prices in EU countries*

	Baseline inflation rate (percentages)			Deviations (percentage points)			Adverse inflation rate (percentages)			Price level deviation 2018 (percentages)
	2016	2017	2018	2016	2017	2018	2016	2017	2018	
Belgium	-1.1	-1.0	-0.8	-4.1	-5.8	-0.8	-5.2	-6.8	-1.5	-10.4
Bulgaria	-1.0	-1.4	1.3	-8.2	-9.4	-8.3	-9.2	-10.8	-7.0	-23.9
Czech Republic	-0.2	-0.2	-0.6	-9.5	-9.9	-1.7	-9.7	-10.1	-2.3	-19.8
Denmark	2.9	2.9	3.4	-12.3	-10.8	-10.0	-9.4	-7.8	-6.6	-28.8
Germany	4.7	6.0	6.1	-8.2	-11.4	-4.6	-3.6	-5.5	1.4	-21.4
Estonia	4.7	2.1	3.1	-10.4	-15.2	-11.7	-5.8	-13.1	-8.6	-32.1
Ireland	6.1	2.9	3.3	-9.8	-11.5	-11.5	-3.7	-8.6	-8.2	-28.4
Greece	-2.3	2.8	1.0	-8.5	-9.6	-9.4	-10.9	-6.8	-8.4	-24.9
Spain	3.6	3.5	3.0	-6.8	-7.8	-2.8	-3.2	-4.4	0.3	-16.0
France	2.7	3.4	3.5	-4.5	-7.7	-7.4	-1.7	-4.4	-3.9	-17.9
Croatia	0.7	1.5	1.9	-7.3	-8.5	-9.7	-6.6	-7.0	-7.8	-23.1
Italy	2.1	3.8	5.0	-9.9	-10.4	-3.2	-7.8	-6.6	1.8	-21.2
Cyprus	-0.7	5.9	2.8	-8.4	-9.9	-8.3	-9.1	-4.0	-5.5	-23.7
Latvia	3.2	1.6	1.3	-9.1	-9.7	-9.1	-5.9	-8.1	-7.8	-25.0
Lithuania	3.8	4.3	2.0	-10.2	-13.3	-8.7	-6.4	-9.0	-6.8	-28.1
Luxembourg	4.4	3.9	4.7	-10.6	-9.4	-8.5	-6.2	-5.5	-3.9	-25.0
Hungary	2.9	3.0	2.2	-8.1	-9.7	-4.7	-5.2	-6.6	-2.5	-20.4
Malta	5.8	2.8	2.3	-8.6	-9.8	-9.4	-2.7	-7.1	-7.1	-24.6
Netherlands	5.2	5.4	5.0	-10.5	-12.0	-12.6	-5.4	-6.6	-7.6	-29.8
Austria	0.6	0.7	0.8	-6.7	-9.0	-8.8	-6.0	-8.3	-8.0	-22.4
Poland	8.2	5.5	-0.4	-4.5	-9.9	-13.5	3.8	-4.4	-13.9	-24.9
Portugal	3.8	3.6	3.4	-8.7	-9.6	-5.4	-4.9	-5.9	-2.0	-21.2
Romania	0.5	3.2	3.5	-9.7	-10.1	-9.6	-9.2	-6.9	-6.1	-26.1
Slovenia	-1.7	-3.1	3.3	-10.4	-6.9	-6.7	-12.1	-10.0	-3.3	-22.3
Slovakia	1.7	3.7	4.0	-10.1	-13.8	-13.1	-8.4	-10.1	-9.1	-31.7
Finland	0.9	1.0	2.8	-9.1	-6.8	-5.4	-8.3	-5.8	-2.7	-19.6
Sweden	3.0	2.6	1.5	-14.7	-13.0	-6.5	-11.7	-10.4	-5.0	-29.9
United Kingdom	1.5	-0.3	0.4	-12.3	-10.9	-11.2	-10.8	-11.2	-10.8	-30.4
Euro area	**3.1**	**4.0**	**4.2**	**-7.6**	**-9.6**	**-5.6**	**-4.5**	**-5.7**	**-1.5**	**-20.4**
European Union	**2.9**	**3.2**	**3.3**	**-8.6**	**-10.0**	**-6.8**	**-5.6**	**-6.7**	**-3.5**	**-22.6**

***Source**: ESRB, European Systemic Risk Board – European System of Financial Supervision (2016)*

In comparison with the adverse scenario of the 2014 EU wide-stress testing exercise, this scenario would result at the end of the horizon in a similarly-sized deviation from baseline of EU GDP level (-7.1% compared with -7.0 in the 2014 exercise) and a much stronger deviation of the price level (-5.8% and -2.8% respectively) from the baseline. Furthermore, the impact on GDP is driven primarily by more sever domestic demand shocks, as foreign demand shocks are less severe than in the 2014 scenario and lower commodity prices stimulate growth in the EU economy. Looking at the baseline scenario, noteworthy to see the baseline projection and how it is more favorable than in the 2014 exercise; that is why GDP over the three-year horizon fall by -1.7% in the adverse scenario which is slightly higher than the -2.1% estimated in the 2014 exercise. In addition, an important matter is the consumer prices which fall by 1.3% over the horizon in the adverse scenario, while they were assumed to increase by 1.7% in the 2014 exercise.

Similar results are shown by EU unemployment rate and residential property prices' charts on both scenarios. The same happens for the change in residential property prices where the horizon, however, is somewhat less adverse in this scenario (-10.7%) than in the 2014 exercise (-15.4%). On the contrary, as the impact of this scenario on commercial property prices is stronger than that assumed in the 2014 exercise, the change over the horizon is also more adverse (-15.0% compared to -8.3% in 2014).

3.3. Methodology

To examine whether stress test have caused abnormal movements in equity, credit market, or others of the variables above mentioned, a particular attention has been reserved to financial intermediaries because of the necessity to restore financial stability along the system, especially in the Southern Europe where banks suffered more in terms of credit quality.

To describe the effective impact of stress tests on bank's performance I use a peculiar multiple linear regression model. The data contain observations of multiple phenomena obtained over multiple time periods for the same banks and this gives the possibility to quantify the strength of the relationship between explained variables and the bank's equity returns. In detail, the model is a *Pooled Ordinary Least Squares (OLS)* with robust standard errors. As it requires, then, I am going to verify all the assumptions the model needs as linearity, lack of multicollinearity, homoscedasticity, joint analysis on named regressors through their tests. The model gives the possibility to perform linear regression when there is a certain degree of heteroscedasticity between the residual in a regression model.

It is necessary to highlight the limitations of our analysis due to the selected sample, which does not allow to the model to work properly. In primis, measurement errors are present in the sample, especially in relation to the *bank-specific variables* as quarterly bank relations, in terms of missing values and missing variables: these instruments are necessary to retrieve the Interest Margin, ROA, and Tier1 Capital. Keep going, the effectiveness of the model is constrained by the meagre *number of observations*. The most indicated variables through which I could get what is the goal of the analysis have mainly quarter or biannual frequency; since the reference of time chosen is the quarter I will have at disposition 28 observations per bank (seven years, 28 quarterly banks relations) to do statistical analysis on. The number of banks participating to the sample implies to have not a huge amount of data but still enough observations, able to

provide consistent estimates considering the first stress test disclosure happened during the 2nd semester of 2009 and the probability to affect the financial system since 2010.

