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Performance and soundness of european banking systems

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PERFORMANCE AND SOUNDNESS OF EUROPEAN BANKING SYSTEMS

Performance et stabilité des systèmes bancaires européens
Sistemele bancare europene din perspectiva criteriilor de performanță și
stabilitate

Thèse Nouveau Régime

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Par

Ioana Iuliana TOMULEASA

Sous la direction de M. Vasile COCRIȘ et M. Alexandru MINEA

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Abstract

The financial system plays a crucial role in the modern society, becoming indispensable in the economic development of a nation. It was stated that an optimal financial system and well-functioning banking sector are commonly considered to be among the most important conditions for a sustainable economic development. Considering the importance of the banking sector, particularly in the last century, this thesis aims to study bank performance and soundness from two perspectives, a theoretical and an empirical one, emphasizing the important efforts made by policy makers in recent years to provide effectively a sufficient stimulus to the economic sectors during the global and domestic downturns and to ensure a sound functioning of financial systems.

The first part of the thesis aims to perform a critical and detailed review of the long-standing and rich literature devoted to identifying and analyzing the main indicators, methodological designs and determinants of bank performance and soundness. From our analysis of the wide literature, we learned the following aspects. First, from a methodological perspective, we have noted a concentration of the literature on bank performance, around three methods, namely data envelopment analysis, stochastic frontier analysis and longitudinal regression analysis. In terms of bank soundness, we can notice a wide variety of methods of different complexity, some of them being still in the development phase, though promising important advances for the literature. On the empirical side, the determinants of bank performance and soundness are numerous (e.g. microeconomic and macroeconomic; real, fiscal, monetary, and institutional; national and international), and their influence is multifaceted. The complexity of the type of influence (significant or not) and the sign (positive, or negative) of the effect is triggered by several factors, namely: (i) the measure of bank performance and soundness (the same variable can exert conflicting effects on different measures); (ii) the measure of the determinant (alternative measures of the same variable can exert conflicting effects); (iii) the design of the study (e.g. the number of countries, data frequency, or bank specialization); and (iv) the economic environment (for example, the level of economic development).

The second part of the thesis aims to explore the role of several bank specific, industry specific and macroeconomic factors on the evolution of European bank performance and soundness during the international financial crisis. We observed that, banks' pre-crisis risk-taking behavior, complemented by a deficient regulatory and supervisory framework, have determined some very profitable although very risky business strategies. These trends concurred with a certain economic and financial fragility, and have generated deteriorating post-crisis profitability and efficiency. In addition, the pre-crisis advantageous business strategies were heightened by high debt levels, cheap wholesale funding and high real estate and securitization exposures.

Considering a first set of measures taken to counteract the negative effects of the subprime crisis, our results show that bank performance and soundness are negatively related, but economic freedom, regulation, corruption, and transparency tend to have mixed effects at the aggregate level depending on the performance and soundness measures used. More noticeable differential effects can be detected when we disaggregate the data: (i) the Euro-area, the non-euro European Union (EU) countries and the EU candidate countries; (ii) the size of banks; (iii) the country income level; (iv) the timing of entrance into the EU; and (v) bank specialization. The main results suggest that policies promoting greater economic freedom, reducing regulation and corruption and enhancing transparency need to be more targeted to reflect the diversity of the banking sector in Europe. Additionally, when studying the implications arising from a second set of measures taken during the crisis, namely the incentives determined by quantitative easing decisions, we observe differences in the sequencing of the quantitative easing strategy. We find that quantitative easing decisions are driven by economic activity, lending rates, and bank leverage. Besides, we observe the high importance of bank leverage and level of securities holdings, as major transmission channels of quantitative easing with the main purpose of amplifying economic growth. Though, we registered a diverging magnitude of these transmission channels on different types of UK banks.

Overall, banks have to accept that they are operating in a different financial setting and further structural challenges are still ahead, thus a return to sustainable performance and soundness will be dependent upon their flexibility in adapting their business models to the new operating environment.

Keywords: bank performance, bank soundness, efficiency, financial fragility, international financial crisis, distributed ledger technology, systemic risk, regulation, corruption, transparency, quantitative easing, European Union, parametric and non-parametric approaches, panel VAR, panel regression.

Résumé

Le système financier joue un rôle vital dans la société moderne, il devenant ainsi indispensable pour le développement économique d'un pays. On considère généralement qu'un système financier opérationnel et un fonctionnement optimal du système bancaire représentent les plus importantes conditions pour un développement économique durable. Ayant en vue l'importance croissante du système bancaire, surtout dans le dernier siècle, cette thèse de doctorat analyse la performance et la solidité bancaire à partir de deux perspectives, à savoir celle théorique et celle empirique. Cette thèse met en évidence les efforts considérables des autorités monétaires des dernières années pour l'assurance d'un stimulant efficace pour le développement économique durant la récession et pour le fonctionnement optimal du système financier.

La première partie de la thèse de doctorat poursuit l'analyse détaillée de la vaste littérature de spécialité avec le but de l'identification des principaux indicateurs, des méthodologies et des facteurs déterminants de la performance et de la solidité bancaire. D'après l'analyse de la littérature de spécialité, j'ai extrait les aspects plus importants. Tout d'abord, d'un point de vue méthodologique, on observe une concentration de la littérature concernant la performance bancaire sur trois méthodes, à savoir : la méthode d'enroulement des données (data envelopment analysis), la méthode de la frontière stochastique (stochastic frontier analysis) et l'analyse de régression longitudinale. Concernant la solidité bancaire, il existe un large éventail de méthodes statistiques plus ou moins complexes, dont certaines sont encore dans la phase de développement mais enregistrant des résultats prometteurs. Deuxièmement, du point de vue empirique, nous pouvons observer une grande variété de facteurs déterminants de la performance et de la solidité bancaire (par exemple, de facteurs microéconomiques et macroéconomiques, réels, fiscaux, monétaires, institutionnels, nationaux et internationaux), mais leur influence a plusieurs facettes. La complexité de l'impact de ces facteurs (significatif ou non significatif statistiquement) et le signe enregistré (positif ou négatif) varie en fonction de: (i) l'indicateur utilisé pour mesurer la performance et la solidité bancaire (pour la même variable, il peut exercer des influences contradictoires sur des mesures différentes; (ii) la modalité de mesurer le facteur déterminant (des mesures alternatives du même indicateur peuvent générer des effets contradictoires); (iii) l'échantillon étudié (par exemple, le nombre de pays, la fréquence des données; (iv) l'environnement économique (par exemple, le niveau de développement économique).

La deuxième partie de la thèse de doctorat vise à explorer le rôle de facteurs déterminants spécifiques de la banque, du secteur bancaire et de l'environnement économique sur la performance et la solidité des banques européennes durant la crise financière internationale. D'après l'analyse effectuée, on a observé que le comportement des banques avant la manifestation de la crise, en

collaboration avec le cadre de réglementation insuffisante a généré quelques-unes des stratégies commerciales les plus rentables. Ces stratégies ont coïncidé avec l'environnement économique et financier fragile, conduisant à des performances extrêmement faibles au cours de la manifestation de la crise financière internationale. En plus, les performances élevées enregistrées par les banques avant la crise, ont été influencées par l'effet de levier, par le comportement orienté envers le risque et par les niveaux élevés de liquidité, générés par les grandes banques centrales du monde. Ayant en vue une première série de mesures adoptées pour contrecarrer les effets négatifs de la crise financière internationale, des résultats enregistrés montrent que la performance bancaire et la solidité bancaire sont dans une relation inverse proportionnelle. Dans le même temps, des variables telles que la liberté économique, le cadre de réglementation, la corruption et la transparence ont la tendance d'enregistrer des effets mixtes au niveau agrégé, étaient fortement influencés par les mesures de performance et de solidité utilisées. Des effets différentiels plus visibles peuvent être détectés au moment de la division de l'échantillon dans les dernières sous-échantillons d'étude : (i) zone euro, les pays membres de l'Union européenne (UE), non-euro et les pays candidats à l'UE; (ii) la dimension de la banque, (iii) le niveau de développement économique du pays; (iv) le moment de l'adhésion à l'UE; (v) la spécialisation des banques. Les principaux résultats suggèrent que les politiques visant à promouvoir une plus grande liberté économique, ce qui réduit le niveau de la réglementation et de la corruption et ce qui augmente le niveau de transparence doivent être spécifiques et ils doivent refléter la diversité des secteurs bancaires européens. En étudiant une deuxième série de mesures adoptées, à savoir les incitatifs liées aux mesures de politique monétaire non conventionnelles (le programme d'assouplissement quantitatif - quantitative easing) on observe des différences significatives dans la séquence de la stratégie d'assouplissement quantitatif. En outre, nous avons constaté que ce programme d'assouplissement quantitatif est déterminé par l'activité économique, par les taux débiteurs et par le niveau d'endettement. En plus, le canal de transmission de l'assouplissement quantitatif pour stimuler la croissance économique dépend du niveau d'endettement et du niveau des titres financiers détenus, ayant un impact différent sur les différents types d'institutions financières.

Enfin, les banques doivent accepter qu'elles agissent dans un environnement financier en mouvement perpétuel, ainsi que le retour à une performance et une solidité durable dépend de leur flexibilité d'adaptation du modèle d'affaire au nouvel environnement économique.

Mots-clés: performance bancaire, solidité bancaire, efficacité, fragilité financière, crise financière, la technologie du registre distribué, réglementations, corruption, détente quantitative, l'Union européenne, des méthodes paramétriques et non-paramétriques, panneau VAR, régression longitudinale.

Rezumat

Sistemul financiar joacă un rol esențial în societatea modernă, devenind indispensabil pentru dezvoltarea economică a unei țări. Se consideră că un sistem financiar operațional și o funcționare în parametri optimi a sistemului bancar, reprezintă cele mai importante condiții pentru o dezvoltare economică sustenabilă. Având în vedere importanța crescândă a sistemului bancar, în special în ultimul secol, această teză de doctorat analizează performanța și soliditatea bancară din două perspective, și anume una teoretică și una empirică. Această lucrare evidențiază eforturile considerabile ale autorităților monetare manifestate în ultimii ani, în vederea asigurării unor stimuli eficienți pentru dezvoltarea economică în perioada recesiunii și pentru funcționarea optimă a sistemului financiar.

Partea I a tezei de doctorat urmărește analiza detaliată a vastei literaturi de specialitate cu scopul identificării principalilor indicatori, metodologii și factori determinanți ai performanței și solidității bancare. Din analiza literaturii de specialitate, am extras următoarele aspecte esențiale. În primul rând, din perspectivă metodologică, se observă o concentrare a literaturii vizând performanța bancară asupra a trei metode, și anume metoda înfășurării datelor (data envelopment analysis), metoda frontierei stochastice (stochastic frontier analysis) și analiza de regresie longitudinală. În ceea ce privește soliditatea bancară, există o paletă vastă de metode statistice, de complexități diferite, unele dintre acestea fiind încă în faza de dezvoltare dar înregistrând rezultate promițătoare. În al doilea rând, din perspectivă empirică, putem observa o varietate mare de factori determinanți ai performanței și solidității bancare (spre exemplu microeconomici și macroeconomici, reali, fiscali, monetari, instituționali, naționali și internaționali), însă influența acestora are multiple fațete. Complexitatea impactului acestora factori (semnificativ sau nesemnificativ statistic) și semnul înregistrat (pozitiv sau negativ), variază în funcție de următoarele elemente: (i) indicatorul utilizat pentru măsurarea performanței și solidității bancare (pentru aceeași variabilă se pot înregistra influențe contradictorii din partea factorilor determinanți); (ii) modalitatea de măsurare a factorului determinant (măsurile alternative ale aceluiași indicator pot genera efecte conflictuale); (iii) eșantionul studiat (spre exemplu, numărul de țări, frecvența datelor, specializarea băncilor); (iv) mediul economic (spre exemplu, nivelul de dezvoltare economică).

Partea a II-a a tezei de doctorat își propune să exploreze rolul factorilor determinanți specifici băncii, sectorului bancar și mediului economic, asupra performanței și solidității băncilor europene în perioada crizei financiare internaționale. Analiza realizată denotă comportamentul orientat spre risc al băncilor înainte de manifestarea crizei, care coroborat cu cadrul de

reglementare și supraveghere insuficient, au generat unele din cele mai profitabile strategii de afaceri pentru băncile europene. Acestea au coincis cu mediul economic și financiar fragil, conducând la performanțe extrem de scăzute în perioada de manifestare a crizei financiare internaționale. În plus, performanțele ridicate înregistrate de bănci înainte de criză au fost influențate și de efectul de pârghie și de nivelurile ridicate de lichiditate generate de principalele bănci centrale ale lumii. Având în vedere un prim set de măsuri adoptate pentru a contracara efectele negative ale crizei financiare internaționale, rezultate înregistrate ne arată că performanța și soliditatea bancară se află într-o relație invers proporțională. În același timp, variabile precum libertatea economică, cadrul de reglementare, corupția și transparența, au tendința de a înregistra efecte mixte la nivel agregat, fiind puternic influențate de măsurile de performanță și soliditate utilizate. Efecte diferențiale puternice pot fi detectate în momentul divizării eșantionului în următoarele sub-eșantioane de studiu: (i) zona euro, țările membre ale Uniunii Europene (UE) non-euro și țările candidate la UE; (ii) dimensiunea băncii, (iii) nivelul de dezvoltare economică a țării; (iv) momentul aderării la UE; și (v) specializarea băncilor. Rezultatele principale ne sugerează că politicile de promovare a unei mai mari libertăți economice, diminuând nivelul de reglementări și corupția și amplificând nivelul de transparență, trebuie să fie ușor adaptabile și să reflecte diversitatea sectoarelor bancare europene. Studiind un al doilea set de măsuri adoptate, și anume stimulentele determinate de măsurile neconvenționale de politică monetară (programul de relaxare cantitativă – quantitative easing), observăm diferențe importante în succesiunea strategiei de relaxare cantitativă. Mai mult, am constatat faptul că acest program de relaxare cantitativă este determinat de activitatea economică, ratele de creditare și nivelul de îndatorare. În plus, canalul de transmitere a relaxării cantitative în vederea stimulării creșterii economice, depinde de nivelul de îndatorare și de nivelul titlurilor financiare deținute, având un impact divergent asupra diferitelor tipuri de instituții financiare.

În final, băncile trebuie să accepte faptul că activează într-un mediu financiar în continuă mișcare, astfel revenirea la o performanță și soliditate sustenabilă depinde de flexibilitatea acestora în adaptarea modelului de afaceri la noul mediu economic.

Cuvinte cheie: performanța bancară, soliditatea bancară, eficiență, fragilitate financiară, criză financiară, tehnologia registrului distribuit, reglementări, corupție, relaxare cantitativă, Uniunea Europeană, metode parametrice și non-parametrice, panel VAR, regresie longitudinală.

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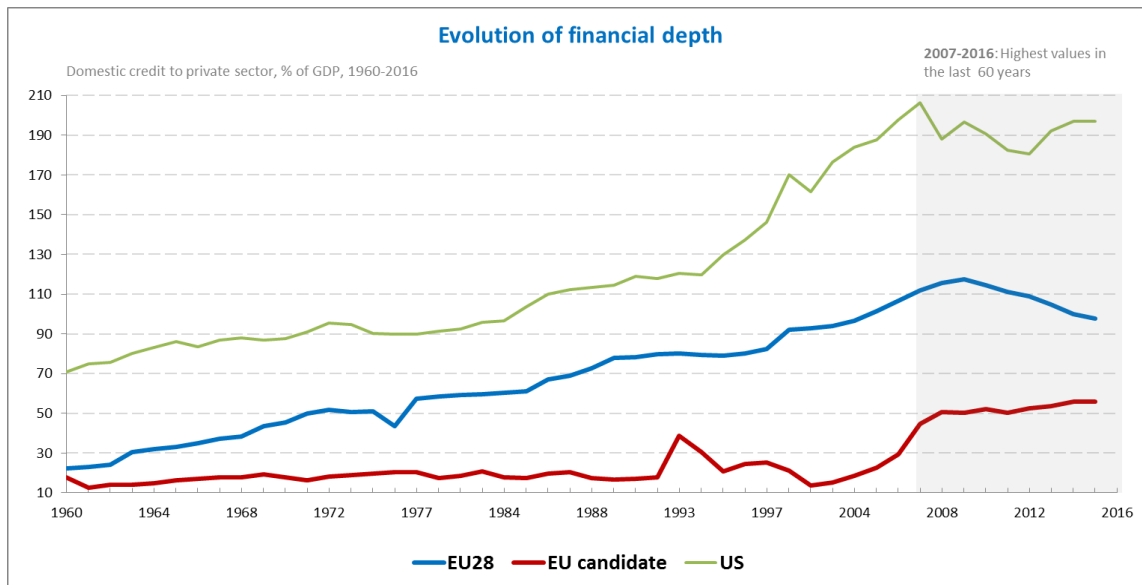
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Introduction

The banking system plays a vital role in the economy. It is an integral part of the economic system, impinging on the economy and influencing its performance and stability. Scholars and policy makers have expressed a variety of visions on the performance and soundness of the banking systems, and their role in promoting economic development. Moreover, banks are seen as the nerve center of the national and international financial systems, being regarded also as barometers of the economic perspectives of a country.

Generally, banks are certifying the financing of productive investments and activities, because they mobilize and allocate financial resources, but also because they ensure a money-creation process through lending activities. They are therefore catalytic agents, creating new prospects for financial resources expansion, while stepping up the tempo of economic development. Furthermore, well-functioning banks diminish the transaction costs, but also the moral hazard and asymmetric information observed in the financial market. Though, in the last century, banks are no longer regarded as simple lending financial institutions, thus they serve a higher purpose in nowadays society. Banks have evolved considerably over the years, however the most profound changes have occurred in the last 30 years, reshaping the economic and financial balance of power on a global scale.

Bolstered by globalization, financial development and political stability, manifested through increasing financial opening, deregulation and re-regulation, financial markets considerably expanded their size and structure, fueled by amplified monetary and financial integration around the world. A key set of statistical information quantifies the economic and financial transformations observed in the last years. For example, the annual growth rate of GDP at market prices over the last 30 years averaged 1.9pps for the European Union (EU) and 2.6pps for the US, being overshadowed by the EU candidate countries with an average of 2.7pps (particularly valid for Montenegro, Serbia and Turkey), while China registered a much higher average of 9.7pps. Additionally, financial depth, estimated by private credit to GDP, reached a 30-year average of 71pps for the EU (with a standard deviation of 28pps) and 127pps for the US (with a standard deviation of 44pps). Though, as shown in Figure O.1, there are significant differences across countries, in correlation with the country income level (e.g. in the EU candidate countries the 30-year average private credit to GDP is 26pps).

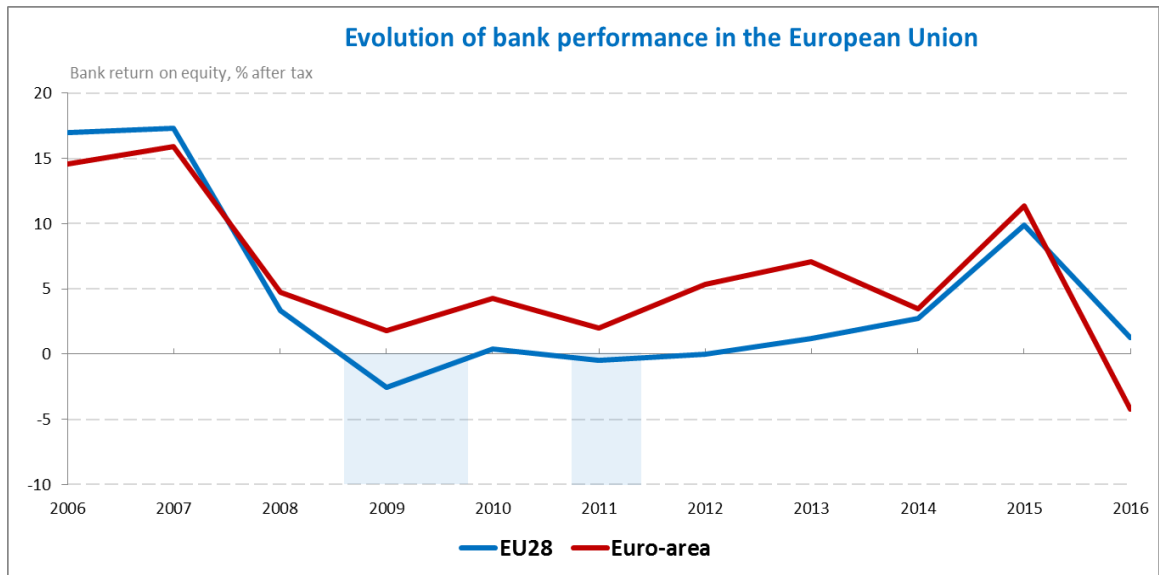


Source: processed after World Bank statistics

Figure O.1 Evolution of financial depth (1960-2016)

As emphasized by the recent crisis, the flipside of these financial markets' developments is the highly interconnected and complex international financial system. Thus, the subprime crisis triggered cascading exposures to potentially volatile capital flows, moral hazard, and contagion, which affected both banks' inputs and outputs and spread to non-banking entities, ultimately disturbing the economic development and the evolution of living standards worldwide. More specifically, deficiencies in corporate and risk management, insufficient capital and liquidity and deficient regulatory and supervisory oversight, all added in different ways to the subsequent economic disorder.

Consequently, over the last years, the economic and financial malaise has impacted severely what was once a performant, developing, vibrant and very innovative banking system. Under these circumstances, banks suffered immense losses, being obliged to raise additional capital privately, or in extreme cases, be bailed out by their national governments. For example, the performance of banks was affected enormously during the recent financial crisis, and as shown in Figure O.2, EU28 return on equity entered into a negative territory in 2009 and afterwards in 2011. This deteriorated post-crisis ROE was determined by the subdued economic growth, the associated low interest rates and the decrease in the loan portfolio quality. Though, starting with 2012 the EU28 ROE is broadly stable but still faces a series of challenges related to a large stock of non-performing loans (NPLs), incomplete business models adjustments and overloading in some Euro-area banking systems.

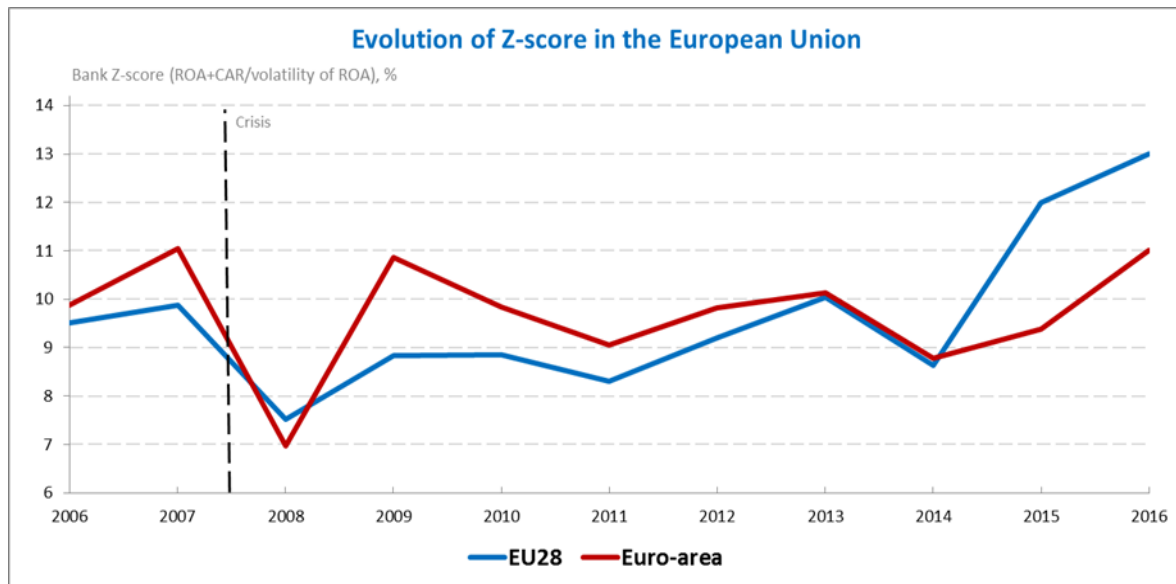


Note: The blue regions represents the period when EU28 ROE registered negative values.

Source: processed after Orbis database

Figure O.2 Evolution of bank performance in the EU (2006-2016)

As expected, the post-crisis sluggish economic recovery coupled with the weak bank performance and the high cost of external financing are among the main factors behind a decrease in bank soundness in the post crisis period, as shown in Figure O.3.



Source: processed after Orbis database

Figure O.3 Evolution of bank soundness in the EU (2006-2016)

These developments have determined both academics and policy makers to reconsider the scale, scope, and implicitly the performance and soundness of banks. Consequently, these issues are of crucial importance for the whole economic system.

1. Motivation and research problem

The international financial crisis has sparked widespread calls for regulatory and supervisory reforms. Although the initial reaction to the crisis was one of disbelief in its probability of expanding worldwide, the latest distressing economic circumstances have exposed many deficiencies related to financial regulation and supervision but also to bank corporate governance, spawning intense debates on the role played by these deficiencies on causing and propagating the financial crisis globally. The difficulties caused by the subprime crisis not only disrupted financial intermediation, but also damaged the efficiency and effectiveness of financial regulation, supervision and monetary policy, aggravating economic downturns, generating capital flights and exchange rate burdens, and important fiscal costs associated to saving troubled banks. Moreover, the international financial crisis revealed significant discrepancies between the European countries in terms of their level of development and economic integration. In addition, the crisis also determined a higher awareness of the strong connectivity among banks worldwide and the importance of tight financial and trade linkages between countries. As such, the economic recession corroborated with the recent migration crisis have put severe weight on the European Union countries, being regarded as a critical test for the future of the European Union and the single currency.

Against this background, there have been adopted a vast array of measures tackling with the negative consequences that the recent financial crisis had on the performance and soundness of the European financial sectors. The main priority was to ensure sound financial systems, which should be well-regulated and well-supervised, as they are essential for domestic and international financial stability. These measures can be classified in four major categories, namely: *bank liability guarantees, macro-prudential measures, conventional and unconventional monetary policy* and *other market interventions*. Though, between the recent developments in the financial market and the numerous policy responses both domestic and international, it became very challenging to understand the complex and emerging reactions of banks to the international financial crisis, particularly regarding the regulatory changes and the unconventional monetary policy (quantitative easing) which represented a top priority for policy makers.

Consequently, we considered of vital importance to understand the fundamentals of bank performance and soundness, how they interact and how they were affected by different factors during the international financial crisis, thus we have focused in this thesis on the *Performance and Soundness of European Banking Systems* within a complex and dynamic financial setting.

This thesis is grouped in two parts, a theoretical and an empirical one.

The first part, focuses on the main definitions, indicators and methodologies used to assess both bank performance and soundness, and aims to answer the following research questions:

- ❖ What are the most commonly applied indicators of bank performance and soundness, and what are their particularities?
- ❖ What are the most common methods employed in the assessment of bank performance and soundness, and under which conditions? Are they operational at the European level?
- ❖ What are the main determining factors of bank performance and soundness? Are there any gaps in the literature?

The second part discusses the impact of the most important determinants on bank performance and soundness, with a particular emphasis on the regulatory framework and unconventional monetary policy. The second part aims to answer the following research questions:

- ❖ What's the relationship between bank performance and bank soundness? Did this relationship change during the financial crisis?
- ❖ What elements are the most important for ensuring an optimal bank performance and soundness for European countries? Do economic freedom, regulation, transparency and corruption play an important role for different European banks?
- ❖ What is the impact of unconventional monetary policy (quantitative easing) on bank activity and which are the main driving factors of quantitative easing decisions?

2. Scope of the thesis and major objectives

As mentioned, the performance and soundness of the banking systems is a matter of serious concern to policy makers, being a highly debated topic among academicians and public at large. As such, this thesis has a *dual purpose*.

On the one hand, the thesis is aiming to perform a critical and comprehensive review of the rich literature devoted to identifying and analyzing the main indicators, methodological designs and determinants of bank performance and soundness. On the other hand, the thesis aims to investigate the role of several bank specific, industry specific and macroeconomic factors on the evolution of European bank performance and soundness, with a particular emphasis on some factors severely affected during the crisis, namely economic freedom, regulation, transparency, corruption and unconventional monetary policy (quantitative easing).

Considering these aspects, the major objectives of the thesis can be defined as follows:

- ❖ To identify the most important indicators of bank performance and soundness and the main techniques used in their assessment;
- ❖ To identify the main determinants of bank performance and soundness, and to assess which of them poses additional pressure on the European banking sector;
- ❖ To assess the progress of the European banking sector in the post-crisis period, highlighting future challenges and opportunities;
- ❖ To make a comparative analysis of the performance and soundness of European banks following several criteria (e.g. bank specialization, bank size, economic development), and highlight the particularities of European banking sectors;
- ❖ To examine the precise role played by economic freedom, regulation, corruption and transparency in the evolution of the performance and soundness of European banks;
- ❖ To determine the impact of quantitative easing decisions on bank performance and soundness, with a particular emphasis on bank specialization;
- ❖ To investigate the quantitative easing policy responses to different shocks of bank performance and soundness and real economic activity;
- ❖ To put forward concrete suggestions and recommendations, providing insights for designing economic policies to mitigate the negative repercussions of the recent distressing events (e.g. international financial crisis, sovereign debt crisis, Brexit).

3. Contributions

Although, there is a vast literature on the banking industry, there is a dearth of a comprehensive study on both the performance and soundness of the European banking system. An extensive review of the existing literature reveals that no exclusive study focused on both the performance and soundness of the banking sector, at least not at this extent. In this context, the present thesis may fill the gap to a certain limit. Furthermore, it may throw some light on the determinants of bank performance and soundness, some of them being highly debated during the last period dominated by severe tensions from the subprime crisis.

This thesis contributes to the literature in a number of important ways.

The first part of the thesis provides a unified perspective, being, to the best of our knowledge, the most comprehensive study on both bank performance and soundness covering three categories

of topics: the various indicators of bank performance and soundness, the numerous methods used to assess bank performance and soundness and the plentiful of determinants of bank performance and soundness. In addition, compared to the existing literature, we include a wide range of theoretical and empirical studies. Indeed, the existing studies either adopt a more empirical perspective (for example, Berger and Humphrey, 1997, reviewed 130 studies applying frontier efficiency analysis to financial institutions), or focus on one technique (for example, following Cook and Seiford, 2009, Fethi and Pasiouras, 2010, draw upon 196 studies to discuss the methodological developments and applications of Data Envelopment Analysis). Moreover, the thesis covers a wide period of time (where the earliest considered contribution goes back to 1935 and the latest publications were in 2017) and a very large number of studies (around 780 publications). In addition, when studying the determinants of bank performance and soundness, we reclassify them in four categories, namely bank specific, industry specific, macroeconomic and international factors, themselves divided in 18 subgroups, for a total of more than 55 variables with roughly 90 measures. Given the importance of the banking system for the entire economy, this part of the thesis goes well beyond academia, as it can provide useful insights to policy makers, bank managers, investors, customers, and also to the general public.

The second part of the thesis develops a framework examining the impact of various factors on both bank performance and soundness. First, we evaluate bank performance and soundness by including specific factors, such as asset quality, capitalization, portfolio orientation, economic freedom, business regulation, corruption and transparency. Thus, this part of the thesis is, to the best of our knowledge, the first study that attempts to examine these issues on both bank performance and soundness in a combined framework at the European level including the European Union candidate countries. Moreover, we analyze the particularity of each country and each bank by disaggregating the sample applying different criteria, based on region, institutional size, country income level, time of entrance into the EU and bank specialization.

Second, we analyze the implications arising from the responses of the financial sector in the United Kingdom (UK) to the incentives determined by unconventional monetary policy (quantitative easing). More specifically, we study the interaction between leverage undertaken by different types of financial institutions and asset purchases by the Bank of England (BoE) as part of its quantitative easing (QE) program and future QE exit strategies, oriented to the UK financial institutions, allowing them to enjoy vast financial conditions. Addressing this issue is a challenge, because it is of great interest to disentangle the implications of the effects of QE decisions for the UK financial sector. Even though there is a considerable empirical literature concerning the wider macroeconomic impact of QE via market rates, few studies, to the best of our knowledge, assessed the influence of QE on the performance and soundness of European financial institutions. As such,

we fill some of the existing gaps in the literature in at least two dimensions. Firstly, we set up a panel vector autoregressive framework, making two assumptions within our modelling settings. In the first assumption, we employ different major types of UK financial institutions and discuss to what extent QE has exerted a differential impact on their performance. This type of identification tries to shed light on a significant gap regarding the vital importance of different types of UK financial institutions in studying the implications of QE decisions, without been oriented narrowly on a macroeconomic perspective. In the second assumption, we consider a decomposition of leverage into three main components, namely gross loans to equity, liquid assets to equity, and securities to equity components, studying their discrete role on the QE policies implemented and their interactions to real economic activity for the different types of UK financial institutions. Secondly, we draw the policy implications based on both directions of impulse and response functions between the QE policy schemes and the performance of UK financial institutions.

Overall, given the significance of the banking sector for the whole economy, the interest of the thesis on bank performance and soundness goes well beyond academia, as it can provide useful insights to policy makers, monetary authorities, bank managers, investors, customers, and also to the general public. Moreover, this thesis may initiate better understanding of some of the causes of the recent global financial crisis, and provide insights for designing policies to mitigate its dramatic consequences and possibly avoid such future major imbalances with global effects.

4. Methodology and data

Methodology¹

The methodological approach proposed involves efforts sustained by large and modern instruments that combine fundamental with quantitative research, having as support representative econometric tools.

In the first part of the thesis, namely the first two chapters, we have adopted a fundamental (qualitative) analysis focusing on the existing literature on bank performance and soundness. Thus we have reviewed, in a comparative manner, numerous research papers covering a wide period of time (the earliest considered contribution goes back to 1935 and the latest publications were in 2017). As such, our analysis provides a detailed overview of the theoretical and empirical studies on bank performance and soundness, highlighting on the one side the main indicators and methods used to evaluate bank performance and soundness, and on the other side their main determinants.

¹ All methodological designs, including a descriptive file with more than 600 published articles on bank performance and soundness, is available to any reader upon request.

In the second part of the thesis, namely the last three chapters, we have adopted a practical (quantitative) approach, using panel regression analyses with different estimators (OLS, GLS, FGLS, and GMM), correlations and a panel vector autoregression framework. We have employed in Chapter III and IV panel regression analyses with different estimators, enabling us to test the effect of the recent crisis while controlling for internal and external factors. In this respect, in our sample the variances of the observations were unequal and it was registered a certain degree of correlation between the observations, thus, in some cases the OLS regression turned to be statistically inefficient and this issue was corrected either by employing regression with Driscoll-Kraay standard errors or feasible generalized least squares (FGLS). In addition, as a robustness test we have applied to the same sample the generalized method of moments (GMM) which was based on either Arellano-Bond estimators or Arellano-Bover/Blundell-Bond estimators. Additionally, in some cases we have used the Hodrick-Prescott (HP) filter to average GDP data ahead and before each data point.

In Chapter V, we have employed a panel vector autoregressive (panel VAR) framework, characterized by cross-sectional heterogeneity and dynamic interdependencies. In a panel VAR framework, a cross-sectional dimension is added to the common VAR representation that may reveal additional information about interdependencies. Within a panel VAR approach, we obtain banks' dynamic responses to shocks because of the model's ability to approximate complicated, interdependent adjustment paths with the time-series information. On the other hand, we can control for individual heterogeneity and can specify the time varying relationships between dependent and independent variables. In addition, in this analysis we impose two assumptions to obtain plausible results. The first assumption of the panel VAR framework is that cross-sectional heterogeneity and dynamic interdependencies are assumed by introducing fixed effects, thus allowing for time-variant individual characteristics. Therefore, the panel VAR is characterized by dynamic interdependencies where the lags of all endogenous variables of all units enter the model for every unit, cross-sectional heterogeneity where innovations are correlated contemporaneously, where intercept, the slope and the variance of the shocks may be unit-specific. In this setting, we have imposed a block structure on the matrix of contemporaneous coefficients to compute structural parameters prior to generating impulse-response functions. The dynamics of the model have been investigated by impulse response analysis. The second model assumption was to identify as a restricted version of the panel VAR framework, and examined dynamic heterogeneity in the responses to shocks that may arise for different consistent formulations of the cross-sectional panel.

Data²

The data required for the thesis was collected from both primary and secondary sources. The majority of financial and accounting information was extracted from Bankscope, a financial database previously distributed by Bureau van Dijk IBCA together with Fitch (currently known as Orbis), based on which we computed individually some of the indicators (e.g. financial system soundness index, Z-score, disclosure index etc.). In addition for some specific indicators we have used the databases from Eurostat, World Bank, Bloomberg, central banks, Heritage and those published on banks' websites. Whenever available, we have employed consolidated banking data in order to avoid bias.

5. Thesis structure

We start this thesis with a theoretical approach, discussing in the first two chapters, namely in *the first part of the thesis*, the main definitions, indicators and methodologies used to assess both bank performance and soundness. In the following chapters, namely in *the second part of the thesis*, we adopt a more practical approach and evaluate the impact of the most important determinants on bank performance and soundness, among which we can note capital adequacy, asset quality, liquidity, portfolio orientation, economic freedom, regulation, corruption, transparency and quantitative easing.

Chapter I – Architecture of the European and International Banking, revises the existing literature and provides a comprehensive evaluation of the most important indicators and methodologies used to assess bank performance and soundness. On the one side, we discuss bank performance, and although it was an intensely debated topic it still hasn't reached a consensus in relation the best indicators or methodological designs to be used in its evaluation. Among the most common indicators of bank performance we have identified return on assets, return on equity and net interest margin, while the methodological designs evolve around the stochastic frontier analysis, the data envelopment analysis and the panel regression analysis. On the other side, for bank soundness, analyses are even more complex. In terms of indicators, we can observe that the most commonly used indicator is the traditional Z-score or its logarithmic value. Though, in terms of the methodological designs, we have identified numerous methods to address bank soundness, starting from more simplistic models such as the expected shortfall methods, moving towards the Delta conditional Value at Risk, and ending up with multiplex network models. Regardless of the indicator used or the preferred empirical approach, the scientific methodology requires that every empirical model yield accurate and realistic implications concerning the economic phenomena analyzed. We consider that no empirical model can be a perfect description of the economic reality, but every process of constructing, testing and revising models

² All data used in this thesis is available to any reader upon request.

determines researchers and policy makers to constrain their views about the functioning mechanisms of an economic system.

Chapter II – Banking Systems around the Globe: Determinants of Performance and Soundness, performs a critical and detailed review of the long-lasting and equally large literature devoted to identifying and analyzing the main determinants of bank performance and soundness. In addition to the detailed discussion on the theoretical and empirical studies on the determinants of bank performance and soundness, we also examine the impact of international events on bank activity, covering a wide period of time spanning from 1935 to 2017. We found two important results. First, it exists a wide range of determinants, with a complex effect, conditional upon variables' measures, the design of the study, or the economic environment. Second, although the effect of some determinants is unambiguously positive or negative, others exert conflicting effects. Consequently, given their conflicting effect (e.g., both positive and negative), the impact of some determinants of bank performance and soundness could be explored by allowing for potential nonlinearities (e.g. asset structure, capitalization, bank size concentration, level of economic development, monetary policy etc.). In addition, subsequent studies could consider additional determinants that haven't been accounted for in the literature, such as recent regulatory measures or technological developments. Moreover, the recent financial malaise has shaped the economic environment in a remarkable way through severe mutations and disparities in the financial sector.

Chapter III – Measuring the performance and soundness of European Banks, debates on the developments in the European financial sector and the current challenges and opportunities that are reshaping the world of finance and last, it empirically investigates the main determinants of bank performance and soundness for a sample of EU commercial banks. In light of the recent international events and important costs that the 2008 financial crisis had in the real economy, regulators embarked in an ambitious regulatory and supervisory program in order to increase the soundness of European banks. Thus, banks had to face the challenges and opportunities of the new regulatory framework, though this was not the sole element of worry for banks. The recent dialogs among regulators, academia and the private sector are dominated by the emergence of the new technological developments which are considered to be revolutionary for the financial services around the world. Considering these elements, but also the current fragility of the banking sector, we can note that a revision of business models to the new operating environment is vital for ensuring sustainable performance and long-term soundness of banks. On the empirical side, by analyzing 263 EU commercial banks, we have identified large and persistent disparities among EU28 countries, which have been determined by national and regional particularities, but also by bank size and stringency of the economic policies promoted. Additionally, the recent financial crisis has seriously impacted the activity of European commercial banks, thus the crisis amplified instability and uncertainty in the financial markets, affecting the level

of impaired loans and forcing banks to redirect an important part of their profit margins towards loan loss provisions, seriously affecting their overall performance and soundness.

Chapter IV – Navigating in uncharted waters – the impact of Economic Freedom, Regulation, Corruption and Transparency on European banking, examines the impact of economic freedom, regulation, corruption and transparency on bank performance and soundness using a sample of European countries and making a distinction between the Euro-area, the non-euro EU countries and the EU candidate countries. The role of the banking sector in the events of recent years shows the importance of looking at how banks are affected by the degree of economic freedom, regulatory framework, degree of corruption and transparency of the countries in which they operate, and changes in these variables can undoubtedly help in the process of ensuring the banking sector returns to profitability and greater soundness. Consequently, from our analysis we have learned that there is a clear trade-off between increasing bank soundness and bank performance. However the impact of increasing economic freedom, increasing regulation, reducing corruption and increasing transparency is less clear-cut and more nuanced at the empirical level. In general, greater economic freedom can decrease or increase performance or soundness depending on the particular measure used. Increased regulation appears to have a detrimental impact on bank performance and a tendency to reduce the risk of bankruptcy. There was less evidence at the aggregate level that reducing corruption improved bank performance and no evidence that it increased bank soundness. We did, however, detect evidence at the aggregate level that increased disclosure adversely affected bank performance but seems to reduce the risk of bankruptcy and promote bank soundness.

Chapter V – Over the cliff – from conventional to unconventional monetary policy, aims to study the implications arising from the responses of the financial sector in the UK to the incentives determined by unconventional monetary policy (quantitative easing decisions). Considerable efforts have been made by the central banks in recent years to effectively provide a sufficient monetary stimulus to their economy during recent global and domestic downturns and to ensure the sound functioning of financial sectors. In the UK, banks are the main collectors of funds and suppliers to the non-financial and households' sectors; therefore, a strong understanding of the UK banks' role during the implementation of Bank of England's quantitative easing strategy is vital because it raises a series of concerns regarding the economic spin-off that could be triggered through these monetary policy decisions. As such, we examine the effects of Bank of England asset purchases on the profitability and disaggregated leverage components for different types of banks, which reflect differences in the sequencing of the quantitative easing strategy. We find that quantitative easing decisions are driven by economic activity, lending rates, and banks' leverage. The transmission channel of quantitative easing on boosting economic growth depends on the degree of banks' leverage and the securities holdings, but with a diverging magnitude on different types of UK banks.

PART I

ARCHITECTURE OF THE

EUROPEAN AND INTERNATIONAL

BANKING

CHAPTER I: Defining bank performance and soundness³

The general theme of profitability has been discussed since Adam Smith's pin factory and before. It was stated that an optimal financial system and well-functioning banking sector are commonly considered to be among the most important conditions for a sustainable economic development. Generally, banks are certifying the financing of productive investments and activities, because they mobilize and allocate financial resources, but also because they ensure a money-creation process through lending activities. Furthermore, well-functioning banks diminish the transaction costs, but also the moral hazard and asymmetric information issues observed in the financial market. Overall, banks play an essential role in the economy, so it is understandable the large and flourishing segment of the literature focusing on bank performance and soundness. In the last century, distressing economic circumstances have emphasized many deficiencies related to bank corporate governance, thus scholars and policy makers reflected on the lessons that have been learnt from the recent events and on the appropriateness of the existing banking system structures. Beholding the importance of the banking sector's performance and soundness and considering the lack of consent among academicians in relation to the overall theme, it's compulsory to fully comprehend the performance (soundness) of the banking system when evaluating its profitability and efficiency (solidity and stability) and contribution to the economy. Consequently, this chapter provides a comprehensive review of the relevant literature by comparing the existing theoretical and empirical studies and debating on the most important indicators and methodologies of bank performance and soundness.

³ A part of this chapter represents a survey and was written with **Richard Hofler** (University of Central Florida, USA) and **Alexandru Minea** (University of Auvergne, France). Another part of this chapter, namely the section on methodological designs measuring bank soundness, will be published in the *Review of the macro-prudential framework 2017*, **European Commission** and in the *European Commission Staff Working Document on European Financial Stability and Integration Review (EFSIR) 2017*.

I.1 Defining and measuring bank performance

Banks play an important and active role in the economy, constantly improving the society's living standards by providing a wide range of products and services, among which we can note: clearing and settlements schemes to facilitate trade, management and channeling of financial resources between savers and borrowers, and various products to cope with risk and uncertainty. In order to ensure an optimal and healthy functioning of the banking sector, it's necessary to understand its fundamentals. Consequently, the following sections provide an overview of the general definitions and indicators of bank performance together with the most important methodologies used in the academic writings.

I.1.1 Defining financial performance

Bank's financial performance or bank performance (hereinafter BP)⁴ seems to be a continuous story for policy makers, managers and academics. This concept was approached over the years in numerous studies, and according to the European Central Bank (ECB, 2010) *bank performance refers to the capacity of generating sustainable profitability*, which is essential for a bank to maintain its ongoing activity, for investors to obtain advantageous returns and also for supervisors in guaranteeing a resilient financial framework. After reviewing the literature, it can be noted that, BP is related to two main notions, namely "profitability" and "efficiency". Moreover, these latter notions are interconnected to other important elements, though different from them (see Figure I.1).

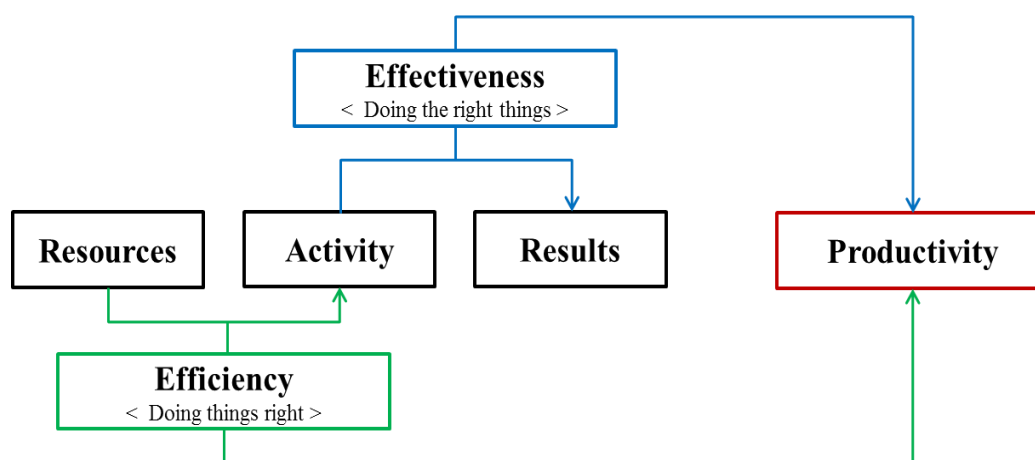


Figure I.1: Elements related to financial performance

⁴ Within this thesis, the term bank performance can refer to both bank profitability and bank efficiency, unless stated otherwise.

To begin with, *profitability* refers to the situation when a bank registers profit or financial benefits (Business Dictionary). To put it differently, profitability is registered when the amount of revenues gained from the business activity exceeds the overall expenses, costs and taxes.

Secondly, according to the Business Dictionary, *efficiency* refers to the assessment of what it's actually produced with what can be accomplished with the same consumption of resources (financial, human and time resources etc.). To avoid confusion, we have delimited between efficiency and other two concepts observed in the economic theory, namely: productivity and effectiveness. On the one side we can distinguish a strong connection between *efficiency and productivity*. In its simplest form, efficiency denotes the quality of the activity performed, while productivity denotes the quantity of the activity performed. Undoubtedly, there is a strong link between these two elements and finding the perfect combination of efficiency and productivity will help optimizing all outputs while minimizing the overall costs. On the other side, we should also make a distinction between *efficiency and effectiveness*, both being important concepts related to business growth. First, efficiency, as defined earlier, represents the activity of doing things correctly in order to produce reliable and quick outcomes. Second, effectiveness stands for the activity of doing the correct things to generate the desired outcomes.

From an economic perspective, efficiency refers to the association between goals and methods employed. According to the Library of Economics and Liberty, economic efficiency is measured not by the link between the final goals and the methods employed to achieve those goals, but by the link between their total values. More specifically, *achieving economic efficiency indicates a balance between benefits and losses*. When a situation is considered as inefficient, it can be claimed that less means could have been used to achieve the objectives, or the means used could have generated more of the outcomes desired. The Business Dictionary also defines *economic inefficiency*, namely the situation when in a specific state of technology, it becomes possible to generate higher welfare from the existing resources compared to the one actually created.

Moreover, when all the conditions, under which the state of economic efficiency occurs, are fulfilled, we can identify the *Pareto efficiency* or *Pareto optimality*. This efficiency was named after Vilfredo Pareto and it describes a state of matters where resources are disseminated such that it's not possible to improve a single individual without also producing at least one other individual to become worse off than before the transformation. More specifically, a Pareto efficient result cannot be improved upon hurting at least one individual. In relation to this we can also note the game theory concept of *Nash Equilibrium*, which implies that an individual obtains the best possible outcomes considering other individuals' business strategies (decisions), thus no individual

can benefit from unilaterally changing his business decision while the rest of individuals remain constant in their decisions. Often, a Nash Equilibrium is not Pareto Efficient suggesting that the individuals' payoffs can all be enlarged.

Efficiency has been intensely discussed in the literature, thus we observe the disaggregation of efficiency in two elements, namely cost efficiency and profit efficiency. These elements correspond to two significant economic objectives, respectively *cost minimization and profit maximization*.

First, *cost efficiency* (E_c) represents the ratio between the minimum cost at which it is probable to achieve a specific output (production) and the cost actually registered. Therefore, an efficiency E_c suggests that it's likely to register the same production vector, saving $(1 - E_c) * 100$ pps of the costs' volume. Continuing, E_c is spanning in the interval (0, 1], where 1 represents the best practice bank in the employed sample. The general costs for a bank are highly dependent on several elements, such as: the output vector, the price of inputs, the level of cost inefficiency, and a set of random factors. Consequently, the cost function takes the following form:⁵

$$C = C(y, w, u, \varepsilon) \quad (I.1)$$

Where y stands for the output vector; w stands for the price of inputs; u stands for the level of cost inefficiency; and ε stands for a group of random factors.