To better understand the use of the selected variables, *Figure 20* depicts the existing relation thanks to the correlation matrix.

***Figure 16**: Explanatory Variables Correlation Matrix*

```
. pwcorr dBetaTrim gIM dTier1 dROA gNPLs dDprice dUnemp

             | dBetaT~m      gIM   dTier1     dROA    gNPLs  dDprice   dUnemp
-------------+------------------------------------------------------------------
   dBetaTrim |   1.0000
         gIM |   0.0223   1.0000
      dTier1 |   0.0058  -0.0100   1.0000
        dROA |  -0.0176  -0.0353   0.0108   1.0000
       gNPLs |  -0.2302  -0.0806  -0.0771  -0.0046   1.0000
     dDprice |  -0.0519  -0.0150  -0.0162  -0.1521   0.2585   1.0000
      dUnemp |   0.0568   0.0506   0.0413  -0.1483  -0.2170  -0.2034   1.0000
```

***Source**: Authors' elaboration on data taken by Stata software*

The correlation matrix shows almost no existing correlation among selected variables. There is a modest negative correlation among *macro-economic variables* and this short-run trade-off is coherent with Phillips curve[17]. Moreover, it is possible to see how NPLs have a positive but acceptable correlation with *macro-economic variables;* this will be used as a possible *hint* for further analysis and the concept will be retaken in the closing chapter. By taking the variation of the selected variables it is useful to lower the correlation and to eliminate the stronger one that there was between NPLs and Interest Margin (0.7750).

The empirical analysis will be conducted as follows.

I regress, firstly, the sample of banks all together independently from passing or failing stress tests; then, the same regression will be run just on banks which passed the stress test with the goal to get the advantages and the influence of supervision authorities in running the stress tests exercise. On this second regression, together with the application of the Pooled OLS approach, to improve the level of criticality of the sample size a bootstrapping method will be also applied.

[17] The Phillips curve is a single-equation empirical model, named after William Phillips, describing a historical inverse relationship between rates of unemployment and corresponding rates of inflation that result within an economy. Stated simply, decreased unemployment, (i.e., increased levels of employment) in an economy will correlate with higher rates of inflation

The latter will help providing straightforward statistical inference when there are situations characterized by insufficient sample size, to power calculations and to assess the properties of the distribution underlying the sample and the parameters of interest that are derived from this distribution. This will make the change in variables coefficients visible to check the effective and possible influence of stress test on bank's performance. Moreover, the analysis will give information and hints on how to lay the foundations for further works in the future according to European programs.

Nowadays, supervisory authorities and their activities are fundamental, as previously anticipated in the first chapter, in which the opacity represents still an important component inside financial institutions and balance sheets. Therefore, Basel III introduced many requirements at which banks should adequate over years as *figure 5* shows; these are variables capable to well explain the stress tests influence on bank's balance sheets and performances and, thus, to provide a good relationship between the equity returns and the other explanatory variables.

In addition, among these phase-in arrangements, the liquidity requirements symbolized by the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR) are banks-specific ratios and useful to better understand the financial incidence of supervisory tools. These are not included in the following regressions because not available for the entire sample of years selected for this analysis[18] but still interesting variables from a banking point of view for future considerations by looking the influence of the tests in exams on liquidity risk in the short and medium term. Finally, according to Basel III program, the 2019 will be the year in which European banks are required to get the parameters thresholds above 100% in terms of capital and liquidity ratios.

The impact on normal equity returns is estimated using the following market econometric model:

$$\boldsymbol{ln(price)_{it} = \alpha_0 + \alpha_1 Beta_{it} + \alpha_2 \cdot ln(InterestMargin)_{it} + \alpha_3 Tier1_{it} + \alpha_4 ROA_{it} + \alpha_5 \cdot ln(NPLs)_{it} + \alpha_6 Inflation_{it} + \alpha_7 Unemployment_{it} + \varepsilon_{it}}$$

[18] These ratios were initially proposed in 2010 and re-proposed in 2014 by the Basel Committee on Banking Supervision. The LCR will be gradually implemented, starting in 2015, when the ratio should be 60% or higher; its implementation must be finished in 2019, with a ratio higher than 100% whilst banks have until 2018 to meet the NSFR standard. Over time this NSF ratio will be reviewed as proposals are developed and industry standards implemented.

where:

- $ln(price)_{it}$ is the natural logarithm of the adjusted close price at time *t* for the *i-th* bank;
- $Beta_{it}$ is the correlation of a bank's equity price with the market; in this case the data are used as proxy to analyze the systematic risk and they represent the quarterly bank data to each trading index of reference;
- $ln(InterestMargin)_{it}$ is the net performance metric that examines how successful a firm's investment decisions are compared to its debt situations, transformed in natural logarithm since it is a monetary value;
- $Tier1_{it}$ is the primary funding source of the bank used to describe the capital adequacy of the institution; banks as BPER did not provide all quarterly data and when these were not available, I assumed the same linear and constant growth;
- ROA_{it} is an indicator of how profitable a bank is relative to its total assets (what earnings were generated from invested capital);
- $ln(NPLs)_{it}$ is the natural logarithm of the amount of non-performing loans and since they can have numerous financial implications, the opportunity to recover the principal or sales of these must be carefully considered affecting the company's profit and loss; data taken by Orbis (the ex Bankscope database) database on annual basis and assumed with a linear growth quarterly – 1st quarter 10%, 2nd quarter 20%, 3rd quarter 30% and 4th quarter 40% - (Impaired / Non-Performing Loans);
- $Inflation_{it}$ is the rate at which the general level of prices for goods and services is rising and, consequently, the purchasing power of currency is falling. ECB attempts to limit inflation, and avoid deflation, to keep the economy running smoothly;
- $Unemployment_{it}$ is represented through its form of ratio. As GDP, it is often used as a measure of the health of the economy.
- ε_{it} is the error term which includes a mix of components measuring the returns in terms of potential speculation related to announcement, clarification, methodology disclosure and results events.

The impact of stress tests effects on banks' quarterly returns is estimated by using the Δ "quarterly variation" of each single variable of the market econometric model above mentioned.

In this model, I difference for one quarter losing the first quarter of time t, obtaining a First-Difference (FD) Estimator for each coefficient.

It follows:

$$\Delta ln(price)_{it} = \alpha_0 + \alpha_1 \Delta Beta_{it} + \alpha_2 \cdot \Delta ln(InterestMargin)_{it} + \alpha_3 \Delta Tier1_{it} + \alpha_4 \Delta ROA_{it} + \alpha_5 \cdot \Delta ln(NPLs)_{it} + \alpha_6 \Delta Inflation_{it} + \alpha_7 \Delta Unemployment_{it} + \varepsilon_{it}$$

The same regression will be represented for the (i) *pooled OLS on all 12 banks* and (ii) *pooled OLS on passing stress tests thresholds banks* by the use of Gretl econometric software and for the (iii) *bootstrap method* application on the same number of banks as (iv) by the help of Stata.