Additionally, if we assume a certain independency between the efficiency and random error and the residual arguments of the cost function, and simultaneously include the logarithmic term, then the equation is taking a different form, namely:

$$\ln C = f(y, w) + \ln u + \ln \varepsilon \quad (I.2)$$

Starting from the estimation of a particular function form f , cost efficiency (E_c) is calculated as the relation between the minimum costs (C^{min}) required to produce the output vector and the costs actually registered (C):

$$E_c = \frac{C^{min}}{C} = \frac{\exp[f(y,w)] \exp[\ln \varepsilon]}{\exp[f(y,w)] \exp[\ln u] \exp[\ln \varepsilon]} = \exp[-\ln u] \quad (I.3)$$

Second, *profit efficiency* (E_p) is wider than cost efficiency because it includes the consequences of choosing a particular vector of production, both on costs and revenue. Taking into account the market power conditions, there can be identified two main profit functions, namely: the *standard* (P_s) and the *alternative* (P_a) profit functions. The standard profit function

⁵ Maudos, J., Pastor, J. M., Pérez, F., Quesada, J. (1999). Cost and profit efficiency in European banks. *Journal of International Financial Markets, Institutions and Money*, 12(1), p.7.

starts from a perfect competition assumption of inputs and outputs. Given the input price vector (p), and the output price vector (w), a bank can capitalize on its profitability by amending the amounts of inputs and outputs. Furthermore, the profit function takes the subsequent form:

$$P_S = P_S(w, p, v, \varepsilon) \quad (I.4)$$

In logarithmic terms, equation 1.4 changes as follows:

$$\ln(P_S + \beta) = f(w, p) + \ln v - \ln \varepsilon \quad (I.5)$$

Where β stands for a constant term added to the profit function for each bank in order to obtain positive values, being able to use logarithms. Thus, profit efficiency function is taking the following form:

$$E_{P_S} = \frac{P_S}{P_S^{max}} = \frac{[\exp[P_S(w,p)] \exp[\ln v] \exp[-\ln \varepsilon]] - \beta}{[\exp[P_S(w,p)] \exp[\ln v]] - \beta} \quad (I.6)$$

More explicitly, the exogenic nature of prices in the above discussions on profit efficiency assumes the absence of market power on bank's side. If we assume the probability of imperfect competition, and not take prices as given, we could consider as prearranged the output vector, and not the one of prices. As such, the alternative profit efficiency function could take the following form:

$$P_a = P_a(y, w, v, \varepsilon) \quad (I.7)$$

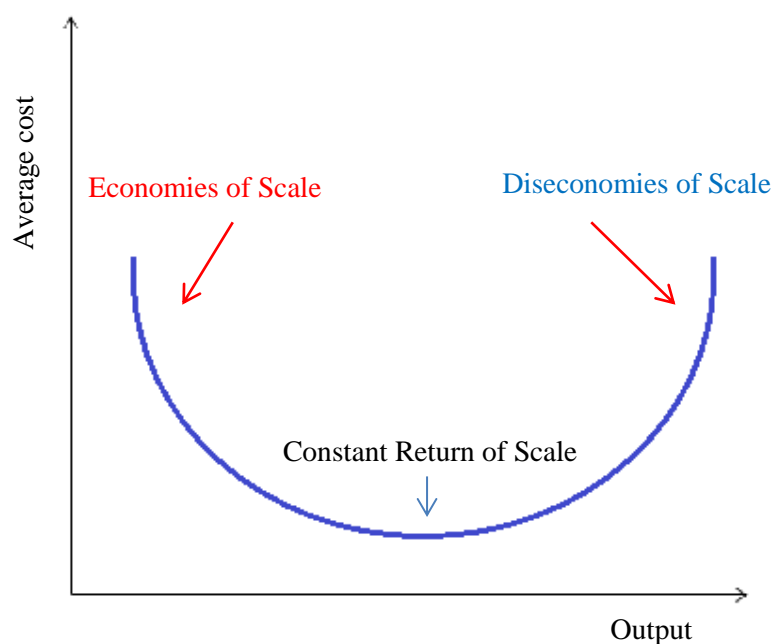
In addition to the above, efficiency could also be related to other aspects. First of all, *technical efficiency*, refers to the efficiency with which a certain group of inputs is used to produce an output. More specifically, a bank is technically efficient when it generated the highest possible output from the minimum quantity of inputs. The second one, *productive efficiency* refers to the creation of some outputs at the lowermost point on the short run average cost curve. This takes us to the third element, namely *X-inefficiency*, which is observed when a company fails to be technically efficient because of a lack of competitive structures. The last element is *allocative efficiency*, implying that a company produces a series of products or services up until the last unit offers a marginal benefit to consumers, equivalent to the marginal cost of production.

The issue of efficiency is also related to the concepts of *economies of scale and scope*.⁶ On the one side, *economies of scale* cover the situation when the factors determine the average cost of production to diminish while the volume of its output increases. Economies of scale divide in two main categories, namely:

⁶ Tomuleasa, I. (2016). Topics related to efficiency in European banking. In V. Cocris, A. Roman (Ed.), *Dynamics of European Banking Integration* (pp.189-225). Iași: Alexandru Ioan Cuza University Publishing.

- ❖ *Internal*: covering cost savings that are accumulated by a company regardless of the sector, market or environment in which it activates;
- ❖ *External*: covering the economies that profit a company given the organizational structure of its industry.

In relation economies of scale we can observe also the opposite, namely *diseconomies of scale* (see Figure I.2).



Source: adapted from Silberston (1972), p.370

Figure I.2: Economies and diseconomies of scale

Diseconomies of scale imply that, the bigger a company becomes, the more complex structures has to manage. This complexity infers a cost, and finally this cost may outweigh the savings obtained from a higher scale. More specifically, rather than being subjected to constant declining costs per increase in output, companies experience an upsurge in marginal cost when the output is amplified.

On the other side, *economies of scope* arise when the total cost of producing two types of products (outputs) together, is smaller than the total cost of producing each type of product (output) individually (see Figure I.3 and Figure I.4).

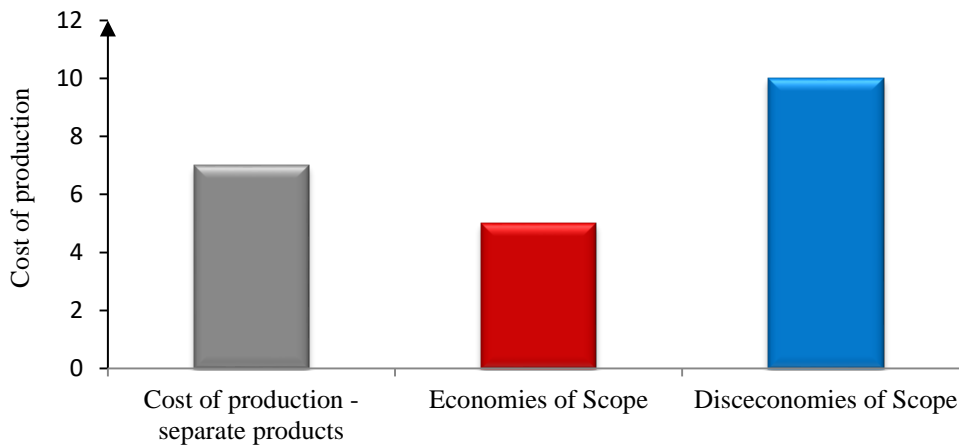


Figure I.3: Economies and diseconomies of scope

The most common way in which economies of scope can be enlarged is the development of the product portfolio while benefiting from the current products. Economies of scope can help companies to obtain a competitive advantage, by lowered expenses on a per-unit basis and an enhanced profitability. Economies of scope can be achieved through various methods, such as diversification, mergers, and supply chains.

Furthermore, the nature of economies of scope can modify the structure of an industry in terms of competition and performance. Economies of scope have the tendency to embolden big companies because of their diversified structure of production. Thus, large companies have a higher probability to gain access to capital markets, determining a series of pressures for small companies to find financial resources. Accordingly, the higher cost of capital could represent a potential entry barrier. As such, economies of scope could lead to monopoly power.

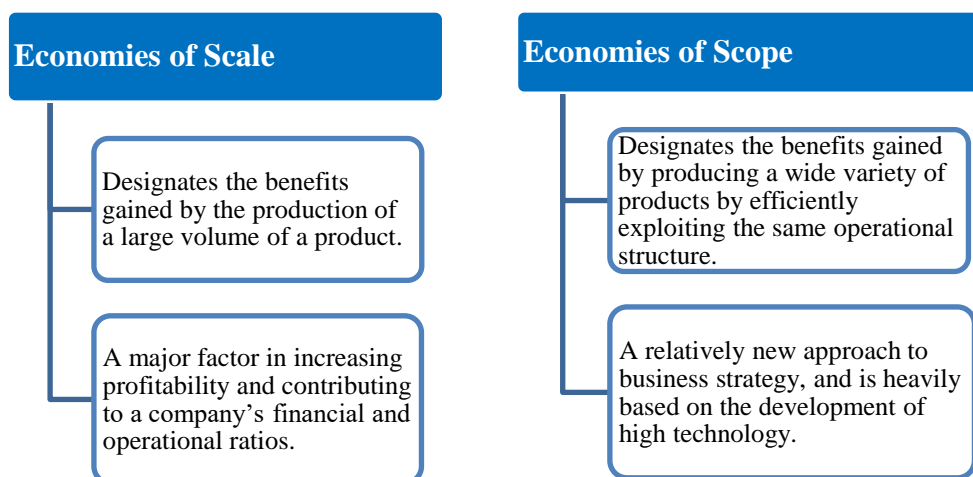
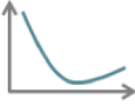



Figure I.4: Short description of economies of scale and scope

As in the previous case, we also identify *diseconomies of scope*, which occur when the overall production cost for two products (outputs) is higher than the costs of producing the products individually.

Overall, economies of scale and scope, no matter in what industry they are observed, generate several advantages, which can be seen from three different perspectives, namely: the production perspective, the distribution perspective and the consumption perspective (see Table no. I.1).

Table I.1: Advantages of economies of scale and economies of scope

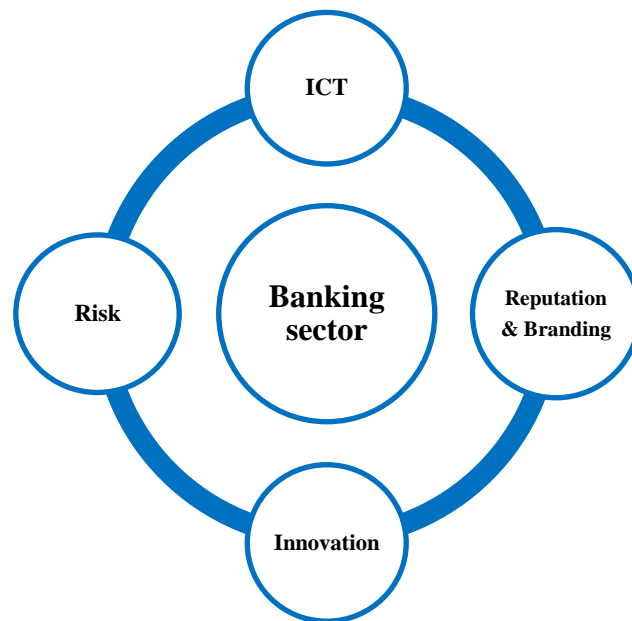
Type	Production	Distribution	Consumption
Economies of Scale 	Lower unit costs with larger plants	Lower unit transport costs through larger modes and terminals	Lower unit costs with larger retail outlets
Economies of Scope 	Lower output costs with more product types	Lower transport costs with building of different loads	Product diversification attracts more customers

Source: adapted from Hofstra University, p.1.

From a more practical perspective, we can note that since the 2008 financial crisis, the financial system gained much more attention particularly from monetary and governmental authorities. In the academic literature there were observed several papers that discuss the importance of *economies of scale and scope in the financial system*, or more precisely in the banking system. Among the first scholars focusing on this topic, Boot (2003) and Walter (2003) discuss the economies of scale and scope within the banking system, and their possible sources (see Figure I.5). They divide these sources in four main groups, namely:

- ❖ Economies of scale and scope that are related to information and communication technology (ICT);
- ❖ Economies of scale and scope that rise from reputation and branding;
- ❖ Economies of scale and scope related to innovation;
- ❖ Economies of scale and scope related to risk and the diversification strategies.

First of all, *economies of scale and scope related to information and communication technology* refer to the dispersion of fixed overhead costs of ICT towards a high operational framework (e.g. distribution of different products and services through the same channel). Additionally, De Young and Rice (2004) outlined that technological changes have a significant impact for the banking sector, dividing banks into two primary size-based groups. The first group refers to *very large banks*, characterized by “hard” information, impersonal relationships, low unit costs and standardized loans. The second group is formed of *small banks*, characterized by “soft” information, relationship development, higher unit costs and non-standardized loans. For example, Berger (1995a) stresses that small banks have a reasonable advantage in granting loans, given their access to “soft” information and various incentives within the organizational configurations.



Source: adapted from Boot (2003), pp.59-62.

Figure I.5: Sources of economies of scale and scope in the banking sector

Second, *economies of scale and scope interrelated to reputation and branding* refer to the fact that the reputation and credibility of a bank can play a significant role for the bank’s brand, thus the products and services are also benefiting from a good reputation.

Third, *economies of scale and scope connected to innovation* emphasize that investment in Research & Development (R&D), which is a fixed cost, will improve BP. Furthermore, as Merton (1992) and Philippas (2011) observe, financial innovations are also helpful for BS,⁷ as they diminish risks, and lessen asymmetric information and also agency costs.

Last, *economies of scale and scope related to the diversification of risks* are a more contentious issue. On the one side, according to the traditional financial theory, an increased

⁷ Within this thesis, the term bank soundness is interchangeable with bank stability and bank solidity (resilience).

diversification strategy will not necessarily bring any benefits to a firm given that investors can costless diversify their own portfolios (investors will not pay a premium for diversified companies). On the other side, the situation is far more complex for banks. *Ex ante*, diversification might be beneficial. As such, diversification can alleviate the possibility of a bank run because usually investors are confident in bank's ability to withstand idiosyncratic shocks. On the contrary, *ex post*, diversification might be, in some cases, damaging (see Appendix II.2 and II.4 for examples of papers where diversification had a negative impact on BP and BS). From a different perspective, Milbourn *et al.* (1999) stress the important role that could be played by an expansion towards new financial markets. Entering a new financial market might bring first mover advantages outlining some helpful opportunities for a bank. Though, if several actors decide to pursue these chances, the value of the opportunity itself might not be considered when assessing economies of scope, consequently causing negative *ex post* economies of scope, although they are positive *ex ante*.

Additionally, an artificial scale benefit can emerge for big banks when they become “*too big to fail*” (TBTF). When a bank, which is very large or very connected, fails (or becomes insolvent), the impact extends to the whole financial system. Consequently, the monetary and governmental authorities are obliged to take some measures to ensure the financial system's stability. This issue generates a *de facto* protection against insolvency for large banks, therefore permitting them to borrow at smaller costs. Additionally, when scale or scope economies are accomplished by mergers and acquisitions (M&A), market concentration will probably amplify, increasing the likelihood of monopolistic fees and commissions. Besides, economies of scale and scope, determined by the market power and TBTF grounds, might offer advantages to individual banks, though deteriorating the financial system and the society overall.

In the recent economic arena, the TBTF issue has gained particular attention when several important banks have benefited from substantial state aid. Since then, the monetary and governmental authorities have proposed and adopted a set of measures that limit banks' scale and scope by means of forbidding specific activities (e.g. the Volcker Rule applied in the US⁸), explicitly sorting out financial activities (e.g. Financial Services Act 2013 applied in UK⁹) or

⁸ *The Volcker Rule*, is known as a part of the Dodd-Frank Act, and refers to a prohibition on proprietary trading and restricted investment in hedge funds and private equity being valid for commercial banks and their affiliates. The Volcker Rule Regulations were initially proposed in 2011, but they were adopted in December, 2013 and became effective on April, 2014. Generally speaking, these rules: (i) prohibit financial institutions to engage in short-term proprietary trading of securities, derivatives, commodity futures and options on these instruments for their own account; and (ii) impose a series of limits on bank's investments in, or in connection with, hedge funds and private equity funds (covered funds). Though, recently it was announced that the Financial Stability Oversight Council (FSOC) together with the Treasury Department are working on a revision of the Volcker Rule aiming at a simplification and a higher freedom.

⁹ *Financial Services (Banking Reform) Act 2013*, which amended the Financial Services and Markets Act 2000, promotes *ring-fencing*, or more specifically a legal separation of retail and investment banking activity. The Vickers Committee proposed this change in 2011, but it was approved in 2013 and the stated implementation date is on January, 2019. Additionally, it was stated that ring-fenced financial institutions will be legally and operationally independent, and they will be able to finance itself and have its own board, but there will be limits regarding financing the rest of the group. What is more, large ring-fenced banks will be

imposing additional taxes or buffers on banks¹⁰ (e.g. in the Netherlands, a policy has been introduced in order to enforce a banking tax¹¹). Overall, we consider that the long-term purpose of these measures was and still is to enhance financial system stability and to strengthen banks both nationally and globally. Though, the short-term implication of these measures is to generate additional costs for the banks, thus the effect could be detrimental in terms of size and scope. More specifically, the possible economies of scale and scope imply that larger banks might have inferior average costs than smaller banks, which could eventually, lead to lower costs for consumers of financial services.

Moreover, size could also have a non-linear impact, thus profitability could increase together with size, but it could be deteriorated by bureaucratic or other causes (Athanasoglou *et al.*, 2008; Roman and Tomuleasa, 2013). Though, larger size may indicate economies of scope, as a consequence of the mutual provisions of related services. Even though some researchers highlight that economies of scope are perceptible in the financial sector, and that bigger and more diversified banks will acquire a stronger capital base, namely higher returns (e.g. Steinherr and Huveneers, 1993; Elsas *et al.*, 2010), some other researchers state that bigger and more diversified banks are more likely to perform poorly, suggesting that smaller and more specialized banks could diminish the information asymmetry related to lending (e.g. Barros *et al.*, 2007).

Lately, much importance has been given to the *too big to fail* (TBTF) problem, though there are other issues, such as the *too many to fail* problem, which deserve a discussion as well.¹² Acharya and Yorulmazer (2008) highlight that bank closure policies are influenced by the TBTF issue, thus banks could react differently in response to the changing regulatory environment, with particular emphasis on the distinct behaviors of small and large banks. Furthermore, Fisher and Rosenblum (2013) have also suggested limiting the absolute dimension of banks. Moreover, Fisher (2013) advocated for a break-up of large banks into smaller ones, so that they come to be *too small*

obliged to hold equity capital of at least 10%, and there will be a minimum requiring for the loss-absorbing capacity of big banks of at least 17% (this requirement will be applicable to the UK operations of British financial institutions, and will similarly be applied to the non-UK operations of UK-headquartered of financial institutions except the case when they can prove that they do not menace the UK taxpayer) (BoE, 2015).

¹⁰ For example, in the EU there were established supplementary requirements in relation to Common Equity Tier 1 capital for global and other systemically important financial institutions (G- and O-SIIs). Currently, in the EU28 banking sectors there were identified 13 G-SIIs and 182 O-SIIs (mutually exclusive categories). Additionally, Cypriot macro-prudential authorities have identified 6 investment funds as O-SIIs.

¹¹ The *new Dutch banking tax* was included in the *Bank Tax Law* (known as *Wet bankenbelasting*) adopted in July, 2012, as a strategy to ensure financial stability in Netherlands, to supplement the measures previously taken by monetary authority, and to manage the level of risks observed in the financial sector. Furthermore, the purposes of the new tax are to “ensure that the banking sector contributes to the cost of stabilization; stimulate long-term financing; and discourage excessive bonuses for the board members of Dutch banks” (Bank Tax Law, 2012).

¹² Tomuleasa, I. (2014). Cross-Sectional determinants of bank soundness in European markets. In R. Stanisław, *Proceedings of International Conference of European Economy*. Paper presented at the International Conference on European Economy, Warsaw, Poland, p.4.

to save, supporting the suppression of mega-banks access to both Federal Deposit Insurance and Federal Reserve discount window.

Another family of papers highlights that not all banking or financial activities could be susceptible to economies of scale and scope. Consequently, Walter (2003) states that trading activities are usually scalable, while Boot and Ratnovski (2012) outline that trading activities are particularly scalable. Additionally, other researchers pay more attention to the overall economic environment, thus Bossone and Lee (2004), stress that banks which are acting on large financial scenes are generally favored in registering more economies of scale than those acting on smaller scenes.

I.1.2 Indicators of profitability and efficiency

In general, in order to evaluate the financial position of a bank and to understand the importance of this bank, it's necessary to employ a financial analysis. Overall, a *financial analysis provides a snapshot of a financial institution's health and soundness*. The information provided by the financial analysis gives an intuitive understanding of how the entity conducts its activity. This information is useful for stockholders, governments and regulators, investors, customers but also for the general public. In the financial analyses there are commonly used several indicators that measure the profitability and efficiency of a bank (for the majority of BP indicators identified in the literature see Appendix I.2). We have classified these indicators in three main categories according to their main objective, namely: *balance sheet management, management efficiency and performance adjusted to risk* (see Table I.2).

Table I.2: Anatomy of financial performance – A short scheme

Category	1. Traditional measures		2. Economic Measures	3. Market-based Measures
	A. Balance Sheet Management	B. Management Efficiency	Adjusted to Risk	
Description	Measures how well a bank is performing at generating profits and revenues comparative to a specific metric. Also, it provides valuable insights into the financial health and performance of a bank.	Measures the capacity of a bank to provide a range of products and services in the most cost-effective manner possible while still guaranteeing the high quality of its financial products, services and support.	Measures the amount of risk that is involved in producing financial returns across various dimensions.	Measures how the capital markets value the activity of a bank, compared to its estimated accounting (economic) value.
Main indicators	Return on assets (ROA), Return on equity (ROE) Net interest margin (NIM), Gross profit margin (GPM).	Non-interest operating income (NIOI).	Risk-adjusted return on capital (RAROC), Return on risk-adjusted capital (RORAC), Risk-adjusted return on risk-adjusted capital (RARORAC), Return on risk weighted assets (RORWA).	Total share return (TSR), Price-earning ratio (P/E).

Note: A full description of all measures included in these categories can be found in Appendix I.1

Most of these ratios are intensely used in the literature, but as Brigham and Houston (2008) state, the analysis of financial ratios should be performed prudently and rationally. Furthermore, they draw attention to the following aspects, which are also applicable for the banks:¹³

- ❖ A wide range of companies have operating divisions in different markets, and it's difficult to develop a relevant system of financial ratios that perfectly suits all entities operating within an economic sector, thus it would be better to evaluate participants from the same industry;
- ❖ The situation when a company registers optimal levels of a financial ratio is not clear enough, thus those levels should be compared with similar values reported by the market leaders operating in the same environment;
- ❖ There are other economic factors that could influence the financial ratios, thus when computing these ratios it should be considered all the factors known at the current time (e.g. inflation rate).

In addition to the above mentioned limits we consider that financial ratios are also limited to different accounting practices worldwide, thus when performing an international financial analysis it should be verified if the accounting method is distorting the comparison across the sample.

All in all, financial ratios are very useful indications of financial health but not on a stand-alone basis, thus they should be benchmarked against the financial sector, the aggregate economy or even the past performance of the bank or of the sector.

As mentioned in Table I.2., in the following we are going to discuss only the most important banking indicators according to IFRS financial and accounting reporting requirements, while the rest of the indicators can be found in detail in Appendix I.1.

I.1.2.1 Main traditional measures

A. Return on assets (ROA)

Return on assets (ROA) is a financial indicator which displays the level of profit that a bank obtains in relation to its total assets. Moreover, ROA is one of the most important profitability ratios because it measures the profit made by a bank per monetary unit of its total assets and shows

¹³ Brigham, E., Houston, J. (2008). *Fundamentals of financial management* (7th ed.). USA: South-Western College Pub, p.113.

the bank's capacity to generate profits before leverage. The general formula for return on assets is:

$$ROA = \frac{\text{Net income}}{\text{Total assets}} \quad (I.8)$$

Where *Net income* represents the difference between bank's operating revenue (e.g. interest, commissions etc.) and its operating costs (e.g. interest paid on financing sources, capital losses from market operations etc.).

Despite the fact that ROA, along with other factors, give a clear picture of corporate health, it can be observed also some *drawbacks* related to this indicator. The criticisms of ROA rotate around the manner in which the metric is employed, thus we draw the attention towards the following:

- ❖ This metric is not suitable for the evaluation of banks that operate in different fields or product segments, mainly because the factors of scale and peculiar capital requirements can be particular to each domain of activity;
- ❖ Intangible assets¹⁴ may have a significant impact on the overall value of assets. Moreover, intangible assets may influence the rational in the process of optimal project selection which determines banks to address the assessment of intangible assets. In addition, the assessment or valuation of intangible assets is preceded by a clear and objective decision which is grounded on a specific set of rules and procedures, otherwise the decision is subject to manipulation;
- ❖ Most of the literature agrees that there are also other elements to consider when evaluating a company's profitability, though there isn't a consensus in terms of these factors. For example, on the one side the classical formula for ROA reflects only a snapshot of a particular moment in time regarding a bank's total assets. However, the variance of assets valuation could actually influence the manner in which a project is appraised. On the other side, risk is another issue which might be considered relevant, thus the inclusion of risk in the evaluation of BP could truly provide an enhanced decision making tool.

¹⁴ According to the Business Dictionary, an *intangible asset* refers to the reputation, name recognition and intellectual property such as knowledge and know-how. Furthermore intangible assets are known as the long-term resources of an entity, but they have no physical existence, drawing their value from intellectual or legal rights and from the value they add to the other assets.

- ❖ In order to cover some of the drawbacks of ROA, some researchers found some *improvements* for this metric, suggesting the calculation of ROA starting from the average of total assets from the last two accounting years (Helfert, 2001).

$$ROAA = \frac{\text{Net income}}{\text{Average total assets}} \quad (\text{I.9})$$

Where *ROAA* represents the return on average assets, and *Average total assets* is computed as follows:

$$\text{Average total assets} = \frac{TA_1 + TA_0}{2} \quad (\text{I.10})$$

Where *TA* represents the total assets (1- at the end of the current year; 0 - at the end of the previous year).

Besides, Hillier *et al.* (2010) recommend that ROA should actually be divided in two main forms, namely:

- ❖ the *gross return on assets* (GROA): which is computed by the ratio between earnings before interest and taxes (*EBIT*) and the average total assets.

$$GROA = \frac{EBIT}{\text{Average total assets}} \quad (\text{I.11})$$

- ❖ the *net return on assets* (NROA): which is calculated by reporting the net income to the average total assets (this equation is the same as the one defined by Helfert (2001)).¹⁵

In addition, another notable perspective on ROA is given by Brealey *et al.* (2008), who advise computing ROA in the following way:

$$ROA = \frac{EBIT(1-t)}{\text{Average economic assets}} \quad (\text{I.12})$$

Where *economic assets* represent the difference between total assets and current debt without interests, and average economic assets are computed as in equation I.10.

Despite the various forms of computing ROA, when it comes to its interpretation it's still necessary to take into account the major specialization of a bank, when comparing two or more entities. Overall, the most common rule of interpretation implies that a higher return on assets is desirable, indicating an efficient and effective use of bank's total assets.

¹⁵ This ratio should not be confused with the *return on net assets* (RONA) which compares net income with net assets (fixed assets plus net working capital). RONA supports investors to evaluate the percentage net income a company is generating from its net assets. This metric is commonly used for the companies where fixed assets are the largest component of the investment project.

B. Return on equity (ROE)

Return on equity (ROE) is another important profitability indicator, and represents the amount of net revenue that a bank is able to return from its shareholder's equity. More specifically, this metric can be interpreted in relation to a bank's ability to use effectively investors' capital to develop the overall financial institution.

The general formula for ROE is the following:

$$ROE = \frac{\text{Net income}}{\text{Shareholder's equity}} \quad (\text{I.13})$$

Additionally, as in the case of the previous profitability indicator, it can be noted some *drawbacks* of ROE. For instance, this ratio can be inflated, thus it doesn't show explicitly if a bank has an excessive debt level and if it's raising more of its funds through borrowing instead of issuing shares (this implies a smaller book value). The book value can also be diminished through write-downs, buy-backs etc., and by this type of actions ROE is increased but the level of profits is not. In addition, it can be raised again the problem of intangible assets which are excluded from shareholder's equity, aspect that can lead to miscalculations of ROE. Besides, the recent economic crisis has revealed that ROE failed to distinguish between best performing banks from other banks in relation to the sustainability of their outcomes. Overall, ROE is a short-term metric of financial performance and must be understood as a snapshot of the short-term strength of banks. Furthermore, ROE does not consider the bank's long-term strategy or the long-term damages produced by the economic crisis. Consequently, ROE's drawbacks are even more noticeable in times of distress, when uncertainty dominates the economic climate.

In order to outweigh some of ROE's limits, a part of the literature is focusing on several *developments* of ROE. First it can be used a different formula, as follows:

$$ROAE = \frac{\text{Net income}}{\text{Average Shareholder's equity}} \quad (\text{I.14})$$

Where *ROAE* stands for the return on average equity.

Second, if the classical formula isn't explicit enough, it can be used another method which segregates *ROAE* in three distinct levers, namely: earnings, turnings (asset turnover) and financial leverage. This method is known as *DuPont Model* and is based on the three dimensions corresponding to three main questions (see Figure I.6).¹⁶

¹⁶ *DuPont Model* is also known as *Strategic Profit Model*, *DuPont Formula*, *DuPont Equation*, and *DuPont Analysis*. The formula was developed in 1919 by an engineer named Donaldson Brown who tried to introduce the scientific rigor in the measurement of financial performance, being first used by DuPont Corporation.

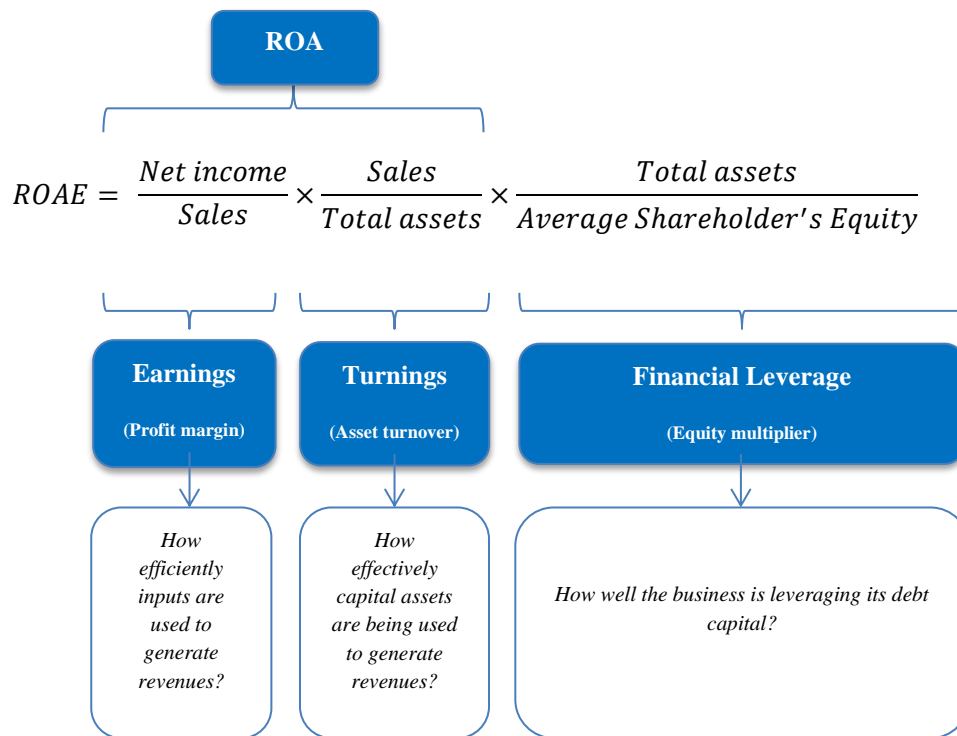


Figure I.6: Decomposition of ROE – The DuPont Model

The DuPont Model is largely used across sectors, although it was initially designed to address BP (Cole, 1972). This model was initially defined by considering the specificities of financial products and services, as well as the adaptive nature of financial regulations. The main advantages of this method refer to the possibility of disaggregating ROE into components that affect profitability and afterwards compare them, but also to the possibility of performing trend analysis which can be beneficial in identifying the source of a profitability shift and taking the counteractive response in an optimal time framework. More specifically, as Jablonsky and Barsky (2001) are stating, this model is a manner of visualizing “the information so that everyone can see it”.

In terms of ROE’s interpretation we can note that it has to be given sufficient importance to bank specialization. Furthermore, we consider that a high return on equity ratio does not always imply a better investment strategy, this issue being directly connected with the type of bank, its capital structure and also its risk-taking strategies.

C. Gross profit margin (GPM)

Gross profit margin (GPM) is a metric that measures how profitable a bank is at the most essential level, designating the overall BP before considering overhead costs. This ratio outlines how efficiently a bank controls for its costs.

The general formula for GPM is the following:

$$GPM = \frac{\text{Gross income}}{\text{Total revenues}} \quad (\text{I.15})$$

This ratio is commonly used by investors to compare similar banks with the same specialization, operating in the same sector, determining the most profitable ones.

As previously mentioned, the optimal value of a financial indicator is particular to each sector and to each economic environment. Therefore, in the case of GPM, a high indicator suggests that a bank registers a reasonable profitability, as long as it controls its overhead costs.

D. Net interest margin (NIM)

Net interest margin (NIM) is a widely used metric of BP and it examines the efficiency and effectiveness of a bank's investment decision as compared to its debt situations. The general formula for NIM is the following:

$$NIM = \frac{(\text{Investment Returns} - \text{Interest Expenses})}{\text{Average earning assets}} \quad (\text{I.16})$$

Though, as expected, NIM has also some *drawbacks*, among which we can note that this ratio is partially measuring the profitability of banks, considering that some of them register important non-interest revenues, such as fees, commissions and other non-interest income by means of services like brokerage, deposit account, trading activities etc. Moreover, NIM doesn't count for operating expenses, such as personnel or credit costs. Furthermore, NIM is difficult to be used in comparisons mainly because this ratio reflects a bank's unique profile, more specifically the nature of its activities, the structure of its customer bases and its funding strategies.

E. Non-interest operating income (NIOI)

Non-Interest Operating Income (NIOI) is a performance indicator that covers management efficiency. The main purpose of this financial ratio is to evaluate the overhead structure of a bank. The general formula for this ratio is the following:

$$NIOI = \frac{\text{Non Interest Operating Income}}{\text{Operating Income}} \quad (\text{I.17})$$

A bank will survive if it keeps the general costs at a lower level compared to the income. The NIOI efficiency ratio evaluates how effectively a bank is operating and how profitable it is. In addition, we consider that a higher ratio of non-interest income will determine a bank to become more stable because it allows a better diversification of the income structure, becoming more resilient in fragile economic conditions.

1.1.2.2 Main economic measures adjusted to risk

A. Risk-adjusted return on capital (RAROC)

Risk-Adjusted Return on Capital (RAROC) is an exclusive performance measuring instrument taking a risk-revenue oriented perspective. This measure was initially introduced at Bankers Trust in the late 1970s with the main purpose of managing and gauging credit risk to limit bank's losses.

According to Padganeh (2014), the measurement of RAROC can be divided in three main groups, namely: the *simplistic formula*, the *generalized formula*, and the *holistic formula*.

First, the *simplistic formula* is based on the following equation:

$$RAROC_{simplistic} = \frac{\text{Revenues} \pm \text{Treasury Transfer Prices} - \text{Expenses} - \text{Expected Losses}}{\text{Economic Capital}} \quad (\text{I.18})$$

Second, the *generalized formula* is based on the following equation:

$$RAROC_{generalized} = \frac{\text{Revenues} - \text{Cost} - \text{Expected Loss}}{\text{Risk Based Required Capital}} \quad (\text{I.19})$$

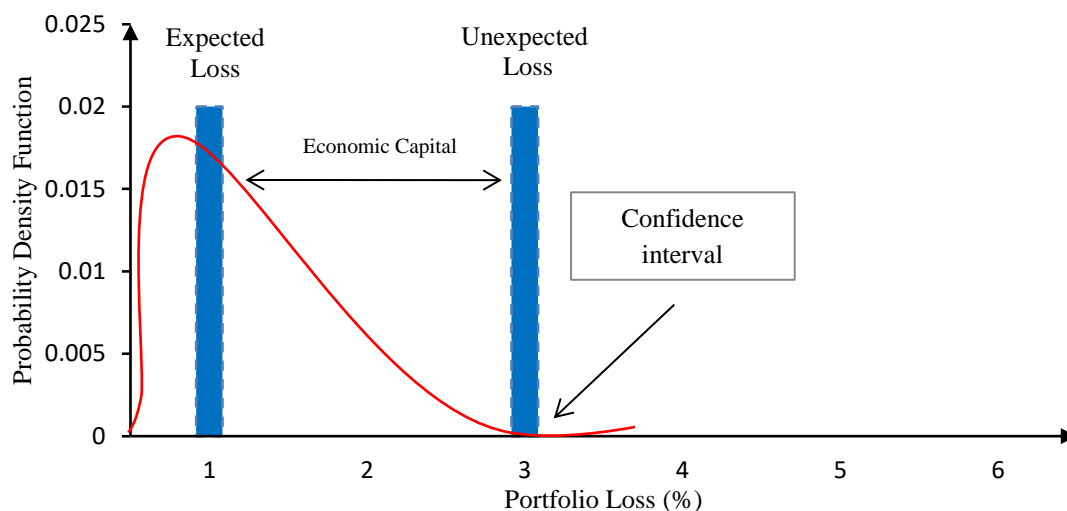
Third, the *holistic formula* is based on the following equation:

$$RAROC_{holistic} = \frac{(\text{Expected Return} - \text{Costs} - \sum(\text{EL}) + \text{Return on EC} - \text{Transfers})(1-T)}{EC_{MR} + EC_{CR} + EC_{OR} + EC_{BR} + EC_{RR} + EC_{SR} + EC_{PE}} \quad (\text{I.20})$$

Where *EC* stands for Economic capital or Capital for Unexpected Losses (expected losses – EL), such as: EC_{MR} - market risk capital, EC_{CR} - credit risk capital, EC_{OR} - operational risk capital, EC_{BR} - business risk capital, EC_{RR} - reputational risk capital, EC_{SR} - strategic risk capital, and EC_{PE} - portfolio effect capital.

Figure I.7 portrays the traditional picture of expected and unexpected loss using a probability density function. Furthermore, expected losses must be incorporated into pricing through a provision for expected losses and should signify the expected loss over the long run, assuming the following year to be neither above nor below average.

In addition, the unexpected loss is the loss which can be registered in the worst-case scenario, standing for the difference of this specific loss to the mean. For example, if there is a 90% worst-case scenario, then the capital assessed should be 9%. From this perspective, capital stands for the amount needed as a cushion for difficult times.



Source: adapted from Padganeh (2014), p.6.

Figure I.7: Economic capital graph

As Stoughton and Zechner (1998) points out, there are several *advantages* of RAROC models, namely:

- ❖ This measure is the only one which accurately incorporates bank's risks through the use of economic capital;¹⁷
- ❖ This indicator measures economic profit by including the opportunity cost of capital;
- ❖ This measure is characterized by flexibility and applicability.

Furthermore, RAROC is also accompanied by some *disadvantages*, respectively:

- ❖ It implies a static feature of credit risk;
- ❖ This index doesn't adjust the barriers as schedule capital requirements increase;
- ❖ This indicator presumes that economic capital is identical with cash equity provided by shareholders. As a consequence, banks incline to over/underestimate day-one schedule and business line RAROCs.

Furthermore, RAROC is a no-arbitrage technique, thus it doesn't reunite the prices of loans with those of comparable securities accessible in the market.

¹⁷ *Economic capital* refers to the methods and/or practices that allow banks to attribute capital to cover the economic effects of risk-taking activities. *Regulatory capital* is similar to economic capital but different in the same time. On the one side *economic capital* is based on bank's internally derived risk measurement methodology and parameters, and on the other side *regulatory capital* reflects the amount of capital that a bank needs in accordance with the regulatory framework (Bank for International Settlements, 2009).

B. Return on risk-adjusted capital (RORAC)

Return on Risk-Adjusted Capital (RORAC) represents a rate of return where riskier projects and investments are assessed based on the capital exposed to risk. Usually, RORAC is used when banks place superior importance on company-wide risk management.

The general formula for RORAC is the following:

$$RORAC = \frac{Net\ Income}{Allocated\ Risk\ Capital} \quad (I.21)$$

Where, *Allocated Risk Capital* stands for the bank's capital, adjusted for a maximum potential loss based on the probability of future returns or volatility of earnings.

In this case, the economic capital is adjusted for the maximum potential loss after calculating probable return and/or their volatility.

C. Risk-adjusted return on risk-adjusted capital (RARORAC)

Risk-Adjusted Return on Risk-Adjusted Capital (RARORAC) is an indicator gauging efficiency in value creation including the total amount of risk. This index combines RAROC and RORAC in order to cover for an accounting measure for the risk element equivalent in the returns of a business line or on the profitability of investments and in the economic capital assigned. RARORAC promotes the procedure of capital allocation between different business lines, permitting the attainment of the optimal amount of equity to assets that diminish the cost of funding. The general formula for RARORAC is the following:

$$RARORAC = \frac{[(Portfolio\ Return - RFR) - Systematic\ Risk(Market\ Return - RFR)] I_0}{Economic\ Capital} \quad (I.22)$$

Where *RFR* stands for risk-free return; I_0 stands for the initial investment in the initial period.

Overall, the main benefit of this ratio is that it incorporates market risk, credit risk and operational risk within a single comprehensive structure, that displays the interrelationship between different categories of risk and circumstances where there might be a too-high concentration of risks.

D. Return on risk weighted assets (RORWA)

Return on risk weighted assets (RORWA) incorporates a balance-sheet-management vision related to the revenue and cost side of the business. Furthermore, RORWA outlines how well a

bank manages its balance sheet and also its appetite for risk, it discloses the cost efficiency per unit of risk for the amount of business a bank produces and highlights the cost of risk by revealing how efficiently a bank is able to diminish its loan-loss provisions on a risk-adjusted basis. The general formula for RORWA is the following:

$$RORWA = \frac{\text{Pretax operating results}}{\text{Total RWA}} \quad (\text{I.23})$$

A more specific formula for RORWA is the following:

$$RORWA = \frac{\text{Net interest income}}{RWA} + \frac{\text{Financial margin}}{RWA} + \frac{\text{Fees and commissions and other revenues}}{RWA} - \frac{\text{Operating expenditure}}{RWA} - \frac{\text{Loan loss provision}}{RWA} \quad (\text{I.24})$$

In addition to RORWA's importance as a guide to highlight risk and capital as important tools for managing a bank's internal performance, it can also be observed that this metric can be used for various communications. Consequently, investors, regulators and also bank managers can use this ratio to easily understand how the bank piles-up against its most important competitors from different regions.

1.1.2.3 Main market-based measures

A. Total share return (TSR)

Total share return (TSR) refers to the total return of a stock to investors, which contain capital gain plus dividends. The general formula for TSR is the following:

$$TSR = \frac{(\text{Price}_{end} - \text{Price}_{begin} + \text{Dividends})}{\text{Price}_{begin}} \quad (\text{I.25})$$

Where *Price* stands for the share price at the beginning of the period and the end of the examined period of time; and *Dividends* stand for the overall dividends paid over a specific time period.

In fact, TSR is known for its major advantage of permitting the shares' performance to be compared although certain shares may register a high growth and low dividends while others may register the opposite.

B. Price-earnings ratio (P/E)

Price-earnings ratio (P/E) is a ratio used to value a bank by measuring its current share price relative to its per-share earnings. This ratio has the following form:

$$P/E = \frac{\text{Market value per share}}{\text{Earnings per share}} \quad (I.26)$$

The earnings used for the calculation of P/E can be either the amount most recently reported by the bank, or even a projection made by an analyst for the future earnings. Furthermore, in an efficient market, the P/E ratio might express a bank's future value creation potential, where a high value of P/E reflects higher expected future gains because of the presumed growth prospects and the competitive advantages but it also reflects that the share price is more expensive. In addition, in difficult economic situations, higher ratios could reflect over-optimism (over-pricing), while low ratios could reflect worsened future opportunities.

In summary, financial performance is the primary objective of all businesses, because without profitability and efficiency, a bank cannot survive in the financial market in the long run. Consequently, measuring past and current profitability and efficiency are key elements in determining the health of a bank. A strong financial analysis is of interest not only for bank managers, but also for monetary and governmental authorities, investors and also for the general public.

Overall, we consider that there is no metric that can provide a perfect tool for studying financial performance, thus we consider that a comprehensive financial analysis should incorporate several financial ratios starting from the most popular ones, namely return on assets, return on equity and net interest margin. Moreover, we highlight the utility in combining various performance indicators with banking soundness indicators in order to capture the overall financial picture.

1.1.3 Methodological designs used in assessing financial performance

The literature on BP is based on various techniques. First, it can be noticed two different approaches: the first one measures performance in terms of economies of scale and scope, while the second uses the efficient frontier concept, or X-efficiency. Broadly, these methodologies can be divided into *parametric approaches* incorporating econometric models (Stochastic Frontier Approach, Thick Frontier Approach, and Distribution Free Approach) and *non-parametric approaches* applying linear programming techniques (Data Envelopment Analysis and Free Disposal Hull Analysis). The parametric procedures rely on the assumptions regarding the distribution's shape in the original population, and the form of parameters in the assumed distribution. Contrariwise, the nonparametric procedures rely on no or few assumptions regarding the shape or parameters of the population distribution from which the sample was drawn.

Alongside there were also observed *other empirical techniques*, among which the most frequently applied are: panel regression analyses (static and dynamic) and VAR techniques. Moreover, in the last years there were developed new measures to evaluate BP and BS, but it's too early to judge their efficiency as some have not yet been implemented in practice.

1.1.3.1 Parametric approaches

The parametric approaches refer to three techniques: *stochastic frontier approach* (SFA), *thick frontier approach* (TFA) and *distribution free approach* (DFA).

A. The Stochastic Frontier Analysis (SFA)

A1. The method

Stochastic Frontier Analysis has been extensively used in the literature, particularly in relation to the banking sector, in order to evaluate its overall efficiency. This method was simultaneously created by Aigner et al. (1977) and Meeusen and Van den Broeck (1977), and is grounded on a cost or profit function with the purpose of estimating the minimum cost frontier or the maximum profit frontier for the entire model. More specifically, this method entails the estimation of cost or profit frontier by regressing a translog, Cobb-Douglas, or other form of logarithmic model, and decomposes the error terms into two parts: (i) the first part covers a random noise component with a normal distribution, which represents the potential measurement errors; (ii) the second part covers a new one-sided inefficiency component (technical or allocative inefficiency). These composed error terms cannot be symmetric and they cannot have zero means.

The production frontier model, including a random component, takes the following form:

$$y_i = f(x_i; \varphi) TE_i \quad (1.27)$$

Where y_i shows the output registered by the individual producer i , $i=1 \dots i$; x_i shows a vector of N inputs registered the same producer i ; $f(x_i; \varphi)$ shows the production frontier; while φ shows the technology specification vector, which must be assessed. Besides, TE_i shows the level of technical efficiency, being defines as the relationship between the observed output and the highest possible output. Moreover, in the above-mentioned equation it was included a stochastic component, designating the random shocks which influence the production process. These shocks have a high diversity, and are expressed by $exp\{v_i\}$. Even though, each individual producer is subject to a distinct shock, it's presumed that these are random shocks, being characterized by a common distribution. Thus, the production frontier model is based on the following equation:

$$y_i = f(x_i; \varphi) TE_i \exp\{v_i\} \quad (\text{I.28})$$

Assuming that TE_i has also a stochastic nature and a common distribution, it can be rewritten as $\exp\{-u_i\}$, where $u_i \geq 0$, thus registering the subsequent equation:

$$y_i = f(x_i; \varphi) \exp\{-u_i\} \exp\{v_i\} \quad (\text{I.29})$$

Moreover, if $f(x_i; \varphi)$ takes a Cobb-Douglas form (log-linear), the mathematical terms change as follows:

$$\ln y_i = \varphi_0 + \sum_n \varphi_n \ln x_{ni} + v_i - u_i \quad (\text{I.30})$$

Where v_i shows randomness (statistical “noise”), being regarded as two-sided normally distributed, while u_i shows the technical inefficiency factor (being non-negative). The corroboration of these two factors gives the “composed error model”.

The error signifying randomness is presumed to be identical independent and identically distributed. Regarding the inefficiency error, a number of distributions have been presumed in the literature, the most commonly used being half-normal, exponential, and truncated from below at zero. If the two error terms are supposed to be independent of each other and of the inputs, and one of the above distributions is employed, then the likelihood functions can be defined, and maximum likelihood estimates can be determined. Besides, for efficiency measurement analysis, the composed error term must be separated. Besides, Jondrow *et al.* (1982) outlined that for the half-normal case, the estimated value of u_i provisional on the composed error term takes the subsequent form:

$$E[u_i | e_i] = \frac{\sigma \lambda}{(1 + \lambda^2)} \left[\frac{\phi(e_i \lambda / \sigma)}{\Phi(-e_i \lambda / \sigma)} - \frac{e_i \lambda}{\sigma} \right] \quad (\text{I.31})$$

Where $\phi(e_i \lambda / \sigma)$ is the density of the standard normal distribution, $\Phi(-e_i \lambda / \sigma)$ is the cumulative density function, $\lambda = \sigma_u / \sigma_v$, $e_i = v_i - u_i$ and $\sigma = (\sigma_u^2 + \sigma_v^2)^{1/2}$.

Battese and Coelli (1988) proposed another alternative point estimator for TE_i , and it's preferred when u_i isn't close to zero.

$$E[\exp(-u_i | e_i)] = \frac{1 - \Phi[\delta + (\gamma e_i / \delta)]}{1 - \Phi(\gamma e_i / \delta)} \exp(\gamma e_i + (\delta^2 / 2)) \quad (\text{I.32})$$

Where $\delta = \frac{\sigma_u \sigma_v}{\sigma}$ and $\gamma = \frac{\sigma_u^2}{\sigma^2}$.

No matter of the estimator chosen, we can observe that all of them have a common issue, respectively, they are not consistent estimates of technical efficiency, since $plim E(u_i | v_i - u_i) - u_i$ is not zero. Despite this, the recent literature has outlined that it's possible to obtain confidence

intervals for any of the alternative technical efficiency estimates discussed above. Consequently, Hjalmarsson *et al.* (1996) suggest confidence intervals for the Jondrow *et al.* (1982) technical efficiency estimator, and Bera and Sharma (1999) for the Battese and Coelli (1988) estimator. Lastly, Horrace and Schmidt (1996, 2000) derive upper and lower bounds on $\exp\{-(u_i|e_i)\}$ grounded on lower and upper bounds of $(u_i|e_i)$, describing a method for calculating confidence intervals for efficiency levels (see Jensen, 2000).

The literature on BP exhibits several notable characteristics as regards the use of SFA. First, the selection of inputs and outputs is frequently based on the intermediation approach, assuming that banks collect funds using labor and physical capital, and transform them into loans and other earning assets (Mamatzakis *et al.*, 2008; Staikouras *et al.*, 2008).

Second, there are two main specifications for the functional form. The *translog* form was used by Altunbaş *et al.* (2001a,b), Rime and Stiroh (2003), Berger *et al.* (2010), Assaf *et al.* (2013) and Dong *et al.* (2014a), among others. Alternatively, the *Fourier-flexible* form augments the translog by including Fourier trigonometric terms, and it has been claimed that it increases the accuracy of results due to its flexibility (McAllister and McManus, 1993; Mitchell and Onvural; 1996). Moreover, De Young and Hasan (1998), Barros *et al.* (2007), Hughes and Mester (2013) and Akhigbe *et al.* (2013) use a hybrid Fourier form, with trigonometric versions of output variables.

Finally, compared to other methods, SFA has a series of *advantages*, thus: (i) it allows incorporating random noise in the model and separating that noise from variation in the outcome due to inefficiency; (ii) it computes confidence intervals for parameters and inefficiency estimates; (iii) it involves additional economies through the estimation of elasticities. Additionally, SFA accounts for potential unobserved heterogeneity among production units operating in different production environments.

A2. SFA drawbacks and developments

The literature has by now improved SFA in several dimensions. The SFA model introduced in 1977 is a parametric production function in a single cross section of data. Among the many extensions of that model are nonlinear specifications, systems of equations, and panel data SFA models (Greene, 2005; Tsionas, 2006; Wang and Ho, 2010; Chen *et al.*, 2014; Zhang *et al.*, 2015). The panel data models generally fall into one of two categories: firm inefficiency is either time-varying or the opposite (time-invariant). Among the time-varying inefficiency models, two of the most popular are the “true fixed-effects” and the “true random-effects” models (Greene, 2005) in which time-invariant unmeasured cross-firm heterogeneity is separated from time-varying firm

inefficiency. Battese and Coelli (1998) propose a time-decay model, in which the one-sided inefficiency term contains a set of covariates explaining the mean of inefficiency. Other time-varying SF models are found in Lee and Schmidt (1993), Cornwell *et al.* (1990) and Kumbhakar (1990).