3.4. Data

To estimate the effective impact of the European stress test on Italian Listed Banks I used the quarterly equity return as dependent variable. *Figure 16* lists the participating banks considered in my research and shows the results of the stress tests; although analysis and considerations could be done even for last *EBA 2016 EU-wide bank stress testing exercise*, a real pass/fail threshold is available as of *EBA 2014 EU-wide bank stress testing exercise.*[19] This provides an overview of all stress tests occurred over the years included in the sample and the number of the event disclosures let us see immediately how the supervisory authorities took care of the European situation. Moreover, it is worth to point out that Banca Ifis, Finnat, Mediobanca are not taken in the sample because of their different core activity with respect to the typical one of Italian banks adopted in the sample. Same happens for Italian listed banks which are part of a consolidated group already present in the list (e.g. Banco di Sardegna is part of BPER and Fineco is part of Unicredit). The equity returns are analyzed in function of (i) *bank-specific and economic* variables such as, TIER1 index, Non-Performing Loans, Return on Assets index and the Net Interest Margin and (ii) *macro-economic variables* as Inflation and Unemployment. Data necessary for the regressions were obtained from different sources and datasets as Bloomberg, Orbis and Eikon; in addition, stress tests results are obtained from the European Banking Authority. The period covered is over 2010-2016 years. In addition, the EBA, in co-operation with the Competent Authorities, is now in the process of preparing the methodology and templates with the objective of discussing with the industry and published on February, 27th 2017

[19] The "pass/fail threshold" in *Figure 16* over the EBA 2016 EU-wide bank stress testing exercise is set according to bank results in view of their adverse scenario results.

to carry out its next EU-wide stress test in mid-2018, in line with its previous decision to aim for a two-years exercise in order to give an assessment of the impact of IFRS 9, which will be implemented on January, 1st 2018.
I used quarterly periods as time measure to remove plausible disturbances caused by different origin in time of the data and, to better evaluate the potential impact of those data, I considered the variation among quarters.

Furthermore, in addition to these economic variables, I used the financial Beta and not the FTSEMIB return index as proxy for the market portfolio because all participant banks do not participate to the same stock exchange's branch as Banca Popolare di Sondrio, Credem, Banca di Desio e Brianza e Credito Valtellinese are traded in other markets and belong to other underlying indices. The beta give the analysis an additional feedback because of the possibility to get significant data and to better explain how stress test influence the systematic risks. In all analysis, I excluded weekends and official holidays.

***Figure 17**: list of participating banks with Stress Test publications*

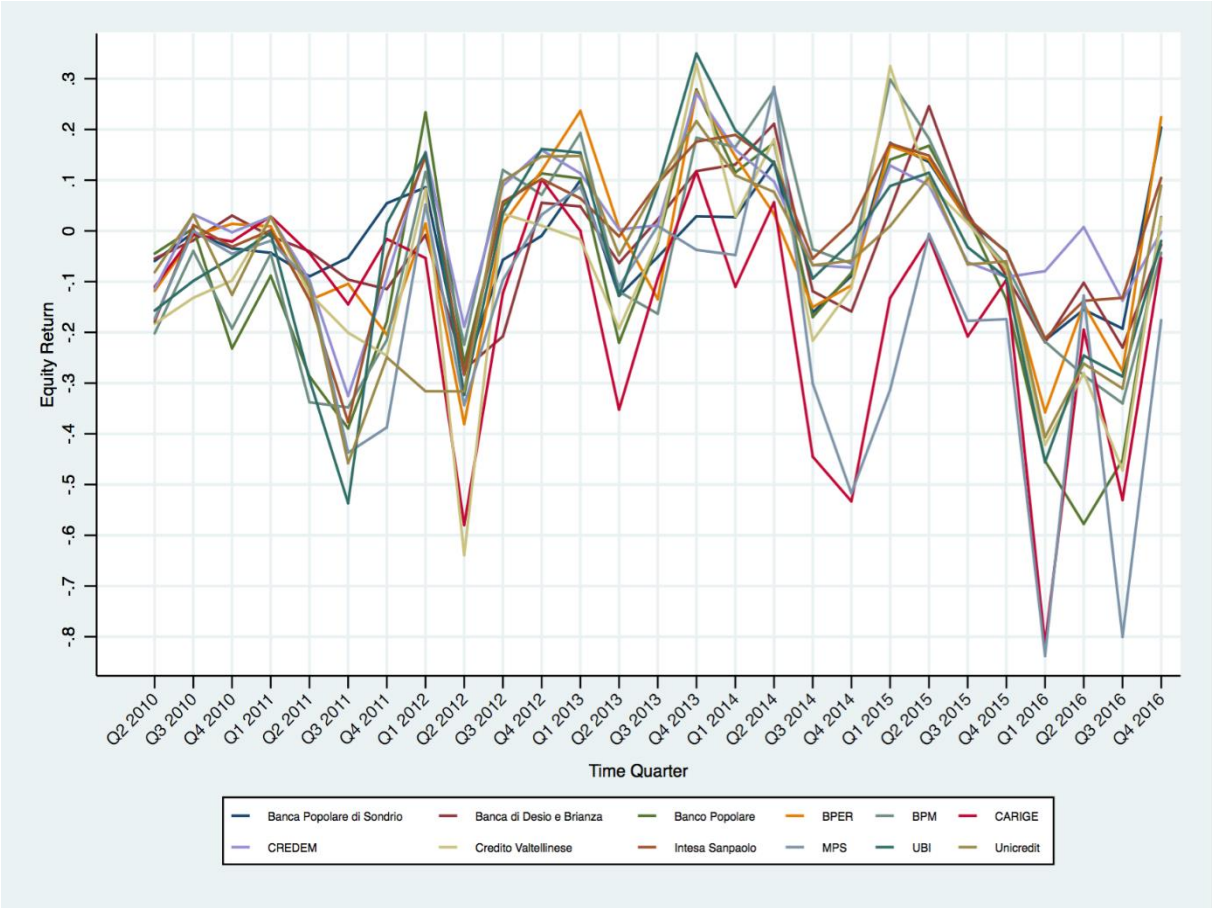
Subset of Banks	Stress Test 01/10/2009	Stress Test 23/07/2010	Stress Test 15/07/2011	Stress Test 26/10/2014	Stress Test 29/07/2016		Stress Test Mid-2018
Banca Popolare di Sondrio	N.A.	N.A.	N.A.	+	+		?
Banca di Desio e Brianza	N.A.	N.A.	N.A.	+	+		?
Banco Popolare	+	+	+	+	+		?
Banca Popolare di Milano	N.A.	N.A.	N.A.	+	+		?
BPER	N.A.	N.A.	N.A.	+	+		?
CARIGE	N.A.	N.A.	N.A.	-	+	...	?
CREDEM	N.A.	N.A.	N.A.	+	+		?
Credito Valtellinese	N.A.	N.A.	N.A.	+	+		?
Intesa Sanpaolo	+	+	+	+	+		?
MPS	+	+	+	-	-		?
UBI	+	+	+	+	+		?
Unicredit	+	+	+	+	+		?

"+" stands for a *positive* and *passed* stress test; "**-**" stands for a *negative* and *failed* stress test

***Source**: Authors' elaboration*

3.5. Descriptive statistics analysis

***Figure 18**: Quarterly Equity Returns variation along the 2010-2016 time window*



***Source**: Authors' elaboration on data taken by Stata*

Figure 18 shows the quarterly equity returns variation for each bank considered in the sample over the time window. All banks, as expected, are correlated being part of the same industry. Along the trend, two things worth to be highlighted. First, the huge fall in stock price happened almost every year after the balance sheets approval; many banks needed to recapitalize the equity (e.g. Unicredit, Carige in 2012). Secondly, it is easy to see how since 2014 two banks have a different and worse trend than all others in the sample; these are Banca Monte dei Paschi di Siena and Carige, in coherence with European supervisors' statements and stress tests results.