Time-invariant inefficiency models include first of all those from the Battese and Coelli (1988), in which the one-sided inefficiency term, normally distributed, is reduced and has a non-zero mean and a constant variance. In addition, in the models of Pitt and Lee (1981) the one-sided inefficiency term is half-normally distributed with a constant variance. A similar approach was taken also by Schmidt and Sickles (1984).

Many researchers who employ SFA panel data models find that time-varying inefficiency more often suits their data better than time-invariant inefficiency models. However, each researcher must determine which case is more appropriate for their particular empirical situation.

Another extension occurred when several studies relaxed the parametric assumption regarding the stochastic frontier structure. Some of these models are nonparametric and others are semi-parametric (Kumbhakar, 1990; Park *et al.*, 1998; Adams *et al.*, 1999; Bellio and Grassetti, 2011; Kuosmanen and Kortelainen, 2012). Additional extensions include Markov-switching SFA (Tsonas and Kumbhakar, 2004), and threshold SFA (Yélou *et al.*, 2010).

In addition to these developments, a most important advance is that SFA accounts for potential unobserved heterogeneity among production units operating in different production environments. Estimation of standard SFA functions rests on the assumption that the underlying production technology is common to all producers. However, firms within a particular industry may use different technologies. In such a case, estimating a common frontier function encompassing every sample observation may not be appropriate in the sense that the estimated technology is not likely to represent the ‘true’ technology in every firm. That is, the estimate of the underlying technology may be biased. For instance, Greene (2005) stresses that individual production units develop their production in diverse environments, related to various external factors that can impact their technology but that are not under their control or are too complex to be controlled. Consequently, production possibilities could be different across a set of firms, and diverse technologies may concurrently coexist at any given time. If this is the case, the assessment of technical efficiency shouldn’t be performed by assuming a common technology. More specifically, incorrectly assuming that firms share the same technology leads to biased efficiency measurement and ignorance about both technological differences and individual inefficiency

across firms. Moreover, in Greene (2005) the “true fixed effects” and “true random effects” SFA models (both mentioned above) are designed to eliminate this problem.

Within this environment comprising firms from a particular industry using different technologies, latent class SFA models play a significant role. A standard approach to this unobserved heterogeneity among production units is a two-stage approach: in the first stage, the sample is divided in different classes/subclasses starting from the exogenous sample division information, while in the second stage various functions are estimated for each class (Hoch, 1962; Fan *et al.*, 1996; Newman and Matthews, 2006; Kumbhakar *et al.*, 2009; Tran and Tsionas, 2013).

The newer latent class SFA models use a single-stage approach, e.g., a latent class stochastic frontier model that associates the stochastic frontier approach with a latent class structure (see Caudill, 2003; Greene, 2004, 2005; Orea and Kumbhakar, 2004; Alvarez and del Corral, 2010; Tsionas, 2012; and Barros *et al.*, 2013).

Lastly, Kuosmanen and Kortelainen (2012) develop a two-step estimator that combines a constrained (convex) nonparametric least squares procedure for the estimation of a nonparametric frontier, while Kumbhakar *et al.* (2013) propose the zero-inefficiency stochastic frontier model, allowing for the presence of both efficient and inefficient firms in the sample.

To summarize, the use of SFA can strengthen banking research because of several benefits, including: (i) it allows for measurement errors and other “noise” factors; (ii) it separates noise from inefficiency; (iii) it permits multiple outputs; (iv) it allows for both different technologies and inefficiencies across firms within a sample; (v) it permits estimating both technical and allocative inefficiencies in the same multi-equation model; and (vi) it provides firm-specific efficiency estimates, which are essential for bank managers in order to improve their operational efficiency.

B. The Thick Frontier Approach (TFA)

First used by Berger and Humphrey (1991), the TFA is different from the SFA as, instead of estimating a frontier edge, it compares the average efficiencies of groups of banks. According to these authors, the TFA presents several *benefits*. First, it requires less statistical assumptions, making it less likely to be substantially violated by data compared to concurrent frontier approaches. For example, the TFA does not need inefficiencies to be orthogonal to outputs and other regressors from the cost function. Second, unlike DEA (discussed in the following), TFA does not bias inefficiency downward by reducing the number of comparison units each time an input or output characteristic is controlled in the analysis. Third, Berger and Humphrey (1991) state that quartile error terms, satisfying standard properties, seem not worse compared to

econometric approaches (assuming that inefficiencies are drawn from an arbitrary probability distribution, like the half-normal) or the DEA approach (assuming no random error).

C. The Distribution Frontier Approach (DFA)

The DFA was initially coined by Berger (1993), who examined the US banking sector, and observed that, within this method, is mandatory to predefine a functional form for the frontier, while inefficiencies are detached from the random error in a different manner. Indeed, the DFA makes no strong assumptions in relation to the distribution of the inefficiencies, and the identifying assumption is that the efficiency of each bank is stable over time, while random errors tend to average over time. Then, the inefficiency estimate for each bank in a panel dataset is grounded on the difference between the average residual of an individual bank and the average residual of the banks from the best-practice frontier, with some trimmed measure used to make up for the failure of the random error to fully average out.

Although less popular than SFA, DFA was equally employed for estimating scale economies and inefficiency. As pointed out by De Young (1997) and Koutsomanoli-Filippaki *et al.* (2009b), DFA could be preferred to SFA because it makes no arbitrary assumptions about the form of the error term, and because it is easy to apply. However, studies such as Bauer *et al.* (1998), Altunbaş *et al.* (2001b), Rime and Stiroh (2003), Yildirim and Philippatos (2007), Weill (2009) and Olson and Zoubi (2011), use DFA as well as SFA, and observe that they register comparable efficiency rankings across banks.

1.1.3.2 Non-parametric approaches

The non-parametric approaches comprise two major techniques, namely: *Data Envelopment analysis (DEA)* and *Free Disposal Hull Analysis (FDH)*.

A. The Data Envelopment Analysis (DEA)

A1. The method

Data Envelopment Analysis, coined by Charnes *et al.* (1978), is a mathematical programming technique for the development of production frontiers and the measurement of efficiency relative to these frontiers. DEA does not require assumptions regarding the shape of the production frontier and it makes simultaneous use of several inputs and outputs. The production units are known in the academic writings as *decision making units (DMU)*. This method defines

the relative efficiency for every decision making unit by making a comparison between inputs and outputs to the rest of the decision making units in the same environment.

Compared to other efficiency techniques, the outcomes of DEA comprise: a piecewise-linear empirical envelopment surface to represent the best practice frontier, containing units which display the most efficient DMUs in the sample, for a given level of inputs; an efficiency-metric to symbolize a relative measure for each DMU expressed by its distance to the frontier; a particular set of projections onto the frontier for each inefficient DMU; and an efficient reference set group for each DMU made up of the efficient units closest to it. Starting from this general setup, we discuss in the following several important characteristics related to the implementation of DEA.

First, DEA can be categorized with reference to the envelopment surfaces, namely *constant return-to-scale* (CRS or CCR, Charnes *et al.*, 1978) or *variable return-to-scale* (VRS or BCC, Banker *et al.*, 1984). The use of the CRS specification when all units observed are operating at an optimal scale can result in technical-efficiency (TE) being confused with scale-efficiencies (SE). As the names suggest, an implicit assumption regarding the return-to-scale is associated with each type of surface. In this way, the choice of a particular envelopment surface is often driven by economic or other types of assumptions made about the analyzed data. The majority of papers surveyed draw upon the VRS-DEA, as CRS-DEA is only suitable when all businesses are operating at an optimal scale. Nonetheless, some studies opted for CRS (e.g. Avkiran, 1999, 2011; Soteriou and Zenios, 1999) and some others report results obtained for both assumptions (e.g. Canhoto and Demine, 2003; Casu and Molyneux, 2003).

In the case of the *CRS model*, among the available options to use DEA is the use of a specific ratio of inputs and outputs. In order to obtain a measure of the ratio between inputs and outputs, such as $u' y_i / v' x_i$, where u is an estimating vector for outputs of $M \times 1$ dimension, and v is an estimating vector for inputs, of $K \times 1$ dimension, it's developed the following system of equations:

$$\begin{cases} \max_{u,v} (u' y_i / v' x_i), \\ u' y_j / v' x_j \leq 1, & j = 1, 2, \dots, N, \\ u, v \geq 0, \end{cases} \quad (I.33)$$

The resolution of this system of equations involves the identification of the optimum values for u and v in order to maximize the efficiency of the unit observed i , subject to the constraint that all efficiency measures must be less than or equal to one. This system might present an infinite number of solutions taking the following form $(\alpha u^*, \alpha v^*)$, where (u^*, v^*) is the systems' solution. So as to avoid this kind of problem, it can be imposed a restriction ($v' x_i = 1$), thus obtaining the following system of equations:

$$\begin{cases} \max_{\mu, v} (\mu' y_i), \\ v' x_i = 1, \\ \mu' y_j - v' x_j \leq 0, \quad j = 1, 2, \dots, N, \\ \mu, v \geq 0, \end{cases} \quad (\text{I.34})$$

The second system of equations is identified as the multiplier form of the linear programming problem. By applying duality in linear programming, it can be generated another envelopment surface correspondent to the previous one, namely:

$$\begin{cases} \min_{\theta, \omega} \theta, \\ -y_i + Y\omega \geq 0, \\ \theta x_i - X\omega \geq 0, \\ \omega \geq 0, \end{cases} \quad (\text{I.35})$$

Where θ is a scalar, and ω is vector of constant, of $N \times 1$ dimension. This envelopment form involves fewer constraints than the multiplier form ($K + M < N + 1$), therefore is usually preferred. The value of θ obtained, will be the efficiency score for the unit observed i . It will satisfy $\theta \leq 1$, with a value of 1, representing a point on the frontier, and consequently a technical efficient DMU is observed according to Farrell's definition (1957).

Regarding the VRS model, it was observed that the assumption of constant scale return is genuine only in the situation when the observed units are operating at an optimal scale. In 1984, Banker *et al.* developed an extension of DEA with constant return-to-scale with the aim of explaining the variable return-to-scale. When all units observed are operating optimally, the use of the CRS specification is starting by measuring the technical efficiency (TE) which could be confused with scale efficiencies (SE). Therefore, the CRS linear programming problem can be simply adapted to account for variable returns to scale, by adding the convexity constraint ($N_1' \omega = 1$), thus obtaining the following program:

$$\begin{cases} \min_{\theta, \omega} \theta, \\ -y_i + Y\omega \geq 0, \\ \theta x_i - X\omega \geq 0, \\ N_1' \omega = 1, \\ \omega \geq 0, \end{cases} \quad (\text{I.36})$$

Where, N_1 is the vector with elements equal to 1, of $N \times 1$ dimension.

A VRS envelopment surface forms a convex shell, over the plans that are intersecting and entangling the points represented by the data, „tighter” than the conical shell determined by the CRS envelopment surface. If there are differences between technical efficiency obtained with CRS and VRS for a unit observed, then that unit has an inefficient scale, and this is dictated by the

difference between the technical efficiency obtained with VRS (TE_{VRS}) and the technical efficiency obtained in the case of CRS (TE_{CRS}).

In the majority of the papers surveyed it was implemented DEA with assumptions of VRS, observing that CRS is only suitable when all businesses are operating at an optimal scale. Nonetheless, other studies are opting for CRS (Noulas, 1997; Avkiran, 1999; Soteriou and Zenios, 1999) and some of them report results obtained for both assumptions (e.g. Canhoto and Demine, 2003; Casu and Molyneux, 2003).

Second, most studies, including Lozano-Vivas *et al.* (2002), Drake *et al.* (2006), Pasiouras (2008b), concentrate on banks' technical efficiency, adopting either an input orientation (minimize inputs to generate a specific volume of outputs) or an output orientation (maximize outputs to generate a specific volume of inputs). Provided price data for inputs and outputs is available and a behavioral objective such as cost minimization or profit maximization is appropriate, then it is possible to measure allocative, cost, or profit efficiency (see Appendix I.2). Although an extensive family of papers has been analyzing cost-efficiency, the estimation of profit-efficiency was rather uncommon up until a few years ago mainly because of the difficulty in collecting reliable and transparent information for output prices (Fare *et al.*, 2004; Coelli *et al.*, 2005).

Third, as highlighted by Berger and Humphrey (1997), a major challenge with DEA is the selection of inputs and outputs, with two main approaches. On the one hand, the *production* approach assumes that banks produce loans and deposit account services using labor and capital as inputs, and that the number and type of processed transactions measure outputs. On the other hand, the *intermediation* approach considers banks as financial intermediaries between savers and investors. In assessing their relative performance, Berger and Humphrey (1997) suggest that the former may be better to evaluate the efficiency of bank branches, while the latter may be more suitable to evaluate banks as a whole. However, given complications in collecting detailed transaction flow information required by the production approach, the intermediation approach is usually favored in practice.

Fourth, DEA-based studies differ regarding the main categories of inputs and outputs. Regarding the former, traditional inputs include fixed assets, personnel, and deposits (Isik and Hassan, 2002; Havrylchuk, 2006). Yet, some studies use branches (Chen, 2001), loan loss provisions (Drake *et al.*, 2006; Pasiouras, 2008b) and equity (Chu and Lim, 1998; Mukherjee *et al.*, 2001; Sturm and Williams, 2004; Pasiouras, 2008a) as alternative inputs. As regards outputs, the majority of studies include two variables, namely loans and other earning assets (Casu and Molyneux, 2003). In addition to these, some other papers divided loans into various sub-groups,

such as housing loans (Sturm and Williams, 2004), real estate, commercial and personal loans (Mukherjee *et al.*, 2001; Fare *et al.*, 2004) or short- and long-term loans (Isik and Hassan, 2002). Besides, another family of papers divide other earning assets into sub-groups, namely investments and liquid assets (Tsionas *et al.*, 2003), or investment in government securities and in public and private firms (Chen, 2001). To sum up, another strand of the literature uses non-interest income or off-balance-sheet elements as supplementary outputs (Isik and Hassan, 2002, 2003; Sturm and Williams, 2004; Tortosa-Ausina, 2003; Havrylchyk, 2006; Pasiouras, 2008b).

Finally, DEA can be implemented using input- or output-oriented approaches. Most banking sector efficiency estimates use the former approach, assuming that bank managers have more control over inputs than outputs. Conversely, several studies focus on the latter approach or use both (Casu and Molyneux, 2003; Beccalli *et al.*, 2006).

A2. DEA drawbacks and developments

Despite its popularity, DEA is subject to several important limitations, starting with the assumption that data are free of measurement errors and its sensitiveness to outliers. Measurement error and other noise will influence the shape and position of the frontier and outliers may influence the efficiency results. Besides, Coelli *et al.* (2005) point out that the measured efficiency scores are only relative to the best entities in the sample. Including other entities may either increase or reduce the efficiency scores of the initial entities for the reason that new entities have been included in the database, not because the efficiency of the initial entities has changed whatsoever. Moreover, Coelli *et al.* (2005) note that having few observations and many inputs or outputs will require that many observed units appear on the frontier. Treating inputs or outputs as homogeneous commodities when they actually are heterogeneous can bias efficiency measurements if environment particularities are unaccounted for. Furthermore, standard DEA does not control for multi-period optimization or risk managerial decision making, and does not distinguish between technical or allocative inefficiency and statistical noise effects.

The literature has offered several improvements to DEA methods in light of these critiques. First, bootstrapping circumvents drawbacks on asymptotic sampling distribution by employing perturbations of data and sampling error. More specifically, bootstrapping evades drawbacks related to the asymptotic distribution of the sample.

Ferrier and Hirschberg (1997) introduce a stochastic component into DEA-based technical efficiency scores, and derive confidence intervals for the original efficiency levels to obtain empirical distributions for the efficiency measures. However, to avoid possible inconsistent

estimates, Simar and Wilson (1998, 1999a,b), show that, to validate the bootstrap, it is essential to define a rational data-generating process and to suggest an appropriate estimator of it.

Second, Cazals *et al.* (2002) present a nonparametric estimator more robust to extreme values, noise or outliers, as it does not have to envelop all observations.

Third, a two-stage approach was developed for simultaneously benchmarking the performance of operating units along different dimensions (Paradi *et al.*, 2011). It first uses DEA to obtain efficiency estimates, and, in the second stage, DEA scores are regressed on a number of explanatory variables (Isik and Hassan, 2003; Hauner, 2005; Ataullah and Cockerill, 2004, Lin *et al.*, 2012; Chen and Liu, 2013; Lee and Hsieh, 2013; Lin and Chiu; 2013; Wanke and Barros, 2014). The second-stage regression can be either Tobit (e.g. Hauner, 2005, Gonzalez and James, 2007; Lee and Chih, 2013), OLS (Ataullah and Le, 2006), GMM (Koutsomanoli-Filippaki *et al.*, (2009a), or GLS (Isik and Hassan, 2003). However, irrespective of the regression method employed, Simar and Wilson (2007) outline that second-stage regression covariates are correlated with first-stage covariates and errors, and suggest accounting for this during the maximum likelihood estimation.

Fourth, fuzzy DEA defines tolerance levels on both the objective function and constraint violations (Sengupta, 1992; Lertworasirikul *et al.*, 2003ab; Karsak, 2008; Chen *et al.*, 2013). The applications of fuzzy theory to DEA falls into four groups: the tolerance approach, the ∞ level based approach, the fuzzy ranking approach, and the possibility approach (Lertworasirikul *et al.*, 2003a,b; Karsak, 2008). More recently, Chen *et al.* (2013) extended the classical non-oriented slack-based measure (SBM) and included fuzzy input and fuzzy output data to deal with imprecise or fuzzy data in DEA (called FSBM or Fuzzy SBM).

Fifth, recent research explored the definition of a crucial feature of DEA, namely decision-making-units (DMU). Lee and Kim (2013), Fujii *et al.* (2014) and Kao and Liu (2014) use the Malmquist index method as sample-DMU, as it builds on the best practice frontier concept to allow for technical inefficiency. Indeed, an individual DMU's productive efficiency may not be exclusively driven by how well it uses available production technologies, but also by each DMU's ability to keep up with existing best practices. Alternatively, Arjomandi *et al.* (2014) use the Hicks-Moorsteen TFP index (HMTFP) as sample-DMU, in their comparison of the intermediation and the production approaches. The HMTFP index is well-defined as the ratio between an aggregated output-quantity to an input-quantity, measuring the variation in output quantities in the output direction and the variation in input quantities in the input direction, opposed to the Malmquist index which usually implements either an input- or an output-orientation. Additionally, compared

to the Malmquist index, the HMTFP is solving the limits that the Malmquist index is facing in the VRS.

To sum up, our analysis reveals the popularity of DEA, mainly driven by its flexibility to integrate multiple inputs and outputs without any assumption for the functional form, which reduces the risk of misspecification of frontier technology compared to parametric approaches. In contrast to classical statistical approaches where the optimal predictors of the dependent variable are conditional mean or conditional median functions (e.g. OLS and least absolute deviations, LAD), DEA is an extreme-point technique that allows comparing each producer with only the best producers. Finally, DEA is more appropriate for small samples compared with parametric techniques.

B. The Free Disposal Hull Analysis (FDH)

B1. The method

Coined by De Prins *et al.* (1984), the FDH generalizes the DEA estimator, as it relies only on the free disposability assumption and is not restricted to convex technologies. In this respect, Farrell (1957) identifies the indivisibility of inputs and outputs, and economies of scale and specialization, as potential sources of non-convexity. If the true production set is convex, DEA and FDH are both consistent estimators; however, if the production set is non-convex, only FDH is consistent because it requires fewer assumptions. The FDH estimator measures the efficiency at a given point, and in practice it is computed by a simple vector comparison procedure that amounts to a complete enumeration algorithm proposed by Tulkens (1993).

The FDH presents three important *advantages*. First, from a theoretical and empirical perspective, it makes weak assumptions on the production technology; thus, restrictions placed on the production technology can vary broadly, but can be less restrictive than those used in parametric approaches. On the contrary, as stressed by Grosskopf (1986), relatively restrictive technology, imposing constant return to scale and strong disposability of inputs, will determine a lower technical efficiency. Those values would be higher if they would have been computed starting from a less restrictive production technology. Furthermore, the issue of measuring technical efficiency of observed production units is detached from the problem of representing the frontier of the production possibility set. However, being a multidimensional step function, this reference technology is less useful in other cases, such as the determination of scale and scope economies.

Second, FDH does not constrain empirical results to specific parametric forms. Indeed, in parametric analyses, it is implicitly assumed that the selected parametric forms are suitable approximations for the true functional relationships. However, since this hypothesis is not directly testable, it has been argued that empirical studies should stay as close as possible to the raw data (Varian, 1984).

Third, from a managerial perspective, estimated efficiency based on FDH draws upon an observed production unit. For other methods, such as DEA or SFA, the point of reference is a hypothetical unit (Banker and Maindiratta, 1988). Thus, it may be problematic to persuade managers that they are outperformed by such a hypothetical unit, so they could always object that such convex arrangements of observed activities are not feasible (Epstein and Henderson, 1989).

B2. FDH drawbacks and developments

Some authors expressed explicit doubts regarding the economic meaning of FDH (Thrall, 1999), while other studies on BP compare it directly with other methods. For example, Cherchye *et al.* (2000) proved that the FDH and the Convex Monotone Hull (CMH) methods are economically meaningful exclusively in environments respecting Thrall's theorem (perfect competition, price rationing, and perfect certainty). Therefore, in terms of economic efficiency, if the conditions are fulfilled, the two methods cannot be discriminated. Nevertheless, in real-life these conditions are not achieved, thus the economic justification of convexity is dissolved and FDH becomes economically more meaningful. Additionally, another primary difference between FDH and CMH is that the latter sets some supplementary assumptions stating that production possibilities are convex. However, there are no theoretical arguments for assuming *a priori* that the production possibilities are indeed convex; thus, FDH presents, yet again, a comparative advantage in terms of technical efficiency.

Moreover, it was observed that one of the main drawbacks of deterministic frontier models, including FDH, is the influence of "super-efficient" outliers, which is caused by sample extreme points. Simar and Wilson (1998) point out the need for identifying and eliminating outliers when using deterministic models. Additionally, it has been stated that nonparametric reference technologies, and resulting efficiency measures, are connected to the outcome of parametric approaches: the former provide upper bounds to the latter (Banker and Maindiratta, 1988).

Overall, FDH is a useful method for evaluating technical efficiency, and works best when all aspects of the production process can be captured in a limited number of input and output dimensions, and when the sample is relatively large. Also, empirical results based on FDH support the use of graph efficiency measures, such as Farrell's measure, the weak graph measure of

technical efficiency, etc. Graph efficiency measures allow several variations in the value of inputs and outputs, and they are considered as an alternative measure of technical efficiency (De Berger *et al.*, 1998).

I.1.3.3 Alternative measures

This section comprises some other techniques that were employed to evaluate BP, which we classified them after the model applied: deterministic or probabilistic (see Appendix I.3).

First, the *deterministic (postulating) models* refer to the events which were completely determined by cause-effect-chains (causality), thus they analyze the effects of assumed causes. In the banking sphere, we observed several techniques employed to measure the overall performance, namely: (i) Granger causality (see Berger and DeYoung, 1997; Fiordelisi *et al.*, 2011); (ii) difference-in-difference (see Havrylchuk and Jurzyk, 2011).

The *probabilistic (prognostic) models* refer to events that can be identified by the probability of occurrence. The probabilistic models are divided in three groups, namely: (a) regression models (linear and nonlinear, simple and multiple, pooled regression), (b) dynamic interaction setups and (c) other models.

(a) The first group, *regression models* were analyzed with respect to linear or non-linear feature. In *linear regression models*, there were frequently used the following estimators: *ordinary least squares* - OLS (see Dermiguç-Kunt *et al.*, 2006; Park and Weber, 2006; Altunbaş and Marques, 2008; Lin and Zhang, 2009; Lee and Chih, 2013), *generalized least squares* - GLS (see Boubankri *et al.*, 2005) or *generalized method of moments* – GMM (Albertazzi and Gambacorta, 2010; Chortareas *et al.*, 2012a). Since OLS poses several problems in estimating models where the explanatory variables were qualitative in nature, several alternatives were developed, namely the *logit* and *probit models* (e.g. Cipollini and Fiordelisi, 2012). There were also noticed several variants of the qualitative response models, such as *Tobit model* (e.g. Lee and Chih, 2013). Several extensions of the qualitative response model are also mentioned in the literature, such as ordered probit, ordered logit and multinomial logit. In terms of clustering, it can also be noted the paper of Epure *et al.* (2011), who studied the changes in productivity and efficiency for a group of private and savings Spanish banks, employing the Luenbergner productivity indicator. Moreover, several papers used more than one method. In addition, Kutan *et al.* (2012), computed the model with both OLS and GMM, in order to evaluate the robustness and consistency of their analysis.

In terms of *nonlinear regression*, in the financial sector, the most commonly used method is the principal component analysis, which regresses the dependent variable on a set of predictors that is a small number of linear combinations of the regressor variables (e.g. Shih *et al.*, 2007).

(b) The second group refers to *dynamic interaction setups*, which are extracting linear components that capture correlations between two variables or data sets. In the literature, it was observed that there are two ways of examining economic issues in *interdependent or correlated economies*. The first is referring to the construction of a multi-sector, multi-market, multi-country *dynamic stochastic general equilibrium* (DSGE) model, where agents are optimizers and where preferences, technologies and constraints are fully specified. Structures like these are currently extensively used in the policy framework (e.g. SIGMA model at the Federal Reserve Board, or the EAGLE at the European Central Bank - ECB). Tightly parameterized DSGE models are useful because they offer sharp answers to important policy questions. However, it was noticed that these models impose a lot of restrictions, not always in line with the statistical properties of the data (see Smith, 1998).

An alternative approach to dealing with interdependent economies is to build a *panel vector autoregression* (VAR) model, which attempts to capture the dynamic interdependencies present in the data using a minimal set of restrictions. This methodology is based on a framework that allows all variables to enter as endogenous within a system of equations, where the short run dynamic relationships can be subsequently identified. Shock identification can then transform these reduced form models into structural ones, allowing the typical exercise, such as impulse response analyses or policy counterfactuals, to be constructed in a relatively straightforward way. Structural panel VAR are accountable to standard criticism of the structural VAR model and thus need to be considered with care (e.g. Cooley and Le Roy, 1985; Cooley and Dwyer, 1998; Dragomirescu-Gaina and Philippas, 2015). Nevertheless, the information they produce can effectively complement analyses conducted with DSGE models, helping to point out the dimensions where these models fail, and to provide stylized facts and predictions, which may improve their realism (Koutsomanoli-Filippaki and Mamatzakis, 2009; Philippas *et al.*, 2016).

(c) Lastly, the third group is referring to *other techniques* applied in the literature. We saw several papers that applied the following methodologies: *fundamental value model* (e.g. Elsas *et al.*, 2010), *optimal contracted model* (e.g. Hakenes and Schnabel, 2011a), and *propensity score matching* (e.g. Havrylchyk and Jurzyk, 2011). Additionally, we observed another set of models in the literature, namely the *non-radial models*, which can be divided into two groups. First, we observe the directional distance measure, which was first, presented by Fare and Lovell (1978), and after developed in numerous studies, such as Cooper *et al.* (2007), Koutsomanoli-Filippaki

and Mamatzakis (2009), Koutsomanoli-Filippaki *et al.* (2009a), Barros *et al.* (2012), Fujii *et al.* (2014). For instance, Pastor *et al.* (1999) revised the model and developed a new measure, respectively Enhanced Russell graph measure (ERGM), which in turn combines input and output Russell measure in a ratio form. Second, we can note the slack-based model which was proposed by Tone (2001), with the objective to maximize all the input and output slacks in fractional programming form, and was further employed in several papers, such as Avkiran (2009), Lin *et al.* (2009), and Chen *et al.* (2013). Besides, Cooper *et al.* (2007) showed that SBM is equivalent to ERGM.

Additionally, a more complex approach was adopted by Koutsomanoli-Filippaki and Mamatzakis (2009), who employed a non-radial model together with a dynamic interaction setup. Thus, they first, use a directional distance function framework along with a cost frontier and a profit function, second, a Merton-type default risk; and third, a panel VAR analysis, which allowed the examination of various relationships, without applying any *a priori* restriction.

Generally, from reviewing the literature we have identified a wide range of empirical models, observing some common features but also some important differences. On the one hand, a strand of the literature suggests that the modeling equations must assume maximizing behavior, efficient markets, and forward-looking behavior; consequently it should be easy to track the effect of specific policy changes, without having to worry about whether the change itself alters agent's behavior. On the other hand, another strand of the literature favors a more nuanced approach, preferring the empirical models which reflect their own experience with observed data; therefore in this way it's questioned the realism of the behavioral constructs in the more formally derived models.

Regardless of the approach, the scientific methodology requires that every empirical model yield accurate and provable implications concerning the economic phenomena analyzed. We consider that no empirical model can be a perfect description of the economic reality, but every process of constructing, testing and revising models determines researchers and policy makers to constrain their views about the functioning mechanisms of an economic system.

I.2 Defining and measuring bank soundness¹⁸

Although an important part of the literature has focused on bank performance as a significant contributor to economic development, it is by no means that bank soundness does not symbolize a vital provider of economic welfare and growth. In fact, bank soundness has received increasing attention especially in the last period, when the volume and flexibility of international capital flows have significantly enlarged making the financial systems more integrated while the boundaries between countries are becoming less noticeable. Furthermore, in the last period dominated by uncertainty, it was observed how the financial system could influence the real economy, noticing that the impact of external financial shocks became far more intense. Consequently, the following sections provide an overview of the general definitions and indicators of bank soundness (stability, hereinafter BS), together with the main methodological designs employed when assessing BS.

1.2.1 Bank soundness and the macro-prudential policy

1.2.1.1 General framework

The soundness of a financial system has become, alongside with financial performance, one of the key elements of strong macroeconomic policies. Though, some uncertainties still remain in relation to the connection between bank soundness and financial stability. Therefore, it's extremely important to delineate the differences between them.

The main difference is dictated by the perspective taken, thus financial stability covers the whole financial system, while bank soundness (stability) takes a sectorial perspective, focusing only on the soundness of banking institutions. On the one side, the European Central Bank (ECB) defines financial stability as “*a condition in which the financial system – comprising financial intermediaries, markets and market infrastructures- is capable of withstanding shocks and the unraveling of financial imbalances, thereby mitigating the likelihood of disruptions in the financial intermediation process which are severe enough to significantly impair the allocation of savings to profitable investment opportunities*”.

On the other side, the International Monetary Fund (IMF) defines bank soundness (stability) as *bank's capability to endure hostile events, such as bank run, major policy changes, financial*

¹⁸ Within this thesis, the term bank soundness is interchangeable with bank stability and bank solidity (resilience).

sector liberalization and natural disasters. Hence, it reflects bank's ability to be solvent and to remain so under adverse economic conditions by means of their capital and reserve accounts.¹⁹

Without doubt, bank soundness is seriously influenced by the following issues:²⁰

- ❖ Banks and the related financial infrastructure are jointly capable of absorbing adverse turbulences;
- ❖ Financial system facilitates a smooth and efficient reallocation of financial resources from savers to investors;
- ❖ Financial risks are priced and weighed in a reasonable and suitable manner;
- ❖ Financial and non-financial risks are efficiently and effectively managed.

Furthermore, we consider bank soundness as being strongly interconnected with other notions observed in the literature, namely "resilience", "solidity", "solvency" and in some cases "robustness" (while opposed to these terms are "financial fragility", or "bank fragility"). For example, solvency highlights the positive net worth of a bank, representing the difference between assets and liabilities, excluding capital and reserves. In other words, the distance between soundness and insolvency can be assessed in relation with the level of capital adequacy, since net worth corresponds to capital plus reserves. Though, the probability of a bank to remain solvent will directly depend on its financial performance but also on its level of capitalization.²¹ Besides, in dynamic and competitive economic markets, profitability and efficiency are strongly connected, thus their relation will influence the future solvency scenarios. Banks that register low levels of profitability and efficiency, or even losses, will turn out to be insolvent and illiquid.²² From another perspective, undercapitalized banks will be predisposed to financial fragility,²³ and finally to failure when they are fronting an undermining shock (e.g. major policy change, financial sector

¹⁹ Lindgren, C.J., Garcia, G.G., Saal, M.I., (1996). *Bank Soundness and Macroeconomic policy*. Washington, D.C.: International Monetary Fund, p. 9.

²⁰ van Sluijs, P. (2006). *Financial Soundness Indicators* (World Bank Presentation), p.3.

²¹ *Capitalization* refers to the structure and amount of long-term equity and debt capitals of a company, commonly portrayed as a proportion of the total capital (equity and debt) (Business Dictionary). *Undercapitalized* stands for the opposite situation, when a company does not have sufficient capital for covering the size of its operations, or more specifically for conducting normal business operations and pay creditors.

²² *Liquidity* refers to a measure of the extent to which a company has enough cash to meet immediate or short-term obligations, or has assets that can be quickly converted to cash or used to settle a liability (Business Dictionary). *Illiquid*, or *illiquidity* stands for the opposite situation, namely when a company does not have enough cash or assets that can be easily converted to cash, in order to meet its current needs and obligations (Business Dictionary). *Insolvency* refers, in legal terminology, to the situation where the liabilities of a company exceed its assets. Though, in practice, insolvency is the situation where an entity cannot raise enough cash to meet its obligations, or to pay its debt as they become due for payment (Business Dictionary). Even if the difficulties are becoming visible by means of illiquidity, typically insolvency is the one that comes first, so it precedes illiquidity. Banks can cover up the losses and finance them by attracting new deposits or even other types of liabilities. Though, the problems are becoming more serious when insolvency intervenes, and after the net flows of funds turnaround and become negative, noticing the issue of illiquidity.

²³ *Financial fragility* refers to the state in which minor shocks can roll-over the economy into a full blown crisis. To put it differently, financial fragility is an extreme case of excess sensitivity (Allen and Gale, 2002).

liberalization etc.). Furthermore, financial fragility describes the weaknesses generated by the structure of the financial system, thus a shock is more probable to result in stressful periods, when financial conditions are feeble. Consequently, shock's dimension and the interaction with the fragility of the financial system define the overall level of stress.

In spite of the fact that BS is a particularly important issue in evaluating the healthiness of a bank or financial sector, it was stated that it's practically impossible to measure or predict all the shocks that could influence in a negative manner the financial sector (Mörtinen *et al.*, 2005). Though, the most suitable option to count for the predisposition of the financial system for distress is to measure the loss absorbing capability of banks. More specifically, it should be determined the level of exposure of each bank to risks and the capacity to absorb several adverse disturbances. In addition, there still isn't an international accepted benchmark measure of BS that can determine whether or not a financial system is unsound or even when a crisis episode will occur.

In recent years, leading up to last global financial crisis, international financial systems experienced extremely rapid and unsustainable growth which determined a series of macroeconomic and financial imbalances. The recent global financial crisis has intensified these imbalances, but also added new ones, thus the primary lessons drawn are that the crisis resulted from an insufficient reach of regulation and that market discipline is little protection against the macro-prudential risks that come with the economic cycle (Persaud, 2013). Consequently, monetary and regulatory authorities started pursuing *financial stability* as a priority objective, and *bank soundness* as a secondary objective, implying certain constancy in the provision of financial services over the entire business cycle.

Against this background dominated by uncertainty, policy makers addressed the development of potential risks in the financial system by developing macro-prudential policies whose major objective is to preserve financial stability and indirectly bank soundness. As such, the overarching objective of the macro-prudential policy is to constrain the build-up of systemic risks in the financial system, particularly in the banking system. Within this framework, systemic risk refers to the "*risk of disruption in the financial system with the potential to have serious negative consequences for the internal market and the real economy*" (European Systemic Risk Board - ESRB).²⁴ From a more narrow perspective, both Acharya and Yorulmazer (2008) and Acharya (2009) argue that systemic risk is translated in failures and freezing of capital markets with major effects on the real economy. Moreover, considering the historical significance of economic crises, highlighted by the recent worldwide events, systemic risk became a prolific

²⁴ Article 2(c) of *Regulation No 1092/2010 establishing the ESRB*, <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R1092&from=EN>

research topic at the crossroads of banking, micro- and macro-economics and econometrics, among others. Subsequently, a significant part of the literature has emerged to identify the main mechanisms behind systemic risk (e.g. Diamond and Dybvig, 1983; Bernanke and Gertler, 1989; Rochet and Tirole, 1996; Allen and Gale, 2000; and Acharya, 2009).

1.2.1.2 Macro-prudential policy

A. Macro-prudential policy and financial cycles

Macro-prudential policies were initially debated in the context of the devastating implications of the banking crises in 1980s and 1990s (Clement, 2010). Besides, Crockett (2000) was among the first to draw the attention to the need for macro-prudential policies, while later on some other studies reviewed them (e.g. Galati and Moessner, 2011, 2014; Hanson *et al.*, 2011; Elliot *et al.*, 2013a).

Apart from ensuring *financial stability and preventing systemic risk*, we consider that another important purpose of the macro-prudential regimes would be to understand the *development of financial cycles*. In the literature there are stylized two main features of the financial cycle, namely: (i) financial cycles have greater amplitude than the normal business cycles (e.g. Borio *et al.*, 2012, show that the average length of a financial cycle for industrialized economies is around 16 years); (ii) the financial cycle is described by oscillations in both credit and real-estate prices (Borio *et al.*, 2012). Moreover, in the growth phase of the financial cycle (a positive shock) it can be noticed an accelerated volume of credit and a serious growth of asset prices, leading to a generalized expansion of economic activity. These evolutions are accompanied by an amplified exposure of numerous banks to the same sectors, by underestimating risks, observing also a higher interconnectedness between them. Thus, as stressed by Frait and Komarkova (2011), concentration risk on both asset and liabilities side poses a great threat to banks, making them vulnerable to different types of shocks. Furthermore, when the cycle turns, asset prices will decline together with the volume of credit, thus economic activity can register a slowdown. Moreover, severe fluctuations of the financial cycle, could determine serious disturbances which could further generate financial crises. However, as highlighted by Claessens and Ghosh (2013), the financial system presents a natural predisposition to pro-cyclical behavior, by amplifying the fluctuations within the financial cycle mainly through lending activities (Athanasoglou and Daniilidis, 2011).

Consequently, in the wake of the 2008 financial crisis, monetary and regulatory authorities are undertaking many efforts to improve financial systems' soundness and reduce the tendency of

pro-cyclicality, which is the main determinant of systemic risk. For example, Akinci and Olmstead Rumsey (2015), by studying 57 countries, showed that the macro-prudential policies have been employed more intensely since the international financial crisis compared with the pre-crisis period, although credit growth and house price inflation were far more pronounced in the pre-crisis period. Moreover, they draw the attention to a potential endogeneity bias which occurs when there's a positive relationship between macro-prudential policies and credit growth, which happens if the macro-prudential policies are promoted and carried out during credit booms.

From a more specific perspective, Claessens (2014) stresses that, in the last decade, financial markets have deepened, noting a series of structural changes accompanied by financial frictions and market imperfections. Thus, the literature discusses the consequences of these mutations, namely externalities and market failures. Furthermore, as highlighted by Mörtinen *et al.* (2005), Brunnermeier *et al.* (2009), De Nicolo *et al.* (2012) and Claessens (2014), the major externalities that give rise to pro-cyclicality and systemic risk are the following:²⁵

- ❖ *Externalities related to strategic complementarities*: a rapid growth of the banking activities in the financial market which has amplified banks' exposure to market risks and earnings volatility;
- ❖ *Interconnectedness externalities*: a higher interconnectedness between the financial system and shadow banking, which has aggravated the probability that the shocks originating from non-banks become systemic and spread to the banking sector;
- ❖ *Externalities related to fire sales and credit crunches*: mutations related to financial funding and investment patterns have amplified the potential role that liquidity conditions play in financial markets, stressing the importance of contagion risks.

Finally, Claessens (2014) evoked the need to implement a proper macro-prudential framework that can deal with these externalities and tendency for pro-cyclicality, emphasizing the significance of risk identification and the assessment of the shock-absorbing buffers from the financial system.

²⁵ See also Allen and Carletti (2012), Bank of England (2011), and Schoenmaker and Wierts (2011).

B. Micro- vs. Macro-prudential policies

The recent international financial crisis revealed the limits of the existing regulatory and supervisory practices in effectively tackling risks to financial system soundness. Thus, the latest events induced the need of addressing risks and challenges present in the financial system from a systemic perspective, complementing the micro-prudential one. Although complementary, the micro- and macro-prudential policies present a series of differences, being best drawn in terms of their objectives and mechanisms used to achieve those objectives (see Figure I.8).

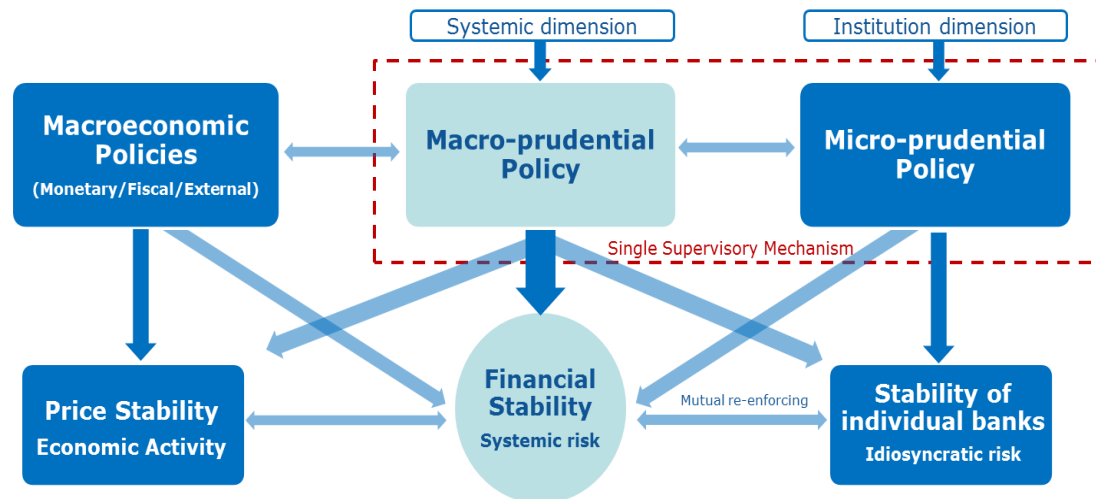


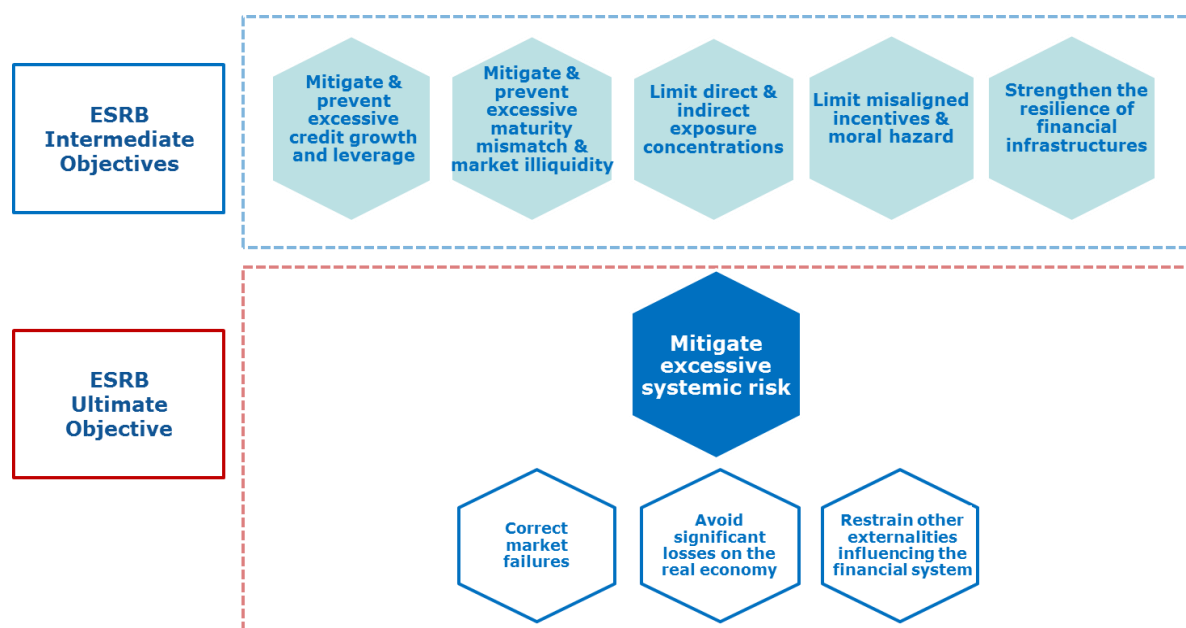
Figure I.8: Macro-prudential policy – broad context

On the one hand, macro-prudential was defined as "the use of primarily prudential tools to limit systemic risk – the risk of disruptions to the provision of financial services that is caused by an impairment of all or parts of the financial system, and can cause serious negative consequences for the real economy" (IMF, 2013ab). Moreover, Caruana (2010) described the macro-prudential policy as being the type of policy which targets a reduction of systemic risk by clearly focusing on the interconnections between, and mutual exposures of, all banks, and the financial system's tendency of pro-cyclicality. Similarly, Perotti and Suarez (2009) are describing the macro-prudential policy as discouraging individual bank strategies which are sources of systemic risk.

With regard to the above mentioned definitions, we can stress that the overarching objective of the macro-prudential policy is to mitigate systemic risk and implicitly safeguard financial system soundness. Besides, according to the European Systemic Risk Board Recommendation (ESRB/2013/1),²⁶ macro-prudential authorities are recommended to cooperate with each other and

²⁶ Recommendation of the European Systemic Risk Board of 4 April 2013 on intermediate objectives and instruments of macro-prudential policy (OJL 2013/ C 170/01, 15.06.2013, pp.3-4).

to follow a series of intermediate objectives to ensure an efficient and effective macro-prudential policy (see Figure I.9).



Source: adapted from ESRB Recommendation (2013), pp.3-4

Figure I.9: ESRB's indicative list of macro-prudential objectives

There is an important part of literature that focuses on the macro-prudential policy and its specific objectives. For example, Crockett (2000) indicates that the main purpose of the macro-prudential policy is to limit the economic costs of financial distress, particularly related to moral hazard.²⁷ Moreover, in the view of Acharya and Calomiris (2014) macro-prudential policies could have multiple objectives. First, macro-prudential policy should ensure the resilience of the financial sector against large common shocks to banks (internalizing negative externalities and limit systemic risk) (see also Borio, 2014). Second, macro-prudential policy should control banks' behaviour in relation to the risk-taking or investment decisions. Finally, macro-prudential policy should improve the safety and soundness of individual banks in respect to non-correlated shocks (correct aggregate common error in risk measurement techniques used in the micro-prudential framework).

On the other hand, *micro-prudential* emphasises the *specific condition of individual banks, their risks, and also their risk management* (Mörtinen *et al.*, 2005).

²⁷ The academic literature describes *moral hazard* as being the situation when the public safety net, providing support to banks in distress and protecting the claim-holders from losses, upsurges the tendency of bank managers to assume excessive risk (Boot and Greenbaum, 1993; Dewatripont and Tirole, 1993ab), Matutes and Vives, 1995; Freixas and Rochet, 1997). Furthermore, *the safety net*, or the safeguard of banks' creditors countering to potential losses resulting from failures, is initially determined by the short maturity configuration of banks' liabilities and the private information particularity of their longer-maturity assets, highlighting banks' exclusive liquidity creation and intermediation functions (Diamond and Dybvig, 1983; Gorton and Pennacchi, 1990; Calomiris and Kahn, 1991).

From all of the above we can note that the major objective of the macro-prudential policy falls directly within the macroeconomic practice, while the micro-prudential approach is best streamlined in terms of customer protection (depositor or investor). The major differences between micro- and macro-prudential policies can be seen in Table I.3.

Table I.3: The macro- and micro-prudential approaches

	Macro-prudential	Micro-prudential
Proximate objective	Limit financial system-wide distress	Limit distress of individual institutions
Ultimate objective	Avoid output costs	Consumer protection (depositor/investor)
Model of risk	Endogenous (partially)	Exogenous
Correlations and common exposures across institutions	Important	Irrelevant
Calibration of prudential controls	In terms of system-wide distress; top-down	In terms of risks of individual institutions; bottom-up

Source: retrieved from Borio (2003), p.2

Macro-prudential policy evaluates the whole financial system and assesses the potential threats generated by common shocks which, in the end, can infiltrate and influence any particular bank. In fact, macro-prudential analysis is adding to the micro-prudential analysis, because the contagion risk or the risk of interrelated failure is not directly enclosed in this micro-prudential perspective. Consequently, the micro-prudential policy is actually subordinated to the macro-prudential one, therefore a successful macro-prudential policy will, in the end, lead to the achievement of the final objective of the micro-prudential policy (Borio, 2003).

Additionally, the macro-prudential policy distinguishes from other economic policies, not only through flexibility and lower costs, but also through the two dimensions addressed, namely the *time dimension* and the *cross-sectional* one, so this marks another major distinction between the micro- and macro-prudential policies, adding to the ones related to objectives, mechanisms and transmission tools (Crockett, 2000; Clement, 2010; Schoenmaker and Wierds, 2011; Borio, 2014). Therefore, the macro-prudential approach addresses the pro-cyclicality of the financial system, by calibrating simultaneously the systemic impression of individual banks and the evolution of systemic risk.

C. A stepwise establishment of the macro-prudential framework

The recent financial crisis paved the way for a comprehensive financial system oversight and determined the creation of an EU dedicated macro-prudential framework, which contains specific financial stability objectives, tailor-made instruments and procedures, and also dedicated authorities.

From an international perspective, we can note that the regulatory standards and prudential guidelines, such as the Basel Agreement, include specific macro-prudential indications. More specifically, the latest Basel Agreement requires banks to hold more regulatory capital of a better quality in view of improving the ability of banks to absorb ex-post shocks and to strengthen bank soundness, transparency and disclosure, but also to control the ex-ante risk-taking behavior of banks and to ensure a proper risk management.²⁸ Thus, the agreement contains new tools that have an explicit macro-prudential nature (e.g. countercyclical capital buffer, capital conservation buffer, and systemic risk buffer).²⁹

From a European Union (EU) perspective,³⁰ the Basel III framework has been fully implemented by the directly applicable Capital Requirements Regulation (CRR)³¹ and the Capital Requirements Directive IV (CRD IV)³² which has been transposed on the national law by EU member states. Consequently, in Figure I.10, it can be seen a timeline of the establishment of the EU macro-prudential framework (European Systems of Financial Supervision – ESFS), where the major role was played by the recommendations of the High Level Group on Financial Supervision, also known as *De Larosière report*.³³

The *European Systems of Financial Supervision* was set up as a decentralized and multidimensional system of micro- and macro-prudential authorities. The micro-prudential pillar is composed of: (i) three main European Supervisory Agencies (ESAs), namely the European Banking Authority (EBA), the European Insurance and Occupational Pensions Authority (EIOPA) and the European Securities and Markets Authority (ESMA); (ii) the Joint Committee of the ESAs; and (iii) national micro-prudential authorities. Furthermore, the macro-prudential pillar is composed of the European Systemic Risk Board (ESRB)³⁴ and national macro-prudential

²⁸ In 2012, the Basel Committee on Banking Supervision (BCBS) started a review of the Basel III framework, namely the **Regulatory Consistency Assessment Programme** (RCAP), known also as **Basel IV** because it has a considerable impact on bank capital requirements. This review analyses the timely and consistent implementation of the Basel agreement, and focuses on a robust calculation of risk-weights assets under the new framework, putting a particular emphasis on the banking book, the portfolio of financial instruments and on the operational risk.

²⁹ In addition to previous Basel agreements, Basel III also contains a leverage ratio, a minimum liquidity coverage ratio and a minimum stable funding ratio.

³⁰ The European countries started to cooperate economically in 1951, on that period existing only 6 European Union (EU6) member countries. Over time, more countries decided to join, and since 2013 the EU is formed of 28 member countries (EU28).

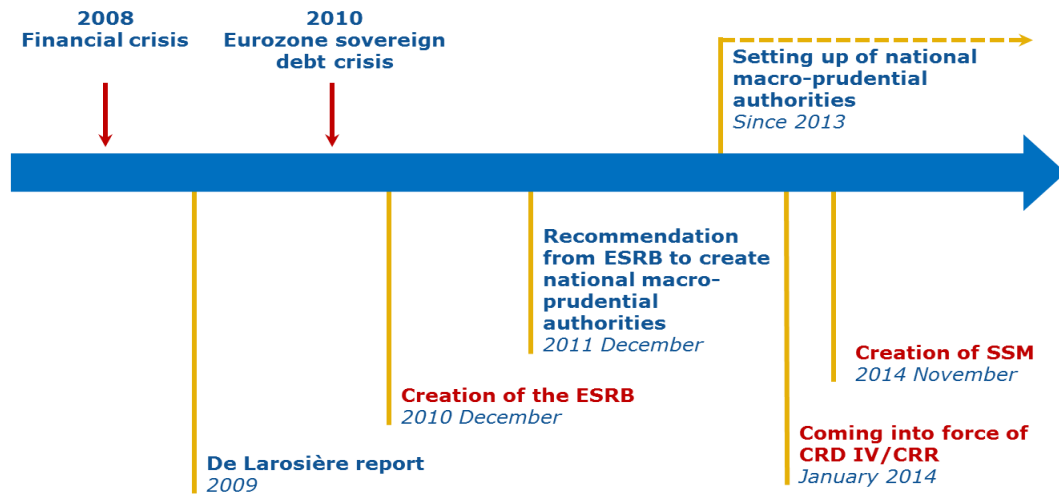
³¹ *Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU), No. 648/2012 (OJ L 176, 27.6.2013, p. 1).*

³² *Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institution and the prudential supervision of credit institution and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC (OJ L 176, 27.6.2013, p. 338).*

³³ De Larosière, J., Balcerowicz, L., Issing, O., Masera, R., Mc Carthy, C., Nberg, L., Pérez, J., Ruding, O. (2009). *The high-level group on financial supervision in the EU*. European Commission.

³⁴ The ESRB was established in 2010, aiming to ensure a EU-wide macro-prudential oversight and a cross-border policy coordination. The legal basis is: *Regulation (EU) No 1092/2010 of the European Parliament and of the Council of 24 November 2010 on European Union macro-prudential oversight of the financial system and establishing a European Systemic Risk Board (OJL 331/1, 15.12.2010, p.1), and Council Regulation (EU) No 1096/2010 of 17 November 2010 conferring specific tasks upon the European Central Bank concerning the functioning of the European Systemic Risk Board (OJL 1096/2010, 15.12.2010, p.1).*

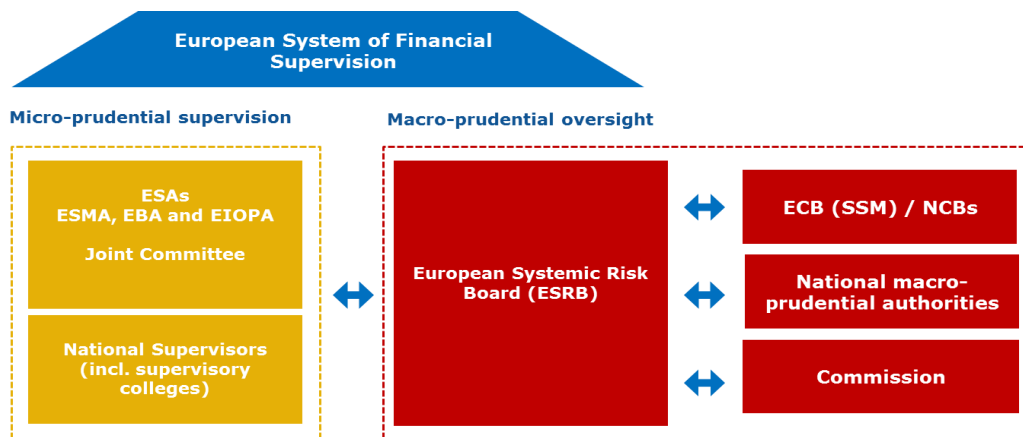
authorities.³⁵ As of 2014, the framework has been complemented with the creation of the Single Supervisory Mechanism (SSM)³⁶ and the Single Resolution Board (SRB)³⁷ with the purpose of supervising and monitoring bank soundness (stability), and ensuring an orderly resolution of failing banks with a minimum impact on the economy.



Source: retrieved from the European Commission

Figure I.10: A stepwise establishment of the EU macro-prudential framework

As it can be seen in Figure I.11, the current existing EU macro-prudential framework and its existing institutions were implemented in a stepwise and coordinated manner.



Source: retrieved from the European Commission

Figure I.11: A stepwise establishment of the European System of Financial Supervision (ESFS)

Consequently, the macro-prudential construction has been broadened in several phases, as a response to different distressing events. Though, this gradual development has given rise to

³⁵ At the national level, macro-prudential authorities were established in response to the ESRB Recommendation ESRB/2011/3 (Recommendation of the European Systemic Risk Board of 22 December 2011 on the macro-prudential mandate of national authorities (OJL 2012/C 41/01, 14.02.2012, p.1).

³⁶ Council Regulation (EU) No 1024/2013 of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions (OJL 1024/2013, 29.10.2013, p.63).

³⁷ Regulation (EU) No 806/2014 of the European Parliament and of the Council of 15 July 2014 establishing uniform rules and a uniform procedure for the resolution of credit institutions and certain investment firms in the framework of a Single Resolution Mechanism and a Single Resolution Fund and amending Regulation (EU) (OJL 806/2014, 30.07.2014, p.1).

subsequent inconsistencies and ambiguities in the macro-prudential framework. For example, the ESRB was preceding the set-up of national macro-prudential authorities, the Single Supervisory Mechanism and the Single Resolution Board, thus these entities are not reflected in the ESRB's constituency. In the same vein, the tools and activation procedures comprised in CRR/CRD IV do not consider the presence of new supervisory structures under the Banking Union,³⁸ which affects the coordination and communication between institutions. What is more, a similar tendency was observed in other jurisdictions as well. For example, the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act in the US created the Financial Stability Oversight Council (FSOC),³⁹ the Office of Financial Research (OFR) and the Bureau of Consumer Financial protection (CFPB), with the main purpose of identifying and managing risks to financial stability. More recently, in 2016, the Chinese monetary authority introduced the Macro-Prudential Assessment System (MPA) with the objective of evaluating a wide range of risks to financial stability and ensuring a better coordination among regulators.

Within this macro-prudential framework, policy makers have sufficient tools to address risks to financial stability, and implicitly to bank soundness. A major input of the current macro-prudential policy is the strategy to encourage the build-up of buffers and to repair balance sheets.

Though, we consider that progress still needs to be done in relation to the future macro-prudential policy, namely the tackling of specific risks from various sectors (e.g. risks in the real estate sector) or even the macro-prudential policy beyond banking. In addition, we consider that revisions of the current macro-prudential framework are very important in order to eliminate or diminish the existing inconsistencies between the macro-prudential measures but also those observed when comparing the micro- and macro-prudential measures. For example, we have identified a series of overlaps between some of the macro-prudential measures with a very high flexibility, namely the systemic risk buffer and art. 458 CRR which can be applied for various categories of risks, covering all intermediate objectives (Figure I.9) but also new classes of risks. As such, these measures can be easily manipulated by national authorities in targeting different risks and avoiding the use of the proper instrument, as aimed by the current regulatory framework. Moreover, other inconsistencies are also noted between the micro- and macro-prudential measures (e.g. overlaps in the use of Pillar 2 requirements) or regarding the voluntary reciprocation

³⁸ The *Banking Union* implies a shift of power from the national to the EU level, allowing for a broad transposition of the EU banking regulation, and the expansion towards new decision-making rules and procedures. In addition, it implies the creation of new tools with the purpose of ensuring a transparent, consolidated and strong banking sector. The Banking Union is based on two main entities, respectively the Single Supervisory Mechanism (SSM) and the Single Resolution Mechanism (SRM), which are driven by a single rulebook applicable to all EU member states.

³⁹ *Dodd-Frank Wall Street Reform and Consumer Protection Act 2010* (H.R. 4173 – 111th Congress, 21.07.2010).

framework for the macro-prudential policy (e.g. lack of clarity in the definition of non-material exposures).

Overall, it would be very important for the macro-prudential policy to keep up and be in tune with policy initiatives, particularly with the micro-prudential, monetary and fiscal ones, in order to ensure its overall efficiency, effectiveness and consistency; thus consensus over the best practices still needs to emerge (for a comprehensive literature review on the efficiency and effectiveness of the current macro-prudential framework, see Appendix I.4).

1.2.2 Indicators of solidity and solvency

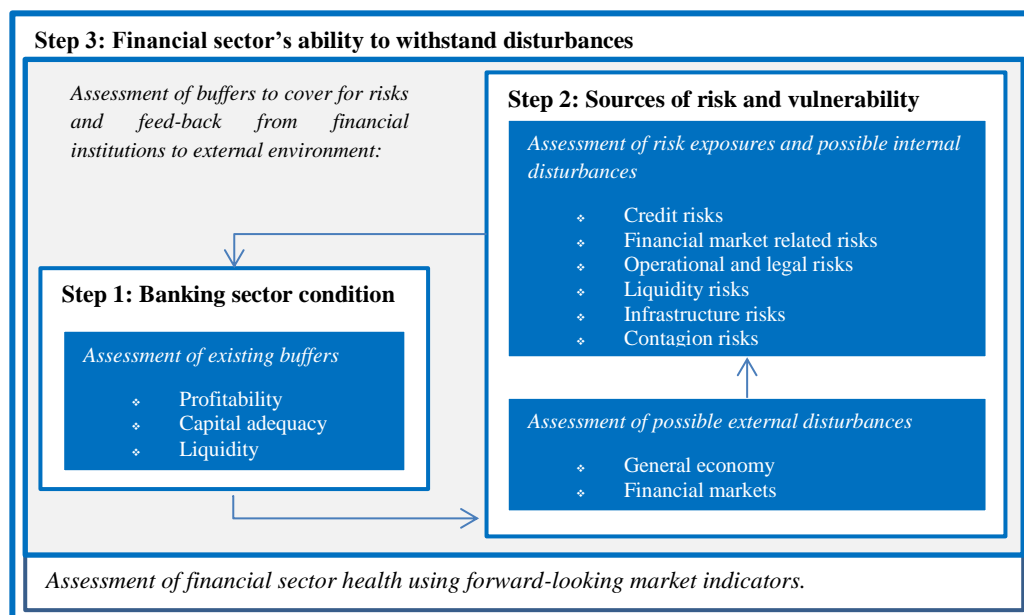
Monetary authorities, additional to the supervision of banks' behaviour, are also monitoring in a systematic manner banks' strength, together with the elements which could pose reasonable risks to financial stability. Thus, in addition to their increased efforts in ensuring an optimal macro-prudential oversight, international monetary authorities in cooperation with academia developed various sets of important banking soundness statistics. Among these sets, we can note the following frameworks: (i) a European framework, namely the ECB's macro-prudential indicators; (ii) a U.S. framework, namely the IMF's financial soundness indicators (FSIs); (iii) a general framework, discussing other financial soundness indicators identified in the literature.

1.2.2.1 ECB's Macro-prudential indicators

Given several continuous variations in the European regulatory framework, the European Central Bank (ECB), by setting the European System of Central Banks (ESCB), and in collaboration with the Banking Supervision Committee (BSC), has engaged in the development of a framework for financial stability analysis.⁴⁰ In fact, in the European Union (EU), the most important contributions that the European Central Bank and the ESBC are bringing, are the monitoring and supervision of financial stability with the main purpose of preserving the financial system's resilience within the EU. Consequently, the macro-prudential analysis has been performed on a consistent base since 2000. In addition, the main purpose was to capture all relevant risks threatening the financial system, which are determined either by traditional elements or by the alterations in the financial markets. Consequently, it was stated the macro-prudential framework should have a wide-ranging purpose and also a dynamic nature (Mörtinen *et al.*, 2005).

⁴⁰ The ECB's commitment in the Treaty on European Union states that ECB should “*contribute to the smooth conduct of policies pursued by the competent authorities relating to the prudential supervision of credit institutions and the stability of the financial system*” (Treaty on the European Union, Art. 105).

The framework promoted by ESCB is characterized by three main sections which cover the macro-prudential prudential indicators, namely: *the first section* focuses on the evaluation of the current situation observed in the financial sector; *the second section* pursues the actual or potential sources of risk that banks are facing, assessing also the size of these exposures; *the third section* is oriented towards the resilience of banks related to various sources of risk and vulnerability (see Figure I.12 for a concise description of the macro-prudential framework).



Source: retrieved from Mörtingen et al. (2005), p.19.

Figure I.12: Main elements of the macro-prudential framework

In Figure I.13 we can note the main sections of the ESCB macro-prudential framework. *The first section* studies the current financial situation observed in the financial system, providing a comprehensible starting point for the assessment of banking system's ability to withstand potential adversative events. Moreover, profitability, capital adequacy and liquidity are the elements that provide a clear picture on bank's cushion to absorb losses or outflows of funding sources. Continuing, the resilience of the whole financial sector is highly dependent on the levels of risks observed in the banking sector, but also on the banks' exposures and their ability to overcome potential threats. As a result, *the second section* deals with two main issues, namely: the identification of actual banking exposures to different types of risks and the channels through which these risks can manifest (internal disturbances), and given the complex nature of risks which can come from endogenous developments in the banking sector but also from external macroeconomic or financial market conditions, the second issue aims an analysis of the potential external disturbances. Finally, in *the third section* it is studied the resilience of bank vis-à-vis the diverse mutual sources of risk. Undoubtedly, consistent with the aforementioned definition of

financial stability given by the ECB, the assessment of the impact of risks on bank's situation (bank's default risk) is the major purpose of the macro-prudential analysis.

Another relevant aspect related to the MPIs refers to the *geographical scope* pursued within this framework. Consequently, while the ECB investigations concentrate mostly on the Euro-area and EU as a whole, the conformation of both geographical regions has transformed in the last period and is going to change ever more considering the recent political events (for more details regarding the structure of the EU see Appendix I.5).⁴¹ As mentioned before the MPIs should be dynamic by nature, which implies a high flexibility so that in an environment with miscellaneous financial sector structures, the MPIs should be capable to accommodate such variations, while permitting the aggregation of national data across regions.⁴²

The ECB makes also the *differentiation between types of banks*, so starting from 2004 the ECB publishes the MPIs for banks based on the consolidated banking data, and divided according to their size into small, medium-sized and large banks. This action has the benefit of being easy to implement and proposes a first estimation for various sorts of business models of banks. Though, the growing complexity of banks makes country-level aggregate data progressively problematic to understand and interpret.

Related to this topic there is also the issue of *data sources* of MPIs, which is diversified, but can be easily divided in three main groups: national supervisory data, consistent macroeconomic statistics, and market data. On the one hand, the harmonization of macroeconomic statistics is easy, while the synchronization and aggregation of micro-prudential data is often more problematic because this type of data was initially designed to monitor the business of individual banks. Besides, it was stated that the construction of meaningful time series is only conceivable if supplemented by comprehensive metadata, aspect that can easily explain the limits of the database.

Lastly, another aspect to study is the one associated to *accounting and supervisory changes* in the European framework. More specifically, the introduction of the International Accounting Standards (IAS), International Financial Reporting Standards (IFRS) and Basel III have determined an update of the fundamental data definitions and aggregation processes of MPIs for banks founded on consolidated data.

⁴¹ Significant changes regarding the structure of the EU are still ahead. For example, following a referendum on June 2016 in which approximately 52% of votes cast were in favour of leaving the EU, the UK government agreed to officially exit from the EU by invoking Art. 50 of the Treaty on European Union by the end of March 2017 (phenomenon known as "Brexit").

⁴² Agresti, A., Baudino, P., Poloni, P. (2008). *The ECB and IMF indicators for the macro-prudential analysis of the banking sector* (ECB Occasional paper Series No. 99), p. 15.

1.2.2.2 IMF's financial soundness indicators

As noted before, an increasing attention is being received by issues as structural, institutional and macroeconomic changes in the financial system. Furthermore, the extent and movement of international capital flows have contoured a significant importance granted to the grounds of national financial systems in relation to the resilience to capital flow volatility. Consequently, bank soundness is a vital element of infrastructure for robust macroeconomic performance and efficient national monetary policy.

In the context of the 1997-98 Asian Crisis there were discovered major gaps in statistical coverage of both internal and external sector vulnerabilities, and it was highlighted the vital need for a better understanding and monitoring of financial data. As a result, the International Monetary Fund (IMF) has started collecting monetary statistics from various countries, and in 1999 they began an investigation of the soundness and risk indicators that had to be compiled based on different types of information and data availability. Furthermore, from the mid-2000, the IMF performed a *Survey on the Use, Compilation, and Dissemination of Macprudential Indicators*, and based on the survey information and after a series of extensive consultation with experts, setting bodies and member countries, the IMF finished and published the *Compilation Guide: Financial Soundness Indicators*.⁴³

In time, the Compilation Guide has been amended with the main purpose of enhancing the comparability among countries. Moreover, the financial soundness indicators (FSIs) have been seen as a part of a large financial stability framework with the main purpose of assisting macroprudential analysis at a country level. In addition, the methodology used for the compilation of the FSIs is based on a mixture of principles, extracted from prevailing statistical, accounting and supervisory standards.

In fact, FSIs are “*indicators of current financial health and soundness of the banks in a country, and of their corporate and household counterparts.*”⁴⁴ In terms of the *structure of FSIs*, it can be noted two main sets, namely the core set and the encouraged set. *The core set* is computed exclusively for deposit takers and is based on the CAMELS approach (see detailed discussion on CAMELS in section I.2.2.4). In addition to the core set, it was developed *the encouraged set*, with the main purpose of providing additional information on deposit takers, but also on non-deposit-takers and markets.

⁴³ The Compilation Guide was resealed in electronic format in 2004 and in printed format in 2006.

⁴⁴ International Monetary Fund (2006). *Financial Soundness Indicators. Compilation Guide* (IMF Compilation Guide), p.12.

Continuing the discussion with the *geographical scope* of the FSI, it can be distinguished that this aspect is not discussed in the Compilation Guide. Generally speaking, FSIs are regarded from a national perspective and have to be compiled by national authorities.

One particularity of the FSIs refers to the consolidation basis. Despite the fact that there are registered several approaches to assess country-specific features and various analytical needs, the Compilation Guide recommends only two of them, namely: the *domestic consolidation basis* (DC) and the *domestically controlled cross-border consolidation basis* (DCCB). The first consolidates only the data for banks and their branches and subsidiaries that activate inside the national limits of the country. However, the cross-border consolidation incorporates the activity of the parent bank and its local and international branches and subsidiaries. The Compilation Guide favors the cross-border procedure for compiling FSIs in the case of deposit takers.

Another aspect important for FSIs is the relationship with *international accounting standards*. The initial 2006 version of the Compilation Guide was drawn on the existing frameworks for statistical, accounting and supervisory data. More specifically the compilation of the FSIs was created by considering the IAS/IFRS. Besides, in 2008 the Compilation Guide was amended to completely fulfill IFRS standards on recording fees and commission receivable/payable along with gains and losses on assets accessible for sale.

Overall, there are a few *points of convergence* between the MPIs promoted by the ECB and the FSIs promoted by the IMF, among which we can observe a similar general objective and similar methodology. However, there are also distinguished many *points of divergence* between these two areas (see Appendix I.6). Amid the differences, the most important ones refer to the geographical space, compilation and consolidation approach. From the comparison of the two sets of indicators we can observe also that the MPIs include a wider range of metrics, but some of the FSIs (especially from the encouraged set) have no equivalent in the MPIs (Mörttinen *et al.*, 2005). Consequently, we consider that, when monitoring bank soundness, it's better to compare both sets and select the pertinent indicators from each of them in order to obtain more robust results.

1.2.2.4 Other financial soundness indicators

Apart from the two sets of financial indicators discussed above, there are also other measures touching upon all significant financial and operational elements that influence the solidity and solvency of a bank. First of all, financial analysts use ***CAMELS Rating System*** to describe bank soundness (see Table I.4).

Table I.4: Description of CAMELS Rating System

CAMELS Rating		
	General question	Weights
Capital adequacy	Does the bank have enough money, loan income, and investments to cover its deposits and business costs?	20%
Asset quality	Are banks granting loans that are probable to be paid back? Are banks' investments expected to be rewarding?	20%
Management	Does bank management take efficient and effective decisions?	25%
Earnings	Is the bank registering sound profit?	15%
Liquidity	Does the bank have a sound asset/liability management?	10%
Sensitivity	How sensitive is the bank to market risk?	10%

Source: retrieved from Lopez (1999)

From a historical perspective, it can be noted that in 1979, the Uniform Banks Rating System was implemented for the US banks, and later, as a recommendation by the US Federal Reserve, it was applied globally. This system was known as CAMEL rating system until 1995, when the Federal Reserve replaced it with CAMELS, including an additional indicator to the system which considers the exposure to market risk. Usually, the analysts rank the banks in five major categories, issuing points from 1 to 5, where 1 is the highest rating and 5 is the lowest rating. In accordance with the points given and weights of each indicator, a bank is classified into a structure of numerical ratings (see Table I.5).

Table I.5: CAMELS Rating System: Numerical Ratings

CAMELS Rating			
Rating	Composite Range	Numerical Rating	Meaning
1	1.00 – 1.49	Strong	<ul style="list-style-type: none"> • Indicatives of soundness and performance are higher than average • Very resistant to external disturbances • No basis for supervisory concern
2	1.50 – 2.49	Satisfactory	<ul style="list-style-type: none"> • Performance and soundness are around average or above • Stable and a high probability to withstand external disturbances • Supervisory concerns are in normal limits
3	2.50 – 3.49	Fair	<ul style="list-style-type: none"> • Performance and soundness are damaged in some degree • Vulnerable to external disturbances • Supervisory concerns are above normal limits for addressing deficiencies
4	3.50 -4.49	Marginal	<ul style="list-style-type: none"> • Performance and soundness are significantly below average • High sensitivity to external disturbances and high probability of failure • Supervision concerns are at a high level in terms of correcting deficiencies
5	4.50 – 5.00	Unsatisfactory	<ul style="list-style-type: none"> • Performance and soundness are critically deficient and in need of immediate intervention • Immediate or near-term probability of failure • Vital need for aid from stockholders and immediate corrective actions (e.g. M&A, liquidations)

Source: retrieved from Lopez (1999)

The main objective of the CAMELS ratings is to identify a bank's overall condition and to discover its strengths and weaknesses in terms of financial, operational and managerial activities. Additionally, Barr *et al.* (2002) outlined that CAMELS ratios have become a brief and crucial instrument used by analysts, supervisors and regulators, highlighting a bank's health conditions by studying diverse aspects of banks' activities. Though, in 1999, Hirtle and Lopez, outlined that this rating system was initially extremely confidential, and it was revealed only to the bank senior management and to appropriate staff, being used in the development of future business strategies. Currently, given the increased transparency of banks, if these ratios are not provided by the bank, in most of the cases, they can be computed individually based on the minimum accounting information provided to the general public.

A second measure used in financial analyses is referring to *Altman's z-score*, which was developed in the paper of Altman (1968) based on multiple discriminant analysis and represented a bankruptcy predicting tool. Furthermore, initially, this indicator was computed for 66 US-based manufacturing companies that were publicly traded, out of which 33 have filed for bankruptcy in the period 1946-1965. The classical design for Altman's z-score takes the subsequent form:

$$Altman's\ z - score_M = 1.2 \times \frac{Working\ Capital}{Total\ assets} + 1.4 \times \frac{Retained\ Earnings}{Total\ assets} + 3.3 \times \frac{EBIT}{Total\ assets} + 0.6 \times \frac{Market\ value\ equity}{Book\ value\ of\ total\ debt} + 0.99 \times \frac{Sales}{Total\ assets} \quad (I.37)$$

Where *Altman's z - score_M* stands for the bankruptcy score for manufacturing companies and EBIT stands for earnings before interest and taxes.

As mentioned, the previous formula was developed specifically for manufacturing companies, but there is also a formula for non-manufacturing companies, such as financial institutions, and takes the following form:

$$Altman's\ z - score_{NM} = 6.56 \times \frac{Working\ Capital}{Total\ assets} + 3.26 \times \frac{Retained\ Earnings}{Total\ assets} + 6.72 \times \frac{EBIT}{Total\ assets} + 1.05 \times \frac{Book\ value\ of\ equity}{Total\ liabilities} \quad (I.38)$$

Where *Altman's z - score_{NM}* stands for the bankruptcy score for non-manufacturing companies.

In terms of the interpretation of Altman's z-score, there can be distinguished three zones of discrimination, respectively:⁴⁵

- ❖ *Safe zone*: where Altman's z-score is higher than 2.99;
- ❖ *Grey or undetermined zone*: where Altman's z-score can be found in the interval [1.81;2.99];
- ❖ *Distress or bankruptcy zone*: where Altman's z-score is smaller than 1.81.

Initially, this metric was found to be 72% precise in predicting bankruptcy two years preceding the bankruptcy but, in time, the accuracy of this metric has improved (Altman *et al.*, 1977). More recently, this indication has been confirmed by Al Zaabi (2011) who used this metric to assess the probability of bankruptcy for major Islamic banks in the UAE. He suggested that Altman's z-score can be adjusted for the Islamic banking system as an autonomous credit risk analysis, mainly because this indicator is a helpful analytical instrument that complements other financial techniques. Similar results were obtained by Lugovskaya (2010), Bhandari and Iver (2013) and Li *et al.* (2013).

Though, as stated by Altman (2000), a revised Altman's z-score is more than suitable, considering the mutations in the size and financial profile of failures, the sequential nature and limited availability of the data, and last but not least, the necessity to evaluate more vulnerable groups of companies, such as banks whose importance has grown fiercely over the last years.

What's more, in response to the challenging economic landscape and sharp demand for real-time information to cope with risk, in 2012, Edward Altman in partnership with Business Compass LLC, has expanded its classical model and launched a new application of *Altman z-score Plus*. Compared to the traditional score, the new metric also covers non-US companies, both public and private, in developed or emerging economies. In addition, the new Altman's z-score comprise the measurement of a 1- to 10-year probability of default, a percentile classification probability of bankruptcy according to the industrial groups, and a bond-rating equivalent for each corporation that compares its latest indicator with the average value for suitable bond rating classes from AAA to D. In addition, Almamy *et al.* (2016) extended the traditional Altman's z-score by including another variable in the equation, namely the ratio of cash flow from operations to total liabilities. Consequently, they observed that, for the UK companies, the extension of the classical model leads to better results and a higher accuracy in predicting the overall financial health.

⁴⁵ Altman, E. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance*, 23 (4), p.594.

A third indicator of soundness, applied in the majority of studies on bank soundness is the one developed by Boyd and Runkle (1993) entitled also *Z-score*,⁴⁶ though being based on a different formula compared to Altman's z-score. The Z-score is an estimate of the *probability of failure* and is computed as follows:

$$Z = \frac{(ROA+CAR)}{d(ROA)} \quad (I.39)$$

Where *ROA* represents bank's return on assets, *CAR* the equity capital as a proportion of total assets and *d(ROA)* shows the standard deviation of ROA, as a proxy for return volatility, and ε represents shareholders' profits. The probability of insolvency, or insolvency risk, is well-defined as the probability that losses exceed equity, as we can see in the following:

$$P[\pi \leq -E] = P[ROA \leq -CAR] = \int_{-\infty}^{-CAR} f(ROA)d(ROA) \quad (I.40)$$

According to the work of De Nicolo (2000), this probability satisfies the following inequality:

$$P[ROA \leq -CAR] \leq \frac{d(ROA)^2}{(ROA+CAR)^2} = \frac{1}{Z^2}, \text{ where } Z = \frac{(ROA+CAR)}{d(ROA)} \quad (I.41)$$

Consequently, an increase of the Z-score's value is equivalent to a decrease of the upper bound of the insolvency risk. Beneath the postulation of bank's return to normality, Z-score can be interpreted as the number of standard deviations below the mean by which would have to fall in order to diminish equality. According to the literature the value of Z-score is increasing with a higher profitability and capitalization and decreasing when there are registered fluctuating incomes.⁴⁷

From one perspective, Z-score is known for its benefits. Beside the fact that this indicator is easy to compute, it can be applied for banks which are more sophisticated and for which market based data is not available. Also, the Z-score permits comparisons between different types of banks, which may differ in terms of their ownership or specialization. For instance, Chiaramonte *et al.* (2015) studied the accuracy of the Z-score compared with CAMELS ratios, and found that the former has the same abilities to identify distress events as the latter, but with the advantage of

⁴⁶ In the empirical literature, the most commonly used measure for BS is Z-score or natural logarithm of Z score (see Appendix II.4 for examples of papers). Though some studies, measure BS by alternative indicators, such as "financial strength of ratings" (Bharath and Shumway, 2008; Lopez-Espinosa *et al.*, 2013), financial distress indicator (Nier, 2005) or tail risk β (De Jonghe, 2010), among others.

⁴⁷ For example: Demirgüç-Kunt and Laeven (2004), Beck *et al.* (2006a), Mercieca *et al.* (2007), Shih *et al.* (2007), Lepetit *et al.* (2008b), Laeven and Levine (2009), Schaeck *et al.* (2009), Čihák and Hesse (2010), Fu *et al.* (2014).

requiring less data. In addition they have proven that Z-score is much more effective when assessing complex business models, as we can note in the case of large banks or commercial banks.

Despite the extensive use of this indicator, it was drawn the attention towards some drawbacks that Z-score might encounter. Perhaps the most important limitation is that this indicator is founded only on accounting data, and this aspect can be seen in relation with the validity and reality of the data provided by each bank. In addition, the Z-score is considering only the microeconomic perspective, examining individual banks, thus it can overlook the contagion risk, when a failure of one bank can cause serious damage to other banks. Furthermore, in terms of Z-score it was also highlighted the problem of endogeneity. Since, ROA and $\sigma(ROA)$ are drawn from different distributions, this could imply an inconsistency problem. To overcome this issue and obtain more robust results it was developed an alternative Z score (Z_{alt}) by Yeyati and Micco (2007) and further applied by Fiordelisi and Salvatore Mare (2014), as following:

$$Z_{alt} = \frac{\mu(ROA)+CAR}{d(ROA)} \quad (I.42)$$

Where, $\mu(ROA)$ stands for the mean of ROA within each individual bank at a specific time.

Moreover, Lepetit and Strobel (2013) assessed and compared various existing approaches for the construction of Z-score, focusing on a panel of banks operating in the G20 countries for the period spanning from 1992 to 2009. Their overall results support a time-varying Z-score which utilizes the mean and the volatility estimates of the return on assets computed for the full sample combined with current values of capital adequacy ratio. More recently, Lepetit and Strobel (2015) re-examined the probabilistic basis of the connection between traditional Z-score and a bank's probability of default (insolvency), constructing a better measure for the probability of insolvency without imposing additional distributional assumptions. They made use of the classical and log-transformed Z-score measures, and proved that the log of Z-score is negatively proportional with the likelihood of insolvency for the banks studied. From a practical implementation point of view, there can be noticed other advocates of the log-transformed Z-score measure over the traditional Z-score measure, being suggested that the latter's distribution is usually heavily skewed, whereas the former's distribution is not (e.g. Laeven and Levine, 2009; Houston *et al.*, 2010).

Apart from the mentioned indicators, in the literature we can note additional measures used to assess BS, being distinguished in terms of their methodological complexity (see Appendix I.7 for a detailed list and description of the major indicators identified).⁴⁸ Furthermore, those

⁴⁸ In addition to indicators described in this section and Appendix I.7, there are also papers who focused on capital flow measures (e.g. Chinn and Ito, 2008; Schindler, 2009; Forbes *et al.*, 2014; Chantapacdepong and Shim, 2014), while some others developed complex international macro-prudential databases (e.g. Lim *et al.* (2011) developed a database of 10 types of macro-prudential

soundness measures can be classified after different criteria. For example, on the one side we can distinguish these measures according to the frequency of data, starting from weekly to annual indicators. On the other side, another criterion can refer to the target sample, expanding from one country, such as Canada or the United States, towards a more diverse group comprising various countries.

1.2.3 Methodological designs used to assess bank soundness⁴⁹

Bank soundness denotes a solid banking system that is well-regulated, well-supervised and where risks borne by individual banks are properly managed and continuously monitored. Though, the recent financial disturbances that peaked in 2008 have shown that the banking sector was the heart of the crisis, being the main source of vulnerabilities. Moreover, an important role was played by banks' individual characteristics, being considered as factors of systemic instability, thus riskier banks, characterized by higher financial fragility, contributed more to systemic risk.

Although the theoretical and empirical literature on BS is flourishing, in the majority of studies the main measure of individual BS is the traditional Z-score. Though, we consider BS as being highly interrelated with systemic risk, thus systemic risk measures could be used to assess banking system soundness (stability).

Owing to the complex and adaptive nature of the financial system, systemic risk measurement is facing a series of limits and challenges both of a regulatory and technical nature. First, the definition and notion of systemic risk is fully recognized and clear, though there is still no agreement among regulators and academia on the best options to operationalize it. Second, systemic risk measurement is challenging particularly considering various competing or even contradictory views on what are the risks to banking soundness and the best methods to assess those risks. Moreover, this measurement translates in particular decisions related to the elements to be measured, the frequency and observation interval and the level of granularity and accuracy of the method. Third, an optimal systemic risk measurement requires rapid access to detailed information on banks and markets both locally and internationally. Currently the access to information is facing a series of barriers, namely regulatory restrictions, limited disclosure,

measures for a sample of 49 countries in the period spanning from 2000 to 2010, while Kuttner and Shim (2012) created a database for 60 countries, focusing on the housing-related macro-prudential instruments for the period 1990-2012.

⁴⁹ A version of this sub-section will be published in the *Review of the macro-prudential framework 2017*, European Commission. A version of this sub-section will be published in the *European Commission Staff Working Document on European Financial Stability and Integration Review (EFSIR) 2017*.

difficulties in obtaining data for all financial market participants (e.g. non-banks) and even reporting discrepancies and lags.

Against this background, there were developed numerous methods to measure systemic risk. The current literature focusing on this topic can be classified in the following two approaches: (i) the main causes (sources) of systemic risk; and (ii) the key measures of systemic risk (see an overview in Table I.6).

Table I.6: Overview of systemic risk approaches, methods and examples of papers

	Approach		Examples of papers
Sources of systemic risk	Systemic risk sources (Source-specific approach)	Systemic-risk taking	Bernanke and Gertler (1989), Lehar (2005, Gray <i>et al.</i> (2007), Acharya (2009), Gray and Jobst (2009), Brunnermeier <i>et al.</i> (2014)
		Contagion	Rochet and Tirole (1996), Allen and Gale (2000), Freixas <i>et al.</i> (2000), Hakenes and Schnabel (2011b), Ratnovski (2009, 2013) Drehmann and Tarashev (2011)
		Amplification	Diamond and Dybvig (1983), Shleifer and Vishny (1992)
Measures of systemic risk	Individual approach (single channels of systemic risk)	Contingent claim analysis	Lehar (2005), Gray <i>et al.</i> (2007), Gray and Jobst (2009)
		Cluster analysis	Blei and Ergashev (2015)
		Systemic risk indicator ACRISK	
		Default intensity model	Giesecke and Kim (2011)
		Liquidity mismatch index (LMI)	Brunnermeier <i>et al.</i> (2014)
	Multi-channel approach (multi-channels of systemic risk)	Systemic risk-adjusted liquidity model (SRL)	Jobst (2014)
		MES/SES	Acharya <i>et al.</i> (2017)
		SRISK	Acharya <i>et al.</i> (2012), Brownless and Engle (2016)
		Δ CoVaR	Adrian and Brunnermeier (2016)
		SYMBOL	
Other approaches	Correlations	Patro and Xian Sun (2013)	
	Joint distribution of extreme losses	Hartmann <i>et al.</i> (2006), de Jonghe (2010)	
	Default probability/ probability of systemic crises	Lehar (2005), Bharath and Shumway (2008), De Jonghe (2010), Uhde and Michalak (2010), Wagner (2010), Vallascas and Keasey (2012), Drehmann and Tarashev (2013), Girardi and Ergün (2013), Lo Duca and Peltonen (2013), Lopez-Espinosa <i>et al.</i> (2013), Fu <i>et al.</i> (2014), Kiema and Jokivuolle (2014)	
	Joint default probabilities	Goodhart and Segoviano (2009), Giglio (2014)	
	Dynamic copula	Oh and Patton (2016)	
Structural models	Network models	Stress testing (distress insurance premium index, DIP)	Huang <i>et al.</i> (2009, 2012)
		Multiple measures	Allen <i>et al.</i> (2012), Cai <i>et al.</i> (2014), Yun and Moon (2014)
		Single layer (Monoplex)	Boss <i>et al.</i> (2004, 2006ab), Inaoka <i>et al.</i> (2004), May <i>et al.</i> (2008), Nier <i>et al.</i> (2007), Propper <i>et al.</i> (2008), Haldane (2009), Gai and Kapadia (2010), Arinaminpathy <i>et al.</i> (2012), Battiston <i>et al.</i> (2012, 2016), Markose <i>et al.</i> (2012), Di Iasio <i>et al.</i> (2013), Montagna and Kok (2013), Bargigliet <i>et al.</i> (2015), Poledna <i>et al.</i> (2015), Leon <i>et al.</i> (2016) and Berndsen <i>et al.</i> (2016).
	Multiple-layer	Multiplex	Berndsen <i>et al.</i> (2016).
		Independent	Berndsen <i>et al.</i> (2016)
	Computable general equilibrium model (CGE)		
	Computational agent-based model (CABM)		Axtell <i>et al.</i> (2003), Poledna and Thurner (2016), Ashraf <i>et al.</i> (2017)

The first approach covers mostly qualitative methodologies on studying various sources and channels of systemic risk, such as bank failures (systemic risk taking), contagion or amplification (crises). Furthermore, a variety of instruments have been developed and introduced to monitor the sources and channels of systemic risk in order to correct market failures, avoid significant losses on the real economy and restrain other externalities influencing the financial system. Although these instruments are long seen as macro-prudential instruments from a regulatory and supervisory perspective (Crockett, 2000; Borio; 2003), only recently the academics started analysing their efficiency and effectiveness.⁵⁰

The second approach debates on various measures of systemic risk, integrating partly the methods discussed in the first family of papers. Systemic risk measures can be classified considering three main interrelated features that explain the vulnerability of financial systems to systemic risk, namely: (i) *the structure of bank balance sheets* (market-data based measures); (ii) *the exposure to the banking networks* (topology, network models); (iii) *inter-temporal nature of financial contracts and credibility concerns* (structural models).

1.2.3.1 Market-data based measures

Market-data based measures can be regrouped as follows: (a) *measures targeting single systemic risk channels*; (b) *measures targeting multiple systemic risk channels*; (c) *other approaches to systemic risk*.

(a) First, a significant part of the empirical literature studies **single systemic risk channels**, noting first of all Lehar (2005), Gray and Jobst (2011ab) who use contingent claims analysis to measure systemic risk-taking. More recently, Blei and Ergashev (2015) develop an indicator of overlap in bank's assets, entitled the ACRISK measure, suggesting that systemic risk is higher when we observe overlapping positions across banks. Additionally, we can also note the Default Intensity Model of Giesecke and Kim (2011) focusing on the conditional probability of failure in the financial sector. The estimators concerning the conditional probability of failure are based on a hazard model of correlated failure timing, including the influence on failure timing of macroeconomic and sector-specific risk factors and past failures. Another approach, in Brunnermeier *et al.* (2014), proposes the Liquidity Mismatch Index (LMI) as a measure to identify most systemically important institutions, which corresponds to the difference between the "cash-equivalent" future values of the assets and of the liabilities of a bank. Additionally, Jobst (2014)

⁵⁰ See, for instance, Akinci and Olmstead-Rumsey (2015), Cerutti *et al.* (2015abc), Schoenmaker and Wierds (2015), and Zhang and Zoli (2016). For a detailed discussion on the efficiency and effectiveness of macro-prudential instruments, see Appendix I.4.

combines option pricing, market information and balance sheet data and develops the Systemic Risk-adjusted Liquidity (SRL) model, which generates a probabilistic measure of the frequency and severity of multiple entities experiencing a joint liquidity event.

(b) Second, another strand of literature is taking a *multi-channel orientation towards systemic risk*. In this sub-category we can note five prominent examples of market-data based measures, namely: (i) the Marginal Expected Shortfall (MES) and the Systemic Expected Shortfall (SES) coined by Acharya *et al.* (2017); (ii) the Systemic Risk Measure (SRISK) developed by Acharya *et al.* (2012) and Brownless and Engle (2016); (iii) the Delta Conditional Value-at-Risk (Δ CoVaR) proposed by Adrian and Brunnermeier (2016); (iv) the Systemic Model of Banking Originated Losses (SYMBOL) developed by the European Commission together with some academics) (Cannas *et al.*, 2012; De Lisa *et al.*, 2011; Benczur *et al.*, 2016).

Acharya *et al.* (2017) uses the *Marginal Expected Shortfall (MES)*⁵¹ as an input to propose another systemic risk measure, called *Systemic Expected Shortfall (SES)*. Their systemic risk measure is defined as the propensity to be undercapitalized when the system as a whole is undercapitalized, and they start by estimating ex-ante MES and leverage using daily equity returns from the year prior to the financial crisis, which is used to motivate the cross-sectional fluctuations in equity returns performances during the recession. Starting from that, Acharya *et al.* (2012) and Brownless and Engle (2016) introduce the *Systemic Risk Measure (SRISK)*. They argue that banks with the largest capital shortfall are assumed to have the highest contribution to systemic risk. The SRISK of a bank is defined as the expected capital shortage the institution would suffer in case of a systemic event. Both the SES and the SRISK are based on the concept of MES; though, the SRISK is considered to have a higher predictive power than SES being an ex-ante methodology, while SES requires the realization of the systemic event, thus being an ex-post methodology. Another popular systemic risk measure is the *Delta Conditional Value-at-Risk (CoVaR)* of Adrian and Brunnermeier (2016) which links the contribution to systemic risk that a bank has, with the increase of the VaR for the whole financial system, being connected with the distressed bank. Besides the advantages that SRISK has over SES, (Brownless and Engle, 2016) argue that this index has some benefits over the CoVaR as well, because it exploits the additivity property, and provides an overall systemic risk measure.

Last, the *Systemic Model of Banking Originated Losses, SYMBOL*, was developed by the JRC, in cooperation with the Directorate-General Internal Market and Services and academics (Cannas *et al.*, 2012; De Lisa *et al.*, 2011; Benczur *et al.*, 2016). The major objective of this method

⁵¹ MES is the expected loss that an investor in the shares of a financial firm would suffer if the market experienced a substantial decline, being seen as a proxy of a systemic event.

is to evaluate the impact of the European Commission's legislative proposals in the field of banking regulation. More specifically, SYMBOL assesses the consequences of bank failures in EU countries, by examining various factors such as higher capital requirements, resolution funds etc.

(c) In addition, some studies take a *different approach* when assessing systemic risk, such as Patro and Xian Sun (2013) who examine the effectiveness of *stock return correlations* among banks as an indicator of systemic risk. Other papers assess systemic risk in relation to the *joint distribution of bank's extreme losses and returns*. For example, Hartmann *et al.* (2006) are among the first to introduce an aggregate banking system risk by using *tail- β* based on multivariate extreme value theory to capture the exposure of banks to extreme shocks. A similar approach was developed by De Jonghe (2010). Another family of studies considers the *joint default probabilities* of banks. For example, Goodhart and Segoviano (2009) assess how individual banks contribute to the potential distress of the system by using the CDSs of these financial entities within a *multivariate copula setting*. Employing a dynamic copula model of credit default swap (CDS) spreads, Oh and Patton (2016) compute a *joint probability of distress*, proving that idiosyncratic default risk has decreased since 2009 in the US while systemic risk has increased during the post-crisis period. Alternatively, Giglio (2014) uses both bonds and CDS spreads to evaluate the joint default of financial entities. Moreover, Huang *et al.* (2009) developed the *distress insurance premium (DIP)*, a distinctive systemic risk indicator related to the insurance premium to cover distressed losses in a banking system, being based on CDS spreads of individual banks and the co-movements in bank's equity return. Huang *et al.* (2012) measure systemic risk as a hypothetical *distress insurance premium*, allocating systemic risk to individual banks. Their results suggested that the elevated systemic risk is initially driven by the risk aversion, as a spillover effect from the international financial crisis; so a decomposition analysis pointed out that bank size is determining the marginal contribution of individual banks to systemic risk, in line with the too-big-to-fail (TBTF) theory.

There are also some studies that combine the previously discussed measures. For example, Allen *et al.* (2012) develops the *CATFIN model* using both VaR and expected shortfall methodologies, complementing bank-specific systemic risk measures by forecasting macroeconomic downturns six months in advance using out-of-sample tests. More recently, Yun and Moon (2014) employs *Engle's dynamic conditional correlation model* by employing the MES and the CoVaR, in order to evaluate the systemic risk contributions of Korean banks. They end up by proposing an aggregate MES with a simpler economic interpretation. Similarly, Cai *et al.* (2014) compared different measures of systemic risk (SRISK, CoVaR, DIP and CATFIN) and proposed another measure of interconnectedness based on Euclidean distances between two bank's

syndicated loan portfolios, observing that highly interconnected banks contribute more to systemic risk, effect which is exacerbated during economic crises.

1.2.3.2 Structural models

Structural models require additional modelling effort and have higher data requirements. In return, they allow policy makers to directly test different assumptions about drivers of risk as well as risk dynamics. There are broadly three categories: (a) *network models*; (b) *computable general equilibrium models* (CGEs) and (c) *computational agent-based models* (CABMs).

(a) Since the paper of Allen and Gale (1998), ***network models*** started to be employed to evaluate the characteristics of the banking sector and financial contagion. Afterwards, we can note Allen and Gale (2000) who studied a complete graph of mutual liabilities. Then, Freixas *et al.* (2000) focused on a circular graph compared to a complete graph. More recently, Berndsen *et al.* (2016) classified network models in two main classes, namely: (i) single layer models (monoplex); and (ii) multi-layer models which can be regrouped in multiplex and independent models.

First, the *monoplex network models*, such as debt rank (Battiston *et al.*, 2012, 2016), allow for the explicit modelling of balance sheet contagion channels as a function of the network structure. As a result, policy variables, such as minimum capital requirements, can be related directly to measures of the overall riskiness of a particular banking network structure. The drawback of monoplex network models is that they require access to supervisory data, they use non-standards modelling techniques, and they model a particular contagion dynamics that cannot be changed during any simulation run since the dependent variable is the network topology.⁵² There are a series of papers employing the monoplex network models, such as: Boss *et al.* (2004, 2006ab), Inaoka *et al.* (2004), May *et al.* (2008), Nier *et al.* (2007), Propper *et al.* (2008), Haldane (2009), Gai and Kapadia (2010), Arinaminpathy *et al.* (2012), Markose *et al.* (2012), and Di Iasio *et al.* (2013). For example, Boss *et al.* (2004) and Boss *et al.* (2006a), employ the monoplex network model to explore the empirical configuration of the Austrian banking system, observing that power laws are strongly interfering within the interbank network, which, in the end, could impact the soundness of the whole system. Starting from a combination of standard techniques from modern quantitative market and credit risk management with a network model, Boss *et al.* (2006b) develop the Systemic Risk Monitor (SRM) model also for the Austrian financial system, assessing the systemic risk in the Austrian banking system at a quarterly frequency (stress testing).

⁵² This lack of capacity to allow for 'conjunctural dynamics' on behalf of financial institutions was prominently criticised by Borio (2003).

In the same vein but focused on different samples are the following papers: Muller (2006) for Switzerland, and Nier *et al.* (2007) for the UK. More recently, Di Iasio *et al.* (2013) implemented a monoplex network model for the Italian financial system to identify systemically important institutions, stressing that the impact of a bank's capital on its contribution to systemic risk in the network is higher when the level of interconnectedness is higher.

Second, *multi-layer frameworks* can be grouped in two main sub-classes, namely multiplex networks and independent networks. This methodology requires defining distinct networks and the interaction between them. On the one side, multiplex networks disclose how single-type financial market participants are interacting with each other in different environments. On the other side, independent networks reveal how distinct layers, corresponding to distinct financial market participants connect with each other. More specifically, in multiplex networks each connection is characterized by its type (Kivela *et al.*, 2012), while in independent networks, the distinct layers are explicitly modelled as separate networks, and the connections between them represent interlayer interactions (Berndsen *et al.*, 2016). The literature on this type of networks is rather new, thus focusing mostly on multiplex networks rather than independent networks.⁵³ Montagna and Kok (2013) examine interbank contagion in the Euro area with a triple-layer multiplex network (long-term direct bilateral exposures, short-term bilateral exposures and common exposures to financial assets). Even more complex, Poledna *et al.* (2015) model the systemic risk changes in the Mexican financial system based on a four-layer multiplex network. More recently, Berndsen *et al.* (2016) assess and compare the properties of both a multi-layered multiplex network and also an independent network for the Colombian financial system. Overall, they stress the importance of infrastructure-related systemic risk, which corresponds to the effects of an inadequate functioning of the financial market infrastructure, or of a contagion conduit in the financial market infrastructure.

(b) Computable general equilibrium models (CGEs) and the sub-group of dynamic stochastic general equilibrium (DSGE) models share as a basis a rigorous, internally consistent modelling of optimizing behaviour of agents, where DSGE models put particular emphasis on the inter-temporal optimization. This is important for monetary policy in particular as it allows the policy maker to "see through" temporary monetary phenomena that should not alter the long-run properties of the economy. CGE models are very flexible and their modelling is well understood (no major skills mismatch), and if inter-temporal aspects are less important, they can shift model flexibility to other parts. CGE models can go a long way in explaining the build-up of risk in the

⁵³ Among the papers focusing on multiplex network models are the following: Montagna and Kok (2013), Bargigiet *et al.* (2015), Poledna *et al.* (2015), Leon *et al.* (2016) and Berndsen *et al.* (2016).

system and in simulating alternative scenarios. Their main drawback remains a limited differentiation of types of agents and they rely on modellers' choices of the speed of adjustment out of equilibrium.

(c) *Computational agent-based models (CABMs)* are preferred because they address the remaining short-comings of CGE models. They do not impose any particular constraint on modelling choices. In particular, they allow for the modelling of institutional detail that may be responsible for real estate sectors in two different locations having very different impacts on systemic risk. The ample modelling flexibility comes at two main costs: first, CABMs require a lot of very granular data, to calibrate their fine-grained behavioural structure, and second, they are very demanding on modelling skills and expert knowledge about the sectors to be modelled (see Axtell *et al.*, 2003). The literature on this topic is scarce, noting first of all Poledna and Thurner (2016) who highlighted that systemic risk tax determines a self-organized restructuring of financial networks that are free of systemic risk. Moreover, Ashraf *et al.* (2017) explored the role played by banks in a model economy, making use of a computational agent-based model. They draw significant distinctions between normal and worst-case scenarios highlighting the "financial stabilizer"⁵⁴ role played by banks, finding also that less restrictive lending standards enable banks to improve their performance during the worst-case scenarios.

Overall, there is a wide variety of methods to measure systemic risk with a particular focus either on the source of systemic risk, the transmission channels or the sample covered. Though, there is a lack of clarity in what concerns the best option for systemic risk monitoring and measurement, and there are still a series of barriers to be overcome before these measures can be made operational at the European level. For example, clarification should be made in relation to the cross-country, cross-currency and cross-market linkages and the location of systemic risk in each financial system. Although promising work is in progress, it is too early to judge how successful each of them will be and what are the advantages and disadvantages of alternative measures.