Then, *Figure 19* briefly illustrates a summary of the main *bank-specific variables* for each bank of the sample.

***Figure 19**: Descriptive analysis summary at bank-level*

		Close Price	Beta	Interest Margin	Tier1	ROA	NPLs	ΔEquityReturn	ΔNPLs	ΔInterestMargin
Banca Popolare di Sondrio	N	28	28	28	28	28	24	27	23	27
	mean	4.081	0.838	114,725	0.0945	0.321	5.546e+08	-0.0258	0.0777	-0.0235
	sd	0.900	0.615	29,219	0.0129	0.216	3.747e+08	0.120	0.800	0.441
	min	2.396	0.102	52,200	0.0748	-0.159	1.009e+08	-0.281	-2.303	-0.799
	max	5.899	1.735	149,871	0.113	0.726	1.507e+09	0.204	0.693	0.736
Banco di Desio e Brianza	N	28	28	28	28	26	24	27	23	27
	mean	2.794	0.936	54,004	0.113	0.358	2.311e+08	-0.0331	0.125	0.00843
	sd	0.766	0.656	7,167	0.00647	0.226	1.653e+08	0.128	0.678	0.0547
	min	1.690	0.227	45,221	0.105	-0.0551	3.374e+07	-0.273	-1.333	-0.0832
	max	4.127	1.951	69,132	0.129	0.690	5.960e+08	0.246	0.693	0.162
Banco Popolare	N	28	21	28	28	27	24	27	23	23
	mean	9.096	2.635	411,337	0.110	-0.601	3.655e+09	-0.0801	0.0860	-0.122
	sd	4.669	5.511	317,766	0.0238	0.739	2.161e+09	0.225	0.807	0.365
	min	2.227	-0.0545	-383,788	0.0716	-1.915	6.838e+08	-0.578	-2.303	-1.097
	max	19.88	26.42	1.317e+06	0.148	0.404	8.201e+09	0.279	0.693	0.209
BPER	N	28	28	28	28	28	24	27	23	27
	mean	6.165	1.267	323,646	0.0950	0.199	2.284e+09	-0.0291	0.0873	-0.00284
	sd	1.648	0.913	25,729	0.0235	0.215	1.173e+09	0.171	0.745	0.0687
	min	3.352	0.0817	285,728	0.0681	-0.225	5.920e+08	-0.381	-1.395	-0.243
	max	9.195	2.469	424,037	0.146	0.499	4.444e+09	0.275	0.693	0.190
Banca Popolare di Milano	N	28	21	28	28	27	24	27	23	25
	mean	0.628	2.635	201,869	0.126	-0.601	1.123e+09	-0.0488	0.104	0.00356
	sd	0.285	5.511	110,506	0.151	0.739	6.386e+08	0.194	0.714	0.0567
	min	0.309	-0.0545	-211,077	0.0620	-1.915	2.283e+08	-0.348	-1.335	-0.122
	max	1.370	26.42	596,040	0.889	0.404	2.495e+09	0.299	0.693	0.165
CARIGE	N	28	25	28	28	28	24	27	23	27
	mean	9.404	0.699	139,043	0.108	-0.748	1.047e+09	-0.162	0.109	-0.0332
	sd	8.101	1.844	52,618	0.113	1.373	7.959e+08	0.232	0.811	0.367
	min	0.303	-5.585	38,927	0.0580	-3.919	1.085e+08	-0.815	-2.303	-1.335
	max	23.94	3.377	217,096	0.670	0.554	2.618e+09	0.117	0.693	0.884
CREDEM	N	28	28	28	28	26	24	27	23	27
	mean	5.123	1.345	123,378	0.106	0.362	2.871e+08	0.000487	0.0819	-0.00635
	sd	1.398	0.351	28,670	0.0191	0.0622	1.424e+08	0.128	0.754	0.458
	min	2.857	0.717	52,601	0.0843	0.257	8.269e+07	-0.325	-1.387	-1.086
	max	7.640	1.938	197,593	0.139	0.510	5.443e+08	0.271	0.693	1.323
Credito Valtellinese	N	28	28	28	28	28	24	27	23	27
	mean	12.93	1.375	118,406	0.0894	-0.235	9.357e+08	-0.0844	0.101	-0.00425
	sd	8.094	0.848	8,613	0.0290	0.635	5.516e+08	0.218	0.719	0.0554
	min	3.513	0.161	103,609	0.00920	-1.272	2.020e+08	-0.639	-1.406	-0.112
	max	35.20	2.605	137,012	0.132	0.425	2.110e+09	0.329	0.693	0.105
Intesa Sanpaolo	N	28	28	28	28	28	24	27	23	27
	mean	2.044	1.376	2.519e+06	0.122	-0.0383	1.294e+10	-0.00759	0.0804	-0.00768
	sd	0.641	0.242	723,246	0.0178	0.624	6.444e+09	0.147	0.758	0.524
	min	1.080	1.038	1.319e+06	0.0850	-1.269	3.645e+09	-0.377	-1.458	-0.736
	max	3.293	2.007	4.148e+06	0.143	0.450	2.486e+10	0.189	0.693	1.057
MPS	N	28	25	28	28	28	24	27	23	27
	mean	787.8	0.652	657,597	0.105	-1.021	8.593e+09	-0.177	0.0947	-0.0210
	sd	748.3	1.393	176,442	0.0169	1.128	4.749e+09	0.255	0.731	0.161
	min	21.44	-2.794	415,800	0.0750	-2.853	2.024e+09	-0.838	-1.372	-0.543
	max	2,517	2.196	928,100	0.135	0.428	1.787e+10	0.284	0.693	0.362
UBI	N	28	28	28	28	28	24	27	23	27
	mean	4.977	1.522	460,644	0.109	-0.273	2.721e+09	-0.0501	0.0821	-0.0142
	sd	2.006	0.605	60,220	0.0197	0.579	1.350e+09	0.207	0.755	0.0420
	min	2.369	0.799	364,765	0.0745	-1.452	7.515e+08	-0.537	-1.448	-0.158
	max	9.154	2.808	552,627	0.132	0.243	5.278e+09	0.350	0.693	0.0425
Unicredit	N	28	23	28	28	28	16	27	15	27
	mean	31.20	1.794	3.277e+06	0.109	-0.302	1.883e+10	-0.0661	0.102	-0.0323
	sd	17.32	0.848	567,979	0.00931	0.709	8.767e+09	0.184	0.763	0,155
	min	10.52	0.536	1.663e+06	0.0932	-1.594	6.960e+09	-0.458	-1.353	-0.539
	max	68.60	4.680	4.230e+06	0.124	0.240	3.200e+10	0.217	0.693	0,167

***Source**: Authors' elaboration on data taken by Stata*

As follows, *figure 20* shows the *macro-economic variables* data over the 2010-2016 period taken in consideration.