⁵⁴ Ashraf *et al.* (2017) define the "financial stabilizer" as the role played by banks when a negative macroeconomic shock is the cause of many business failures. In this case banks' presence can finance a replacement of the failed business and sustain the other existing businesses which will outweigh the effect of the shock and will ameliorate a possible second wave of failures. They stress that the "financial stabilizer" role is even more powerful than the financial accelerator one.

I.3 Conclusions

Bank performance and soundness were and continue to be among the most discussed topics in the literature given the vital role played by banks in the current financial systems.

Considering the importance of banks in the financial system, it is understandable the large and flourishing segment of literature focusing on defining and measuring its performance and soundness. Moreover, after the recent financial crisis, banks took important steps to improve their overall performance and soundness in light of the changing economic and financial market conditions. As such, it's essential to understand bank performance and soundness, from their most relevant indicators to complex statistical methodologies.

The main purpose of this chapter is to revise the existing literature and provide a comprehensive evaluation of the most important indicators and methodologies of bank performance and soundness.

First, bank performance (BP) has been addressed in numerous ways in academia, public and private sectors, and no consensus has yet been reached in terms of the best indicators or methodologies to be used when measuring BP. However, the most popular indicators of BP are return on assets, return on equity and net interest margin. Though, recent events have shown us that the common measures of BP highlight only a part of the whole banking picture. For example, return on equity might either reflect a good profitability levels or a limited equity capital. From a methodological point of view, we have observed that the most frequently applied methodology for evaluating BP are the data envelopment analysis, longitudinal regression analysis and stochastic frontier analysis. Regardless of the methodological approach, the scientific methodology requires that every empirical model yields accurate and provable implications concerning the economic phenomena analyzed. Thus, we consider no empirical model as perfect, and give sufficient importance to the construction, testing and revision of models as determining elements in finding an optimal method to describe the economic reality.

Second, in terms of bank soundness (BS), we have noticed that the majority of studies use the traditional Z-score or natural logarithm of Z-score to assess BS. Though, when assessing BS another important aspect has to be considered, namely systemic risk as it poses additional challenges for bank behavior. The recent international financial crisis revealed the limits of the existing regulatory and supervisory practices in effectively tackling risks to financial system soundness. Thus, the 2008 financial crisis corroborated with the multifaceted and robust nature of the financial system, induced the need of addressing risks and challenges present in the financial

system from a macro-prudential perspective. Although the macro-prudential policy plays a vital role in the banking system, some progress still needs to be done, especially in relation to specific risk targeting and inconsistencies in the current framework. In terms of the methodological approaches taken in evaluating BS, we can notice a wide variety of methods of different complexity. Though, more clarity is needed in relation to BS methodological designs, thus there are still numerous barriers to be overcome in order to operationalize these methods (e.g. regulatory restrictions, limited disclosure, reporting discrepancies etc.)

Overall, we consider that the scientific process is a road of discovery, and that novelty is a vital aspect to consider in a scientific research. As such, future research could start from the following aspects.

First, in order to ensure a higher accurateness of the analyses, studies with similar research questions should start from the same basis, namely the same theoretical models with an initial set of variables, and after that develop a complex structure to achieve their main goals. In this way, it should be easier to understand, clarify and predict phenomena, and to challenge and enlarge the existing knowledge, within the limits of the critical bounding presumptions.

Second, a decomposition of BP and BS measures would be very useful particularly during benign financial times, considering that the traditional measures could have certain deficiencies and could be misleading, manipulated or influenced by seasonal elements. Consequently, a more detailed analysis of BP and BS could be most beneficial particularly when the traditional indicators or methodologies of BP and BS do not show a clear picture of the bank business models and risk-taking behaviour.

Third, future work could focus more on alternative measures of BP and BS or alternative techniques. Regarding the former, our analysis revealed that measures, such as profit efficiency and capacity efficiency, received quite limited attention, particularly with non-parametric approaches. Regarding the latter, more research could be devoted to more flexible techniques (e.g. parametric frontier approaches with bootstrapping or the analytical network technique). Additionally, clarification should be made in relation to the cross-country, cross-currency and cross-market linkages and the location of risks in each financial system.

Appendix Chapter I

Appendix I.1: Anatomy of financial performance

Category	1. Traditional measures		2. Economic Measures Adjusted to Risk	3. Market-based Measures
	A. Balance Sheet Management	B. Management Efficiency		
	Measures how well a bank is performing at generating profits and revenues comparative to a specific metric. Also, it provides valuable insights into the financial health and performance of a bank.	Measures the capacity of a bank to provide a range of products and services in the most cost-effective manner possible while still guaranteeing the high quality of its financial products, services and support.	Measures the amount of risk that is involved in producing financial returns across various dimensions.	Measures how the capital markets value the activity of a bank, compared to its estimated accounting (economic) value.
Main indicators (Main text)	Return on assets (ROA), Return on equity (ROE) Net interest margin (NIM), Gross profit margin (GPM)	Non-interest operating income (NIOI)	Risk-adjusted return on capital (RAROC), Return on risk-adjusted capital (RORAC), Risk-adjusted return on risk0adjusted capital (RARORAC), Return on risk weighted assets (RORWA)	Total share return (TSR), Price-earning ratio (P/E)
Additional indicators (Appendix I.1)	Return on capital employed (ROCE), Return on invested capital (ROIC), Return on investments (ROI), Return on debt (ROD), Return on evenue (ROR), Economic value added (EVA)	Cost-to-income ratio (CIR), Operating efficiency (OI), Asset turnover (AT), Client turnover (CT)		Price-to-book value (P/B), Credit default swap (CDS)

In addition to the profitability and efficiency indicators discussed in the main text, we have identified additional indicators which can be grouped according to the above table.

1. Traditional measures of financial performance

A. Balance Sheet Management

A1. Return on capital employed (ROCE)

Return on Capital Employed (ROCE) is a financial indicator that measures the efficiency with which a company's capital is employed. The general formula for ROCE is the following:

$$ROCE = \frac{\text{Earnings Before Interest and Tax (EBIT)}}{\text{Capital Employed}} \quad (\text{A1.1})$$

Where *Capital Employed* stands for the difference between total assets and current liabilities.

ROCE is considered to be a proficient metric for comparing the efficiency across banks based on the quantity of capital they utilize. In terms of ROCE it was noticed the following problem. The denominator includes all assets, stating that it includes both fixed assets and their related accumulated depreciation. Accordingly, the quantity of the denominator descends over time and produces an advanced relation, unless a bank is continuously elevating its fixed assets with supplementary acquisitions. Generally speaking, a higher ROCE implies a more efficient usage of bank capital. Additionally, this indicator should exceed

bank's capital cost, or else it could stressed that the banks aren't employing their capital in an effective manner and are not generating shareholder value.

A2. Return on invested capital (ROIC)

Return on invested capital (ROIC) is a measure to evaluate a bank's efficiency and effectiveness at the allocation of capital in terms of profitable investments. The general formula for ROIC is the following:

$$ROIC = \frac{(Net\ income - Dividends)}{Capital\ Investment} \quad (AI.2)$$

In Equation AI.2, we can note that both the numerator and denominator cannot be found on any standard financial statement, thus they have to be calculated. Furthermore, *Capital Investment* can be defined as the difference between total assets, and excess cash and non-interest-bearing current liabilities.

In terms of return on invested capital's interpretation we can note that there isn't an optimal value, thus the obtained value should be compared with the average or maximum value obtained in the financial market, or by the market-leader operating in the same environment.

A3. Return on investments (ROI)

Return on Investment (ROI) is a measure to assess the efficiency of an investment, or it can be used to compare the efficiency of several investment projects. In general, this index measures the quantity of return on an investment compared to the investment's cost.

The general formula for ROI is the following:

$$ROI = \frac{(Gain\ from\ Investment - Cost\ of\ Investment)}{Cost\ of\ Investment} \quad (AI.3)$$

Where *Gain from Investment* discusses to the profits obtained from the sale of investment of interest.

Return on investment index is known for its simplicity and versatility, thus it can be utilized as a rudimentary index of an investment's effectiveness. ROI can be used in any form of investment within a corporation, company, bank, personal investment by an individual etc. In terms of disadvantages, ROI does not account for the time value of money and ROI can be simply manipulated to suit the user's objectives. Overall, ROI is a financial metric that compares the scale and timing of investment returns with the scale and timing of the costs specific to those investments. Consequently, a higher ratio implies that gains from investments can be favorable comparable with the costs from the investments made.

A4. Return on debt (ROD)

Return on debt (ROD) is another measure of performance, and it can be distinguished as the assessment of a BP as connected to the amount of debt issued by the bank. The general formula for this metric is the following:

$$ROD = \frac{Net\ income}{Long\ term\ debt} \quad (AI.4)$$

Where *Long term debt* stands for the financial obligations with a duration higher than twelve months.

As mentioned, this financial indicator exposes the amount of net income that is generated for each monetary unit that a bank holds in debt, thus a higher value of this ratio implies that bank's long term debt are generating higher returns, increasing the overall profitability.

A5. Return on revenue (ROR)

Return on revenue (ROR) known also as *Net profit margin* is a measure of performance which compares the net income obtained by a banks with its total revenues. The general formula for ROR is the following:

$$ROR = \frac{\text{Net income}}{\text{Total revenues}} \quad (\text{AI.5})$$

The utility of this ratio can be seen when evaluating bank performance, although it doesn't provide a clear image of the financial position of a bank given that it doesn't take into account banks' assets or liabilities. Return on revenue is a ratio that evaluates how efficient a bank is and how well it controls its costs, thus a higher ROR indicates a more efficient bank in transfiguring revenues in actual profit.

A6. Economic value added (EVA)

Economic Value added (EVA) is a measure of financial performance grounded on the residual wealth computed by subtracting cost of capital from its operating profit (economic profit).

$$EVA = \text{Return on invested funds} - (\text{weighted average cost of capital} \times \text{Invested capital}) \\ - (\text{weighted average cost of debt} \times \text{net debt}) \quad (\text{AI.6})$$

This measure was developed in 1991 by Stern and Stewart, and it consider the opportunity cost for stockholders to grasp equity in a bank, measuring whether a bank produces an economic rate of return greater than the cost of invested capital so as to increase the market value of the bank. Furthermore, this metric can be used in case of both listed and non-listed banks.

EVA is a complex financial performance measurement indicator, so when discussing the interpretation of this index it should be considered that a positive EVA reflects a good financial strategy, but the trend and changes in EVA should also be taken into account. Thus, in most of the cases the economic value added is really meaningful when it's studied the whole timespan of a financial project.

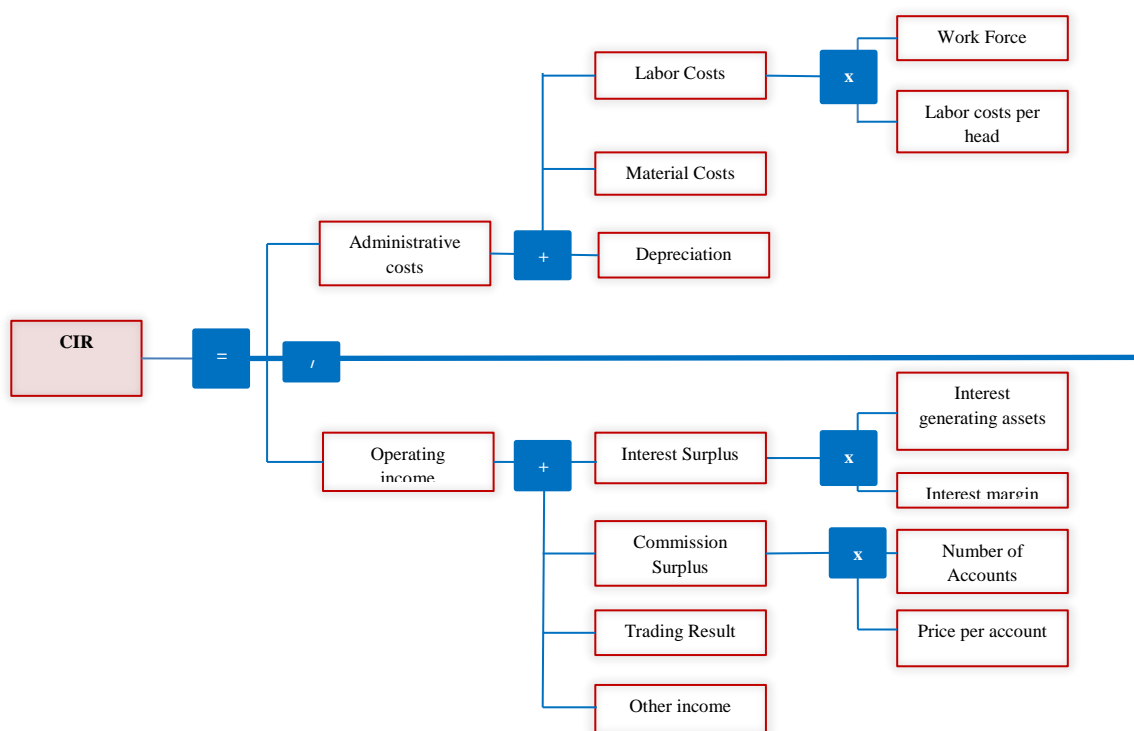
B. Management Efficiency (Operational Efficiency)

B1. Cost to income ratio (CIR)

According to the literature, Cost to Income Ratio (CIR) is also known as *efficiency ratio*, and although the predication power of this index is ambiguous, this index is seen as a benchmark when comparing the productivity and efficiency of banks. The general formula for CIR is the following:

$$CIR = \frac{\text{Administrative Costs}}{\text{Operating Income}} \quad (\text{AI.7})$$

In general, this ratio measures the output of a bank related to its used inputs. If we study at the CIR calculation scheme (*see* Figure AI.1), we can noticed that price constituents influence the amount of earnings and expenses and accordingly alter the predication power of the cost to income ratio. Even though the amount of earnings is grounded on sales quantities, which are measured based on prices, the determination process of managerial costs includes costs of production factors.



Source: adapted from Burger and Moornmann (2008), p.87.

Figure AI.1: Scheme of CIR calculation

The financial theory states that a high CIR is correspondent to a small productivity and small efficiency and vice versa. Accordingly, positive changes in this indicator could reflect that the bank is going through some problems, registering higher administrative costs than the operating income produced.

B2. Operating efficiency (overhead ratio)

Operating Efficiency (OI) is measuring personnel and administrative expenses relative to total revenues. It is also known as operating expense ratio, and the general formula is the following:

$$OI = \frac{\text{Operating Expense}}{\text{Total revenue}} \quad (\text{AI.8})$$

Furthermore, this ratio is useful when performing comparisons between banks, observing that a lower operating efficiency ratio is a good indicator of operational efficiency.

B3. Asset turnover

Assets Turnover (AT) is one of the ratios that demonstrate how efficiently a bank uses its assets and how efficiently it manages its operations and activities.

This ratio takes the following form:

$$AT = \frac{\text{Total turnover}}{\text{Total Assets}} \quad (\text{AI.9})$$

Furthermore, in terms of interpretation, it was noticed that banks with low profit margins incline to have high asset turnover, whereas those with high profit margins have lower asset turnover.

B4. Client turnover

Client Turnover Index (CTI) measures the number of clients that continue to access banking products and services during the studied period. Overall, it is regarded as a client loyalty and satisfaction index. Client Turnover Index has the following formula:

$$CTI = \frac{\text{No of Active Clients}_{beginning} + \text{No of new clients}_{During} + \text{No of Active Clients}_{end}}{\text{Average Number of Active Clients}} \quad (\text{AI.10})$$

As in any other business, customer retention (client retention) is also extremely important for banks, consequently customer mix (customer attrition) is a topic periodically studied. Furthermore, in the last period dominated by a hyper-competitive market place, banks have oriented towards new strategies for the retention of customers shifting away from a product-centric culture headed for a customer-centric model in order to maintain the client loyal and satisfied with its products and services.

2. Market-based measures of financial performance

A. Price-to-book value (P/B)

Price-to-book value (P/B), also known as *price-equity ratio*, is a financial ratio utilized to compare a stock's market value to its book value. The general formula for P/B is the following:

$$P/B = \frac{\text{Market value per share}}{\text{Book value per share}} \quad (\text{AI.11})$$

Where *Book value per share* reflects the difference between total assets and intangible assets and liabilities. Overall, a lower P/B ratio could reflect that the stock is undervalued, but it could also mean that something is wrong with the bank. One of the potential limits of this metric is that there are many underlying elements that can influence the formula (e.g. issuing new stocks, paying dividends, stock repurchases), aspects which can determine a manipulation of this ratio affecting its overall integrity.

B. Credit default swap (CDS)

Credit default swap (CDS) refers to the cost of insuring an unsecured bond of the bank for a given period of time. More specifically, a CDS is an agreement between two parties, namely the protection buyer and the protection seller, which ends at either maturity of credit event, whichever happens first. In this contract, the protection buyer agrees to pay a period fee (premium) and/or an upfront payment in return for a payment by the protection seller in case of credit events distressing a third party, namely a reference entity or a portfolio of reference entities.⁵⁵ The amount paid on the payment date is based on the following formula for a standard CDS contract:

$$\text{Payment} = \text{Notional} \times DCC(s_i, e_i) \times C \quad (\text{AI.12})$$

Where *DCC* stands for the day count convention used for premium payments; s_i stands for an accrual start date; e_i stands for an accrual end date; and C stands for the fixed coupon amount.

⁵⁵ European Central Bank (2009a). *Credit default swaps and counterparty risk* (ECB Publications), p.9.

Appendix I.2: Description of bank performance measures (profitability and efficiency), and examples of studies

Variable	Description	Definition	Examples of studies
ROA	The return on total assets of the banks (%)	Net income divided by average total assets	Bourke (1989), Beck <i>et al.</i> (2005), Nier (2005), Park and Weber (2006), Stiroh and Rumble (2006), Micco <i>et al.</i> (2007), Pasiouras and Kosmidou (2007), Athanasoglou <i>et al.</i> (2008), Chiorazzo <i>et al.</i> (2008), Naceur and Goaid (2008), Garcia Herrero <i>et al.</i> (2009), Uhde and Heimeshoff (2009), Elsas <i>et al.</i> (2010), Barry <i>et al.</i> (2011), Chen (2011), Dietrich and Wanzenried (2011), Naceur and Omran (2011), Kanas <i>et al.</i> (2012), Sufian and Habibullah (2012), Hoque (2013), Dietrich and Wanzenried (2014), Tan (2016)
ROE	The return on equity of the banks (%)	Net income by average total equity	Bourke (1989), De Young and Rice (2004), Beck <i>et al.</i> (2005), Park and Weber (2006), Stiroh and Rumble (2006), Chiorazzo <i>et al.</i> (2008), Pasiouras (2008a,b), Athanasoglou <i>et al.</i> (2008), Albertazzi and Gambacorta (2009), Garcia Herrero <i>et al.</i> (2009), Elsas <i>et al.</i> (2010), Barry <i>et al.</i> (2011), Dietrich and Wanzenried (2011), Naceur and Omran (2011), Kanas <i>et al.</i> (2012), Dietrich and Wanzenried (2014), Tan (2016)
NIM	Net interest income, represented as a percentage of earning assets		Angebazo (1997), Demirgüç-Kunt <i>et al.</i> (2004), Maudos and De Guevarra (2004), Mamatzakis <i>et al.</i> (2005), Micco <i>et al.</i> (2007), Chiorazzo <i>et al.</i> (2008), Claeys and Vander Vennet (2008), Naceur and Goaid (2008), Albertazzi and Gambacorta (2009), Dietrich and Wanzenried (2011), Chortareas <i>et al.</i> (2012b), Dietrich and Wanzenried (2014), Tan (2016)
OTHER	The net profit after tax with staff expenses and provisions for loan losses		Bourke (1989), Molyneux and Thornton (1992)
	The ratio of net non-interest income to net operating income as a non-interest income measure		Lee <i>et al.</i> (2014a)
	Pre-provision profits	Operating income minus operating expenses, over assets	Kwan (2003), Albertazzi and Gambacorta (2009, 2010), Garcia Herrero <i>et al.</i> (2009)
	Operating pre-tax cash flow returns		Cornett <i>et al.</i> (2010)
	Non-interest income to assets		Claessens <i>et al.</i> (2001), De Young and Rice (2004)
	Growth of non-interest income / Growth of other earning assets		Micco <i>et al.</i> (2006)
Profit before taxes		Albertazzi and Gambacorta (2009), Bolt <i>et al.</i> (2012), Bertay <i>et al.</i> (2013)	

	Stock return			Choi et al. (1992), Chamberlain et al. (1997), Chow et al. (1997), Merikas (1999), Atindéhou and Gueyie (2001), Elyasiani and Mansur (2005), Aebi <i>et al.</i> (2012), Beltratti and Stulz (2012), Kutan <i>et al.</i> (2012)
	Efficiency measure	Profit / Productive efficiency	Technical efficiency of the bank varying between 0 and 1	Altunbaş <i>et al.</i> (2001b), Berger and De Young (2001), Casu and Molyneux (2003), Rime and Stiroh (2003), Yildirim and Philippatos (2007), Mamatzakis <i>et al.</i> (2008), Berger <i>et al.</i> (2009), Pasiouras <i>et al.</i> (2009), Barth <i>et al.</i> (2013), Duygun <i>et al.</i> (2013), Gaganis and Pasiouras (2013), Jian <i>et al.</i> (2013), Andrieş and Căpraru (2014)
		Cost efficiency	Technical efficiency of the bank varying between 0 and 1	Hughes and Mester (1998), Altunbaş <i>et al.</i> (2001a,b), Rime and Stiroh (2003), Paradi and Schaffnit (2004), Fries and Taci (2005), Yildirim and Philippatos (2007), Evanoff and Ors (2008), Mamatzakis <i>et al.</i> (2008), Berger <i>et al.</i> (2009), Koutsomanoli-Filippaki <i>et al.</i> (2009a), Weill (2009), Berger <i>et al.</i> (2010), Casu and Girardone (2010), Olson and Zounbi (2011), Duygun <i>et al.</i> (2013), Fungacova <i>et al.</i> (2013), Jian <i>et al.</i> (2013), Andrieş and Căpraru (2014)
			Operating costs / Total assets	Naceur and Omran (2011)
			Costs / Income Cost / Assets	Chortareas <i>et al.</i> (2012b) Micco <i>et al.</i> (2007)
		Inefficiency measure (inverse measure)	Profit / Productive inefficiency	Inefficiency to fully exploit the available production technology and superior management technology
	Cost inefficiency		Technical efficiency of the bank varying between 0 and 1	Altunbaş <i>et al.</i> (2001a,b), Hasan and Marton (2003), Staikouras <i>et al.</i> (2008), Pasiouras <i>et al.</i> (2009)

Note: By considering these measures, we abstracted of studies that use what could be considered as indirect measures of BP as dependent variable (for example: bank lending, financial intermediation, financial development, etc.). Examples of such studies are reported in Appendix II.3 in chapter II).

Appendix I.3: Additional examples of papers using various techniques

Techniques to evaluate BP			Example of papers	
1. Type of parametric / nonparametric	Data Envelopment Analysis (DEA)		Pastor <i>et al.</i> (1999), Dekker and Post (2001), Tone (2001), Paradi and Schaffnit (2004), Avkiran (2006), Park and Weber (2006), Cooper <i>et al.</i> (2007), Avkiran (2009), Lin <i>et al.</i> (2009), Barros <i>et al.</i> (2012), Barth <i>et al.</i> (2013), Chen <i>et al.</i> (2013), Lee and Chih (2013), Lin and Chiu (2013), Dong <i>et al.</i> (2014a), Fujii <i>et al.</i> (2014), Wanke and Barros (2014)	
	Stochastic Frontier Analysis (SFA)		Berger and DeYoung (1997), Altunbaş <i>et al.</i> (2000), Altunbaş <i>et al.</i> (2001a,b), Koutsomanoli-Filippaki <i>et al.</i> (2009a,b), Nguyen and Swanson (2009), Burki and Ahmad (2010), Fiordelisi <i>et al.</i> (2011), Dong <i>et al.</i> (2014a)	
2. Type of model	Deterministic	Granger causality	Berger and DeYoung (1997), Fiordelisi <i>et al.</i> (2011)	
		Difference-in-Difference		Havrylchyk and Jurzyk (2011)
	Probabilistic	Event study		Chong <i>et al.</i> (1996)
		Linear Regression	OLS	Demirgüç-Kunt <i>et al.</i> (2006), Park and Weber (2006), Altunbaş and Marques (2008), Lin and Zhang (2009), Lee and Chih (2013)
			GLS	Boubankri <i>et al.</i> (2005)
			GMM	Albertazzi and Gambacorta (2010), Chortareas <i>et al.</i> (2012a)
			Tobit regression	Lee and Chih (2013)
			Logit and probit	Cipollini and Fiordelisi (2012)
		Non-linear Regressions	PCA	Shih <i>et al.</i> (2007)
		Pooled regression		To and Tripe (2002)
		Dynamic interaction setups	DSGE	Smith (1998)
			VAR	Koutsomanoli-Filippaki and Mamatzakis (2009), Philippas <i>et al.</i> (2016)
	Other techniques	Fundamental value model		Elsas <i>et al.</i> (2010)
		Optimal contracted model		Hakenes and Schnabel (2011a)
Propensity score matching		Havrylchyk and Jurzyk (2011)		
Non-radial models		Directional distance function	Fare and Lovell (1978), Cooper <i>et al.</i> (2007), Koutsomanoli-Filippaki and Mamatzakis (2009), Koutsomanoli-Filippaki <i>et al.</i> (2009a), Barros <i>et al.</i> (2012), Fujii <i>et al.</i> (2014)	
	Slack-based model	Tone (2001), Avkiran (2009), Lin <i>et al.</i> (2009), Chen <i>et al.</i> (2013)		

Appendix I.4: Efficiency and effectiveness of macro-prudential policy⁵⁶

Macro-prudential regimes gained popularity in the wake of the recent financial crisis, as an important policy action with the purpose of preventing and mitigating systemic risks which could cause very large economic and social costs. Post-crisis actions reflected policy makers' commitment to improve the institutional policy frameworks for dealing with systemic risk, observing the creation of new macro-prudential oversight bodies in the EU countries while macro-prudential instruments have also been embedded in the legislative texts transposing the Basel III regulatory standards into EU law.

Seven years since the creation of the ESRB and three years since the implementation of the new macro-prudential rules for the EU banking system (CRR/CRD IV), and still an evaluation of the efficiency and effectiveness of macro-prudential instruments is regarded as extremely difficult. Although, there are many macro-prudential instruments, there is relatively little experience in their implementation. Moreover, neither in the academia nor amongst policy makers is there a widely accepted position on the proper scope, optimal tools and specific objectives of macro-prudential policies nor of their coordination across countries and across other economic policies. It's difficult to disentangle the independent effects of macro-prudential policies from the effects of other policies employed in concurrence with them. As the macro-prudential framework advances further, considerable uncertainties are still existing in relation to the macro-prudential tools and their interaction with other policy tools, as well as the transmission channels of macro-prudential instruments and their calibration to reduce the upswing of the financial cycle.

The efficiency and effectiveness of macro-prudential policy are influenced by:

- ❖ ***The extent to which the instrument is closely targeting specific risks (scope of application):*** from a macroeconomic perspective, Cerutti *et al.* (2015a) and Cerutti *et al.* (2015b) found that institution-based instruments are less effective than borrower-based measures in containing household credit growth in advanced and financially open economies. In addition, they stress that foreign exchange-related measures are used more intensely in emerging economies, while borrower-based policies are commonly used in advanced economies. On the contrary, Fendoğlu (2016) highlight the effectiveness of institution-based instruments, and find that these measures contributed to a decrease in the impact of capital flows on domestic credit. In addition, from a microeconomic perspective, Jimenez *et al.* (2015) discuss that institution-based measures are smoothening and maintaining credit availability and have positive real economic effects. From a sectoral standpoint, Akinci and Olmstead-Rumsey (2015) show that housing-market related instruments are more effective in containing house price and mortgage growth, while non-mortgage related measures are more effective in slowing down credit growth. More recently, Avdijev *et al.* (2016) discover that LTV limits and local currency reserve requirements have a high impact on international lending, particularly for banking sectors which are better capitalized and less dependent on deposit funding. Also, Crowe *et al.* (2011), and Cerutti *et al.* (2015b) find evidence that LTV is very useful in curbing the real estate excessive growth. The former results are confirmed by the International Monetary Fund (2011), Claessens *et al.* (2013), Kuttner and Shim (2016) and Vandenbussche and Vogel (2015), observing, in addition, a similar impact for the debt-service-to-income (DSTI) ratio, the limits on housing sector exposure and the housing-related

⁵⁶ A version of this Appendix, will be published in the *Review of the macro-prudential framework 2017*, European Commission.

taxes. More recently, Zhang and Zoli (2016), constructed an aggregate macro-prudential index or sector-specific index, and found that, in particular the housing-related macro-prudential measures were extremely effective and helped mitigate the build-up of financial risks, proving to be useful tools in the hands of policy makers. From a microeconomic point of view, Igan and Kang (2011) together with International Monetary Fund (2014a) and International Monetary Fund (2014b) confirm the previous results. More specifically, International Monetary Fund (2014a) found that macro-prudential policies are particularly effective in the first six months following adoption, stressing that loan-to-value (LTV) is among the most effective instruments in reducing transactions, though the impact is limited in curbing house price inflation (similar results in International Monetary Fund, 2014b). Some other papers, such as Wong *et al.* (2011) present evidence that tighter LTV caps can significantly reduce the households' susceptibility to income and property price shockwaves, which could upsurge the resilience of banks by improving borrowers' creditworthiness.

- ❖ ***The scope for arbitrage and cross-border spill-overs:*** on the one hand, we can note the positive effects of the macro-prudential measures. For example, Forbes and Warnock (2012) indicate that macro-prudential measures reduce financial fragility in terms of bank leverage, credit growth, bank exposures and inflation expectations. Similar results were obtained at a macroeconomic level by Kapan and Minoiu (2013), Schoenmaker and Wierds (2015), and at a microeconomic level by Gambacorta and Mistrulli (2004), Igan and Kang (2011), Albertazzi and Marchetti (2010). In addition, Akinci and Olmstead-Rumsey (2015), examine a sample of 57 countries, and show that although macro-prudential measures effectively reduce bank credit growth, the effects are weaker for total credit growth because of possible regulatory arbitrage. Focusing on UK, Aiyar *et al.* (2014, 2016) proved that the effect of capital requirements on the lending of UK regulated banks is offset by unregulated foreign branches operating in UK (hence, the need for reciprocity). In the same vein, Beirne and Friedrich (2014), expands the analysis to 139 countries, and highlight that capital-related macro-prudential measures have the potential of creating more spillovers in a framework dominated by non-resident bank loans. Evidence collected by the International Banking Research Network equally shows how these policies can present leakages and lead to (unintended) spillovers across systems Buch and Goldberg (2015, 2016). Additionally, Cerutti *et al.* (2015a) highlight the existence of further leakages in more developed financial markets and that policies leads to more cross-border banking flows. On the other hand, another strand of literature pointed out that capital flow measures could determine a slowdown of banking and bond inflows, suggesting the need of tightening these measures (Kuttner and Shim, 2012; Ostry *et al.*, 2010; Dell'Ariccia *et al.*, 2012; Bruno *et al.*, 2015).
- ❖ ***The phase of the financial cycle:*** in view of the subprime crisis, the literature is discussing mainly the *ex-post* relationship between the phase of the financial cycle and specific macro-prudential instruments. From a macroeconomic perspective, Beirne and Friedrich (2014), find that macro-prudential measures targeting excessive credit growth, maturity mismatches and capital requirements are much more effective if the country is experiencing real growth. In the same vein, Claessens *et al.* (2013) showed that macro-prudential measures are mostly effective during expansionary stages of the cycle while their buffer capacity might have historically been weak. Furthermore, Fendoğlu (2016) focused on 18 emerging economies and found a higher effectiveness of macro-prudential policies during more pronounced financial cycles, observing some complementarities among tools. In the

same vein, Cerutti *et al.* (2015b) discussed that the effectiveness of macro-prudential tools is both instrument and country-specific, and that this effectiveness could be asymmetrical with higher results during the boom phase of the economic cycle, and lower impact during the bust phase (ex-ante effectiveness). Confirming these results for an international sample, McDonald (2015) shows that borrower-based measures have weaker effects during busts phases. From a microeconomic perspective, Jimenez *et al.* (2015), focusing on Spain, provide evidence that the countercyclical macro-prudential policies are very effective in calming credit supply cycles.

- ❖ ***Path-dependency, boundaries, and policy consistency:*** a countercyclical capital buffer, for example, can only be released when it has been built up in the past. Moreover, the buffer cannot turn negative (e.g. effectively reducing minimum capital requirements). Furthermore, consistent and gradual application of policy measures would be expected to reduce economic and financial volatility, by helping to anchor economic agents' expectations. Multiple instruments can be used in combination to achieve a given objective. Sometimes the use of multiple instruments might be preferable as they can target different dimensions of vulnerabilities, work through different channels and prevent policy leakages, thus increasing the policy's expected effectiveness. A complication that arises in this context is how to measure the macro-prudential stance when multiple instruments are used simultaneously. Such accumulation of instruments can also have unintended consequences (e.g. unduly constraining credit supply, overlaps etc.), making any policy assessment even more challenging. For example, Portes (2014) highlights the risk that macro-prudential instruments often overlap with other macroeconomic instruments (e.g. the ceilings on lending and borrowing and reserve requirements are overlapping with monetary policy). However, as Avdjiev *et al.* (2016) stress, a contraction of macro-prudential policy tools with the purpose of controlling the expansion of domestic credit, could determine potentially substantial expansionary international spillovers. Thus, the effectiveness of an instrument might be asymmetric depending on whether it is tightened or eased.
- ❖ ***National & International coordination:*** it's necessary to promote a combination of macroeconomic and macro-prudential policies to evade shockwaves in the economic system (Viñals, 2011). Likewise, Borio (2003) argues that monetary and macro-prudential policies should work concurrently since monetary policy impacts risk perceptions and risk appetite. Bruno *et al.* (2015) investigate the macro-prudential policies in Asia-Pacific countries, and find that macro-prudential instruments have been more effective in slowing down bank and bond inflows when they have complemented and reinforced monetary policy. Additionally, Schoenmaker (2014), highlights that another important challenge posed by the macro-prudential policy refers to the "one size fits all" monetary policy and the need to address economic imbalances at the country-level. Put differently, macro-prudential policies must be a part of the solution but it cannot be the solution itself Borio (2014). Additionally, Borio (2014) also highlights the vital need for international coordination and alignment of macro-prudential instruments. He stresses that a lack of coordination will most probable make arrangements extremely vulnerable to cross-country arbitrage, while specific reciprocity measures could tackle the inaction bias. In the same vein, Schoenmaker (2014) argues that a reliable policy framework implies an alignment of policy tools at the same level, avoiding an inconsistency risk, which could arise if all macro-prudential policy responsibilities lie within the national authorities.

Appendix I.5: On the road to EU membership



***The evaluation of the convergence criteria and of the single currency adoption
(in the first phase as an account currency)***

1999	Austria, Belgium, Finland, France, Ireland, Italy, Germany, Luxemburg, Portugal, Spain and the Netherlands
2001	Greece

The introduction of euro banknotes and coins (2002)

2007	Slovenia
2008	Cyprus and Malta
2009	Slovakia
2011	Estonia
2013	Latvia
2015	Lithuania

Note: There are currently 19 countries in the Euro-area (see table above with the introduction of the euro), 9 EU non-euro countries (Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, United Kingdom) and 5 EU candidate countries (Albania, FYROM, Montenegro, Serbia and Turkey). In the period spanning from February 2010 until March 2015, Iceland was also part of the EU candidate countries, but in 2015 Iceland’s government requested that “Iceland should not be regarded as a candidate country for EU membership”.

Source: adapted from “EU member countries” by the European Commission, p.1

Appendix I.6: Comparison between MPIs and FSIs

SIMILARITIES		
General goal	To create quantitative standards for the analysis of the resilience of the financial sector.	
General methodology	The general methodology applied is similar on many points.	
Particular aspect	In terms of the banking sector, the indicators are similar and based on measures of profitability, capital adequacy, asset quality, asset structure, and sensitivity to market risk.	
DIFFERENCES		
Category	ECB - MPIs	IMF - FSIs
Origins	Arise from the need to identify all risks facing the financial sector.	Arise from the vital need to handle the heterogeneity of financial systems worldwide.
Particular purpose	To provide a coherent set of indicators in order to monitor relatively well-developed economies, which are strongly interconnected through common regulation, common currency, common monetary policy etc.	To provide a minimum and robust set of tools for compiling FSIs to countries at all levels of economic development.
Perspective	Focuses on the risks developing in the financial systems and takes a supervisory approach. Thus, ECB focuses on a broad range of indicators.	Focuses on a macroeconomic perspective and includes a limited number of indicators.
Utility	Permits only comparisons for EU countries.	Permits worldwide comparisons and discourage local practices.
Geographical space	The MPIs are primarily compiled only for the EU average and the euro area, and secondarily they are compiled for each EU country.	In the Compilation Guide it is not included a discussion on regional construction of the FSIs. Consequently, FSIs are considered at the national level, and can be computed by national authorities in each country. It doesn't provide cross-country data tables.
Frequency	The ECB collect data on an annual frequency.	The Compilation Guide recommends the quarterly data.
Timeliness	The ECB publishes the data five to seven months after the reference date.	The IMF publishes data one quarter after reference date.
Sample	Determined by the complexity of financial markets and the interest in ensuring financial stability and controlling systemic sources of risk, the ECB has oriented towards a categorization of banks after their size.	The Compilation Guide focuses only on national banking sector. Though, a section of the Compilation Guide emboldens peer group and dispersion analysis as a complement to the basic analysis of FSIs.
Compilation and accounting	The ECB relies mainly on the common accounting practices provided through EU directives, the IAS/IFRS and common supervisory standards.	The 2006 version of the Compilation guide provided accounting guidance on a series of aspects, but some of these accounting guidance diverged from the international standards. Thus, the 2008 amendments aligned the FSIs to the current international accounting and supervisory practices.

<p>Basel Adjustments</p>	<p>The switch to the new supervisory requirements is easier for the ECB, mainly because the Capital Requirements Directive has offered a common point of reference for the application of Basel requirements.</p>	<p>It was provided guidance on the need to comply with Basel Agreements in the compilation of indicators for the banking system founded on supervisory data.</p>
<p>Consolidation approach</p>	<p>The ECB has always oriented towards the domestically controlled, cross-border and cross-sector consolidated basis.</p>	<p>The 2006 version of the Compilation Guide promoted primarily the cross-border consolidation approach and secondarily the domestically consolidated approach. Furthermore, the 2008 amendments focused on the cross-border and cross-sector consolidation basis for all domestically incorporated deposit-takers and also on domestically controlled, cross-border and cross-sector consolidation basis.</p>
<p>Specific indicators</p>	<p>The ECB focuses only on the financial system, thus the methodology employed doesn't require additional reporting for other segments of the economic system. There are some indicators that are computed differently than the IMF. For example, in contradiction with the IMF, the ECB suggests that the gathering of information on ROA and ROE should be done pre- and post-tax extraordinary items base.</p>	<p>The IMF addresses the necessity to combine various indicators in the economic sector. Initially some of the FSIs have been computed after a different methodology from the one used by the ECB. Though, after the 2008 amendments, the definitions have been closer to the ones used by the ECB.</p>
<p>Publication of data</p>	<p>The ECB provides more condensed metadata. Though, there are registered, sometimes, deviation from the ECB recommendations.</p>	<p>The IMF has published extensive metadata in order to ensure access to detailed information on the financial sectors worldwide. The amendments of the Compilation Guide don't influence the publications of the metadata.</p>

Source: adapted from International Monetary Fund (2006), pp.25-41.

Appendix I.7: Major financial soundness indicators

Author(s)	Time*	Indicator	Frequency	Method	Sample
Das <i>et al.</i> (2004)	2004	Financial System Soundness Index (FSSI)	Annual	$FSSI = \frac{Credit}{GDP} \times \left[\frac{1}{2} \times (CAR + NPL) \right]$	International
Illing and Liu (2006)	1980	Financial Stress Index	Annual	Factor analysis Credit aggregated-based weights Variance equal-weights Cumulative distribution Functions	Canada
Nelson and Perli (2007)	1994	Financial Fragility Indicator	Weekly	Logit model	US
Guichard and Tuner (2008)	1990	OECD Financial Conditions index	Quarterly	VAR, judgmental calibration	US, Euro-area, Japan, the UK
Swiston (2008)	1990	US Financial Conditions index	Quarterly	VAR	US
Cardarelli <i>et al.</i> (2009, 2011)	1980	Financial Stress Index	Monthly	Variance-weighted average of sub-indices	International
European Central Bank (2009b)	1994	Global Index of Financial Turbulence (GIFT)	Monthly	Variance-weighted average of sub-indices	International
Hakio and Keeton (2009)	1990	Kansas City Financial Stress Index (KCFSI)	Monthly	Principal Component Analysis	US
Rosenberg (2009)	1991	Bloomberg Financial Conditions index	Daily	Variance-weighted average of sub-indices	US
Blix Grimaldi (2010)	1999	Financial fragility index based on Nelson and Perli (2007)	Monthly	Logit model	Euro-area
Hatzius <i>et al.</i> (2010)	1970	Financial Condition index	Quarterly	Principal Component Analysis, approximate Dynamic Factor Model	US
Kliesen and Smith (2010)	1993	Aggregate financial stress indicator (STLFSI)	Weekly	Principal Component Analysis	
Yiu <i>et al.</i> (2010)	1997	Financial Stress Index	Monthly	Average of standardized sub-indices, GARCH	Hong-Kong
Balakrishnan <i>et al.</i> (2011)	1997	Financial Stress Index	Monthly	Variance-weighted average of sub-indices	International
Brave and Butters (2011a)	1971	Chicago Fed National Financial conditions index (NFCI)	Weekly	Principal Component Analysis	US
Brave and Butters (2011b)	1971	Chicago Fed National Financial conditions index (NFCI)	Weekly	Principal Component Analysis with large approximate dynamic factor methods	US
Lo Duca and Peltonen (2011)	1990	Financial Stress Index	Annual	Average of standardized sub-indices	International

Matheson (2011)	1994	Financial Condition index	Monthly	The first common factor of a dynamic factor model	US and Euro-area
Oet <i>et al.</i> (2011)	1991	Cleveland Financial Stress Index (CFSI) based on Illing and Liu (2006)	Weekly Monthly	Credit aggregated-based weights Variance equal-weights Equal weights Principal component weights Cumulative distribution Functions	US
van Roye (2011)	1981	Financial Conditions Index based on Brave and Butters (2011a)	Monthly	Dynamic factor model in Principal Component Approach	Germany and Euro-area
Holló <i>et al.</i> (2012)	1999	CISS	Weekly	Basic portfolio theory to the aggregation of sub-indices	Euro-area
Louzis and Vouldis (2013)	1998	Financial Systemic stress based on Hollo <i>et al.</i> (2012)	Monthly	Basic portfolio theory to the aggregation of sub-indices Multivariate GARCH	Greece
Park and Mercado Jr. (2014)	1992	Financial Stress Index based on Balakrishnan <i>et al.</i> (2011)	Quarterly	Variance-weighted average of sub-indices	International

Note: Papers are cited chronologically; *Time stands for the year since the specific index has started to be computed.

CHAPTER II: Banking systems around the globe- Determinants of performance and soundness⁵⁷

In the last decades, the financial arena experienced profound changes, especially in the performance and soundness of banks. From a global perspective, in the context of financial development through increasing financial opening, deregulation and re-regulation, financial markets considerably expanded their size and structure, fueled by amplified monetary and financial integration around the world. However, as emphasized by the recent crisis, the flipside of these financial markets' developments is their higher exposure to potentially volatile capital flows, moral hazard, and contagion, which may affect both banks' inputs and outputs, and, ultimately, economic development and the evolution of living standards worldwide. Consequently, given the importance of banks to economic development, there is a vital need for a better understanding of the factors driving the performance and soundness of banks. This chapter performs a critical and detailed review of the long-standing and fairly large literature devoted to identifying and analyzing the determinants of bank performance (BP) and bank soundness (BS). First, we provide a unified perspective, as we cover two categories of topics: the most important BP and BS determinants and the impact of international events on bank activity. Second, our study covers a wide period of time (the earliest considered contribution goes back to 1935 and the latest publications were in 2017) and a very large number of studies, both theoretical and empirical. Finally, our analysis provides a detailed overview of the theoretical and empirical studies focused on assessing the impact of the main BP and BS determinants

⁵⁷ A part of this chapter represents a survey and was written with **Richard Hofler** (University of Central Florida, USA) and **Alexandru Minea** (University of Auvergne, France).

II.1 Determinants of bank performance

A considerable number of studies attempt to empirically identify the determinants of BP and a series of them focused also on BS. In addition to differences in BP and BS measures and the methods used (see the previous chapter), these studies also differ regarding the data employed, particularly concerning the number of countries studied and the frequency of data. Following the first studies that focused on a *single* country, subsequent research adopted a *multi*-country perspective. However, as highlighted by Appendix II.1, there is not a clear dominance of the latter type of studies nowadays. Regarding the frequency of data, the largest majority of research focuses on *annual* data, and only relatively few studies consider *quarterly* or *daily* data.

Bank performance and its measurement is an ongoing story for policy makers, managers, or and researchers. According to the European Central Bank (ECB), *bank performance* refers to the *capacity to generate sustainable profitability*, which is essential, among other reasons, for a bank to maintain its activity, for investors to obtain returns, or and for supervisors to guarantee resilient financial infrastructures. As discussed in Chapter I of this thesis, BP is related to “profitability” and “efficiency”. On the one side, profitability is measured by three representative indicators, namely return on assets, return on equity, and net interest margin, in the largest majority of studies on BP. On the other side, efficiency is measured by various profit and cost (in) efficiency indicators (see Appendix I.2). Adding to the following analysis contained in this section, Appendix II.2 provides additional information for each of the BP determinants in the three categories identified. Compared to BS determinants, BP determinants are more numerous and the empirical analyses are based on different BP measures.

Taking these facts into account, we can categorize BP and BS determinants into three main categories: (i) *bank-specific determinants* (microeconomic perspective); (ii) *industry-specific determinants*; (iii) *environmental determinants* (macroeconomic perspective.)

II.1.1. Bank-specific determinants

Some researchers use statistical or dimension-reduction (e.g. factor analysis) methods to select the most relevant variables from a wider set. Nevertheless, in most studies, the variables are derived from the CAMELS model (for a detailed discussion see section I.2.2.4).

II.1.1.1 Asset structure

Most of these studies use the degree of liquidity to represent a bank's asset structure. Liquidity is commonly measured by the ratios *liquid assets to total assets* and *liquid assets to short-term liabilities*, and also by the inverse measures *loans to total assets*, *loans to deposits* or *loans to customers and short-term liabilities* (McKenzie and Thomas, 1983; Kosmidou, 2008).

According to the risk-return hypothesis, higher (lower) liquidity is usually associated with lower (higher) BP – a *negative* relationship. Indeed, using different ratios of *liquid assets*, Goddard *et al.* (2004b) and Angbazo (1997) discover that highly liquid assets yield a low liquidity premium, and implicitly a lower return. These findings are backed up by studies using inverse measures of liquidity. For example, a higher ratio of *loans to assets* implies a higher credit risk exposure, which is associated with higher BP (Maudos and Guevarra, 2004; Stiroh and Rumble, 2006; Naceur and Omran, 2011), a result shared by Chortareas *et al.* (2012b) using the *loans to deposits ratio*.

Conversely, another strand of literature uncovers a *positive* relation between liquidity and BP. Using the *liquid assets to total assets* ratio, Bourke (1989) examines cases in which liquidity positively impacts BP. Similarly, drawing upon the inverse measure of *loans to total assets*, or *loans to customers and short-term funding*, De Young and Rice (2004), Staikouras and Wood (2004), and Kosmidou (2008) find that a sudden increase in the loan portfolio could sometimes imply higher funding-related costs for banks, which could negatively impact BP. Furthermore, using the inverse measure of *loans to customers and short-term funding*, Pasiouras and Kosmidou (2007) reveal that, contrary to domestic banks, the increasing volume of loans negatively affects BP in foreign banks.

II.1.1.2 Asset quality

Asset quality is among the most critical factors for the overall health of a bank. Particularly vital is the quality of the loan portfolio, considering that loans have the highest share in banks assets and have a high risk profile. The most common measure for the quality of the loan portfolio is represented by ratio of *nonperforming loans to total loans* (NPL), being also regarded as a proxy for credit risk.

The literature unambiguously finds a negative effect of higher NPL on BP.⁵⁸ Indeed, higher NPL requires a bank to reallocate larger shares of the gross margin to provisions to cover expected

⁵⁸ For example: Angbazo (1997), Demirguç-Kunt and Huizinga (1999), De Young and Rice (2004), Hernando and Nieto (2007), Kosmidou (2008), Athanasoglou *et al.* (2008), Chiorazzo *et al.* (2008).

credit losses, with an unfavorable effect on BP. Besides, riskier loans require additional resources for credit underwriting and loan monitoring, which increase costs and decrease BP (Mester, 1996; Iannotta *et al.*, 2007; Kasman *et al.*, 2010).

II.1.1.3 Capitalization

As one of the most commonly analyzed BP determinants, capitalization represents capital adequacy, being measured by *the ratio of total equity to total assets*, displaying the ability of the banking sector to absorb losses generated by risk occurrence.

Different theories demonstrate the effect of capitalization on BP, with conflicting results. On the one hand, the pecking order theory and the trade-off theory agree about the importance of debt not only as a source of financing, but also as a source of associated risks. Both state that, when retained earnings are unavailable, companies should consider issuing debt (and, as a last resort, issuing equity). On the other hand, the market timing hypothesis, unlike the above capital structure theories, states that companies use the cheapest type of financing regardless of the current level of internal resources (debt and equity), in order to increase revenues. Such contradictory theoretical predictions also occur when capturing capitalization by *the change in regulatory capital or regulatory capital to risk weighted assets* (Berger *et al.*, 1995; Blum, 1999).

These differences are echoed by the empirical analysis. Confirming early evidence from Kim and Santomero (1988), Dietrich and Wanzenried (2014) find a positive effect of *equity to total assets ratio* on BP. Intuitively, higher capitalization, acting as a safety net, strengthens depositors' confidence, which lowers costs with interests and external financing. In addition, Berger (1995b) suggests that the expected bankruptcy-costs hypothesis is seen as a cause of all, or a part of, the observed positive relationship between capital and BP. That is, when a bank's capital is below its equilibrium level, expected bankruptcy costs are moderately high, and increasing capital ratios raises expected profits by lowering interests on uninsured debt.

Nevertheless, as illustrated by Stiroh and Rumble (2006) and Dietrich and Wanzenried (2011), there could be a trade-off between capitalization and BP, when high capital holding may jeopardize BP by increasing financing costs and disrupting lending activity, particularly during period of economic turbulences, such as the recent financial crisis. Conversely, Berger and Bouwman (2013) refute these results by showing that higher capital enhances the performance of small and large banks during both crises and normal times.

II.1.1.4 Financial structure

Since deposits are the cheapest and most stable financial resource (Claeys and Vander Vennet, 2008; Garcia-Herrero *et al.*, 2009), the most natural proxy for banks' financial structure is the *ratio of deposits* to either *total liabilities* or *total assets*.

Traditionally, by fostering the growth of banking activity, larger deposits increase BP (Iannotta *et al.*, 2007). For example, Garcia Herrero *et al.* (2009) focused on the Chinese banking sector, and confirmed previous results, stating that a larger share of deposits in the total value of assets seems to boost BP, given that deposits are the cheapest liability and interest rates are not completely liberalized.

However, such a finding could be constrained by a bank's ability to convert deposits into additional income-earning assets. Indeed, not only are deposits sometimes allocated to problematic borrowers, but high activity growth rates could attract competitors (a so-called "*deposit war*"), forcing banks to pay higher interest rates (Trujillo-Ponce, 2012).