***Figure 20**: Quarterly Unemployment and Inflation rates (%)*

	Quarterly Unemployment Rate Italy (%)	Quarterly Inflation Rate Italy (%)
31/03/2010	8,469228	1,243174
30/06/2010	8,467260	1,419853
30/09/2010	8,162721	1,597759
31/12/2010	8,276660	1,814120
31/03/2011	7,967141	2,311114
30/06/2011	8,014557	2,656151
30/09/2011	8,404869	2,823474
31/12/2011	9,157371	3,314492
31/03/2012	10,029045	3,282508
30/06/2012	10,584063	3,286690
30/09/2012	10,751412	3,197710
31/12/2012	11,374350	2,483690
31/03/2013	11,895542	1,880824
30/06/2013	12,027554	1,150937
30/09/2013	12,181358	1,111626
31/12/2013	12,382284	0,639493
31/03/2014	12,814054	0,503255
30/06/2014	12,390969	0,468710
30/09/2014	12,586301	-0,066534
31/12/2014	12,721359	0,100402
31/03/2015	12,334526	-0,266967
30/06/2015	12,210600	0,066633
30/09/2015	11,564522	0,200001
31/12/2015	11,522784	0,166967
31/03/2016	11,585162	-0,066396
30/06/2016	11,594786	-0,399501
30/09/2016	11,629413	-0,033134
31/12/2016	11,812157	0,133867

***Source**: Authors' elaboration on data taken by Eikon Financial Analysis, Thomson Reuters*

3.6. Pooled OLS Results

I present my findings related to *pooled OLS on all 12 banks* of the sample in *Model 1*. It follows, then, the procedure executed to explain the model and all the various steps tracked.

```
Model 1: Pooled OLS, using 232 observations
Included 12 cross-sectional units
Time-series length: minimum 10, maximum 23
Dependent variable: ld_Equity_Returns
Robust (HAC) standard errors

                      coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------------
  const                -0.0654511   0.0256078    -2.556    0.0267  **
  d_Beta_Trim           0.00437975  0.00178960    2.447    0.0324  **
  ld_Interest_Marg~    -0.0529490   0.0554045    -0.9557   0.3598
  d_Tier1               0.204306    0.0447805    4.562    0.0008  ***
  d_ROA                 0.0315135   0.0135431    2.327    0.0401  **
  ld_NPLs10_20_~_40    -0.0469485   0.0159741    -2.939   0.0135  **
  d_Inflation          -0.115640    0.0228347    -5.064   0.0004  ***
  d_Unemployment       -0.0318647   0.0300474    -1.060   0.3117

Mean dependent var   -0.062529   S.D. dependent var    0.199585
Sum squared resid     8.108774   S.E. of regression    0.190263
R-squared             0.118772   Adjusted R-squared    0.091233
F(7, 11)             24.38547    P-value(F)            7.39e-06
Log-likelihood       59.84598    Akaike criterion     -103.6920
Schwarz criterion   -76.11807    Hannan-Quinn         -92.57170
rho                   0.208602   Durbin-Watson         1.525663

Excluding the constant, p-value was highest for variable 56 (ld_Interest_Margin)
```

The model, immediately, let us see how almost explanatory variables, on which stress test supervisors act, are significant to detect a variation in stock prices from a statistical point of view.

Below, I show the tests to support the validity of the model.

1) White's test for heteroskedasticity

The White's test is used to test homoscedasticity in a linear regression model. It's similar to the Breusch-Pagan test, but the White test allows the independent variable to have a nonlinear and interactive effect on the error variance. Typically, you apply the White test by assuming that heteroskedasticity may be a linear function of all the independent variables, a function of their squared values, and a function of their cross products. The White test is a statistical test that establishes whether the variance of the errors in a regression model is constant: that is for homoscedasticity. the White test can be a test of heteroskedasticity or specification error or both. If no cross-product terms are introduced in the White test procedure, then this is a test of pure heteroskedasticity. If cross products are introduced in the model, then it is a test of both heteroskedasticity and specification bias.

```
White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 18.2514
  with p-value = P(Chi-square(14) > 18.2514) = 0.195569
```

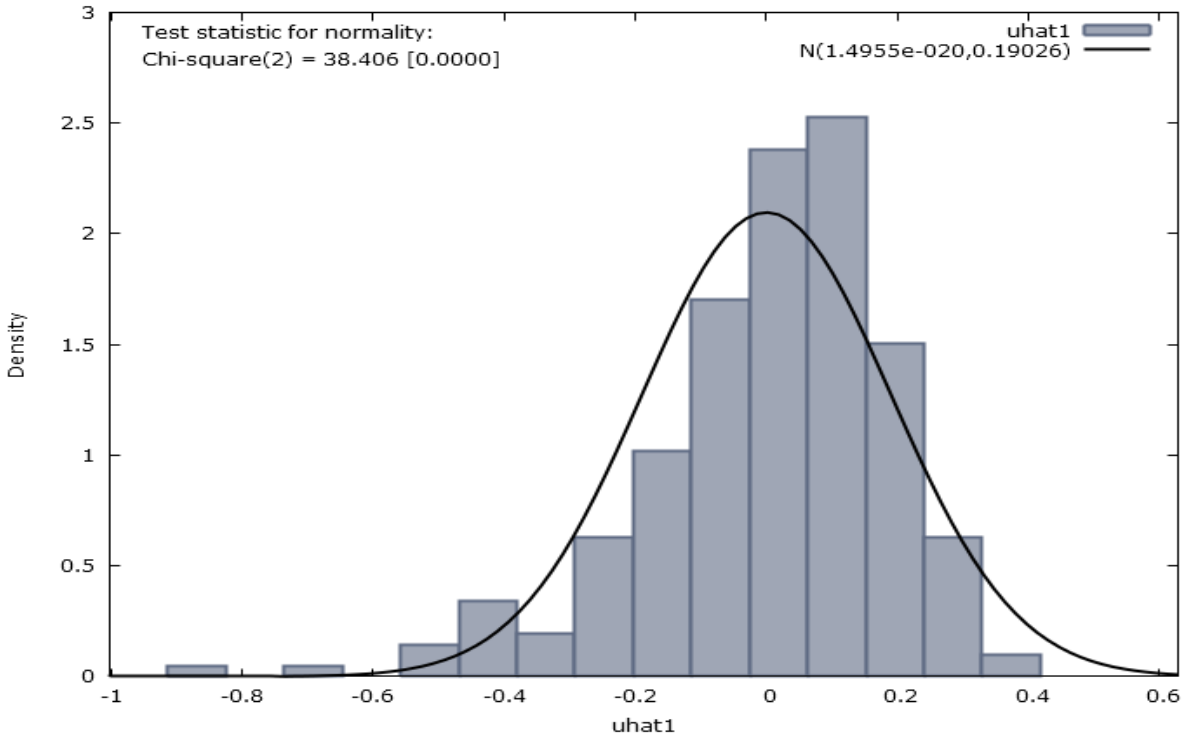
$H_0: Variance\ of\ the\ unit - specific\ error = 0$

$H_1: Variance\ of\ the\ unit - specific\ error \neq 0$

➔ The p-value (0.195569) is greater than 0.05; I accept H_0. There is no heteroskedasticity in the model.