II.1.1.5 Management quality

Management quality is usually proxied by one of a three measures: the *cost-to-income ratio*, reflecting the bank's capacity to cover its operating expenses from the generated income; the *non-interest expense over total assets ratio*, outlining management's ability to perform daily activities at lower costs; and *X-efficiency*, which refers to the efficiency achieved by banks under market types other than perfect competition. A large strand of literature emphasizes a favorable effect of lower costs on BP.⁵⁹ Moreover, Pasiouras and Kosmidou (2007), Dietrich and Wanzenried (2011), and Sufian and Habibullah (2012) find that lower non-interest-expense increases BP. Finally, Berger (1995a) and, more recently, Garcia Herrero *et al.* (2009) and Fu and Heffernan (2009) show that banks with higher volumes of loan commitments, more lines of credit and credit guarantees exhibit higher X-efficiency. Overall, these studies report a robust positive relation between management quality and BP.

⁵⁹ For example: El-Gamal and Inanoglou (2005), Pasiouras and Kosmidou (2007), Athanasoglou *et al.* (2008), Albertazzi and Gambacorta (2009), Garcia-Herrero *et al.* (2009), Dietrich and Wanzenried (2011).

II.1.1.6 Bank size and age

By allowing economies of scale and of scope, bank size should foster better BP. Hirtle (2007) and Elsas *et al.* (2010), measuring bank size by the (natural logarithm of) *total assets*, and Dietrich and Wanzenried (2011), using *early growth of deposits*, find empirical support for this theory.

However, other studies emphasize several comparative advantages of small (and more specialized) banks, compared to large banks, including their ability to grant loans based on both “soft” information (e.g. information that “cannot be credibly communicated from one agent to another”, Berger, 1995a) and the deposit accounts (Peterson and Rajan, 1994; Carter *et al.*, 2004) or to develop lending relationships that reduce informational asymmetry (Nakamura, 1993; Udell, 1989; Barros *et al.*, 2007). As such, recent evidence suggests that a bank’s size impact could be complicated, with profitability either growing with bigger size or falling with larger size due to bureaucratic inefficiencies and other reasons (Athanasoglou *et al.*, 2008). In particular, Iannotta *et al.* (2007) and Mercieca *et al.* (2007) assert that, because the average cost curve in banking takes a fairly flat U-shape, medium-sized banks are more scale-efficient compared to large or small banks, while Cornett *et al.* (2010) concluded that, among all banks, the largest ones suffered the highest losses during the subprime crisis. Focusing on the systemic size of banks, Bertay *et al.* (2013) studied the impact of *total bank liabilities to GDP* on the performance of more than 2000 banks from 90 countries, and found that BP, measured by ROA, declines when the systemic size increases, which means that banks in large systems either have fewer business opportunities in their domestic markets, or face higher funding costs.

From a related perspective, some studies focus on the effect of *bank age* on BP. Indeed, as emphasized by the early contribution of Fraser and Rose (1972), the entry of new banks into the financial market might impact the profitability of existing banks. Using a dummy variable to differentiate between old and new banks, Dietrich and Wanzenried (2011) found that newer banks are more profitable than banks founded during 1950-1989, due to higher ability to pursue new profit opportunities and a higher efficiency in terms of IT infrastructure. Similarly, Beck *et al.* (2005) used the *years of establishment* of a bank to show that older banks perform less well than newer banks, the latter being able to adapt faster and to pursue new profit opportunities.

II.1.1.7 Revenue diversification

In the context of the financial transformations during the last decades, banks had to identify new sources of revenue. For instance, Elsas *et al.* (2010) assert that banks increase diversification mainly by moving into fee-based businesses, followed by trading and insurance activities. Using

the most popular measure for revenue diversification, namely the *non-interest income over total income*, several studies emphasized the positive effects of revenue diversification on BP (De Young and Rice, 2004; Chiorazzo *et al.*, 2008; De Jonghe, 2010).

However, results based on alternative measures of diversification are contradictory with the above conclusions. Moreover, studies using the same measure of diversification register opposite results. Discussing the *adjusted Herfindahl-Hirschman index*, Elsas *et al.* (2010), on the one hand, and Stiroh (2004), Acharya *et al.* (2006), and Stiroh and Rumble (2006), on the other hand, perceive that revenue diversification either amplifies (Elsas *et al.*, 2010) or reduces (the other three articles) BP. The same conclusions is registered when including the *diversification among different types of assets or income sources*. According to Lepetit *et al.* (2008a), diversification through lower interest rates on certain loans (to attract more clients for loans-related products and services) could hurt BP, if additional profits on alternative activities do not compensate interest rate discounts, a result consistent with Laeven and Levine (2007) who use several measures of diversification. On the contrary, Elsas *et al.* (2010) found a positive impact of diversification on BP. Altogether these conflicting results might suggest the presence of an optimal, BP-maximizing, extent of revenue diversification that will reconcile the tradeoff between the gains and the losses of diversification.

II.1.1.8 Ownership and nationality

The financial liberalization and the globalization processes triggered a large number of studies analyzing the impact of ownership and nationality on BP.

Regarding the former, early work found no or little influence of differences in ownership (e.g. *state-owned* or *privately-owned*) on BP (Bourke, 1989; Molyneux and Thornton, 1992). However, subsequent studies confirmed these findings only in industrialized countries. According to Beck *et al.* (2005), Iannotta *et al.* (2007), Micco *et al.* (2007), Naceur and Goaid (2008) and Das and Ghosh (2009), state-owned banks operating in developing countries exhibit lower BP compared to privately-owned banks.

Regarding nationality, Berger *et al.* (2000) develop two concurrent theories, namely the *global advantage* and the *home field advantage*. The first implies that *foreign banks* might perform better than *domestic banks* by, for example, using more advanced technologies. Several cross-country studies, including Sabi (1996), Claessens *et al.* (2001), Havrylchuk (2006), Garcia-Cestona and Surroca (2008), and Barry *et al.* (2011), support higher BP of foreign banks in developing countries. On the contrary, the second theory predicts that foreign banks perform less

well than domestic banks, for example because of higher costs of providing the same financial services or difficulties in adjusting to, and dealing with, a host country's operating framework. Demirgüç-Kunt and Huizinga (1999) find that foreign banks are less profitable in developed countries, a result backed up by Lensink *et al.* (2008), and Angkinand and Wihlborg (2010), who conclude that foreign ownership reduces BP mainly because of their following riskier strategies, thus inducing higher levels of nonperforming loans.

II.1.1.9 Transparency

Since it may allow information asymmetries and lower cost of capital, transparency plays a central role in the financial sector, with potential favorable consequences for BP (Diamond and Verrecchia, 1991).

In the literature, bank transparency is measured in various ways. Using *binary measures of disclosure*, Nier and Baumann (2006) find a positive impact on BP. This result is confirmed by Nier (2005) and Nier and Baumann (2006) who use a *disclosure index* based on 17 sub-dimensions of accounting information, who employ *disclosure quality scores*. In addition, using stock market activity data, Akhigbe *et al.* (2013) report that a higher *number of analysts following a bank's stock* and implicitly a lower *dispersion of analysts' forecasts* (inverse measure), determines a higher BP.

Finally, evidence from studies measuring transparency through *information sharing* is mixed. Albeit Pasiouras *et al.* (2009) confirm the previous results that find a positive correlation between transparency and BP. On the contrary, Chortareas *et al.* (2012b) state that information sharing and private monitoring can actually impede BP, emphasizing the importance of other factors that can influence this result, such as the credibility of the information. Such opposite findings imply the need for additional research on the connection between bank transparency and BP.

II.1.2 Industry-specific determinants

II.1.2.1 Banking concentration

The relationship between banking concentration and BP is mainly driven by two theoretical approaches. First, the *structure-conduct-performance theory* (SCP), also known as (*relative*) *market-power hypothesis*, states that higher bank concentration fosters collusion among large

banks, which subsequently increases their market share and leads to higher BP.⁶⁰ Second, the *efficient structure theory*, conceived by Demsetz (1973), implies that more efficient banks have lower operational costs, implying higher BP. The same banks hold an important share of the financial market. Therefore, different efficiency levels generate an unequal distribution of positions within the financial market and implicitly a high concentration.⁶¹

Several measures of banking concentration are seen in the literature. Using the ratio of *the assets of the three*, or of the *five, largest banks over total commercial banking assets*, many studies reveal a positive impact of banking concentration on BP, engendered mainly by better risk diversification, operational synergies, efficiency gains, and the use of best practices (Molyneux and Thornton, 1992; Boyd *et al.*, 2004; Pasiouras and Kosmidou, 2007). On the contrary, focusing on the three largest banks, Garcia-Herrero *et al.* (2009) and Dietrich and Wanzenried (2014) report a negative effect of concentration on BP, through increasing risks undertaken by banks and the stock of NPLs in a context of harsher competition in the financial industry.

Such conflicting results about concentration and BP also emerge when using alternative measures of concentration. When using the *volume of mergers and acquisitions* (M&A), several studies call in question the negative effect previously reported by Peristiani (1997) and Avkiran (1999).⁶² In the same vein, using a *Herfindahl-Hirschman index*, De Young and Rice (2004), Goddard *et al.* (2004b), Maudos and Guevarra (2004), and Dietrich and Wanzenried (2011), on the one hand, and Carter *et al.* (2004), Athanasoglou *et al.* (2008) and Garcia-Herrero *et al.* (2009), on the other hand, find that the effect of banking concentration on BP is positive (the first four sources) or negative (the last three sources.)

II.1.2.2 Banking competition

Since the mid-1980s, dramatic transformations of the regulatory environment, demand composition, and technology modified the structure and borders of credit markets, and in particular strengthened competition (Bhattacharya *et al.*, 1998). Two important groups of theories portray the competition-performance relationship, with opposite conclusions. On the one hand, the previously emphasized *efficient structure hypothesis* and the *market power hypothesis* (SCP) state that more efficient banks, with lower costs and higher market shares, face lower competition, which raises BP (Bikker and Haaf, 2002). In the same vein, the *information generating hypothesis*

⁶⁰ For example: Berger (1995a), Akhigbe and McNulty (2003), Chirwa (2003), Goddard *et al.* (2004ab), Maudos and De Guevara (2004), Samad (2005), Claeys and Vander Vennet (2008).

⁶¹ For example: Goldberg and Rai (1996), Park and Weber (2006), Homma *et al.* (2014).

⁶² For example: De Long (2001), Cornett *et al.* (2006), Altunbaş and Marques (2008), Molyneux *et al.* (2014).

(IGH) focuses on the primary function of banks, which consists of reducing borrowers' adverse selection, through collecting information. Under strong competition, many small banks (with low market knowledge compared to larger banks) poorly screen borrowing firms. Also, customers can easily switch between banks because of low costs, which erode the vital information collected by banks. Consequently, strong competition lowers BP, because of higher probability of adverse selection of lower quality borrowers and less rational decision-making (Marquez, 2002; Zarutskie, 2013). On the other hand, the *quiet life hypothesis* (QLH) of Hicks (1935) states that market power decreases competition. In this theory, banks with market power are ready to incur inefficiencies rather than reap monopolistic rents, because of a desire for a "*quiet life*" (Berger and Hannan, 1998; Maudos and De Guevara, 2007).

A large empirical literature aims at testing these theories. Using the most popular measure of competition, namely the *Lerner index*, several studies find that higher competition decreases BP.⁶³ Additional work confirms this relationship using *inverse* measures of competition, namely the *H-statistic* based on Rosse and Panzar (1977) and Panzar and Rosse (1987)'s work (Bikker and Haaf, 2002; Weill, 2004, 2009; Mamatzakis *et al.*, 2008) or the *ratio of the number of branch offices in total bank offices* (Carlson and Mitchener, 2006). Finally, using the Lerner index Casu and Girardone (2009), reject the QLH, and state that monopoly power may foster BP if it enables banks to operate at lower costs.

II.1.3 Economic environment determinants

In complement to the previous section, we now focus on the macroeconomic determinants of BP. Adding to the following analysis contained in the main text, Appendix II.2 provides additional information for each of the BP determinants in these categories.

II.1.3.1 Structural factors

We focus on two key structural factors, namely the *phase of the economic cycle*, and the *level of economic development*.

The literature accentuates a procyclical connection between BP and the *phase of the economic cycle*, traditionally measured by *real GDP growth* (Albertazzi and Gambacorta, 2009). Bad economic conditions affect the quality of the loan portfolio, generating credit losses and larger

⁶³ For example: Angelini and Cetorelli (2003), Maudos and Guevara (2004), Pruteanu-Podpiera *et al.* (2008), Agoraki *et al.* (2011).

provisions, thereby reducing BP (Bernanke and Gertler, 1989), while better economic conditions enhance borrowers' solvency and increase the demand for loans, thereby increasing BP.⁶⁴ On the contrary, real GDP growth could also hurt BP (measured by NIM, when better economic outcomes decrease the lending rate due to lower credit risk of corporate and private borrowers, as found in both Latin American countries (Chortareas *et al.*, 2012a) and high-income countries (Dietrich and Wanzenried, 2014).

In addition, BP seems also to be affected by the *level of economic development*. Most studies focus on an international sample and include different measures of economic development. A comprehensive contribution is Demirgüç-Kunt and Huizinga (1999), who consider 80 OECD countries and three measures of economic development, namely (a) *GDP per capita*, (b) the ratio of *bank assets to GDP*, and (c) the ratio of *stock market capitalization to GDP*. In particular, these authors found that economic development measure (a) increases (decreases) BP captured by before tax profits/total assets (NIM); measure (b) reduces BP (captured by both NIM and before tax profits/total assets) in well-developed financial systems (mainly because of more intense bank competition), while its impact is smaller, and may even become insignificant, in developing countries. Finally, although this weak impact in developing countries is confirmed using economic development measure (c), Demirgüç-Kunt and Huizinga (1999) emphasize a positive effect of measure (c) on BP in relatively developed banking sectors, confirming the presence of important heterogeneities driven by the level of economic development. More recently, using a sample of 90 countries, Bertay *et al.* (2013) confirm the negative effect of measure (a) on BP captured by ROA and ROE, with opposite findings for the (d) *inflation-adjusted growth rate of GDP per capita*. Moreover, Dietrich and Wanzenried (2014) analyze 118 low-, middle-, and high-income countries. They find a negative effect of measures (a) and (d) on BP captured by NIM, particularly for high-income countries. In addition, the effect of measure (c) on BP measured by bank returns is positive (negative) in low-(high-) income countries. Finally, Claey's and Vander Venet (2008) discover that higher economic development increases BP in Western Europe, while there is no significant link in the Central and Eastern European countries.

⁶⁴ For example: Claessens *et al.* (2001), Bikker and Hu (2002), Athanasoglou *et al.* (2008), Dietrich and Wanzenried (2011).

II.1.3.2 Monetary stance

A. Inflation

An early study by Perry (1992) states that the extent to which inflation is anticipated influences its impact on BP: the better that inflation is anticipated, the more a bank's management can perform interest rates changes so as to increase revenues faster than costs. A positive relationship between *annual change in consumer prices*, as a measure of inflation, and BP is reported in the literature.⁶⁵ However, Naceur and Kandil (2009) and Naceur and Omran (2011) find that inflation negatively influences interest margins and thus BP, mainly because higher inflation increases uncertainty and reduces credit demand.

B. Monetary policy

Through its capacity to influence the financial sector, monetary policy is a key determinant of BP. First, the central bank can modify the *level of interest rates*. Accordingly, Demirgüç-Kunt and Huizinga (1999) reveal a positive link between high real interest rates, bank margins and BP, particularly in developing countries where demand deposits frequently pay below-market interest rates. Within Europe, Claeys and Vander Vennet (2008), find that short-term interest rates have a positive and significant impact on BP measured by NIM in Western Europe⁶⁶ and in Accession countries⁶⁷ but have the opposite effect in Non-Accession countries.⁶⁸ Furthermore, in 10 industrialized economies, Albertazzi and Gambacorta (2009) report a positive effect of long-term interest rates on BP, measured by NIM and before-tax profit, but a negative effect of the *money market rate*. In addition, Garcia-Herrero *et al.* (2009) find that *interest rates volatility* decreases BP.

Second, an amplified level of *required reserves* or of *required liquidity ratios*, by altering the money multiplier, credit expansion, and money supply, should exert a negative effect on BP. Focusing on US banks, Gilbert and Rasche (1980) found that Federal Reserve membership, proxied by the *minimum required reserves*, decreases BP of members relative to nonmembers of comparable size, a result reinforced for the smallest banks. Moreover, Demirgüç-Kunt and

⁶⁵ For example Molyneux and Thornton (1992), Claessens *et al.* (2001), Staikouras and Wood (2004), Athanasoglou *et al.* (2008), Claeys and Vander Vennet (2008), Garcia-Herrero *et al.* (2009), and Barth *et al.* (2013) by using *3-year average percentage inflation*.

⁶⁶ Western Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

⁶⁷ Accession countries: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

⁶⁸ Non-Accession countries: Bulgaria, Croatia, Romania, Russia and Ukraine.

Huizinga (1999) observe a negative impact of higher minimum reserves on BP, given they are seen as a form of indirect taxation and are remunerated below market rates.

C. Exchange rates

Foreign exchange risks in the banking system arise when a bank holds assets or liabilities in foreign currencies, making it vulnerable to exchange rates fluctuations, and are usually measured by *changes in the real exchange rate* or the *exchange rate index*.

Using data for 65 industry groups over 12 years, Chow *et al.* (1997) found that the *short-run* impact of *changes in the real exchange rate* on BP is negative, but it turns positive in the *long run*. Additionally, Choi *et al.* (1992), Chamberlain *et al.* (1997) and Merikas (1999) found that, albeit the sign of the effect is not clear-cut, bank stock returns are influenced by foreign exchange movements, an effect mainly driven by the “money-center status”.⁶⁹

More recently, Chortareas *et al.* (2012a) studied the impact of *average annual exchange rates* on the profitability of Latin American banks, and found mixed results. On average, the impact was positive for the overall sample of Latin American banks, but when disaggregating the sample this effect was significant only for Chile (negative) and Paraguay (positive).

Furthermore, Atindéhou and Gueyie (2001), using the *exchange rate index*, show that BP is improved by foreign currency movements in Canadian banks, a result consistent with the finding of Elyasiani and Mansur (2005) for Japanese banks. Finally, Kutan *et al.* (2012) determine that *dollarization* decreases BP, but this effect could be outweighed by high institutional quality, decreasing risk aversion and cash holdings.

D. Fiscal stance

Compared to monetary policy, the impact of a government’s fiscal stance on BP has received less attention. Early evidence from Demirgüç-Kunt and Huizinga (1999) finds that taxation, measured by the level of *effective tax rate applied on pre-tax profits*, reduces BP measured by bank returns (Also see Dietrich and Wanzenried, 2011, 2014; Tan, 2016). For example, Dietrich and Wanzenried (2014), studying more than 10,000 commercial banks from 118 countries during 1998-2012, find that higher taxes reduced BP as measured by ROA and ROE. However, these authors also show that higher taxes *increase* BP, measured by NIM, particularly in high-income countries.

⁶⁹ Choi *et al.* (1992) uses this term for banks engaged in international lending and borrowing, while non-money-centered banks have zero net foreign positions.

Moreover, Albertazzi and Gambacorta (2010) examine a certain form of taxation, namely the *corporate income tax* (CIT), which targets bank equity holders and thus interrelates with prudential capital requirements. Compared to the previous measure, the CIT is exogenous, and thus unaffected by banks' choices or by policy makers' decisions on industry-specific taxation. Focusing on 10 industrialized economies, Albertazzi and Gambacorta (2010) found that CIT increases profit before taxes and NIM, and decreases non-interest income, suggesting that CIT can induce a substantial change in the composition of banking sector revenues.

Finally, Boubankri *et al.* (2005) revealed a negative impact of overall budget deficit on bank returns in a sample of 81 banks from 22 developed economies, triggered by the fact that countries that stimulate their domestic economy through large-scale financing of public sector projects suffer from lower foreign investment and higher inflation. However, recent evidence is mixed: focusing on 90 countries during 1991-2011, Bertay *et al.* (2013) found that short-term debt (defined as customer and short-term funding divided by total interest paying debt) decreases other types of income (such as fee income or other operating income), but it increases BP when measured by ROE and NIM.

II.1.3.3 Institutions

A. Law and order

The importance of the regulatory framework for BP is stressed by a large theoretical literature. Following Rochet (1992), Hovakimian and Kane (2000) stated that, given the limited liability of commercial banks, a minimum regulation related to capital is necessary to ensure optimal performance and prevent banks from "betting for resurrection". In addition, Rochet (2004) argues that the increased complexity of financial markets and banking activities made traditional centralized regulation insufficient, marking a shift from the traditional set of prescriptions and prohibitions towards a new regulatory and supervisory framework, intended to enhance market monitoring and to ensure improved bank disclosure.

Some of the most commonly-used measures of regulation include: *law enforcement indicators*, the degree of *restrictions on bank activities*, *capital regulation* and *official supervisory power*. Looking at *law enforcement* in 80 countries during 1988-1995, and particularly at *contract enforcement* and *law and order*, Demirgüç-Kunt and Huzinga (1999) found that less law enforcement may allow banks to require higher interest margins to compensate for additional risk, which positively impacts BP measured by NIM and before tax profit. However, Naceur and Omran

(2011) reported that an improvement in law enforcement increased BP in Middle East and North Africa (MENA) countries.

Focusing on *restrictions on bank activities* in 4,000 banks, Barth *et al.* (2013) related that restrictions limiting the diversification of financial activities reduce BP measured by both NIM and efficiency scores, consistent with the theoretical conclusions of Hakenes and Schabel (2011a). Although Chortareas *et al.* (2012b) validated these results for bank efficiency scores in European Union (EU) countries, they also revealed a positive impact of activity restrictions on BP measured by NIM, corroborating early results by Demirgüç-Kunt and Laeven (2004). However, Barth *et al.* (2004) emphasized this positive link exclusively for government-owned banks, while Pasiouras *et al.* (2009) confirmed it only for *profit* efficiency, whereas the reverse was observed for *cost* efficiency.

Finally, Pasiouras *et al.* (2009), Chortareas *et al.* (2012b) and Gaganis and Pasiouras (2013) consider *capital regulation* and *official supervisory power*. Using different samples of countries, these studies found that *tighter capital regulation* will obstruct the efficient operations of banks, by increasing the probability that banks counteract through engaging in riskier operations and investments, which will negatively impact BP. However, regarding the second measure, *official supervisory power*, results are mixed. Pasiouras *et al.* (2009) observed that powerful supervision increases BP, by fostering banks' corporate governance and reducing corruption, while Chortareas *et al.* (2012b) and Gaganis and Pasiouras (2013) concluded that strong supervision can either lower or elevate BP.

B. Corruption

The complexity of modern financial practices, the greed and unwariness of individual players, and the lack of financial education can facilitate financial fraud and corruption. In the financial system, corruption arises through dishonest practices of bank managers or officials, and is usually measured through *indexes of corruption perception* or *control of corruption*.

Since corruption has been mostly studied from a macroeconomic perspective, few existing studies reveal a direct effect on BP. Early evidence by Demirgüç-Kunt and Huizinga (1999) found that a high *corruption index*, measuring *lower* corruption, reduces BP measured by NIM and before tax profits, and that this effect is lower in developed countries. However, more recently, based on the *corruption perception index* of Transparency International, Naceur and Omran (2011) found that lower corruption increases BP measured by NIM in Middle East and North Africa (MENA) countries, but has no effect on other measures of BP. Finally, Chortareas *et al.* (2012b) obtained

mixed results for a sample of 22 EU countries, namely a negative effect of control of corruption on both cost effectiveness and bank inefficiency.

C. Political factors

The relationship between banks and politics is antagonistic. On the one side, banks could take advantage of their political power by means of political networks, thus indirectly manipulating the national regulatory and supervisory framework. On the other side, banks could also be subjected to various political pressures from governments and other groups.

The literature focusing on the relationship between BP and political factors is rather limited, and mainly draws upon indirect BP measures (see Appendix II.3). However, several studies employ direct BP measures. Focusing on *electoral years*, Baum *et al.* (2009) show that Turkish banks register lower BP measured by NIM during the electoral cycle. Conversely, results are mixed for Micco *et al.* (2006, 2007) and Jackowicz *et al.* (2013). First, they stressed that, for the entire sample, election years increased BP measured by NIM. Quite the opposite, they obtain contradictory results when interacting election years with state ownership of banks, suggesting that state-owned banks register considerably lower BP measured by NIM during election years, because of lower interest rates on loans.

II.2 Determinants of bank soundness

After the recent international financial crisis, we have witnessed also a shift of research interest worldwide, thus a significant strand of literature has been focusing, in the last period, on bank soundness (BS), but more specifically on the assessment of bank risks and predictability of future financial shocks. Furthermore, in the last period dominated by uncertainty, it was observed how the banking system could influence the real economy, noticing that the impact of external financial shocks became far more intense. Consequently, the soundness of a banking system has become, alongside with financial performance, one of the key elements of strong macroeconomic policies.

The existing literature on BS can be divided in two distinct approaches, namely: (i) an individual approach which focuses on systemic risk measurement, covering the main sources of systemic risk and the most important methodologies applied to measure systemic risk; (ii) a multi-level approach which focuses less on the measurement of risk and more on the major determinants of bank soundness. The former approach is largely covered in the literature and is discussed in detail in section I.2.3, where in Table I.6 it can be observed a wide variety of methods used to

assess systemic risk. The latter approach is less debated in the literature, mainly because the determining factors of BP are considered to be the same for BS.

In the majority of studies, bank soundness was measured either by the traditional Z score or by the natural logarithm of Z score. In fact, Laeven and Levine (2009) and Houston *et al.* (2010) advocate the use of the natural log of the Z-score ($\ln Z$) over the traditional Z-score on the basis that the latter's distribution is heavily skewed, whereas the former's is not. More recently, Lepetit and Strobel (2015) prove that the traditional Z-score is providing a less effective upper bound of the probability of insolvency, thus suggesting log of Z-score as an improvement of this traditional measure without imposing any further distributional assumptions. Regarding the frequency of data, as it was the case for BP determinants, the largest majority of papers are focusing on annual data.

Finally, we identify three main groups of determinants, namely: *bank specific*, *industry specific* and *environmental determinants*. Complementing the following sections, Appendix II.4 provides additional information for the BS determinants classified according to the above-mentioned criteria.

II.2.1 Bank specific determinants

II.2.1.1 Bank performance

Bank performance (BP) is commonly measured by *return on average assets* (ROAA), *return on average equity* (ROAE) and *net interest margin* (NIM), though given that ROAA is used in the calculation of Z score, in the majority of studies it is excluded from the analysis.

The relationship between BP and BS has a dual nature. On the one hand, BP should positively influence BS, as a higher profitability should ensure higher financial resources for the bank and imply a lower fragility. Though, this direct relationship is highly dependent on the BP measure and the banking business model. For example, Nguyen *et al.* (2012) observed that BP measured by NIM has a positive impact on bank stability for commercial banks operating in South Asian countries.

On the other hand, BP could also negatively impact BS, as long as a higher profit margin implies a higher amount of risk taken by the banks, thus the relationship is dependent on bank's income source. Contradicting previous findings, Beck *et al.* (2013) register a negative impact of BP on BS for the US banks, though they have used natural logarithm of Z score as proxy for bank

soundness. By using a different BS measurement, namely tail risk β , De Jonghe (2010) confirm the negative impact of BP (measured by ROAE) on BS for a sample of small, medium and large European banks. Additionally, they stress that smaller and better capitalized banks have a higher capability to withstand adverse shocks.

II.2.1.2 Asset structure

Liquidity is commonly measured by *liquid assets to total assets*, or by the inverse measures *loans to total assets*, *credit growth* or *loans to customers and short-term funding*.

The theoretical studies of Instefjord (2005) and Wagner (2007) highlight that liquid assets intensify banking instability, and increase externalities related to banking failures. This fact may imply that, although higher asset liquidity directly benefits stability, by encouraging banks to diminish the risks on their balance sheets and by facilitating the liquidation of assets in times of crisis, it also makes crises less costly for banks. As a result, it's created an environment where banks are determined to assume a higher amount of risks that offsets the positive direct impact on BS. In line with this theory are the results of De Jonghe (2010) and Michalak and Uhde (2012) who focused on the direct measure of BS. Similarly, but including an indirect measure of liquidity, Uhde and Heimeshoff (2009), Demirgüç-Kunt and Detragiache (2011) and Bertay *et al.* (2013), suggested that a lower liquidity will positively impact BS.

II.2.1.3 Asset quality

Asset quality is among the most debated factors regarding the overall health of a bank, especially in the last period. Particularly emphasis falls on the quality of the loan portfolio, as it is the primary factor affecting the overall asset quality. Moreover, the loan portfolio usually represents the majority of bank assets and poses the highest amount of risk to bank capital.

The representative measure for the quality of the loan portfolio is the ratio of *nonperforming loans to total loans* (NPL), being regarded also as a proxy for credit risk. In addition, the literature also includes the ratio of *loan loss provisions* (LLP) as an important measure.

First, the literature unambiguously finds a negative effect of higher NPLs on BP (e.g. Nguyen *et al.*, 2012). Indeed, higher NPLs require banks to reallocate larger shares of the gross margin to provisions to cover expected credit losses, with an unfavorable effect on BS.

Second, a higher LLP ratio should ensure a higher BS, though this is contradicted by Beck *et al.* (2013) and Tabak *et al.* (2013) who observe a negative impact of LLP on BS in the pre-crisis and first years of crisis for the banks operating in the US and Latin American countries, respectively.

II.2.1.4 Capitalization

Capitalization is currently one of the most commonly employed indicators in assessing both BP and BS, gaining much more importance in the aftermath of the crisis when a series of regulatory measures related to capital have been taken. Capitalization is usually measured by *total equity to assets* or by *Tier 1 capital to total assets*.

The family of papers identified in the literature assessing the impact of capitalization on BS, has identified that a higher capitalization is positively related to bank soundness, acting a safety cushion, and strengthening depositors' confidence, which lowers costs with interests and external financing.⁷⁰ For example, Mirzaei *et al.* (2013) studied the impact of equity to assets for a sample of 40 emerging and advanced economies, and obtained a positive impact of capitalization on banks operating in both groups, stressing the need to further enhance the role of capitalization and to create an efficient cost-control strategy. Moreover, Hoque (2013) proved that during the sovereign debt crisis, banks with higher quality capital, tangible equity and lower agency problem performed better during the crisis, also advocating for higher regulatory capital.

II.2.1.5 Financial structure

Financial structure is usually represented by the ratio of *deposits to assets*. Deposits are known as the cheapest and most stable financial resource, and are expected to positively impact both BP and BS. Though, such an outcome could be conditioned either by a bank's ability to convert deposits into income-earning assets or by the level of competition in the market which could force banks to pay higher interest rates to ensure an optimal level of deposits. For example, Barry *et al.* (2011) found that, in the period 1995-2005, the European commercial banks suffered from an increased competition in banking, thus they observed that a higher deposits to assets ratio actually amplified the level of risk contained in bank portfolios.

⁷⁰ For example: Laeven and Levine (2009), De Jonghe (2010), Michalak and Uhde (2012), Nguyen *et al.* (2012), Bertay *et al.* (2013), Hoque (2013), Mirzaei *et al.* (2013), and Tabak *et al.* (2013).

II.2.1.6 Management quality

The most known indicator of management quality is the *cost-to-income ratio (CIR)*, which reflects a bank's ability to cover its operating expenses from the generated income. In the literature it was observed that a higher CIR, which signifies that higher operational efficiency and management quality, will positively impact BS (Uhde and Heimeshoff, 2009; De Jonghe, 2010; Barry *et al.*, 2011; Barakat and Huissainey, 2013).

II.2.1.7 Bank size and age

Bank size allows for economies of scale and of scope, diminishing bank fragility. This is confirmed by Lepetit *et al.* (2008b), Nguyen *et al.* (2012), Beck *et al.* (2013) and Michalak and Uhde (2012) who measure bank size by the natural logarithm of total assets.

Though, another family of papers emphasizes a series of advantages that small banks could have compared with large and complex entities, such as access to soft information or a reduced information asymmetry.⁷¹ Moreover, De Jonghe (2010) highlights that smaller and better capitalized banks have a higher capability to withstand adverse shocks. In addition, Bertay *et al.* (2013) emphasize that an increase in systemic size is not in the interest of their shareholders, considering that larger banks are subject to greater market discipline and mandatory regulatory requirements (e.g. global systemically important institutions are subject to a specific regulatory buffer, expressed as a percentage of risk weighted assets).

Correspondingly, some studies focus on the effect of *bank age* on BS. Using a dummy variable to differentiate between old and new banks, Mirzaei *et al.* (2013) found that older banks operating in emerging economies are more resilient compared to younger banks, which is intuitively plausible for emerging economies. Incumbent banks have a better credibility and reputation, a more stable customer relationship and better access to external funding, which eliminate the risk of liquidity shortages.

II.2.1.8 Revenue diversification

Against a continuously transforming background in the last years, banks have been obliged to move towards new business models, and implicitly to find new sources of revenues. For instance, Elsas *et al.* (2010) assert that banks increase diversification mainly by moving into fee-

⁷¹ For example: Barry *et al.* (2011), De Jonghe (2010), Demirgüç-Kunt and Detragiache (2012).

based businesses, followed by trading and insurance activities. Consequently, revenue diversification can be generally measured by *non-interest operating income* or more specifically by *commission and fees, trading income* or *other operating income*.

Disregarding the measure used for revenue diversification, the majority of papers identified in the literature is emphasizing that banks expanding towards non-interest income activities are accompanied by a higher risk compared to the ones that are supplying loans (see Lepetit *et al.*, 2008b, De Jonghe, 2010). However, Lepetit *et al.* (2008b) emphasize that this negative impact of revenue diversification on BS is particularly relevant for small banks which are essentially driven by commission and fee income.

II.2.1.9 Off-balance sheet items

The strategy of moving some of the items off the balance sheets has gained much attention in the post-crisis period. The off-balance sheet items are measured through *credit risk securitization* or *through mortgage securitization*. The direct impact of securitization on BS refers to how much credit risk is transferred to external parties. Considering this, we can observe two main perspectives in relation to securitization. First, the *securitization-stability perspective* highlights that a bank's total risk exposure is most probably reducing if the transferred tail risk of security's senior tranches (less risky) surpasses the volume of default risks of the retained first-loss position (see Jiangli *et al.*, 2007). Second, the *securitization-fragility perspective* considers the majority of default risks as remaining within the bank's portfolio of first-loss piece performing as an indication for potential external parties (Instefjord, 2005).

In the literature, the majority of studies find that an increase in the volume of *credit risk securitization* implies an amplification of bank risk, thus having a negative impact on BS.⁷² On the contrary, Jiangli and Pritsker (2008) study the impact of mortgage securitization on BS for a sample of US bank holding companies and, in line with Uzun and Webb (2007), find that mortgage securitization has a tendency to amplify BS. Additionally, Michalak and Uhde (2012) emphasize that European banks, are predominantly employing securitization as a source of regulatory capital arbitrage.

⁷² For example: Franke and Krahen (2006), Hansel and Krahen (2007), Krahen and Wilde (2008), Shin (2009), Michalak and Uhde (2012).

II.2.1.10 Ownership and nationality

The financial liberalization and the globalization processes triggered a higher interest of academics on the impact of *ownership* and *nationality* on BS.

First, *ownership* can be measured either by classifying banks as: (i) *state or private banks* or as (ii) *family business or institutions investors*. Nguyen *et al.* (2012) found that state banks operating in South Asian countries are more resilient than the private banks. Besides, Tabak *et al.* (2013) complemented the previous study and focused on Latin American countries, and found similar results, justifying that a private bank might lack the experience and know-how that a state banks has. Additionally, Barry *et al.* (2011) studied the European commercial banks that are structured either as family businesses or institutional investors, and found that family businesses are more resilient than institution investors, given their reduced incentives to take risk, thus a shift towards family businesses will result in a decrease of bank default risk.

Second, *nationality* is considered by classifying banks in relation to their foreign capital. On the one side, Uhde and Heimeshoff (2009) and Mirzaei *et al.* (2013) find that foreign banks are more resilient than domestic banks, supporting the global advantage theory. Quite the opposite, Tabak *et al.* (2013) advocate for the home field advantage for banks operating in Latin American countries, suggesting that foreign banks are actually more fragile given their higher size and interconnectedness to other banks and markets worldwide.

II.2.1.11 Transparency

Since it allows for a mitigation of information asymmetries and a reduction of the cost of capital, bank transparency plays a central role in the financial sector, with potential favorable effects on BS (Diamond and Verrecchia, 1991). The literature assessing the impact of transparency on BS is scarce. Nier (2005) developed a disclosure index based on 17 sub-dimensions of accounting information and finds that transparency diminished the probability of severe banking problems and enhances the overall BS.

II.2.2 Industry specific determinants

II.2.2.1 Banking concentration

Banking market concentration can be measured by the *assets of the three* or the *five largest banks* over total commercial banking assets, the *market share* or the *Herfindahl Hirschmann Index*.

The literature addresses banking concentration from two perspectives. First, we can observe the *concentration-stability theory* (implying that a higher bank concentration will induce a higher soundness⁷³). The second perspective is the *concentration-fragility theory* (suggesting that a higher bank concentration will determine a higher fragility⁷⁴). For example, Uhde and Heimeshoff (2009) found that for the banks operating in European Union, banking market concentration measured by the asset of the three largest banks, has a detrimental impact on BS. These results are further confirmed by Barakat and Huissainey (2013), but also by Mirzaei *et al.* (2013) who expanded the sample to 40 emerging and developing economies. In addition, Mirzaei *et al.* (2013) corroborated the previous results with the market share, and found that banks with a higher market share have a higher resilience to shocks, which positively influence BS.

Confirming previous findings, Tabak *et al.* (2013) also emphasize that concentration is the major issue in relation to the risk-taking behavior of banks, particularly for small entities which are forced to take more risk in order to cope with the size of the other competitors in the financial market.

II.2.3 Economic environment determinants

II.2.3.1 Structural factors

The literature is considering the structural factors by using the phase of the economic cycle and the level of economic development. First, the *phase of the economic cycle* is measured by *real GDP growth*, and the academic writings unanimously find that better economic conditions will implicitly lead to a higher BS (Demirgüç-Kunt and Detragiache, 2011; Michalak and Uhde, 2012; Bertay *et al.*, 2013; Mirzaei *et al.*, 2013).

Second, the *level of economic development* is also a determining factor for BS, thus Laeven and Levine (2009) found that GDP per capita will positively influence BS, suggesting that a higher

⁷³ For example: Boyd and Prescott (1986), Allen and Gale (2000), Boot and Thakor (2000), Boyd *et al.* (2004).

⁷⁴ For example: Mishkin (1999), Uhde and Heimeshoff (2009), Nguyen *et al.* (2012), Barakat and Huissainey (2013), Mirzaei *et al.* (2013).

economic development, translated in a higher economic welfare, will enhance banks' resilience to external shocks.

II.2.3.2 Monetary stance

The monetary stance is seen from two perspectives, namely *inflation* and *monetary policy*. On the one hand, inflation's impact on BS is depending on whether it is anticipated or not, and banks' behavior in relation to that (Perry, 1992). A positive relationship between annual change in consumer prices, as a measure of inflation, and BS is emphasized by Barakat and Huissainey (2013) and Bertay *et al.* (2013). However, Uhde and Heimeshoff (2009) together with Demirgüç-Kunt and Detragiache (2011) and Mirzaei *et al.* (2013) find that inflation could actually amplify the uncertainty in the economic sector, and implicitly the general level of risk, which could negatively affect BS.

On the other hand, monetary policy is considered to be one of the main contributors to financial stability, playing a particular role in June 2014 when the ECB introduced the negative interest rates to stimulate economic growth. In this respect, Mirzaei *et al.* (2013) found that, monetary policy, measured by the interest rate spread, is positively impacting the resilience of banks operating in emerging economies.

II.2.3.3 Institutions

The increased complexity of financial markets and services accentuated by impressive technological developments, have made traditional regulation insufficient (Rochet, 2004). Moreover, the 2008 international financial crisis has reinforced this idea, and determined policy makers to pursue a shift to a new regulatory and supervisory framework, adapted to the new and changing economic environment.

In the literature, the regulatory framework's impact on BS is measured either by *restrictions on bank activities* or by using the *rule of law index*. First, we observe Laeven and Levine (2009) who found that higher restrictions on bank activities will force banks to seek new income sources, which implies accentuated risk-taking behaviour, negatively affecting BS. Though, Demirgüç-Kunt and Detragiache (2011) observed that rule of law has actually a positive impact on BS, suggesting that a competent, ethical, stable and just legal system will positively affect bank activity by increasing the resilience to economic crises.

II.3 International events and the banking sector

During the last decades, factors such as globalization, monetary integration, and international financial crises transformed the banking market. The literature on these topics is dominated by the impact of the mentioned international events on bank performance (BP) and less on bank soundness (BS). Though, we consider BS as a crucial element when studying financial crises, but the majority of papers focused either on the risk-taking channels and different measures developed to assess or predict new financial shocks in the economy, or on the main determinants of BS disregarding the crisis years (aspects discussed in section I.2.3 and section II.1.2). Moreover, important work is still in progress in what concerns novel measures for BS under different shifting scenarios, but it's too early to judge how successful each of them will be and what are the advantages and disadvantages of alternative measures.

Consequently, in the following we focus on the impact of international events on BP. Adding to the following analysis contained in the following section, Appendix II.2 provides additional information for each of the BP determinants in these categories.

II.31 The winding road towards globalized banking structures

Both the liberalization of national financial markets and financial deregulation resulted in a sound increase in financial flows around the world. In the financial sector, globalization has been studied in relation to *macroeconomic processes*, *financial structure*, and *general globalization* indicators.

First, regarding *macroeconomic processes*, four globalization measures have been utilized: *geographic extension and diversification*, *technological change*, *liberalization*, and *capital flows*. Regarding *geographic extension*, Berger and De Young (2001) found that US banks expanding into nearby states or regions increase both their cost and profit efficiencies, although inefficiencies tend to amplify with the distance from the parent bank. Berger and De Young (2006) stress how innovations in the banking system enabled the geographic extension of US banks, by reducing distance-related inefficiencies of subsidiaries in relation to parent banks, and Meslier *et al.* (2016) reveal that intrastate and interstate geographic diversification benefit BP as captured by ROA and risk-adjusted ROA. Using a distinct indicator, Lee *et al.* (2014b) studied more than 2,000 US and European banks and observed a positive impact of *diversification* on BP, particularly when interacted with *capital flows*. Moreover, Altunbaş *et al.* (2001a,b) and Goddard *et al.* (2007) revealed that *technological change* reduces costs of collection, storage, processing, and

transmission of information, which positively impacts BP. Finally, focusing on 81 banks from 22 developing countries, Boubankri *et al.* (2005) concluded that *privatization and liberalization* should stimulate BP, although newly privatized banks are also more exposed to credit and interest rate risks.

Second, in terms of *financial structure*, some studies focused on some specific financial variables, such as *bank credit* or *trading revenue*, and found a positive relationship with BP (Naceur and Omran, 2011, Lee *et al.*, 2014b etc). However, Naceur and Goaid (2008), who included in their study on 80 countries the level of *financial intermediation*, reported that, although in theory a higher bank credit-to-GDP ratio should boost the demand for banking services and implicitly improve BP, in practice this also fuels competition leading to lower BP, particularly in terms of interest margins. Moreover, regarding *market capitalization* (measured by either the *value of listed shares to GDP*, or as the *value of listed shares to total assets*), well-developed financial markets present higher profit opportunities and better credit risk evaluation, which boosts BP (Naceur and Goaid, 2008; Albertazzi and Gambacorta, 2009). Though, when observing a tough competition, such as in the case of well-developed financial systems (high-income countries), BP could be negatively impacted (Dietrich and Wanzenried, 2014). This latter result has confirmed for banks operating in Middle East and North Africa (MENA) countries (Naceur and Omran, 2011), and also for Chinese banks (Sufian and Habibullah, 2012).

Finally, in one of the rare and extensive contributions dedicated to studying the impact of *globalization* on BP, Sufian and Habibullah (2012) found that higher economic integration, through greater actual trade flows, closer cultural proximity, fewer restrictions, more frequent personal contact, better information flow, and political globalization, positively affects BP.

II.3.2 Monetary integration: past, present and future

In the context of integration and amplified globalization of financial markets, monetary integration should, in the long term, enhance BP. Among existing monetary unions, the relation between the Economic and Monetary Union (EMU) and BP received by far the largest amount of attention. To evaluate the impact of EMU integration on BP, several popular indexes include *financial structure factors*, and β - and σ -convergence.

Regarding *financial structure factors*, the European integration process has significantly improved in recent times, although cross-country heterogeneities may still persist mainly because of historical differences in market structures, bank supervision and regulation, and legal traditions

(Casu and Molyneux, 2003; Barros *et al.*, 2007). In other words, limited institutional convergence in European banking and the importance of national characteristics, among other factors, are considered to be responsible for these cross-country heterogeneities. These cross-country heterogeneities (e.g., differences in EU banking sectors) are more likely to transit into performance heterogeneities across banks. In addition, from an industry-specific perspective, Evans *et al.* (2008) found that the *deregulatory process* is associated with substantial convergence of cost effectiveness, and, to some extent, with a BP improvement when measured by NIM and before-tax profits.

Regarding β - and σ -convergence, results on different EU samples support the convergence of efficiency levels towards the EU average, translating into both cost and profit efficiencies within and between countries (Mamatzakis *et al.*, 2008; Weill, 2009; Casu and Girardone, 2010).

II.3.3 Financial crises

An important family of papers is oriented towards the causes of financial crises, and implicitly the strategies taken to prevent or inhibit their negative repercussions. Although there have always been strong debates regarding the causes of financial crises, a consensus on the main contributors to financial fragility hasn't been reached completely. Moreover, we observed two main perspective in relation to bank failures and banking crises, namely the *pure panic* and the *information-based* perspective.

The *pure panic* view, coined by Diamond and Dybvig (1983), analyzes bank runs as a coordination problem among depositors, even in the presence of safe assets. Runs may be self-fulfilling, being triggered by either depositors' incomplete information or weak bank ground rules (Chari and Jagannathan, 1988), or may be a natural outgrowth of the business cycle (Allen and Gale, 1998). The *information-based* view outlines the importance of uncertainty and of asymmetric information on banks' financial conditions as the source of bank runs. The chain response comprises bad information about a bank, agents withdrawing their deposits, liquidity issues for banks, bankruptcies, and contagion effects.

Crises often examined by the literature include: the *Great Depression*, the *Latin American Debt and Banking Crisis*, the *Asian Currency and Financial Crisis*, and the recent *International Financial Crisis*. In most studies, the impact of the crisis was measured either by dividing the sample according to the *crisis years*, estimating the same model on two subsamples and then comparing the two sets of results—or by using a *crisis dummy variable*.

Regarding the 1929-1933 *Great Depression*, Balderston (1991) used *crisis years* and revealed its serious consequences on the German banking system, and the fact that, being unable to protect their capital and revenues, German banks shifted towards mergers and acquisitions, which granted them a certain level of security. Using *crisis dummy variables*, Carlson and Mitchener (2006) emphasized the negative effect of the years 1929-1930 on the BP of US banks.

The *Latin American Debt and Banking Crisis* from the 1970s, was studied from a general perspective by Trebat (1991), who used *crisis periods* to show that its grounds, namely foreign exchange risks, unreliable lending and borrowing practices, inadequate regulatory and supervisory frameworks, decreased BP in the affected countries.

Following a period of stability and rising living standards, the *Asian Currency and Financial Crisis* burst into existence in the late 1990s. Focusing on *crisis periods*, Corsetti *et al.* (1999) evaluated banking activity during 1987-1998 and attributed the crisis' negative impact on BP to a fragile, poorly supervised Asian banking and financial system that had, in addition, a deficient regulatory framework (even before the onset of the crisis.)

More recently, some studies analyzed the *International Financial Crisis* and the *Sovereign Debt Crisis*. Using *crisis periods/years*, Dietrich and Wanzenried (2011), in addition to discovering different BP in crisis and non-crisis years, found that large Swiss banks were more profitable compared to medium and small ones before the crisis, while such differences vanished during and after the crisis as BP decreased for all banks. Confirming these findings, Andrieş and Căpraru (2014) found that profit efficiency of EU27 banks decreased starting 2008. However, using a sample of more than 500 banks from 32 countries, Beltratti and Stulz (2012) established that larger banks with higher capitalization, more deposits, less exposure to the real estate, and less funding instability, performed better during the crisis. From a different perspective, Aebi *et al.* (2012) looked at banks' management and corporate governance, and revealed that US banks in which chief risk officers reported directly to the board of directors displayed considerably higher returns during the crisis. Finally, using *crisis dummy variables* in a wide database on 118 countries, Dietrich and Wanzenried (2014) uncovered a negative impact of the recent crisis on BP, particularly in high-income countries. In addition, they found that banks in low-income countries better faced the challenges raised by the crisis.

II.4 Conclusions

The banking system plays a vital role in the economy, so it was drained and consolidated over time in order to ensure the soundness of the whole financial system. The performance and soundness of the financial industry have long been a focus for researchers, but in the recent period, due to international financial pressures, this interest has amplified. From a global perspective, the current economic circumstances, have emphasised many deficiencies of the practices related to bank performance and soundness (BP and BS), thus it was stressed the vital need to reassess the main determinants of BP and BS.

The purpose of this chapter is to survey the literature on bank performance and soundness, by adopting a unified perspective that consists of discussing three categories of determinants, namely bank specific, industry specific and environmental factors. We found two important results. First, it exists a wide range of BP and BS determinants, with a complex effect, conditional upon variables' measures, the design of the study, or the economic environment. Second, although the effect of some BP and BS determinants is unambiguously positive or negative, others exert conflicting effects.

Consequently, the starting point of future research could be based on the following points. First, given their conflicting effect (for example, both positive and negative), the impact of some BP and BS determinants could be explored by allowing for potential nonlinearities. Based on our study, such candidates include bank-specific BP and BS determinants (e.g. asset structure, capitalization, banks' size or nationality, or revenue diversification), industry-specific determinants (e.g. concentration), macroeconomic determinants (e.g. level of economic development, monetary policy, or some institutional factors), or some international determinants;

Second, subsequent studies could consider additional BP and BS determinants that were not accounted for so far in the literature, such as house price indexes, more recent regulatory measures (e.g. changes in capital conservation buffer, countercyclical buffer or systemic risk buffer), or the latest technological developments in banking (e.g. distributed ledger technologies or quantum technologies);

Last, the recent international financial crisis shaped the global (economic) environment in an unprecedented way (e.g. unconventional monetary policies; deteriorated fiscal stances; important financial mutations and reorganizations; other real imbalances, such as large unemployment, etc.). Therefore, there is need for academic work to evaluate the BP and BS determinants in such fairly novel environments (see, e.g., the recent study on unconventional monetary policies and BP by Mamatzakis and Bermpei, 2016).