2) Test for normality of residual

Normality test allows to determine if a dataset is well-modeled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed. In descriptive statistics terms, one measures a goodness of fit of a normal model to the data – if the fit is poor then the data are not well modeled in that respect by a normal distribution, without making a judgment on any underlying variable.



3) RESET test for specification

It tests whether non-linear combinations of the fitted values help explain the response variable. The intuition behind the test is that if non-linear combinations of the explanatory variables have any power in explaining the response variable, the model is mis-specified in the sense that the data generating process might be better approximated by a polynomial or another non-linear functional form.

```
RESET test for specification -
  Null hypothesis: specification is adequate
  Test statistic: F(2, 222) = 1.60974
  with p-value = P(F(2, 222) > 1.60974) = 0.202264
```

H_0: *Specification is adequate*

H_1: *Specification is not adequate*

➔ The p-value (0.202264) is greater than 0.05 and I accept H_0. The specification of the model is adequate

As previously mentioned, the same regression on same variables has been run on stress test passing banks, that is, on the sample except for the Banca Monte Paschi di Siena e Banca

CARIGE. To do so, I have introduced a dummy variable with 1 if the bank *i* passed the threshold over 2010-2016 period and 0 otherwise. By doing this, the sample lose 38 observations related to the two banks exclusion.

I present my findings related to *pooled OLS on passing stress tests thresholds banks* in *Model 2* with its supporting tests, that are White's test for heteroskedasticity and test for cross-sectional dependence.

```
Model 2: Pooled OLS, using 194 observations
Included 10 cross-sectional units
Time-series length: minimum 10, maximum 23
Dependent variable: ld_Equity_Returns
Robust (HAC) standard errors

                      coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------------
  const                -0.0350403    0.0115870    -3.024    0.0144  **
  d_Beta_Trim           0.00462241   0.00233904    1.976    0.0795  *
  ld_Interest_Marg~    -0.0273021    0.0534385    -0.5109   0.6217
  d_Tier1               0.181857     0.0302027     6.021    0.0002  ***
  d_ROA                 0.0321414    0.0196736     1.634    0.1367
  ld_NPLs10_20_~_40    -0.0582943    0.0128390    -4.540    0.0014  ***
  d_Inflation          -0.109820     0.0239612    -4.583    0.0013  ***
  d_Unemployment       -0.0565633    0.0211776    -2.671    0.0256  **

Mean dependent var  -0.038965   S.D. dependent var   0.182364
Sum squared resid    5.427144   S.E. of regression   0.170816
R-squared            0.154453   Adjusted R-squared   0.122631
F(7, 9)              104.4555   P-value(F)           6.81e-08
Log-likelihood       71.64110   Akaike criterion    -127.2822
Schwarz criterion   -101.1393   Hannan-Quinn        -116.6962
rho                  0.158319   Durbin-Watson        1.617343

Excluding the constant, p-value was highest for variable 56 (ld_Interest_Margin)
```

1) White's test for heteroskedasticity

```
White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 22.0903
  with p-value = P(Chi-square(14) > 22.0903) = 0.0767773
```

$H_0: Variance\ of\ the\ unit - specific\ error = 0$

$H_1: Variance\ of\ the\ unit - specific\ error \neq 0$

➔ The p-value (0.0767773) is greater than 0.05; I accept H_0. There is no heteroskedasticity in the model.

3.6.1. Bank-specific variables effect on equity returns

As shown in previous models, both in *Model 1* and *Model 2*, the influence of stress tests presented significant explanatory variables in terms of equity returns variation; this effect on equity returns is greater, as expected from the analysis, if we take in consideration only the banks that passed the tests thresholds. Whereas, the effect is smaller when we consider banks jointly and the responses are less significant over the short term. This is because, in line with Neretina *et al* (2015), stress tests announcements might produce limited information on the way these instruments' results will be used or, other possible alternative, future results might be already discounted in the stock prices.

Regarding *bank-specific variables*, as core part of the analysis, many considerations could be done. Firstly, Tier1, probably the most important on which European supervisors act. It is a capital ratio and a measurement of a bank's core equity capital compared with its total risk-weighted assets that signifies a bank's financial strength. The Tier 1 is utilized by regulators and investors because it shows how well a bank can withstand financial stress and remain solvent. Bank investors pay attention to the Tier 1 common capital ratio because it foreshadows whether a bank has not only the means to pay dividends and buyback shares but also the permission to do so from regulators.

In recent quarters, the U.S. banking system has rapidly improved its capital strengths. Motivated by strategic business opportunities and regulatory pressures, bank holding now appear to be targeting capital ratios well above the minimum set by regulation; those banks that have significantly increased their capital ratios, particularly those that began from initially low levels, have experienced large appreciations in their stock prices. The same is for European and Italian banking industry (the exception is represented by Banca Monte dei Paschi di Siena which presents a negative adverse scenario). The literature suggests that, other things being equal, change in capital structure that have not already been anticipated by the market and that move banks toward their optimal capital ratios should lead to stock price appreciations.

In fact, this happened in the analysis above illustrated.

Considering both *Model 1* and *Model 2*, the correlation between stock price appreciation and the Tier 1 capital ratio in my sample was strong, and the relationship was the strongest for those set of banks. The analysis, in *Model 1*, reveals that a 1% increase of Tier1 lead to quarterly returns 20% higher, *ceteris paribus*. The significance of the variable goes over the judgment of supervisors and their "pass/fail tests" because it presents values even higher when we consider all banks in *Model 1* instead of just ones passing stress tests in *Model 2* (p-value<0.001).

The second *bank-specific variable* worth to be analyzed is the Return on Asset. A positive variation in banking productivity helps identify variation in investors' required rates of return and generates higher average returns than unprofitable firms. The higher the ROA the better, because the company is earning more money on less investment. Results show there is a robust and strong return premium in holding profitable banking stocks and it makes sense with expectation of the analysis. By the way, this fact motivates the return-on-asset significance only in *Model 1*; it says that a 1% increase of ROA leads to 3.4% increase of equity returns variation. By analyzing *Model 2*, this variable is no longer significant. Since an economic point of view it does not have much sense; it should have earned even more significance because all banks passed the thresholds and get even stronger results for all other variables than those in *Model 1*.

This criticality of this is supposed to be related to the size of the sample.

3.6.2. How do stress tests affect credit risk?

The credit risk is identified in the SREP as by far the most important financial risk for the majority of institutions. In line with EBA risk assessment report of Dec. 2016, the overall Italian credit risk is still considered high by historical standards. This is mainly driven by last *bank-specific variable* taken in exam: the bullish levels of NPLs above the European level, albeit some improvements in the quality of assets have been recorded, not least as the net inflows to defaulted assets decelerated.

Data showed a deceleration on 2016 because of supervisory authorities' imposition to manage the huge amount of these and to plan a good management process. However, these improvements are rather slow and further progress in dealing with legacy portfolios is needed. This includes clear strategies for addressing non-performing loans. Going forward, the SREP assessments highlighted several prospective risks which may increase the inflow of non-performing

loans. They include exposures to emerging economies, uncertainties related to energy business and a rising appetite for growth in certain asset classes such as commercial real estate. The supervisors plan to further analyze internal models designed for credit risk management purposes to make sure that these models do not underestimate credit risk.

The results of both models give evidence of what economic literature provides. An increase of 1% in quarterly returns is accompanied by a decrease of 0.047% in Non-Performing Loans. Moreover, according to Model 2, it is easy to see how the significance of the variables increase; the 1% increase in quarterly returns will lead to a 0.058% decrease in NPLs with a p-value of 0.0014.

3.6.3. How do stress tests affect systematic risk?

The systematic risk is represented by the interaction between stress tests with betas. By looking at the results, over the time window taken in exam there is no a consistent trend evidence of movements in betas but the quarterly beta has resulted to be significant in a stock price change. The *model 1* specifies that a 1 unit of beta increase lead to a 0.4% increase in equity returns and this might be considered logical from an economic point of view because, in other word, in a situation with a bullish market, the choice to invest on stocks with beta greater than 1 is evaluated as correct. The same is found in the analysis of *Model 2*; the coefficient is significant, an increase of 1 unit of beta will lead to almost 0.5% increase in equity returns. Whereas, the systemic risk, defined as the undiversifiable risk or market risk, affects the overall market and not just a particular stock or industry. This type of risk is impossible to completely avoid and of difficult measurement given the available data.

3.6.4. Macro-economic variables effect on equity returns

In line with the traditional Italian banking activity I expected a positive correlation between *macro-economic variables* and banking equity returns. As follows, in a market efficiency situation, inflation influences other variables, the risk for example, that even in the absence of assessment mistakes, make the stock prices decrease. Again, in a monetary policy regime with a predetermined money supply increase, an inflation increase will lead to a reduction in terms of real money and, therefore, to a reduction of production which, in turns, induces stock prices reductions. After having approved, firstly the negative relation existing between the inflation and the economic activity and, then, the positive one between the latter and stock prices, I have

proved the mechanism how the inflation depresses quotations. This is even more remarked in the short term; stocks often highlighted this negative correlation over time especially when there are sudden or brusque inflation growth. In the sample of time taken in exam this is what happened. In detail, up to the end of 2012 there is an increasing trend (since 1.24% to 3.28%), reversed into deflation in 2016. The consequences have been uncertainty in the market with decreasing reviews of banking profits and stock prices, that are, the obstacles the supervisors are fighting against through the application of regulations and the Quantitative Easing[20] program in order to take the inflation stable and around 2%.

Going to the analysis, it showed as expected, both in *Model 1* and *Model 2,* how a 1% of positive variation in inflation leads to 11% steeper quarterly returns. These are strong assumptions considering quarterly variations but significant and coherent from a statistical point of view (p-value < 0.001).

The second *macro-economic* explanatory variable is Unemployment. Stock prices and the unemployment rate have moved in tandem over the past 15 years. What is most remarkable is that changes in the direction of the unemployment rate occur pretty much at the same time as changes in the direction of stock prices and, in the case of the financial crisis time window, the rise in unemployment actually led the fall in stock prices. As studied in others works that stock prices have their own forward momentum, just as most business decisions do, need time to adjust quickly to changes in economic direction. Investors and employers seem to change their minds about future economic conditions at about the same time. The tide goes in and the tide goes out during the economic cycle for both investors and workers. Almost at the same time, once the stock market drops, unemployment start to increase and vice versa.

The regression results, therefore, revealed an existence of a negative correlation between unemployment and stock prices. The variables has not resulted significant if we consider all the sample without differentiating between passing and failing banks; *Model 1* proves the significance form an economic point of view and justify the negative correlation but the coefficient is not significant. On the contrary, *Model 2* shows a strong negative correlation; it tells that 1% increase of unemployment lead to a 5.65% decrease of equity returns variation and this resulted to be significant at 5% of confidence level. This analysis testifies how "good banks" are related to macro-economic variables and how the latter are important for the good trend of the industry.

[20] From now on Quantitative Easing will be abbreviated with QE

3.7. Bootstrap Approach Results

The bootstrap approach is the practice of estimating properties of an estimator by measuring those properties when resampling from an approximating distribution and this has been implemented by constructing a number of 10.000 resamples with replacement of the observed dataset. *Model 1* and *Model 2*, constructed with the same features of *Pooled OLS* method, are showed as follows:

***Figure 21**: Model 1 – Bootstrap approach*

```
. bootstrap, reps(10000): reg return dBetaTrim gIM dTier1 dROA gNPLs dDprice dUnemp, robust

Linear regression                               Number of obs     =        232
                                                Replications      =     10,000
                                                Wald chi2(7)      =      26.89
                                                Prob > chi2       =     0.0003
                                                R-squared         =     0.1188
                                                Adj R-squared     =     0.0912
                                                Root MSE          =     0.1903

------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
      return |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   dBetaTrim |   .0043798    .013726     0.32   0.750    -.0225228    .0312823
         gIM |  -.0529489   .0433498    -1.22   0.222    -.1379129    .0320151
      dTier1 |   .2043062   .5539711     0.37   0.712    -.8814571     1.29007
        dROA |   .0315136   .0242676     1.30   0.194    -.0160501    .0790773
       gNPLs |  -.0469485   .0223557    -2.10   0.036    -.0907648   -.0031322
     dDprice |  -.1156399   .0327959    -3.53   0.000    -.1799188   -.0513611
      dUnemp |  -.0318647   .0343148    -0.93   0.353    -.0991204    .0353911
       _cons |  -.0654511   .0164072    -3.99   0.000    -.0976086   -.0332936
------------------------------------------------------------------------------
```

***Source**: Authors' elaboration on data taken by Stata software*

***Figure 22**: Model 2 – Bootstrap approach*

```
. bootstrap, reps(10000): reg return dBetaTrim gIM dTier1 dROA gNPLs dDprice dUnemp if bkey!=10 & bkey!=6, robust

Linear regression                               Number of obs     =        194
                                                Replications      =     10,000
                                                Wald chi2(7)      =      26.56
                                                Prob > chi2       =     0.0004
                                                R-squared         =     0.1545
                                                Adj R-squared     =     0.1226
                                                Root MSE          =     0.1708

------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
      return |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   dBetaTrim |   .0046224   .0309303     0.15   0.881    -.0559998    .0652447
         gIM |   -.027302   .0412923    -0.66   0.508    -.1082334    .0536294
      dTier1 |   .1818573   .4279127     0.42   0.671    -.6568361    1.020551
        dROA |   .0321414   .0264308     1.22   0.224    -.0196619    .0839448
       gNPLs |  -.0582943   .0231818    -2.51   0.012    -.1037298   -.0128588
     dDprice |    -.10982   .0332898    -3.30   0.001    -.1750667   -.0445732
      dUnemp |  -.0565633   .0322037    -1.76   0.079    -.1196813    .0065547
       _cons |  -.0350403   .0151868    -2.31   0.021    -.0648058   -.0052748
------------------------------------------------------------------------------
```

***Source**: Authors' elaboration on data taken by Stata software*

By the application of this method, there is no a substantial difference in estimators coefficients. Again, the problem of sample size is present even through this approach; here, in both models, it is possible to see how standard errors increase for some variables and get worse for the others because of higher variability of the sample. Coherently, the confidence level increases the variability inside which the estimate might vary and, consequence of this, there is a general worsening of p-values.