Appendix Chapter II

Appendix II.1: Structure of data and examples of papers

1. Sample		
Single country	America and Canada	Berger <i>et al.</i> (1987), Berger (1995a), Angbazzo (1997), Brocket <i>et al.</i> (1997), Hughes and Mester (1998), Clarke (2004), Paradi and Scaffnit (2004), Carlson and Mitchener (2006), Fields <i>et al.</i> (2006), Landon and Smith (2007), Tabak and Staub (2007), Martinez-Jaramillo <i>et al.</i> (2010), Aebi <i>et al.</i> (2012), Barros and Williams (2013), Berger and Bouwman (2009, 2013), Jones <i>et al.</i> (2013), Wanke and Barros (2014)
	European countries	McKenzie and Thomas (1983), Chong (1991), Dekker and Post (2001), Focarelli <i>et al.</i> (2002), Sapienza (2002), Angelini and Cetorelli (2003), Hasan and Marton (2003), Ongena <i>et al.</i> (2003), Bonaccorsi di Pati and Dell'Aricea (2004), Degryse and Ongena (2005), De Vries (2005), Karceski <i>et al.</i> (2005), Acharya <i>et al.</i> (2006), Bonaccorsi Di Patti and Gobbi (2007), Athanasoglou <i>et al.</i> (2008), Felici and Pagnini (2008), Bos <i>et al.</i> (2009), Dietrich and Wanzenried (2011), Epure <i>et al.</i> (2011), Goedde-Menke <i>et al.</i> (2014)
	Asian countries	Chong <i>et al.</i> (1996), Parkan and Wu (1999), Altunbaş <i>et al.</i> (2000), Brewer III <i>et al.</i> (2003), Kao and Liu (2004), Park and Weber (2006), Shih <i>et al.</i> (2007), Berger <i>et al.</i> (2009), Das and Ghosh (2009), Garcia-Herrero <i>et al.</i> (2009), Lin and Zhang (2009), Berger <i>et al.</i> (2010), Burki and Ahmad (2010), Avkiran (2011), Barros <i>et al.</i> (2012), Pennathus <i>et al.</i> (2012), Sufian and Habibullah (2012), Chen and Liu (2013), Fungacova <i>et al.</i> (2013), Jian <i>et al.</i> (2013), Lee and Chih (2013), Arjomandi <i>et al.</i> (2014), Dong <i>et al.</i> (2014a), Fujii <i>et al.</i> (2014), Kao and Liu (2014), Zhang <i>et al.</i> (2015)
	African countries	Beck <i>et al.</i> (2005), Naceur and Goaid (2008), Naceur and Kandil (2009), Alber (2014)
Multiple countries	American countries	Clarke <i>et al.</i> (2005), Chortareas <i>et al.</i> (2012a), Tabak <i>et al.</i> (2013), Goddard <i>et al.</i> (2014)
	European countries	Frydman <i>et al.</i> (1999), Vander Venet (2002), Weill (2003), Goddard <i>et al.</i> (2004a,b), Staikouras and Wood (2004), Bonin <i>et al.</i> (2005a,b), Fries and Taci (2005), Barros <i>et al.</i> (2007), Pasiouras and Kosmidou (2007), Van Poeck <i>et al.</i> (2007), Yildirim and Philippatos (2007), Mamatzakis <i>et al.</i> (2008), Staikouras <i>et al.</i> (2008), Koutsomanoli-Filippaki <i>et al.</i> (2009a,b), Uhde and Heimeshoss (2009), De Jonghe (2010), Barry <i>et al.</i> (2011), Hui and Chung (2011), Michalak and Uhde (2012), Jackowicz <i>et al.</i> (2013), Andrieş and Căpraru (2014), Molyneux <i>et al.</i> (2014)
	Asian countries	Corsetti <i>et al.</i> (1999), Kwan (2003), Huang <i>et al.</i> (2012), Lee and Hsieh (2013), Lee and Hsieh (2014), Lee <i>et al.</i> (2014a,b)
	African countries	Khamfula and Huizinga (2004), Alagidede <i>et al.</i> (2012)

	G20 countries	Lepetit and Stroebel (2013)
	BRIC countries	Zhang <i>et al.</i> (2013)
	MENA countries	Naceur and Omran (2011)
	GCC countries	Maghyereh and Awartani (2014)
	Mix	Molyneux and Thornton (1992), Demirgüç-Kunt and Huizinga (1999), Honohan and Klinggebiel (2003), Claessens and Laeven (2004), Boubankri <i>et al.</i> (2005), Kroszner <i>et al.</i> (2007), Micco <i>et al.</i> (2007), Albertazzi and Gambacorta (2009), Goddard <i>et al.</i> (2011), Delis (2012), Beltratti and Stulz (2012), Klomp and De Haan (2012), Barth <i>et al.</i> (2013), Bertay <i>et al.</i> (2013), Hoque (2013)
2. Frequency of data		
Daily	Aharony and Swary (1983), Parkan and Wu (1999), Brewer III <i>et al.</i> (2003), Karceski <i>et al.</i> (2005), De Vries (2005), Harada and Ito (2011), Arnold (2012), Patro and Xian Sun (2013)	
Monthly	Parkan and Wu (1999), Khamfula and Huizinga (2004), Rughoo and Sarantis (2014)	
Quarterly	McKenzie and Thomas (1983), Sapienza (2002), Mian (2006), Van Poeck <i>et al.</i> (2007), Brown <i>et al.</i> (2009), Jones <i>et al.</i> (2011), Hughes and Mester (2013)	
Annually	Claessens and Laeven (2004), Goddard <i>et al.</i> (2004a,b), Micco <i>et al.</i> (2007), Pasiouras and Kosmidou (2007), Albertazzi and Gambacorta (2009), Goddard <i>et al.</i> (2011), Bertay <i>et al.</i> (2013), Lepetit and Stroebel (2013)	

Note: BRIC is an acronym for the following countries: Brazil, Russia, India and China; MENA is an acronym for the Middle East and North Africa countries; GCC is an acronym for the Gulf Cooperation Council countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates).

Appendix II.2: Description of bank performance determinants and examples of papers

Determining factor	Variable	Measurement	Impact	Examples of papers
<i>BANK-SPECIFIC DETERMINANTS</i>				
Asset structure	Liquidity	Liquid assets to total assets	-/+	Negative: Molyneux and Thornton (1992), Sabi (1996), Angbazo (1997), Carter <i>et al.</i> (2004), Demirgüç-Kunt <i>et al.</i> (2004), Goddard <i>et al.</i> (2004b) Positive: Bourke (1989)
		Liquid assets to short-term liabilities	-	Negative: Angbazo (1997)
		Loans to total assets (inverse measure)	+/-	Positive: Demirgüç-Kunt and Huizinga (1999), Maudos and De Guevarra (2004), Stiroh and Rumble (2006), Barros <i>et al.</i> (2007), Chiorazzo <i>et al.</i> (2008), Naceur and Goaid (2008), Naceur and Omran (2011), Chortareas <i>et al.</i> (2012a) Negative: De Young and Rice (2004), Staikouras and Wood (2004)
		Loans to deposits (inverse measure)	+	Sabi (1996), Chortareas <i>et al.</i> (2012b)
		Loans to customers and short-term funding (inverse measure)	+/-	Positive: Pasiouras and Kosmidou (2007) Negative: Pasiouras and Kosmidou (2007), Kosmidou (2008)
Asset quality	Nonperforming loans	Nonperforming loans to total gross loans	-	De Young and Rice (2004), Hernando and Nieto (2007), Iannotta <i>et al.</i> (2007), Athanasoglou <i>et al.</i> (2008), Chiorazzo <i>et al.</i> (2008), Kasman <i>et al.</i> (2010)
Capitalization	Capital adequacy	Total equity to total assets	+/-	Positive: Kim and Santomero (1988), Bourke (1989), Molyneux and Thornton (1992), Lloyd-Williams <i>et al.</i> (1994), Berger (1995b), Angbazo (1997), Demirgüç-Kunt and Huizinga (1999), Demirgüç-Kunt <i>et al.</i> (2004), Goddard <i>et al.</i> (2004a), Staikouras and Wood (2004), Stiroh and Rumble (2006), Iannotta <i>et al.</i> (2007), Pasiouras and Kosmidou (2007), Athanasoglou <i>et al.</i> (2008), Chiorazzo <i>et al.</i> (2008), Naceur and Goaid (2008), Garcia Herrero <i>et al.</i> (2009), Chen (2011), Naceur and Omran (2011), Chortareas <i>et al.</i> (2012b),

				Haq and Heaney (2012), Sufian and Habibullah (2012), Barth <i>et al.</i> (2013), Berger and Bouwman (2013), Dietrich and Wanzenried (2014) Negative: Stiroh and Rumble (2006), Das and Ghosh (2009), Dietrich and Wanzenried (2011), Dietrich and Wanzenried (2014)
		Change in regulatory capital and Regulatory capital to risk weighted assets	+/-	Negative: Berger <i>et al.</i> (1995), Angbazzo (1997), Blum (1999)
Financial structure	Deposits	Total deposits to total liabilities	+	Iannotta <i>et al.</i> (2007)
		Total deposits to assets	+	Garcia Herrero <i>et al.</i> (2009)
Management quality	Cost-to-income ratio (inverse)	Operating costs to total income	-	Maudos and De Guevarra (2004), Pasiouras and Kosmidou (2007), Uhde and Heimeshoff (2009), Albertazzi and Gambacorta (2010), De Jonghe (2010), Dietrich and Wanzenried (2011), Dietrich and Wanzenried (2014)
	Non-interest-expense	Non-interest expense over total assets	-	Pasiouras and Kosmidou (2007), Dietrich and Wanzenried (2011), Sufian and Habibullah (2012)
	X-efficiency	The degree of efficiency maintained by banks under conditions of imperfect competition (inverse measure)	+	Berger (1995a), Clark and Siems (2002), Garcia Herrero <i>et al.</i> (2009), Fu and Heffernan (2009)
Bank size	Bank size	Natural logarithm of the accounting value of the total assets of bank	+/-	Positive: De Young and Rice (2004), Stiroh and Rumble (2006), Chiorazzo <i>et al.</i> (2008), Das and Ghosh (2009), De Jonghe (2010), Cornett <i>et al.</i> (2010), Barth <i>et al.</i> (2013), Bertay <i>et al.</i> (2013), Dietrich and Wanzenried (2014) Negative: Boyd and Runkle (1993), Berger (1995a), Demirgüç-Kunt <i>et al.</i> (2004), Barros <i>et al.</i> (2007), Pasiouras and Kosmidou (2007), Elsas <i>et al.</i> (2010), Chortareas <i>et al.</i> (2012b)
		Early growth of deposits	+	Dietrich and Wanzenried (2011, 2014)
	Systemic size	Total bank liabilities to GDP	-	Bertay <i>et al.</i> (2013)
Bank age	Age group	Dummy variable for different age group	-	Dietrich and Wanzenried (2011)
	Longevity	Years of establishment	-	Fraser and Rose (1972), Beck <i>et al.</i> (2005)
Revenue diversification	Non-interest income	Non-interest income over total gross revenues	+	Positive: De Young and Rice (2004), Chiorazzo <i>et al.</i> (2008), De Jonghe (2010)

	Diversification index	Adjusted Herfindahl-Hirschman index to measure diversification	+/-	Positive: Elsas <i>et al.</i> (2010) Negative: Stiroh (2004), Acharya <i>et al.</i> (2006), Stiroh and Rumble (2006)
	Measures of diversification	Diversification among different types of assets or income sources	+/-	Positive: Elsas <i>et al.</i> (2010) Negative: Laeven and Levine (2007), Lepetit <i>et al.</i> (2008a)
Ownership and nationality	Ownership	State banks	-	Beck <i>et al.</i> (2005), Iannotta <i>et al.</i> (2007), Micco <i>et al.</i> (2007), Naceur and Goaid (2008), Das and Ghosh (2009)
		Private banks	+	Beck <i>et al.</i> (2005), Naceur and Goaid (2008)
	Nationality	Foreign banks	+/-	Positive: Sabi (1996), Demirgüç-Kunt and Huizinga (1999), De Young and Rice (2004), Havrylchyk (2006), Micco <i>et al.</i> (2007), Claessens <i>et al.</i> (2001), Dietrich and Wanzenried (2011), Barry <i>et al.</i> (2011) Negative: Demirgüç-Kunt and Huizinga (1999), Havrylchyk (2006), Lensink <i>et al.</i> (2008), Angkinand and Wihlborg (2010), Dietrich and Wanzenried (2014)
		Domestic banks	-	Dietrich and Wanzenried (2011), Dietrich and Wanzenried (2014)
Transparency	Binary measures of disclosure		+	Nier and Baumann (2006)
	Disclosure index / Disclosure quality score		+	Nier (2005), Nier and Baumann (2006), Barakat and Hussainey (2013)
	Analyst following	The number of analysts following a bank's stock	+	Akhigbe <i>et al.</i> (2013)
	The dispersion of analysts' forecasts	Standard deviation of analysts' forecasts (inverse measure)	-	Akhigbe <i>et al.</i> (2013)
	Information sharing	A dummy variable that equals one if a public registry or a private bureau operates in the country, and zero otherwise	+/-	Positive: Pasiouras <i>et al.</i> (2009) Negative: Chortareas <i>et al.</i> (2012b)
INDUSTRY-SPECIFIC DETERMINANTS				

Banking concentration	CR3	The assets of the three largest banks over total commercial banking assets (%)	+/-	Positive: Molyneux and Thornton (1992), Chirwa (2003), Boyd et al. (2004), Demirgüç-Kunt <i>et al.</i> (2004), Claeys and Vander Venner (2008), Delis (2012), Sufian and Habibullah (2012), Dietrich and Wanzenried (2014) Negative: Garcia Herrero <i>et al.</i> (2009), Dietrich and Wanzenried (2014)
	CR5	The assets of the five largest banks over total commercial banking assets (%)	+	Pasiouras and Kosmidou (2007)
	Concentration dummy	Dummy variable that takes on the value one if the concentration ratio is above 0.8 or zero otherwise	+	Uhde and Heimeshoff (2009)
	Mergers and acquisitions		+/-	Positive: De Long (2001), Cornett <i>et al.</i> (2006), Altunbaş and Marques (2008), Evanoff and Ors (2008), Harada and Ito (2011), Molyneux <i>et al.</i> (2014) Negative: Peristiani (1997), Avkiran (1999)
	Herfindahl-Hirschman index	Sum of the squares of the market shares of all the banks within the industry	+/-	Positive: De Young and Rice (2004), Goddard <i>et al.</i> (2004b), Maudos and De Guevarra (2004), Dietrich and Wanzenried (2011) Negative: Carter <i>et al.</i> (2004), Garcia Herrero <i>et al.</i> (2009), Athanasoglou <i>et al.</i> (2008), Barth <i>et al.</i> (2013)
Banking competition	Lerner index	The difference between price and marginal cost, divided by price. Lerner index equals zero under the condition of perfect competition. The degree of competition decreases as Lerner index increases	+	Angelini and Cetorelli (2003), Maudos and De Guevarra (2004), Pruteanu-Podpiera <i>et al.</i> (2008), Solis and Maudos (2008), Casu and Girardone (2009), Agoraki <i>et al.</i> (2011), Fernández <i>et al.</i> (2013), Tan (2016)
	H-statistic	By using Rosse-Panzar model, H statistic reflects the average of a bank's conduct in each specific market where it operates. It equals 0 in monopoly, between 0 and 1 in monopolistic competition, and 1 in perfect competition (inverse measure)	-	Bikker and Haaf (2002), Claessens and Laeven (2004), Weill (2004, 2009), Mamatzakis <i>et al.</i> (2008), Agoraki <i>et al.</i> (2011)
	Branch	Ratio of branch offices to total bank offices of state and national banks	-	Degryse and Ongena (2005), Carlson and Mitchener (2006)

		(inverse measure)		
<i>ENVIRONMENTAL DETERMINANTS</i>				
Structural factors	Phase of the economic cycle	Real GDP growth	+/-	Positive: Claessens <i>et al.</i> (2001), Bikker and Hu (2002), Goddard <i>et al.</i> (2004b), Iannotta <i>et al.</i> (2007), Pasiouras and Kosmidou (2007), Athanasoglou <i>et al.</i> (2008), Claeys and Vander Vennet (2008), Naceur and Goaid (2008), Albertazzi and Gambacorta (2009, 2010), Uhde and Heimeshoff (2009), Dietrich and Wanzenried (2011, 2014), Sufian and Habibullah (2012), Barth <i>et al.</i> (2013) Negative: Claessens <i>et al.</i> (2001), Demirgüç-Kunt and Huizinga (1999), Chortareas <i>et al.</i> (2012a), Dietrich and Wanzenried (2014)
	Level of economic development	GDP per capita	+/-	Positive: Demirgüç-Kunt and Huizinga (1999), Dietrich and Wanzenried (2014) Negative: Demirgüç-Kunt and Huizinga (1999), Demirgüç-Kunt <i>et al.</i> (2004), Naceur and Omran (2011), Bertay <i>et al.</i> (2013), Dietrich and Wanzenried (2014)
		Bank assets to GDP	-	Demirgüç-Kunt and Huizinga (1999)
		Stock market capitalization to GDP	+/-	Positive: Demirgüç-Kunt and Huizinga (1999), Dietrich and Wanzenried (2014) Negative: Naceur and Omran (2011), Dietrich and Wanzenried (2014)
		Inflation-adjusted growth rate of GDP per capita	+	Bertay <i>et al.</i> (2013)
		Growth of GDP per capita	+	Barth <i>et al.</i> (2013)
	Monetary stance	Inflation	Annual change in consumer prices	+/-
3-year average percentage inflation			-	Barth <i>et al.</i> (2013)

		Monetary policy		Interest rates (long- and short-term)	+/-	Positive: Demirgüç-Kunt and Huizinga (1999), Claessens <i>et al.</i> (2001), Claeyns and Vander Venet (2008), Albertazzi and Gambacorta (2009), Garcia Herrero <i>et al.</i> (2009), Uhde and Heimeshoff (2009), Bolt <i>et al.</i> (2012), Rubio and Carrasco-Gallego (2014) Negative: Claeyns and Vander Venet (2008), Bolt <i>et al.</i> (2012)	
				Money market rate	-	Albertazzi and Gambacorta (2009)	
				Volatility of interest rates	-	Garcia-Herrero <i>et al.</i> (2009)	
				Reserve requirement/liquidity ratio	-	Gilbert and Rashce (1980), Demirgüç-Kunt and Huizinga (1999)	
		Exchange rates		Changes in the real exchange rate		+/-	Positive: Choi <i>et al.</i> (1992), Chamberlain <i>et al.</i> (1997), Chow <i>et al.</i> (1997), Merikas (1999) Negative: Choi <i>et al.</i> (1992), Chamberlain <i>et al.</i> (1997), Chow <i>et al.</i> (1997), Merikas (1999)
				Average annual exchange rate		+/-	Chortareas <i>et al.</i> (2012a)
				Exchange rate index		+	Atindéhou and Gueyie (2001), Elyasiani and Mansur (2005)
				Dollarization (Foreign exchange deposits to M2 money supply)		-	Kutan <i>et al.</i> (2012)
Fiscal stance		Effective tax rate applied on pre-tax profit		-/+	Negative: Demirgüç-Kunt and Huizinga (1999), Dietrich and Wanzenried (2011), Dietrich and Wanzenried (2014), Tan (2016) Positive: Dietrich and Wanzenried (2014)		
		Corporate income tax		+/-	Albertazzi and Gambacorta (2010)		
		Fiscal deficit	Overall deficit budget (% of GDP)	-	Boubankri <i>et al.</i> (2005)		
		Short-term debt		-/+	Bertay <i>et al.</i> (2013)		
Institutions	Law & order	Law enforcement	Contract enforcement dummy	Indicators ranging from 1 to 4, measuring the degree to which contractual agreements are honored and not subject to language and mentality differences.	-	Demirgüç-Kunt and Huizinga (1999)	
			Law and order	A score from 0 to 6; Low scores indicate that the law is ignored and high scores indicate a better legal enforcement.	-/+	Negative: Demirgüç-Kunt and Huizinga (1999), Boubankri <i>et al.</i> (2005) Positive: Naceur and Omran (2011)	

		Restrictions on bank activities	Measures whether bank activities are unrestricted, where 1 means that they are permitted and 4 that they are prohibited	-/+	Negative: Pasiouras <i>et al.</i> (2009), Chortareas <i>et al.</i> (2012b), Barth <i>et al.</i> (2013) Positive: Barth <i>et al.</i> (2004), Demirgüç-Kunt <i>et al.</i> (2004), Pasiouras <i>et al.</i> (2009), Chortareas <i>et al.</i> (2012b), Gaganis and Pasiouras (2013)	
		Capital regulation		-	Pasiouras <i>et al.</i> (2009), Chortareas <i>et al.</i> (2012b), Gaganis and Pasiouras (2013)	
		Official supervisory power	Power of supervisory agencies, indicating the extent to which supervisors can change the internal organization structure of a bank or take specific disciplinary action against managers, directors, shareholders and auditors.	+/-	Positive: Chortareas <i>et al.</i> (2012b), Gaganis and Pasiouras (2013) Negative: Chortareas <i>et al.</i> (2012b), Gaganis and Pasiouras (2013)	
			Principal component indicator of 14 dummy variables	+	Pasiouras <i>et al.</i> (2009)	
	Corruption	Corruption index (inverse measure)	Ranges from 0 to 6, and reflects a lack of corruption in government. A higher score indicates that government officials are less likely to take bribes.	-	Demirgüç-Kunt and Huizinga (1999)	
		Corruption Perception Index (inverse measure)	CPI was developed by Transparency International and ranges from 0 to 6. Higher values indicate less perception of corruption.	+	Naceur and Omran (2011)	
		Control of corruption (inverse measure)	Evaluates the degree to which public power is applied for private gains, and interests. Higher values indicate better control of corruption	-/+	Chortareas <i>et al.</i> (2012b)	
	Political factors	Electoral years	Dummy variable that takes 1 when the country is in an election year and zero otherwise	-/+	Negative: Micco <i>et al.</i> (2006, 2007), Baum <i>et al.</i> (2009), Jackowicz <i>et al.</i> (2013) Positive: Micco <i>et al.</i> (2006, 2007), Jackowicz <i>et al.</i> (2013)	
	<i>INTERNATIONAL DETERMINANTS</i>					
	Globalization	Macroeconomic processes	Geographic extension and diversification	+/-	Positive: Berger and De Young (2001, 2006), Lee <i>et al.</i> (2014b), Meslier <i>et al.</i> (2016)	

					Negative: Berger and De Young (2001, 2006)
		Capital flows		+	Lee <i>et al.</i> (2014b)
		Technological change	A company's cost function over time	+	Altunbaş <i>et al.</i> (2001a,b), Goddard <i>et al.</i> (2007)
		Liberalization	Privatization and liberalizations dummies	+	Beck <i>et al.</i> (2005), Boubankri <i>et al.</i> (2005)
	Financial structure	Bank credit	Bank claims on the private sector by deposit money banks divided by GDP	+	Naceur and Omran (2011)
		Trading revenue		+	Lee <i>et al.</i> (2014b)
		Financial Intermediation	Bank assets/GDP	-	Naceur and Goaid (2008)
		Market capitalization	Value of listed shares divided by GDP	+/-	Positive: Naceur and Goaid (2008), Albertazzi and Gambacorta (2009), Naceur and Omran (2011), Dietrich and Wanzenried (2014) Negative: Naceur and Omran (2011), Sufian and Habibullah (2012), Dietrich and Wanzenried (2014)
			Value of listed shares divided by total assets	-	Naceur and Goaid (2008)
	General globalization indicators	The actual flow index; the restrictions index; the personal contact index; the information flow index; the cultural proximity index; the political globalization index		+	Sufian and Habibullah (2012)
Monetary integration	Financial structure factors		+	Casu and Molyneux (2003), Barros <i>et al.</i> (2007), Evans <i>et al.</i> (2008)	
	β and σ convergence	β convergence – refers to catch-up effect or lagging behind effect	-	Mamatzakis <i>et al.</i> (2008), Weill (2009), Casu and Girardone (2010), Andrieş and Căpraru (2014)	
σ convergence – identified how quickly each country's efficient levels are converging to the average					

International financial crises	Crisis periods/years	-	Balderston (1991), Trebat (1991), Corsetti <i>et al.</i> (1999), Dietrich and Wanzenried (2011), Aebi <i>et al.</i> (2012), Beltratti and Stulz (2012), Lee and Hsieh (2014)
	Crisis dummy	-	Carlson and Mitchener (2006), Dietrich and Wanzenried (2014)

Appendix II.3: Examples of studies using indirect measures of bank performance

In addition to the direct measures of BP reported in Appendix I.2 in Chapter I, other studies may use what could be considered as indirect measures of bank performance, such as: bank lending, financial intermediation, financial development, etc. The current Appendix reports examples of such studies, regarding theoretical contributions, the methods used, and the BP determinants. Although such studies are important, they are not included in the main text, since the conclusions in terms of BP are often hard to establish. For example, Altunbaş et al. (2010) found that bank lending negatively responds to an increase in the 3-month Euribor rate; however, since the effects of loans to total assets on BP is found to be either positive or negative (see Appendix II.2), nothing can be inferred with respect to the effect of 3-month Euribor rate on BP. Of course, the list of studies based on such indirect measures of BP reported in this appendix has no ambition of being exhaustive.

Theoretical contributions	Main topic		Examples of papers
	Financial regulation		De Ceuster (2003), Mishkin (2006)
	Financial development		Ang (2008)
	Bank capital		Drumond (2008)
	Bank risk		Hasman (2012)
Methods used	Method	Main topic	Examples of papers
	Difference-in-difference	Bank lending	Spiegel (2009), Dewally and Shao (2014)
	OLS	Bank lending	Uchida <i>et al.</i> (2008)
	GMM	Bank lending	Altunbaş <i>et al.</i> (2010)
		Market power	Nguyen <i>et al.</i> (2012)
		Economic growth	Moshirian and Wu (2012)
		Bank capital	Guidara <i>et al.</i> (2013)
	Instrumental variables	Bank lending	Uchida <i>et al.</i> (2008)
BP determinants	Name	Main topic	Examples of papers
Monetary stance	Inflation (annual change in consumer prices)	Financial intermediation	Detragiache <i>et al.</i> (2008)
	3-month Euribor rate	Bank lending	Altunbaş <i>et al.</i> (2010)
Corruption	Corruption Perception Index	Bank lending	Pagano (2008), Park (2012)
	Composite indicator of corruption	Bank lending	Weill (2011a)
Political factors	Political strength (The number of votes received by the party to which the chairperson of the bank is affiliated in the area where the company is borrowing)	Bank interest rates	Sapienza (2004)
	Political affiliation (Affiliation with strong political parties from company's board of directors)	Bank lending	Khawaj <i>et al.</i> (2005)
	Electoral years (Dummy variable that takes 1 when the country is in an election year and zero otherwise)	Bank lending	Dinç (2005), Cole (2009)

Appendix II.4: Description of bank soundness determinants and examples of papers

Determining factor	Variable	Measurement	Impact	Examples of papers
BANK-SPECIFIC DETERMINANTS				
Bank performance	ROAE		+/-	Negative : De Jonghe (2010)
	NIM		+/-	Positive : Nguyen <i>et al.</i> (2012) Negative : Beck <i>et al.</i> (2013)
Asset structure	Liquidity	Liquid assets to total assets	-/+	Negative : De Jonghe (2010), Michalak and Uhde (2012)
		Loans to total assets (inverse measure)	+/-	Positive: Demirgüç-Kunt and Detragiache (2011)
		Credit growth	+	Positive: Uhde and Heimeshoff (2009)
		Loans to customers and short-term funding (inverse measure)	+/-	Positive : Bertay <i>et al.</i> (2013)
Asset quality	Nonperforming loans	Nonperforming loans to total gross loans	-	Negative : Nguyen <i>et al.</i> (2012)
	Loan loss provisions		-	Negative : Beck <i>et al.</i> (2013), Tabak <i>et al.</i> (2013)
Capitalization	Capital adequacy	Total equity to total assets	+	Positive : Bertay <i>et al.</i> (2013), De Jonghe (2010), Nguyen <i>et al.</i> (2012), Mirzaei <i>et al.</i> (2013), Tabak <i>et al.</i> (2013)
		Tier 1 to total assets	+	Positive: Laeven and Levine (2009), Michalak and Uhde (2012), Hoque (2013)
Financial structure	Deposits	Total deposits to assets	-	Negative : Barry <i>et al.</i> (2011)
Management quality	Cost-to-income ratio (inverse)	Operating costs to total income	-	Negative : Uhde and Heimeshoff (2009), De Jonghe (2010), Barry <i>et al.</i> (2011), Barakat and Huissainey (2013)
Bank size	Bank size	Natural logarithm of the accounting value of the total assets of bank	+/-	Positive : Lepetit <i>et al.</i> (2008b), Nguyen <i>et al.</i> (2012), Beck <i>et al.</i> (2013), Michalak and Uhde (2012) Negative : Barry <i>et al.</i> (2011), De Jonghe (2010), Demirgüç-Kunt and Detragiache (2011)
Bank age	Age group	The established year of a bank	+	Positive : Mirzaei <i>et al.</i> (2013)

Revenue diversification	Non-interest income	Non-interest income over total gross revenues	+	Negative : Lepetit <i>et al.</i> (2008b)
	Commission & fee income		-	Negative: Lepetit <i>et al.</i> (2008b), De Jonghe (2010)
	Trading income		-	Negative : Lepetit <i>et al.</i> (2008b), De Jonghe (2010)
	Other operating income		-	Negative : De Jonghe (2010)
Off-balance sheet items	Credit risk Securitization		-	Negative: Franke and Krahen (2006), Hansel and Krahen (2007), Krahen and Wilde (2008), Shin (2009), Michalak and Uhde (2012)
	Mortgage securitization		+	Positive: Jiangli and Pritsker (2008), Uzun and Webb (2007)
Ownership and nationality	Ownership	State banks	+	Positive: Nguyen <i>et al.</i> (2012)
		Private banks	-	Negative: Tabak <i>et al.</i> (2013)
		Family business	+	Positive: Barry <i>et al.</i> (2011)
		Institutional investor	-	Negative: Barry <i>et al.</i> (2011)
	Nationality	Foreign banks	+/-	Positive : Uhde and Heimeshoff (2009), Mirzaei <i>et al.</i> (2013)
		Domestic banks	-	Negative : Tabak <i>et al.</i> (2013) Ngeative: Uhde and Heimeshoff (2009)
Transparency	Disclosure index / Disclosure quality score		+	Positive: Nier (2005)
<i>INDUSTRY-SPECIFIC DETERMINANTS</i>				
Banking concentration	CR3	The assets of the three largest banks over total commercial banking assets (%)	-	Negative : Uhde and Heimeshoff (2009), Barakat and Huissainey (2013)
	CR5	The assets of the five largest banks over total commercial banking assets (%)	-	Negative : Nguyen <i>et al.</i> (2012), Mirzaei <i>et al.</i> (2013)
	Market share		+	Positive : Mirzaei <i>et al.</i> (2013), Tabak <i>et al.</i> (2013)
	Herfindahl Hirschman Index		-	Negative : Tabak <i>et al.</i> (2013)
<i>ENVIRONMENTAL DETERMINANTS</i>				

Structural factors		Phase of the economic cycle	Real GDP growth	+	Positive: Demirgüç-Kunt and Detragiache (2011), Michalak and Uhde (2012), Bertay <i>et al.</i> (2013), Mirzaei <i>et al.</i> (2013)
		Level of economic development	GDP per capita	+	Positive : Laeven and Levine (2009),
Monetary stance		Inflation	Annual change in consumer prices	+/-	Positive: Barakat and Huissainey (2013), Bertay <i>et al.</i> (2013) Negative : Uhde and Heimeshoff (2009), Demirgüç-Kunt and Detragiache (2011), Mirzaei <i>et al.</i> (2013)
		Monetary policy	Interest rates spread	+	Positive : Mirzaei <i>et al.</i> (2013)
Institutions	Law & order	Restrictions on bank activities	Measures whether bank activities are unrestricted, where 1 means that they are permitted and 4 that they are prohibited	-	Negative : Laeven and Levine (2009),
		Rule of law		+	Positive : Demirgüç-Kunt and Detragiache (2011)

Note: In the majority of papers, bank soundness is measured either by Z or log of Z, though some studies, measure BS by alternative indicators, such as “financial strength of ratings” (Bharath and Shumway, 2008; Lopez-Espinosa *et al.*, 2013), financial distress indicator (Nier, 2005) or tail risk β (De Jonghe, 2010), among others.

PART II

EVALUATING FINANCIAL CRISES IN

THE 21st CENTURY

CHAPTER III: Measuring the performance and soundness of European banks⁷⁵

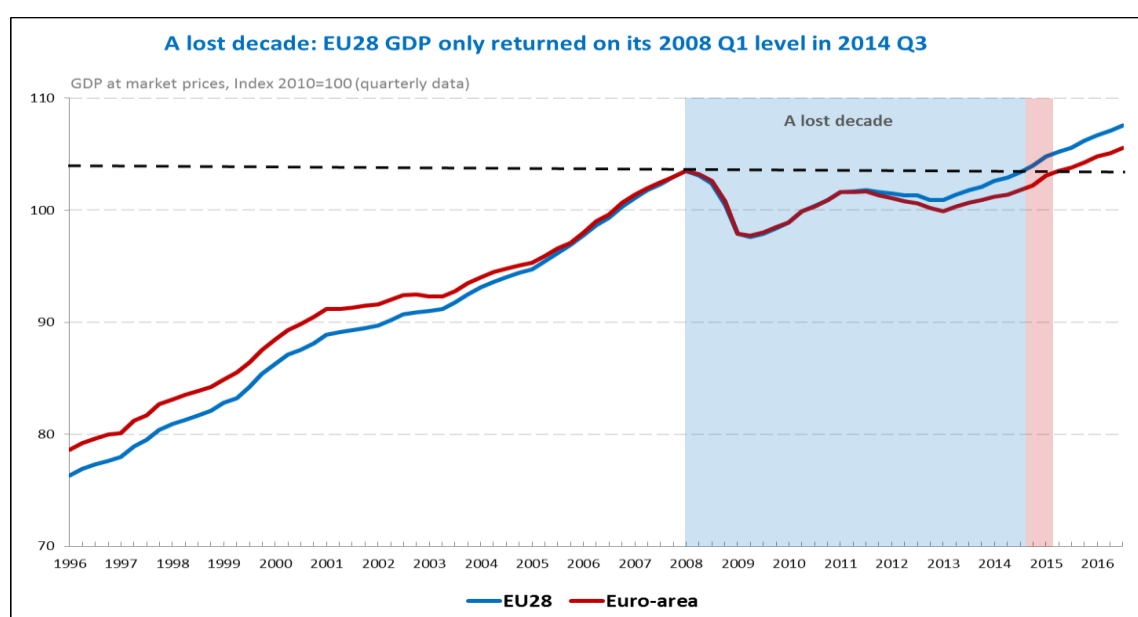
The financial world has experienced profound changes over the past two decades. Among the global forces that are driving these changes we can note technological innovation, deregulation of financial services and opening-up to international competition, and changes in bank's behaviour through disintermediation and higher accent on shareholders' value. In addition, the recent global financial events have accentuated these pressures stressing that the new global order is becoming more complex while progress across the financial industry is becoming uneven. Against this background, this chapter first discusses the developments in the European financial sector, then it debates the current challenges and opportunities that are reshaping the world of finance, and last, it empirically investigates the main determining factors of bank performance (BP) and bank soundness (BS) for 263 EU commercial banks in the period 2005-2012. Overall, banks' pre-crisis risk-taking behavior, complemented by a deficient regulatory and supervisory framework, have determined some very profitable although very risky business strategies. These trends concurred with a certain economic and financial fragility, and have generated deteriorating post-crisis profitability and soundness. In addition, the pre-crisis advantageous business strategies were heightened by high debt levels, cheap wholesale funding and high real estate and securitization exposures. Now, banks have to realize that the financial system is in a continuous change, thus further structural challenges and opportunities are still to come. Moreover, a return to a sustainable performance and an optimal soundness level are highly dependent on banks' flexibility in adjusting their complex business models to the new and dynamic financial environment.

⁷⁵A part of this chapter represents an internal report, performed and presented at the **National Bank of Romania**, in collaboration with **Virgil Dăscălescu**, Head of Unit, 2015.

III.1 A journey through the European operating environment

III.1.1 European general economic outlook

The European economy continued its gradual recovery path started in 2013, although the marginal boost in economic activity in the European advanced economies was counterbalanced by the economic slowdown in emerging economies, observing substantial heterogeneity across countries and regions. Figure III.1 shows a lethargic pace of economic recovery in the EU countries, thus the pre-crisis economic performance peak of early 2008, has been reached in EU28 in the third quarter of 2014 and in the euro-area in the second quarter of 2015.

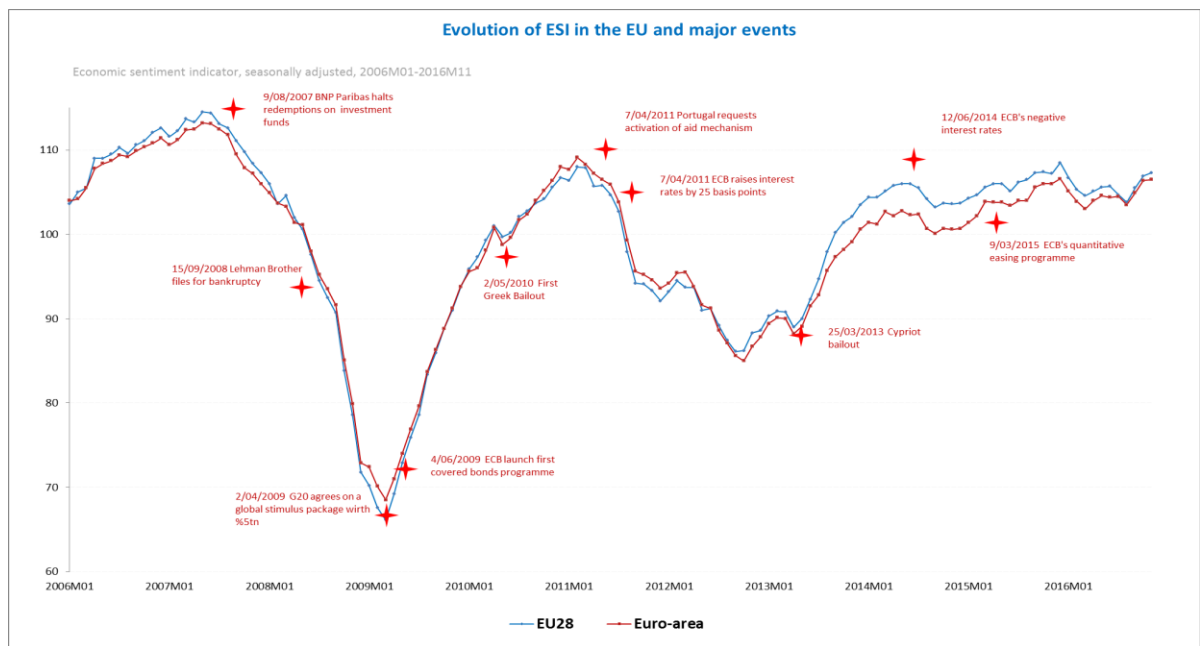


Note: the blue zone represents the catching-up period for EU28 GDP (2008Q1 - 2014Q3). The red zone represents the additional catching-up period for the Euro-area GDP (2008Q1 - 2015Q2).

Source: processed after Eurostat database

Figure III.1: Evolution of GDP at market prices in the EU

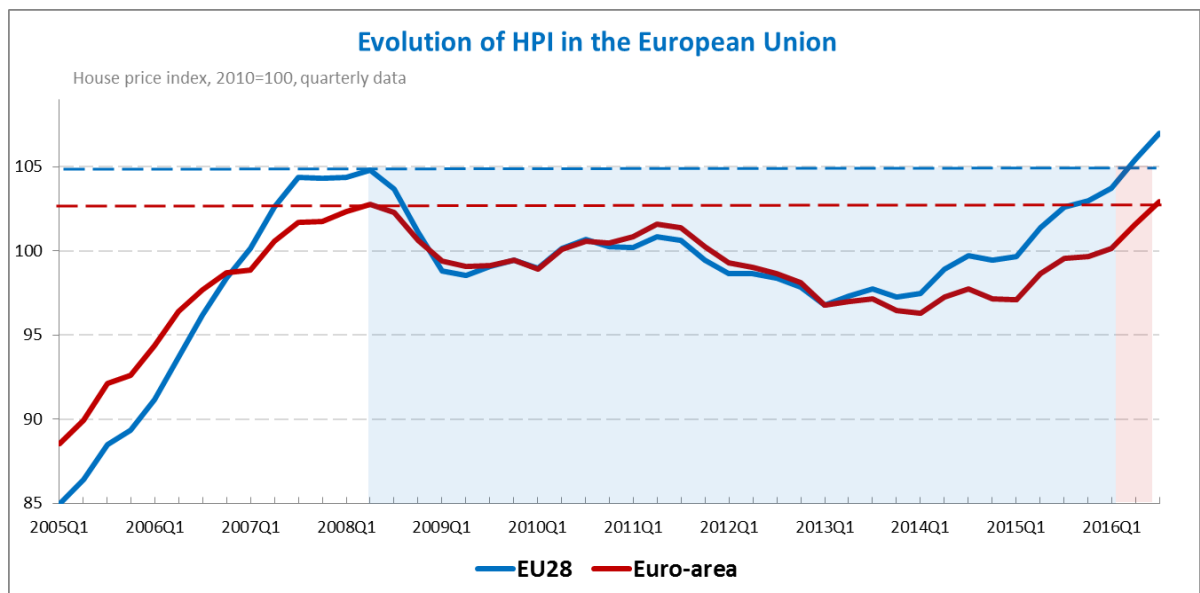
The prolonged period of recovery is disappointing, particularly considering that the Euro area benefited from a double stimulus: (i) the fall in energy prices caused by the collapse in the oil price which acted as a tax cut, boosting consumer spending; (ii) the negative interest rates (June 2014) and quantitative easing (March 2015) carried out by the ECB. Though, the slow economic growth can be motivated by the sharp uncertainty, structural impediments and also contraction of external financing conditions. The revival of EU business and consumer confidence was observed starting with Mid-2013, and it continues to improve. The latest positive trends in the Economic Sentiment Indicator (ESI) and GDP add to other signs that the EU28's economy has experienced a stronger growth momentum only from the beginning of 2015 (see Figure III.2).



Source: processed after Eurostat database

Figure III.2: Evolution of Economic Sentiment Indicator (ESI) and major events in the EU

Among other aspects influencing economic activity and confirming previous results is the evolution of the real estate market. As shows in Figure III.3, an optimistic trend for the House Price Index (HPI) started in 2015 and continues to develop in 2016. Though, we can note a long period of recovery also for the real estate market, thus the EU28 pre-crisis HPI reached its 2008 value only in the first quarter of 2016.



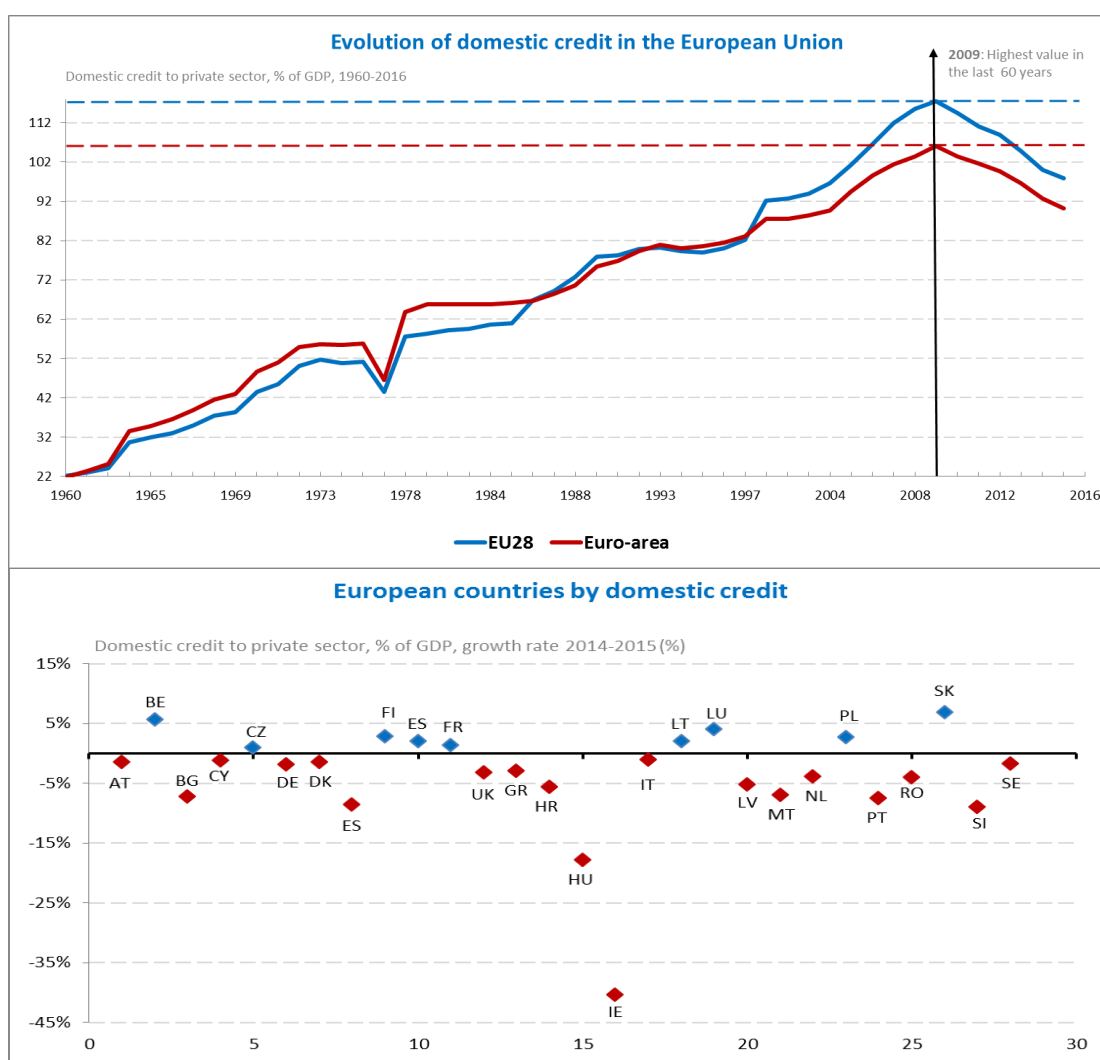
Note: HPis are computed as Laspeyres-type annual chain indices allowing weights to vary every year, and it shows the price changes of residential properties purchased by households, independently of their final use or previous owners. The blue region represents the necessary period for the EU28 HPI to reach its 2008 level (2008Q1-2016Q1), while the red zone represents the additional period necessary for the Euro-area HPI to reach its 2008 level (2008Q1-2016Q3)

Source: processed after Eurostat database

Figure III.3: Evolution of House Price Index (HPI) in the EU

Consequently, we can note an important trace of caution across EU countries in the last years as a result of geopolitical concerns, political uncertainty and other economic impediments, all of which could deteriorate and impact the real estate market. While concerns over the Greek situation and a possible break-up of the Euro-area have alleviated for the moment, there are new potential issues which could harm the economic activity, and implicitly the real estate market (such as Brexit).

Against this background of improving conditions in the EU economic sectors, we can observe that real estate investments continue to improve, while the volume of debt regarding these transactions continues to increase. Moreover, as represented in Figure III.4, both EU28 and Euro-area experienced a post-crisis decrease in outstanding amounts of domestic credit over GDP particularly because of the tightening European financing conditions.



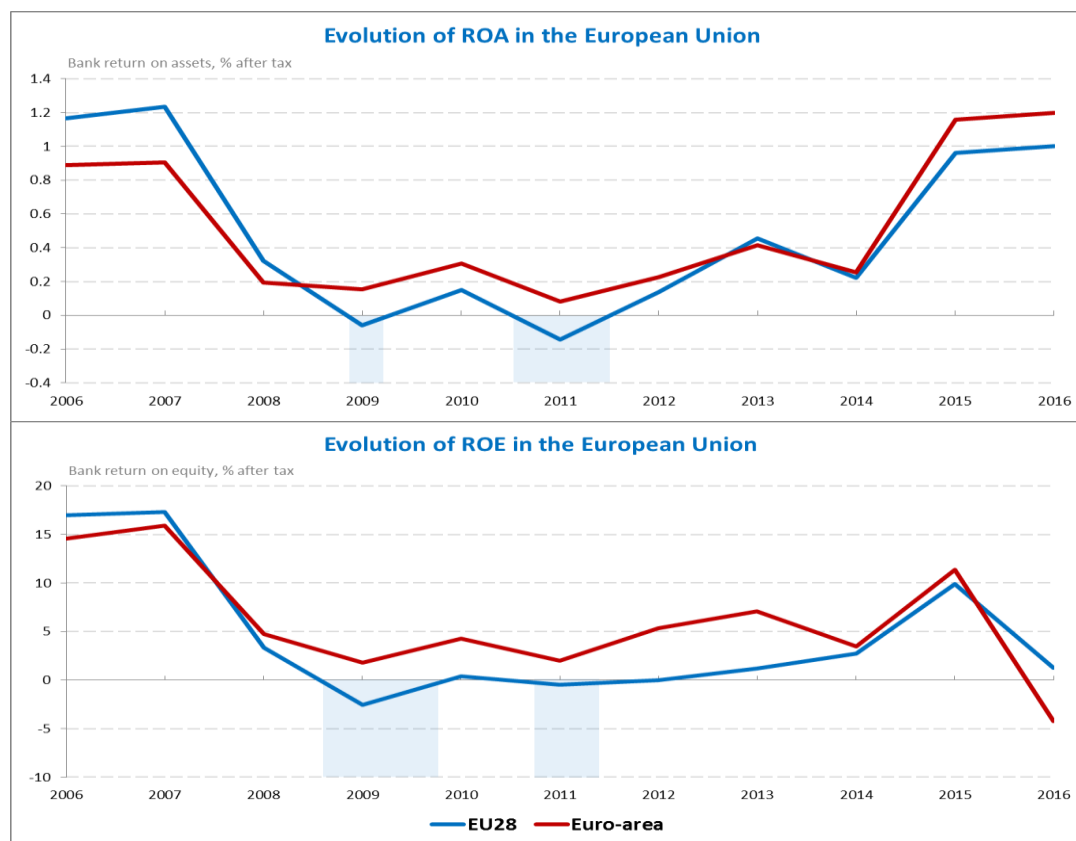
Source: processed after World Bank Statistics

Figure III.4: Evolution of EU28 domestic credit-to-GDP in the EU

Furthermore, Figure III.4 also indicates the growth rate of domestic credit to private sector as a percentage of GDP (2014-2015) by country, and it can be noted that only in nine EU countries

there's a positive growth rate in credit in the period 2014-2015, while for the rest of EU countries there was registered a decrease in this indicator. On the one side, we can distinguish that countries such as Belgium or Slovakia have registered a continuous expansion in the private sector lending, which has not yet been echoed in the real estate sector. On the other side, Ireland⁷⁶ and also Hungary are among the only countries that experienced a negative double digit growth rate of domestic credit in the period 2014-2015, thus lending activity has still not recovered to the pre-crisis levels. Moreover, in the majority of EU countries we can observe that credit conditions remain strict while interest rates are still high particularly for small and medium-sized firms (SMEs).

In the same vein as the economic indicators discussed above, the profitability of European banks has also suffered from the negative consequences of the recent financial crisis. Therefore, as shown in Figure III.5 the banking sector profitability remains low and broadly stable, though far-off from the pre-crisis double digit figures.



Note: The blue regions represents the period when EU28 ROA/ROE registered negative values.

Source: processed after Orbis database

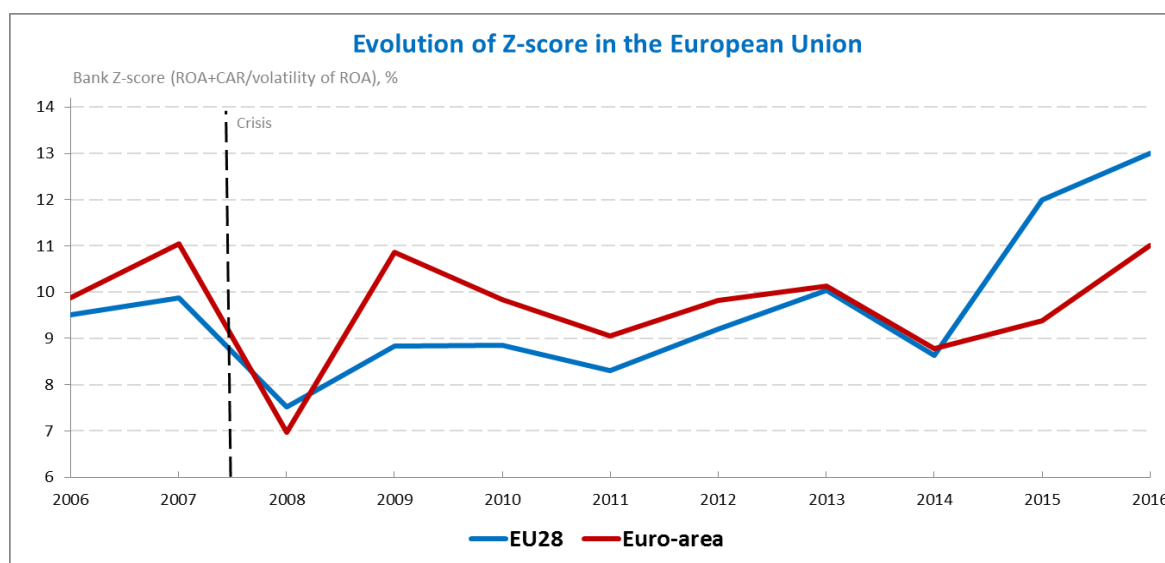
Figure III.5: Evolution of ROA and ROE in the EU

⁷⁶ In an effort to enhance bank lending for SMEs, the Irish Government introduced in October 2012 the **Credit Guarantee Scheme**, which guaranteed more than EUR 20 million up until 2015. This program was amended in 2015 to permit for the refinancing of loans in the cases when a SME's banks are exiting the Irish SME credit market to prolong the maximum time interval of the guarantee from three to seven years. Moreover, a **Microenterprise Loan Fund Scheme** was created to enable the financing for small and innovative business projects which were failing to meet the severe credit standards of commercial banks.