However, through this method, the models get more reliable estimates and they highlight, one more time, which are the most influent variables in terms of significance. *Model 1* shows, if other things being equal, NPLs and Inflation are still significant and, at the same way, lead to a negative of equity return variation by improving their coefficients. Whereas, *Model 2* gets smoother inflation and this might be because "good banks" can obviate at the systematic risk in a better way. NPLs present a sharper trend looking at the coefficients; in the previous model a 1% increase lead to 5% decrease of equity returns, instead, here, the same increase lead to a 6% decrease in equity returns. This testify the importance of this variables in the balance sheets of Italian banks and, especially, in good banks which passed the thresholds.

Finally, independently of the approach, the last variable to analyze and which has never resulted significant is the Interest Margin. I found out that this variable might be relevant, especially for banks failing stress tests. More in detail, half of the whole capital reduction of Banca Monte dei Paschi di Siena might be attributed to the interest margin decrease. The remaining is due to capital deduction increase, to credit losses to Italian bonds depreciations available in the Available for Sale (AfS) portfolio. Therefore, two thirds of the income statement impact have due to interest margin reduction. In particular, the entity of idiosyncratic shock (in the amount of 220 basis point), adapted to the bank rating (actually level is B-), is much higher than the amount estimated for banks with better ratings (25 basis points for banks with AAA rating). The same happened for Carige but with lower percentages. As previously said, banks balance sheets are kept stable over the three years of estimation and this shock, producing consistent effects for the three years following the stress tests results disclosure, gives the idea of why banks like these failed the stress test.

To sum up the obtained results, the analysis came upon the significance of several of selected variables but with modest coefficients. The authorities, through the supervisory process, helped to put in light all the *junk* bonds and debts banks have inside in their core activities and their

work, according to the estimate helped the industry and the Italian economy. However, the estimation produced good results in terms of which variables to look at (both, *bank-specific* and *macro-economic* variables) if we want to get the causes of equity returns variation and it left many *hints* to think about future works.

4. CONCLUSION

The scope of my thesis was an analysis of several *bank-specific* and *macro-economic* variables in order to understand if they could be good variables to verify if and how stress test results affect bank's performance.

During this investigation, I tried to understand what *European supervisory process* means and to describe whose implementation in order to generate a positive influence in the financial market. The analysis rests on the possibility, to create a positive banks equity returns variation through the activity of European authorities. It has not been easy to find good instruments on how to measure this and I analyzed these variables from an historical point of view, trying to comprehend their development during the recent economic cycle of the last 7 years and the way they dealt with the financial crisis that occurred in the same period.

I wanted, therefore, highlight how stress tests are important tools for banking supervisors and it is important to consider their real effects on stocks and credit markets. To do so, I have quantified the Italian market reactions of EU stress tests performed after the first publication in 2009 by considering their effects on stock returns, credit market and systematic risk. I concluded that stress tests have produced valuable information for market participants and play a fundamental role in mitigating bank opacity. The main findings indicate that stress tests affected the Italian banking market strongly putting in light all *junk debt*, available in enormous quantities inside the financial market. The situation is present despite of the quite typical and regulated intermediation activity of Italian banks with the exception of some of the bigger groups as Intesa Sanpaolo, Unicredit with a relevant investment portfolio. The same analysis resulted to be significant but with less impact on banks equity returns.

The estimation has been conducted through the application of two approaches, firstly a *Pooled OLS* and, then, a *Bootstrap model*. The equity returns variation, considered in function of the first difference of all explanatory variables, has been analyzed in order to get the differences between regressing all the sample of banks and, afterwards, just the ones which passed the threshold. Overall, the findings suggest that variables coefficients are modest but sufficient to present statistical significance.

Post-result analysis merits attention even in terms of sample size. To individuate the right sample of banks I came across with a trade-off consisting in excluding some banks because their core activity was different, getting coherent results from an economic point of view but losing statistical inference or including these banks but achieving significant and more reliable estimates from a statistical point of view. The choice to exclude banks as Banca Profilo, Mediobanca, Finnat and others already part of a group, gave the expected output back: higher oscillations and variation degree of the parameters which advice to opt for a bigger sample. This is verified by looking at the Bootstrap models made with the use of Stata in which confidence intervals are wide and some precise parameters values might pass from negative to positive estimation inside the interval.

The conclusions so far made prove the evidence of significant variables and the influence of these on equity returns; the variables resulted to be the most significant are NPLs as *bank-specific* and Inflation as *macro-economic* where a reduction lead to an appreciation of stock prices and to an increase of equity returns. Again, especially the NPLs issue has not yet been overcome although recently considerable steps forward have been made; banks have better protected themselves against the risk of loss and the growth rate of the non-performing loans bad debt in particular, has decreased. Moreover, the estimation produced substantial results to analyze the systematic risk, whereas, there were not available data to determine the plausible decrease of systemic risk. Bank's beta suggests that the publication of stress tests results has affected banks' systematic risk for the years taken in exam in the way that, although the absence of a consistent trend because of the volatility of period, it resulted to be significant in a stock price variation and, therefore, in equity returns.

Though estimating the impact of supervisory tools on equity returns gave significant results it is clear how, by having a bigger sample of banks or a longer time window, it would be possible to retake the analysis by getting more reliable and precise estimates. Along the thesis, from the literature review to the empirical analysis, I became aware of how the explanatory variables have a different impact on stock price and how these might even be replaced by others. For example, CET1 instead of TIER1 would better capture the bank's solidity. To the same aim, the addition of LCR and NSFR. Again, the Return on Tangible Equity (ROTE) instead of ROA, it could better identify the return on shareholders' equity considering that banking primary sources of financing are intangible, such as loans and mortgages.

Over the analysis, some pills on the credit market and the NPLs have been said but the credit market is influenced also by the possible effect on CDS spread over years. There is still fear on the market, and the introduction of the analysis of these numbers would give surely a further idea about the risk trend and its relation to risk market.

Another interesting circumstance related to the current work is the approach through which I looked for statistic and consistent results. The correlation matrix showed a good and positive correlation among NPLs and *macro-economic variables* and this, for example, could recommend to use NPLs as Instrumental Variable (IV) for Inflation and Unemployment (GDP has been excluded because of multicollinearity reasons with Unemployment).

4.1. Further analysis

Concluding, if I were asked how and if there really is the possibility to get better results, I would say to retake the same analysis on 2020. The estimation has been done in the middle of the Basel III planning which will ends in 2019; the latter is the year imposed by the Committee in which all European banks are going to reach all targets required and banks' resilience level will get results above the thresholds through its capital and liquidity ratios. This, together with all previous observations, would let the analysis achieve a bigger time window, to use more *bank-specific* variables (LCR and NSFR would become available for a consistent period of time) and, therefore, to get a more specified model in terms of homoscedasticity, better confidence intervals and more reliable estimates. At this regard, in addition, The European Banking Authority published on February, 27th 2017 to carry out its next EU-wide stress test in mid-2018, in line with its previous decision to aim for a biennial exercise in order to give an assessment of the impact of IFRS 9, which will be implemented on January, 1st 2018.

5. References

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5.1. Web – Databases

- *Equity Return Prices, Inflation, Unemployment*:
  Reuters, Thomson. - EIKON
- *Banks Balance Sheet:*
  Bureau van Dijk - Orbis Banks, Database of banks worldwide
- *Betas, CDS, NPLs, ROA:*
  Bloomberg, Reference Data – Bloomberg Professional Services