In Figure III.5, we can note the evolution of return on assets (ROA) for the EU countries, observing the EU28 ROA entrance into a negative territory in 2009 and afterwards in 2011 caused by the subdued economic growth, the associated low interest rates and the decrease in the loan portfolio quality.

Similarly, we can observe a deteriorated post-crisis return on equity (ROE) determined by the volatile stock market developments which further caused an increase in banks' cost of equity and severe constrains in banks' ability to support the real economy through lending. Though, starting with 2012 the EU28 ROE is broadly stable but still faces a series of challenges related to a large stock of non-performing loans (NPLs), incomplete business models adjustments and overloading in some Euro-area banking systems.

Naturally, the sluggish economic recovery coupled with the weak BP and the higher cost of external financing are among the main factors behind a decrease in BS in recent years, as can be seen in Figure III.6.



Source: processed after Orbis database

Figure III.6: Evolution of Z score in the EU

Moreover, the new regulatory requirements, the low interest rates and the strengthening of competition from non-banks in financial intermediation have also played an important role in the evolution of BS and the post-crisis business model structures. Though, this decline in BS has been somehow greater for the Euro-area banks particularly post-crisis, in light of the most recent macro-

prudential measures adopted in the EU and the recommendation of reciprocating some of these measures.⁷⁷

After the recent international financial crisis, the European banking sector has experienced a prolonged period of low profitability, when banks have scaled back their activities in some specific units that involved risk-taking, while consolidating core business activities. Banks are shaping their business models and risk-taking strategies to a diverse set of external factors, such as the new regulatory requirements, low interest rate environment, increased competition from non-banking institutions etc. Additionally, from the sample studied, we can observe large and persistent disparities between the EU28 and the Euro area countries regarding the level of economic development and bank performance and soundness, disturbing the long-term growth potential of the EU. Although EU accession was considered an anchor for progress in terms of financial stability, some of the EU countries are still lagging behind, being necessary to continue the implementation of a mix of economic policies to stimulate the catching-up progress.

III.1.2 European banking sector: Emerging challenges and strategic priorities

In the post-crisis period, economic growth and financial stability was, and still is, threatened by a grim mixture of low profitability, negative interest rate policy, severe bank resolution structure and uncertainty in the regulatory framework. Therefore, the European economy has been facing a series of risks that have morphed into uncertainty. These risks are related to the direction of the EU and its resilience to new shocks but also to the future challenges that the European financial sectors have to face. To reduce this uncertainty, both policy makers and banks ensured that the European financial system is fit for purpose and is able to recover from the deep scars left by the recent distressing events. Consequently, the risks and challenges to the financial sectors

⁷⁷ For macro-prudential measures to have an effect, it is important that they be applied equally to all the credit institutions operating in a market whether they are domestic banks, foreign subsidiaries, branches of foreign banks or foreign banks providing cross-border services directly. Reciprocity is mandatory only when a country applies stricter risk-weights for mortgage lending or sets the countercyclical capital buffer rate at up to 2.5%. Recognition of other macro-prudential measures remains voluntary and the decision to apply them is taken by the designated or competent authorities of each country. The ECB is also able to require that stricter requirements be followed as part of single banking supervision. The ESRB issued a *Recommendation on 15 December 2015 (ESRB/2015/2) for assessing the cross-border effect of and voluntary reciprocity for macro-prudential policy measures*. The recommendation set out the principles that member states (MS) should follow when notifying and requesting reciprocation of their macro-prudential measures and deciding on reciprocity of the measures adopted by other countries. The ESRB assesses how appropriate the request of a MS for its measures to be recognized is, and if the request is justified, it advises other MS to recognize the measure. If a MS decides not to recognize the measure, it has to give grounds for this decision. For example, Estonia has set a new systemic risk buffer (SRB) of 1pps and in 2016. For risk exposures in Estonia, the host country was asked to provide an institution-specific threshold. Domestically authorized institutions are exempted from applying the reciprocating measure if they do not exceed the institution-specific threshold of EUR 200 million. Estonia proposed that this threshold should be reciprocated and the ESRB recommended this reciprocation (ESRB/2016/4).

have to be treated as opportunities and in some cases as priorities to make the financial sector more efficient, resilient and to ensure better financial services and products.

We have grouped the most important challenges to BP and BS as follows:

- ❖ *Fragility in the banking sector*: persistent low interest rate environment, credit quality issues, overcapacity, consolidation;
- ❖ *Uncertainty in the regulatory framework*;
- ❖ *New forms of technology (Fintech)*;
- ❖ *New business models*.

These challenges could also be grouped as *cyclical challenges*, such as the weak macroeconomic conditions or persistent low interest rate inflation, or as *structural challenges*, such as credit quality issues, overcapacity and consolidation, new business models and harsher regulation.

III.1.2.1 Fragility in the banking sector

A. Low interest rates

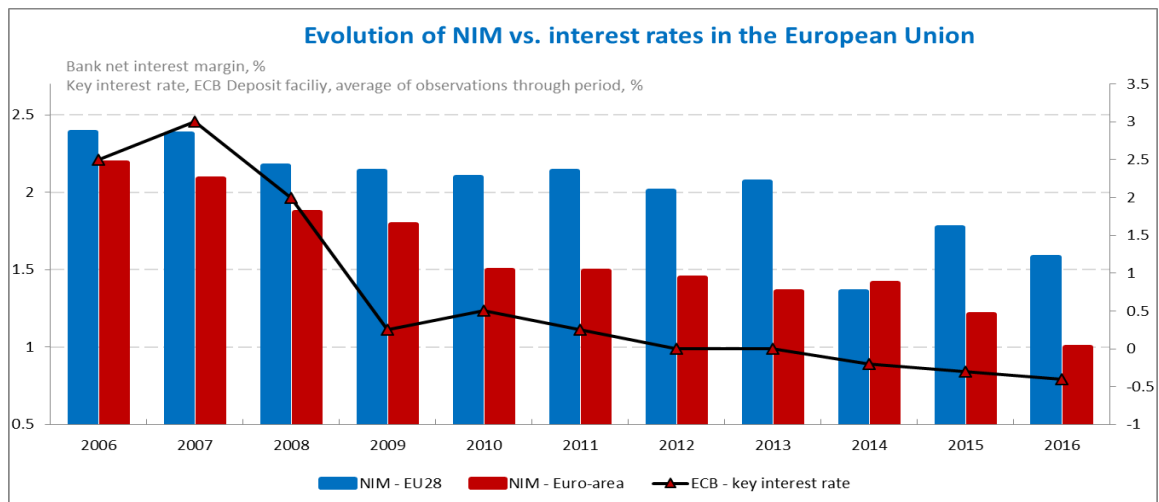
In the post-crisis period, policy makers have acted swiftly and adopted a package of measure in order to safeguard financial stability and to shield the economic system from the recent financial malaise. Consequently, monetary authorities ensured sufficient liquidity in the financial markets, by endorsing long-term refinancing operations, unconventional monetary policy, and reduced interest rates. As such, financial market participants have been continuously guided through the future policy route.

Beyond several trends and developments in the financial sector, the current low interest rate environment poses significant challenges for the European financial sector (for example, the ECB is among the only central banks that promoted a negative interest rate on the deposit facility in June 2014).

The influence of the low interest rate setting is bank specific and dependent on the interest rate sensitivity to bank's assets or bank's capacity to reprice deposits. Thus, the pressure of low interest rates has different intensity depending on the balance sheet structure of the banks. On the one side, lower interest rates have benefited banks through cheaper funding and capital gains on marketable assets. Moreover, the low interest rates have also enhanced the asset quality of banks

and improved the sustainability of the current debt stock. What is more, as a response to the low interest rate environment, banks increased the non-interest income level through fees and commissions.

On the other side, the low interest rates impacted traditional banking, particularly banks highly dependent on interest revenues. Additionally, there is limited room for further declines in funding costs, assuming that depositors and investors are not likely to accept high negative returns on their investments.



Source: processed after Orbis database

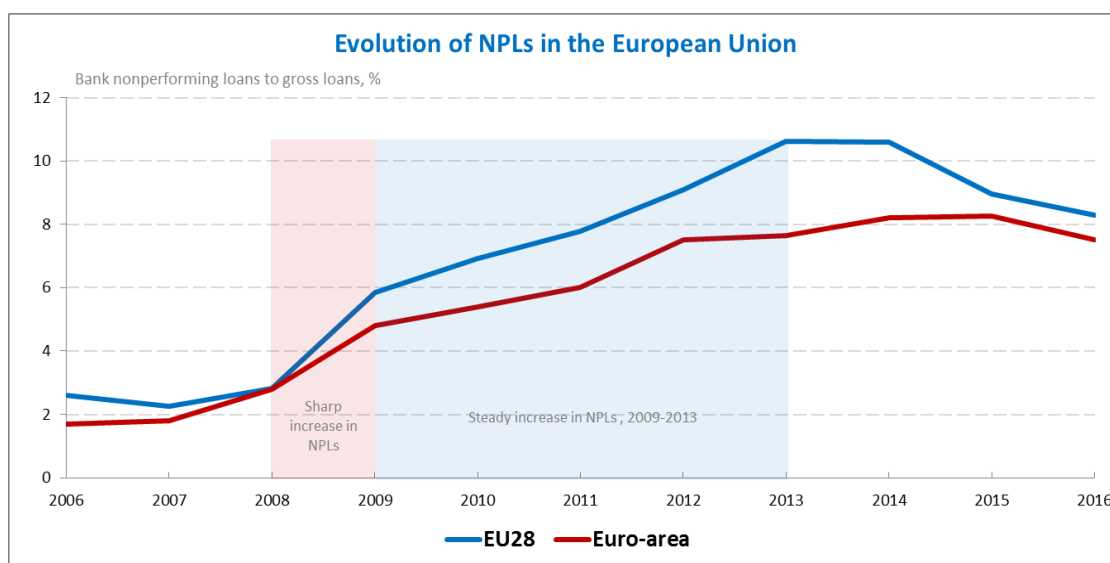
Figure III.7: Evolution of NIM and interest rates in the EU

Indeed, as Figure III.7 shows, a decrease in the interest rates was associated with a reduction in interest revenues, in both EU28 and Euro-area. Banks have been less capable to overcome the sharp decline in interest rates by passing them to retail deposits, considering that the interest rates reached the zero-level in 2012 and moved into a negative territory in 2014 which exacerbated potential non-linearities. Though, these negative effects are offset by other positive consequences of low interest rates, such as an improvement in the quality of loan portfolio, which contributed to a decrease in loan loss provisions. Overall, against this background, asset quality together with banks' balance sheet continued to improve, while the impact on the Profit and Loss is marginally diminishing.

B. Non-performing loans

The second factor which contributed decisively to the fragility of the European financial sector is the high level of non-productive assets of European banks, although we observed a decreasing trend in the last three years. As shown in Figure III.8, in the period 2008-2009 there was an acute increase in the non-performing loans (NPLs), followed by a constant proliferation in the period 2009-2013, suggesting that in this period credit risk was and still is the main

vulnerability of European financial sector. Moreover, in 2013, NPL ratio exceeded levels of 10pps in EU28. Though, starting with 2014, the NPL ratio started to decrease determined by the positive



economic prospects in the EU.

Note: The red region represents the sharp increase in NPLs from 2008-2009, while the blue region represents the constant increase in NPLs in the period 2009-2013.

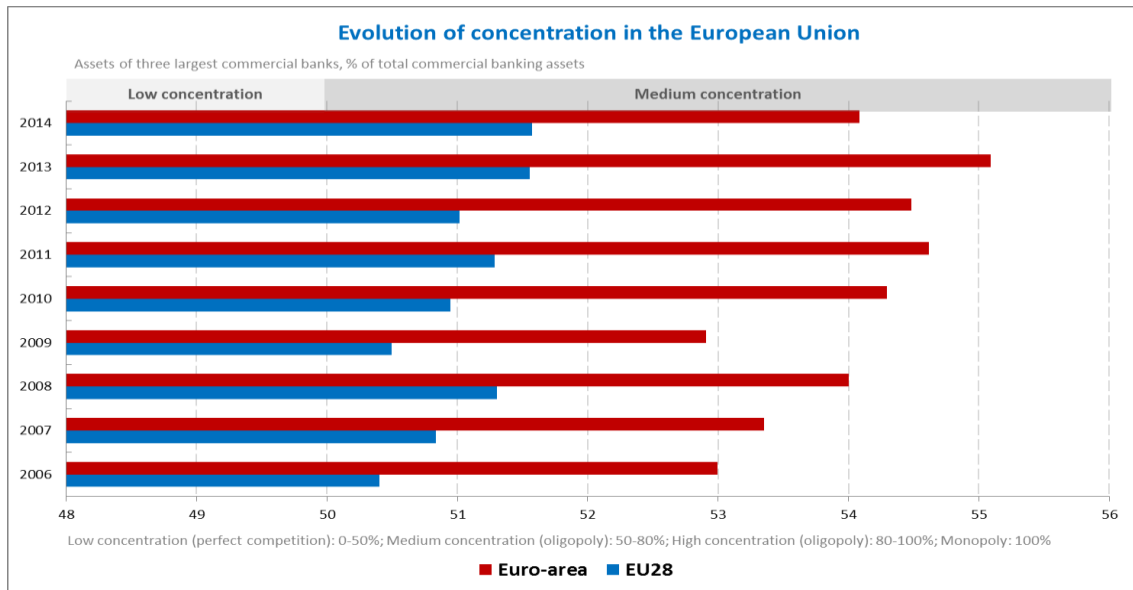
Source: processed after Orbis database

Figure III.8: Evolution of NPL ratio in the EU

These large levels of NPLs exacerbated the challenges that bank performance had to face in the EU, considering that NPLs are only posing additional pressure on BP as they only consume capital and don't generate additional profits. Moreover, the high levels of NPLs have also macroeconomic consequences as many borrowers become incapable of fulfilling their debt obligations on time, thus they become over indebted in the lack of feasible long-term restructuring options, negatively affecting bank soundness as well. This can be explained by institution-specific factors, such as management efficiency and experience. Furthermore, there are a series of structural impediments in swiftly resolving the issue of NPLs, among which we can note corporate insolvency laws and regulations, ineffective judicial system and complex procedures, absence of an efficient out-of-court workout structures, accounting and tax issues, flawed and unprepared personal etc.

C. Bank concentration and competition

Banking sector concentration has continued on an upward path in both EU28 and Euro-area in comparison with the pre-crisis period, though developments have been quite heterogeneous across EU countries (see Figure III.9). This trend is primarily the reflection of a decrease in the number of banks, considering that Mergers & Acquisitions (M&A) remained rather passive.



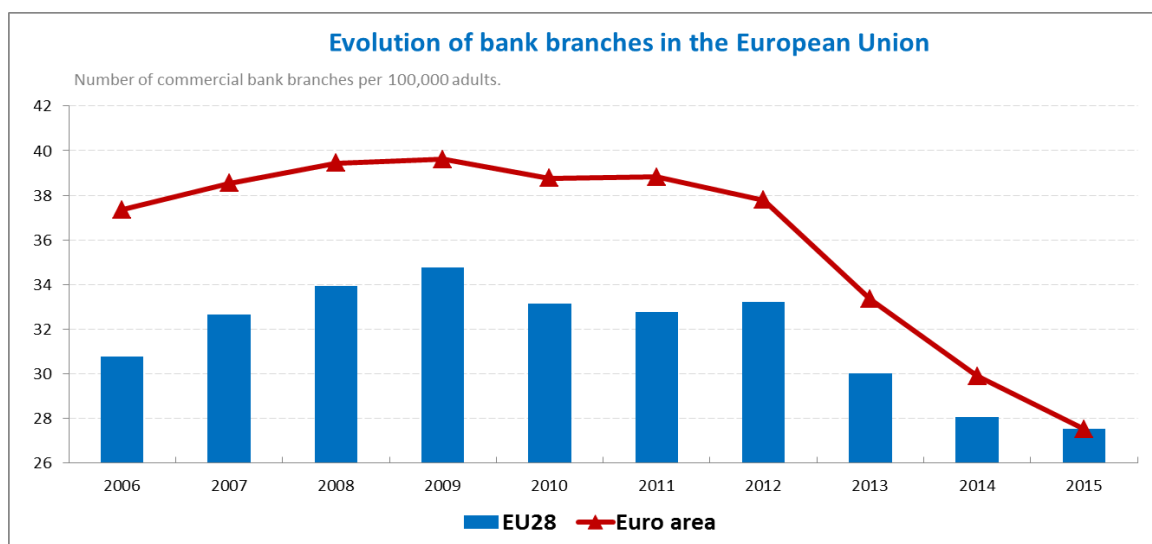
Source: processed after World Bank database

Figure III.9: Evolution of banking sector concentration in the EU

With regard to cross-country variations, the concentration index is reflecting a series of structural factors. For the Euro-area, the trend is driven mainly by developments in large countries, such as France, Germany, Italy and Spain, where the banking systems are more fragmented and include a variety of banks, such as savings and cooperative banks. On the contrary, the banking sectors in smaller countries tend to be less fragmented, and more concentrated which offsets the trend determined by the large Euro area countries (except for Austria and Luxembourg where the banking sector includes a large number of foreign credit institutions).

In addition, Figure III.10 shows recent trends in banking dynamics, where the majority of EU28 countries have experienced a decrease in the number of branches between 2013 and 2014, except for Hungary, Poland, and Slovakia. The country that experienced the strongest decline in the number of commercial bank branches in the period 2013-2014 was Netherlands.

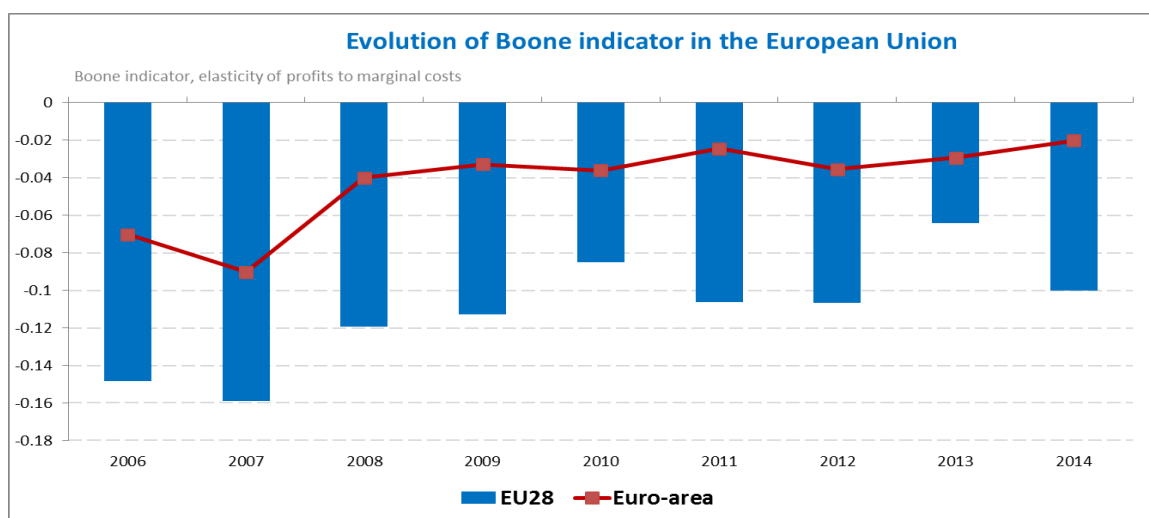
Looking at the Euro area, we can also observe that foreign branches in the total number of banks increased with 3pps in the period 2008-2014, where more than half of this increase occurred between 2013 and 2014.



Source: processed after World Bank database

Figure III.10: Evolution of commercial bank branches in the EU

In terms of competition, Figure III.11 below is showing the trend registered by Boone indicator in the period 2005-2014. In the post-crisis period, we can notice a growing indicator, which implies a deterioration of the competitive conduct of financial intermediaries, particularly in the Euro-area.



Source: processed after World Bank database

Figure III.11: Evolution of banking sector competition in the EU

Looking at the competitive environment in the EU in the run-up of the 2008 financial crisis, we can also observe another factor which added additional weight on BP and BS, namely *shadow banking*. Shadow banking has developed very quickly, and created a new market-based credit system, covering mainly the non-bank financial institutions that engaged in maturity transformation. There are two perspectives related to shadow banking. From a narrow perspective, shadow banking is considered to be related only to the credit intermediation performed by non-

bank financial institutions. From a broad perspective, shadow banking is referring to all non-banking activities, containing a diverse and large collection of financial services and products in the market-based credit system (e.g. securitization, securities financing transactions, securities lending and repurchase agreements, collateral management and intermediation, risk transformation through swaps etc.). The main element that enabled these non-bank financial institutions to expand rapidly, was the fact that some of them fall under the circumscription of the regulatory requirements but some of them don't, being less or non-regulated institutions. This issue could pose serious threats to bank soundness and implicitly to financial stability, being one of the major concerns of international regulators.

Since the inception of the international financial crisis, the EU28 banking sectors have been going through a rationalisation process which has determined a decrease in the number of banks. Moreover, considering the negative consequences of the crisis but also the lethargic economic recovery, European banking systems have to continue their consolidation process in order to achieve cost containment, deleveraging and restructuring.

III.1.2.2. Uncertainty in the regulatory agenda

In the pre-crisis period, some banks had too little and too low quality capital, excessive short-term funding and excessive leverage, which led to an extreme cost for the whole society when some of them failed. Consequently, the regulatory agenda was vital in solving these issues and making banks more resilient.

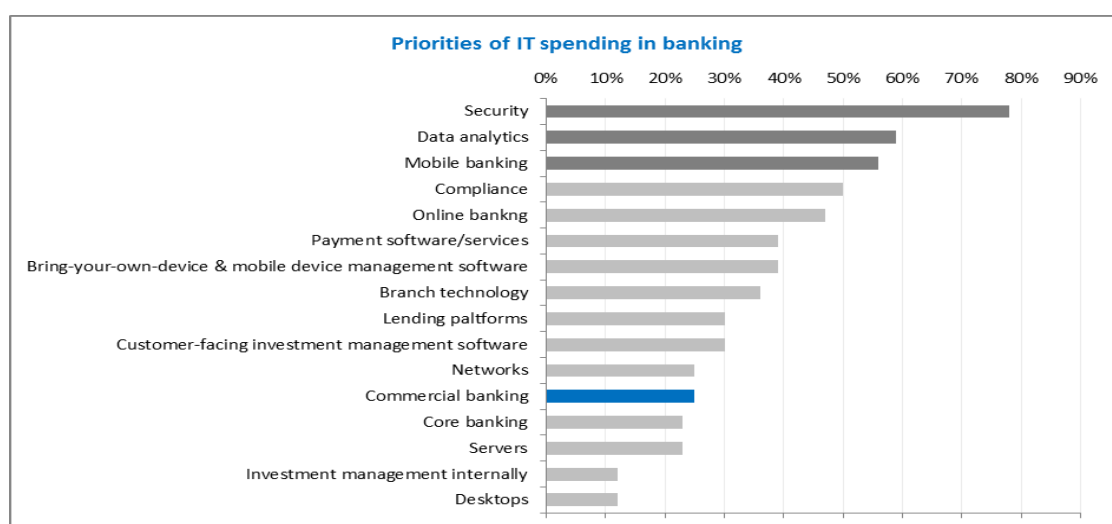
The ongoing regulatory reform which started immediately after the crisis shows a tendency to become more and more complex which comes with additional compliance costs. Moreover, banks are further challenged by uncertainty regarding the final form of the post-crisis regulatory framework, which negatively affects BP and BS. While policy makers and regulators are keen on maintaining the regulatory reforms from the recent period (see detailed discussion sub-chapter I.2.1.2), the rising political uncertainty caused by latest events (such as Brexit or the US elections) augmented the volatility and unpredictability of the European macroeconomic environment. At the same time, the new technologies are putting additional pressure on the future of the regulatory framework given that they stand to enlarge the cyber risks in the financial industry, though they could also revitalize the traditional business models.

For example, one of the most recent amendments of the European regulatory framework refers to revision of the *Capital Requirements Directive* and *Capital Requirements Regulation* (CRR II, CRD V) and amendments to the *Bank Recovery and Resolution Directive* (BRRD) which

will post probably spring an important change for the European financial sector in the next decade. This revision includes essential outstanding elements of Basel III, and in particular it includes: (i) the Net Stable Funding Ratio (NSFR) to diminish excess maturity transformation risk; (ii) the Leverage Ratio to diminish excessive leverage risk and constrain banks with low-risk weighted portfolios with a requirement of minimum 3% in Tier 1; (iii) the introduction of the new Total Loss Absorbing Capacity (TLAC) requirements for global systemically important institutions, requiring a minimum of capital and eligible liabilities in order to end the "too big to fail" tendency. The new CRR II/CRDV package will play an important role in the regulatory developments in the following years, so European banks should assess the potential impact that this new legislation could have on their business models, particularly regarding capital and liquidity requirements, risk management and measurement.

III.1.2.3 Fintech

In the past decade, technology has completely transformed the banking sector. Moreover, new technologies will reshape bank customers' experience but will also transfigure banks' operational activity by increasing their efficiency and effectiveness. The majority of banks are planning substantial increases in spending across an extensive range of technologies in the following years, though the rises will be more intense for securities, data analytics and mobile banking, while commercial banking is seen as less of a priority for the overall banking activity in the near future (see Figure III.12).



Source: adapted from Terris (2015).

Figure III.12: Priorities in IT spending in banking, 2015

Driven by technological innovation, the financial services industry looks to be on the brink of a paradigm shift in the way businesses are run and in the way financial products and services are delivered to end users.

Undoubtedly, *distributed ledger technology* (DLT) is among the most talked-about technologies in the financial sector nowadays, potentially with the highest impact on the banking sector. DLT is now capturing the imagination of the whole financial services ecosystem and promises a simplification of banking business models, and an increased performance and soundness of next financial services infrastructures and processes. Blockchain is commonly used as a synonym for the DLT, though it represents actually the practical way to operate a distributed ledger.

A distributed ledger is an asset database that can be shared across a network of multiple institutions, geographies or sites. More specifically, DLT is considered a decentralized, trustless, and universal digital ledger that is functioning by using a public peer-to-peer network. Blockchain per se preserves a continuously-growing list of ordered records called blocks. Each block has to be certified by some set of participating nodes. The block is time-stamped to define the order of the blocks in the chain. In terms of security, blockchain is counting on the validation mechanism performed by the so-called "miners", which have to generate a complex algorithm called hash, to validate the block and append it to the previous one – in order to create a chain of blocks or a blockchain). The immutability is given by the fact that any variations in past blocks would determine an altering of the cryptographic signature of the block, thus making the block invalid (and all the following blocks). Additionally, cryptography, which refers to public and private keys together with digital signatures are used to prove identity, authenticity and impose read or write access rights.

The blockchain lies behind the Bitcoin, which was first implemented in 2009, and further inspired other applications such as the "smart contracts" (the pre-written computer software which are stored and replicated on a DLT) or the Ethereum (another public Blockchain supporting smart contracts applications).

Generally speaking, this technology could help improve information security, increase databases integrity and intensify the protection against malicious attacks. Though, as any emerging technology, it also possess several challenges starting from its complexity and continuing with competing standards, proper regulation, compatibility of IT infrastructure and the constant stream of new innovations.

DLT has the potential to profoundly change the financial services and products by increasing efficiency, decreasing costs, and enhancing resilience by redistributing risks and overcoming a major weakness in traditional financial systems such as the single point of failure.

In the banking sector, DLT has a wide range of potential applicability. Apart from payment systems and post-trade settlements, DLT has started to be developed in trade finance, mortgage loan applications and digital identity management. The DLT benefits, such as avoiding multiple intermediaries and duplication of data entry, increasing transparency and efficiency of transactions and working in a secure environment, are very appealing for banks, especially in back-office processes which are largely manual, labour intensive and paper-based, thus DLT can bring many efficiency gains.

For example, in the area of mortgage credit, DLT may provide an environment where copies of digitized documents from banks, notaries and valuation firms are shared. It can thus offer secure, transparent, fast and efficient way for the property valuation, property ownership verification and the count of borrower's mortgages with other banks.

In trade finance, the possibility to share digitized documents helps improve the efficiency and accuracy of the workflow and reduces the risk of fraud. Finally, development has also been done in digital identity management where DLT may enable automatizing of the customer authentication process.

Banks are already operating in multidimensional interlinked financial transaction systems. The way how DLT may be deployed was described by Mersch (2016). He envisages three possible scenarios:

- ❖ individual market participants use DLT to increase their internal efficiency and effectiveness with no significant impact on the overall financial system;
- ❖ a core group of market participants adopts DLT and obtains a competitive advantage by gaining a critical mass and enabling the whole financial markets to shift to DLT;
- ❖ a peer-to-peer (P2P) world emerges, excluding completely financial institutions.

The first two scenarios seem rather realistic. Indeed, the majority of real use and the current cooperation between banks and Fintech firms go in the direction of the first two scenarios. But the process of migration to DLT base will likely be gradual. There will most probably be a mixture of existing financial systems and newly emerging DLT systems working together at the same time. The European Banking Federation (2016) also recognises that a massive implementation of DLT

is premature. The third scenario is therefore regarded more as a hypothetical one, at least at this stage.

Banks and Fintech firms are already actively collaborating via consortia to accelerate the development of DLT and exploring its opportunities for commercial applications (e.g. R3CEV⁷⁸).

Among the examples of DLT use cases in the banking sector are the following:

- ❖ [January, 2017]: The consulting firm, Deloitte, launched the creation of an *EMEA Financial Services Blockchain Lab* in Dublin with the purpose of developing strategic blockchain capabilities and proof-of-concepts into functioning prototypes to create 'ready to integrate' solutions for financial services clients. Based on the cooperation between blockchain developers and the Bank of Ireland, it was developed a joint proof-of-concept trial combining blockchain with the bank's existing systems in order to provide a next generation client experience and regulatory oversight at a lower cost;
- ❖ [September, 2016]: Credit Suisse, Ipreo, Symbiont, and R3 assemble a *proof of concept for syndicated loans* (Synaps Loans LLC). The project demonstrated the potential for DLT to reshape the syndicated loan market by increasing efficiency and reducing costs;
- ❖ [October, 2016]: Bank of China and HSBC evaluated the use of DLT for the *mortgage valuation system*, which implies a secure database capability of DLT to provide quick property valuation for mortgage loans applications. Trials for this system are being directed in the Hong Kong's fintech sandbox, which is overseen by Astri and the Hong Kong Monetary Authority.
- ❖ [August, 2016]: Santander, Deutsche Bank, BNY Mellon and the inter-dealer broker Icap launched a partnership with UBS and Clearmatics to create a *Utility Settlement Coin* that could be used to clear and settle financial trades over a distributed ledger;
- ❖ [January, 2016]: Commonwealth Bank of Australia simulated at the beginning of 2016 a *blockchain transaction* with 10 of the world's largest banks (CBA, Barclays, BMO Financial Group, Credit Suisse, HSBC, Natixis, RBS Bank of Scotland, TD Bank, UBS, UniCredit and Wells Fargo).

⁷⁸ R3 (R3CEV LLC) is a distributed database technology company. It leads a consortium of more than 70 of the world biggest financial institutions in research and development of blockchain database usage in the financial system.

In relation to use cases of DLT in central banking, we can note that European authorities have started to embrace the blockchain technology in order to refurbish their own products and infrastructures, starting with 2016, as follows:⁷⁹

- ❖ [December, 2016]: *The European Central Bank* (ECB) started an international partnership with the Bank of Japan, launching a joint research project in relation to the use cases of DLT for financial market infrastructure;
- ❖ [December, 2016]: *Central Bank of Denmark* announced their plans to develop blockchain-based virtual currency (E-krone);
- ❖ [November, 2016]: *Deutsche Bundesbank* together with *Deutsche Börse Group* started testing a prototype of a blockchain-based system for trading and settlement of securities;
- ❖ [July, 2016]: *Banque de France* launched a blockchain experiment for the identification process and security enforcement within the Single Euro Payments Area (SEPA). The first testing was carried out together with the French IT startup *Labo Blockchain* (a group of French banks and the Caisse des Dépôts et Consignations);
- ❖ [March, 2016]: The *Dutch Central Bank* is exploring the possibility to develop a blockchain-based prototype of digital currency (DNBcoin);
- ❖ [February, 2016]: *Bank of England*, in a partnership with *University College in London*, is exploring the possibility to introduce a coin called RSCoin, eliminating the intermediation approach and focusing on a direct approach between clients and central banks.

As to the financial services landscape, large banks are faced with the challenge of overcoming institutional inertia, improving their overall efficiency and adapting to the future financial environment. New technologies, such as DLT, open new horizons for them as it carries enormous potential. Though, for small or medium-sized banks, DLT might present a greater challenge as big competitors dominate the market with new technologies. New or smaller players may have the advantage of being able to respond faster to new developments, but the possibility for them to succeed will depend on their ability and capacity to overcome and address the many

⁷⁹ From an international perspective, we can observe that numerous monetary authorities have started exploring the potential of DLT, such as: the Federal Reserve, Central Bank of Canada, Reserve Bank of Australia, Central Bank of Russia, National Bank of Ukraine, People's Bank of China, Bank of Korea, Hong Kong Monetary Authority, the Monetary Authority of Singapore, Reserve Bank of India, Central Bank of Argentina, Central Bank of Nigeria, the Central Bank of the West African Economic and Monetary Union, the Reserve bank of South Africa, among others. Additionally, the Tunisian Central Bank is among the first adopters of a blockchain-based digital currency, entitled eDinar.

risks the technology poses. IT resources and architecture will be crucial assets in order to ensure the performance and interoperability of DLT while safeguarding data privacy and security.

The need for privacy protection in banking services is obvious, so are the data and the system security. The risks are also very important, thus solutions need to be found in relation to network breakdowns, targeted cyber-attacks and viruses, stolen private keys etc. On the other hand, governments and supervisors want to be able to detect money laundering, drug trafficking, tax evasion, etc. The conflict between the need for users' privacy and the right for authorities to monitor activities cannot be underestimated and will pose a great challenge.

Moreover, effective risk management procedures will need to be developed, preventive and detection measures implemented and robust business continuity management arrangements put in place. Financial stability and banking soundness, financial market efficiency and effectiveness, avoidance of financial market fragmentation and consumer protection are the key objectives of EU regulatory authorities.

Discussions have been already initiated by ECB and EU supervisory authorities in order to evaluate the opportunities that DLT could bring, particularly regarding efficiency and solutions to diminish financial market fragmentation.

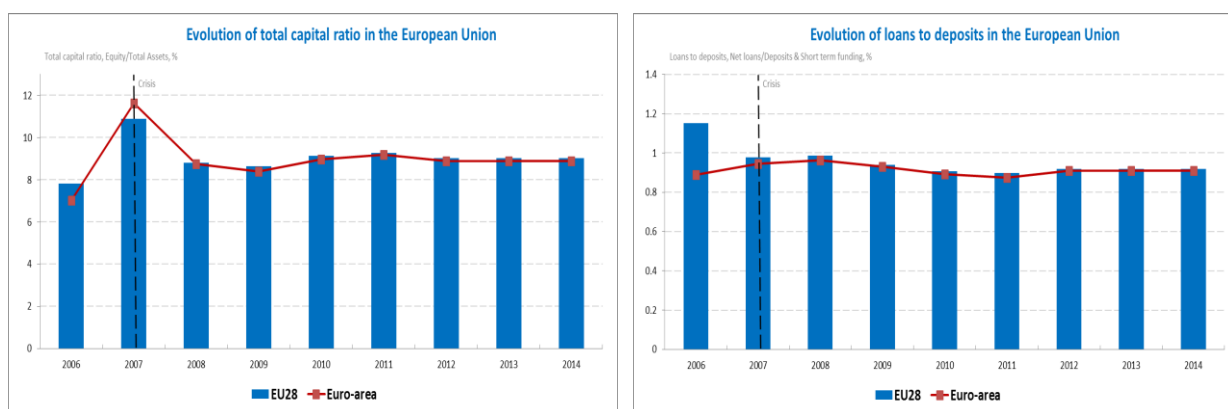
When implementing DLT oversight, access to the DLT environment for central banks and monetary authorities, reporting needs and monitoring functions need to be duly taken into consideration. But to make these possible, issues as enforceability of laws, liability and legal basis, including in cross-border situation, data protection or dispute resolution need to be addressed.

III.1.2.4 New business models

In the post-global financial crisis environment, business model adjustments are more than necessary. These adjustments have been driven by at least three aspects. First, the *weak economic growth and the fragility of the European financial* sector affected business models, determining banks to scale back their activities in several high-risk sectors, consolidating their core business activity.

Moreover, it was observed a shift from investment banking and wholesale activities to more traditional financial services (such as retail banking), which determined a decline in the loans to deposit ratios (see Figure III.13). The latter can also be explained by the second factor influencing business models, namely the *recent regulatory reforms*. These reforms have impacted business models by requiring more stable funding sources, higher-quality capital (see Figure III.13), and

sufficient liquid assets which made some business lines, such as trading, too costly, and determined banks to downsize some of these activities. In addition, the 2014 Bank Recovery and Resolution Directive⁸⁰ impacted directly business models by forcing them to adapt their operating structures to new requirements.

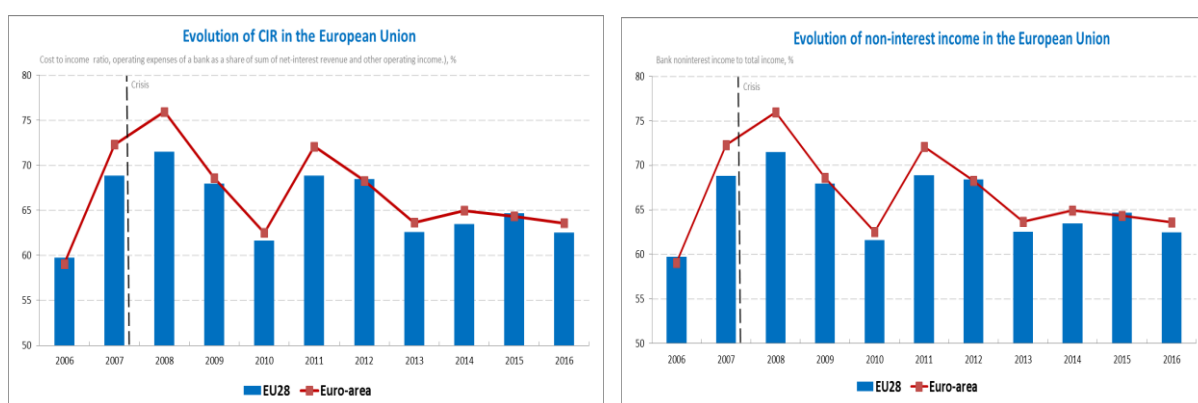


Source: processed after Orbis database

Figure III.13: European banks' consolidation process

Consequently, the fragile economic arena, complemented by the new regulatory and supervisory settings have, without doubt, contributed to the solidity of the financial system, by ensuring a minimum level of bank soundness through lower leverage, higher-quality capital, minimum liquidity and capital buffers etc.

Confirmed by Figure III.14, European banks have moved towards retail banking, and changed the composition of non-interest income from volatile trading revenues into fees and commissions, observing a decrease in the non-interest income immediately after the crisis but also a gradually increase, bringing the ratio closer to the pre-crisis levels.



Source: processed after Orbis database

Figure III.14: European banks' adjustment to new business models

⁸⁰ Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms amending Council Directive 82/891/EC, and Directives 2001/24/EC, 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU, 2012/30/EU and 2013/36/EU, and Regulations (EU) No 1093/2010 and (EU) No 648/2012, of the European Parliament and of the Council Text with EEA relevance.

Additionally, we observe significant differences in terms of cost efficiency across periods and countries, and although European banks were expected to significantly reduce their costs, we can note that they haven't been sufficiently effective in adjusting them, registering a stable cost-to-income ratio in the last four years.

The third factor influencing business models is the *new technological trend*. Thus, in the fee-generating business there is a developing competition given the rise of new unlicensed competitors with the ability of harness the new technologies. These new competitors, or Fintech companies, are specializing in financial intermediation and have the advantage of not being subject to banking regulation requirements. Although, these new technologies can pose serious challenges to the banking sector, it could also represent an opportunity for banks to increase their efficiency and effectiveness and to extend the portfolio of financial products and services.

Overall, the business model adjustment is a complex and costly process, thus this change shouldn't be regarded as one-size-fits-all strategy, but each bank should build on its existing strengths and should identify potential weaknesses that are likely to aggravate under stressful scenarios. Additionally, business models should be constantly reevaluated in order for banks to consider all recent development in the financial markets that could affect the efficiency and effectiveness of their business lines.

III.2 Case study⁸¹

The European financial system plays a vital role in the regional economic environment, so during the recent distressing events, a high significance was given to the soundness and performance of this sector. In general, bank performance (BP) was a theme intensely addressed in the literature, mainly because of the belief that a profitable financial intermediation activity will strongly influence the development of the whole economic sector. Though, there are other opinions according to which banking activity can also have harmful consequences for the overall economic system. In this respect, banks' failures can transform into systemic crises, with devastating consequences for the entire economy. If in general, the financial sphere is volatile because of a high range of factors, in particular, during the recent period of economic instability, the volatility has substantially amplified, and it was created the optimal environment for risk manifestation. In this context of severe fragility of European financial systems corroborated with new trends in the

⁸¹ This sub-chapter is part of a report done during a research internship at the National Bank of Romania, under the supervision of Virgil Dăscălescu, Head of Unit Financial Markets and Institutions, August-September 2015.

regulatory and structural frameworks, the performance and soundness (BS) of European banks were intensely affected.

Within this framework, the purpose of this section is to identify the main determinants of BP and BS, focusing on a sample of 263 commercial banks which are operating in the EU countries. The period studied is 2005-2012, and is covering the most important changes that occurred in the European financial sector (such as the establishment of the European Systemic Risk Board in 2010).

By using unbalanced panel data, and employing static and dynamic statistical techniques, the results provide substantial evidence that risks play a significant role in the evolution of BP and BS. Moreover, the results outline that the main vulnerability of the analysed European banks was and still remains credit risk.

Overall, better risk management, an optimal size and an efficient regulatory framework are associated with higher levels of performance and soundness. Evidence outlines also that the European banking systems are currently under the sign of profound changes, determined, in a significant extent, by the mutations in financial markets, while the regulatory and institutional changes have illustrated their powerful impact on the financial markets participants.

III.2.1 Data selection

The database used is formed from individual information collected from Bankscope, a financial database previously distributed by Bureau van Dijk IBCA together with Fitch (currently known as Orbis). In addition for the external factors there were used the databases from Eurostat, World Bank, Bloomberg and central banks. Whenever available, we have employed consolidated banking data in order to avoid bias.

Considering several factors, such as the level of economic development and the importance of the banking system for the whole national financial system, we have divided our sample as follows:

- ❖ Extended Euro-area: EU19,⁸² Denmark, Sweden and the United Kingdom;
- ❖ EU non-euro countries.⁸³

⁸² The EU19 countries are: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain.

⁸³ The EU non-euro countries are: Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania.

From an initial sample of more than 2000 banks operating in the EU in the period 2000-2013 (where 726 were commercial banks), we have restricted our sample to the period 2005-2012 focusing on the top ten EU commercial banks in relation to their size in the last available year. Though, given that in some countries there is a limited number of commercial banks and that for some of them we don't have sufficient data available for at least six consecutive years, we have ended up with 263 commercial banks operating in EU, out of which 204 entities are operating in the extended Euro-area and 59 entities are operating in EU non-euro area.⁸⁴ The frequency of the data is annual for all indicators, except the consumer confidence index for which it was computed the average per year.

The dependent variables used in our sample focus on BP and BS. First, following the literature,⁸⁵ BP is represented by three main indicators, respectively return on average assets (ROAA), return on average equity (ROAE) and net interest margin (NIM), as it can be seen in Table III.1.

Among the academic writings, the most commonly used variable to assess the BS, is the Z-score. The Z-score is inversely related to the probability of a bank's insolvency (Boyd and Runkle, 1993). More specifically, the Z-score exposes the number of standard deviations that a bank's return has to drop below its expected value, to deplete equity and make the bank insolvent.⁸⁶ Theoretically, the Z-score permits a time-varying measure of BS that does not experience endogeneity issues. However, since ROAA and the standard deviation variance of ROAA are extracted from different distributions, this could generate an inconsistency issue. We differentiate our paper from the current literature by employing an alternative measure of BS overcoming this problem and leading to more robust results. Thus, we use the log of Z-score as an insolvency risk measure, being less problematic to use and providing more rigorous results.⁸⁷

In the following, we include as independent variables a series of factors, which have been sub-divided in two classes, namely internal and external factors (see Table III.1).

⁸⁴ The exceptions for restricting the sample to the top ten commercial banks are: Cyprus (N=8), Estonia (N=5), Finland (N=6), Hungary (N=9), Lithuania (N=9), Luxembourg (N=9), Malta (N=4), Portugal (N=9), Slovakia (N=9), United Kingdom (N=15).

⁸⁵ For example: Bourke (1989), Demirgüç-Kunt *et al.* (2004), Beck *et al.* (2005), Pasiouras (2008ab), Micco *et al.* (2007), Naceur and Goaid (2008), Elsas *et al.* (2010), Naceur and Omran (2011), Chortareas *et al.* (2012b), Dietrich and Wanzenried (2014) etc. (for more details see Appendix I.2).

⁸⁶ For example: Boyd and Runkle (1993) Lepetit *et al.* (2008ab), Laeven and Levine (2009), Chortareas *et al.* (2012b), Sufian and Habibullah (2012), Bertay *et al.* (2013), Bourkhis and Nabi (2013), Pasiouras and Gaganis (2013), Tabak *et al.* (2013), Anolli *et al.* (2014), and Fu *et al.* (2014).

⁸⁷ Lepetit and Strobel (2015) prove that the traditional Z-score is providing a less effective upper bound of the probability of insolvency, thus suggesting that the natural log of Z-score is an improvement of this traditional measure without imposing any further distributional assumptions.

First, the *internal factors* are covering the following: (i) capitalization (capital ratios - CAR and TAC); (ii) asset quality (nonperforming loans - NPL); (iii) asset structure (credit growth - CRG, liquidity - LIQ and LD, and portfolio orientation – POR1, POR2, POR); (iv) management efficiency (CIR); and (v) size.

Table III.1: Description of the variables used and their expected impact

	Variable	Definition	Source	Expected Impact		
Dependent variable	Profitability / Soundness	ROAA	Return on average assets: Net income/average total assets	Bankscope		
		ROAE	Return on average equity: Net income/Average shareholders' equity	Bankscope		
		NIM	Net interest margin: (Interest received-Interest paid) / Average invested assets)	Bankscope		
		LN Z	Natural logarithm of the index: (ROAA+TAC/Variance of ROAA)	Author's calculations		
Independent variables	Internal factors	CAR	Capital adequacy ratio: Tier1/Total assets	Bankscope	+/-	
		TAC	Total capital ratio: Total capital/total assets	Author's calculations	+/-	
		CRG	Annual credit growth	Author's calculations	+	
		NPL	Nonperforming loans ratio: Nonperforming loans/total assets	Bankscope	-	
		LIQ	Liquidity ratio: Liquid assets/total assets	Author's calculations	+/-	
		LD	Net loans/Total deposits	Bankscope	+/-	
		POR1	Portfolio Orientation 1: Securities/Total assets	Author's calculations	+	
		POR2	Portfolio Orientation 2: Net loans/Total assets	Bankscope	+	
		POR	General portfolio orientation: POR1+POR2	Author's calculations	+	
		CIR	Cost to income ratio	Bankscope	-	
		SIZE	Natural logarithm of the accounting value of banks' total assets	Author's calculations	+/-	
		External factors	GDPG	Annual GDP growth rate	Eurostat	+
			INF	Annual inflation rate (consumer prices)	World Bank	-
INTR	Key interest rates (end of the year)		Central banks	+		
HPIC	House price index (annual change)		Eurostat	-		
CDS	Credit default swap		Bloomberg	-		
CCI	Consumer confidence indicator (seas.adj, average of monthly data)		Eurostat	+		

Second, the *external factors* include the following: (i) the level of economic development (GDP growth – GDPG); (ii) monetary factors (inflation – INF, and interest rates – INTR); (iii) business environment (credit default swaps – CDS, house price index – HPIC, and consumer confidence indicator – CCI).

The majority of internal and external factors involved in our analysis are discussed in Chapter II, though in addition to the existing literature we have decided to include in our study portfolio orientation (POR1), general portfolio orientation (POR), house price index (HPIC), CDS

and consumer confidence index (CCI) as important elements in the analysis of European bank performance and soundness.

III.2.2 Model setup

The empirical analysis of BP and BS could theoretically suffer from an inconsistency issue, determined mainly by omitted variables and endogeneity (Poghosyan and Hesse, 2009; Naceur and Omran, 2011). Following the work of Uhde and Heimeshoff (2009), Demirgüç-Kunt and Detragiache (2011), Bourhis and Nabi (2013), we estimate a modified version of the models employed in the mentioned papers, which enables us to test the effect of the recent crisis while controlling for internal and external factors. Compared to the previous studies we have employed both weighted and non-weighted estimators, depending on which suited best a specific dataset. In this respect, in our sample the variances of the observations were unequal and it was registered a certain degree of correlation between the observations, thus, in some cases OLS regression turned to be statistically inefficient and this issue was corrected either by employing regression with Driscoll-Kraay standard errors or feasible generalized least squares (FGLS). In addition, as a robustness test we have applied to the same sample the generalized method of moments (GMM) which was based on either Arellano-Bond estimators or Arellano-Bover/Blundell-Bond estimators.

Our estimates take the following reduced form:

$$Dep_{i,k,t} = \alpha_i + \sum_{m=1}^{11} \beta_m INT_{i,k,t} + \sum_{m=12}^{17} \beta_m EXT_{i,t} + \varepsilon_{it} \quad (III.1)$$

Where $Dep_{i,k,t}$ represents the dependent variable, namely BP or BS, for a commercial bank "k" in country "i" for the period "t"; $Int_{i,k,t}$ is the vector representing internal factors for a commercial bank "k" in country "i" for the period "t"; $Ext_{i,t}$ is a vector representing external factors in a country "i" for the period "t"; and ε_{it} is a disturbance term being different in the two methods employed, weighted and non-weighted.

Before employing the model, we have applied the Fisher-type unit-root test for unbalanced panel, which assumes that all series are non-stationary under the null hypothesis. Additionally, in some cases we have used the Hodrick-Prescott (HP) filter to average GDP data ahead and before each data point.

Then, the consistency of the models is determined through Hausman specification test so in case null hypothesis is not accepted the test has a Chi-square distribution, with the degrees of

freedom equal to the controlled variable in the model.⁸⁸ Moreover, it was employed also Breusch and Pagan Lagrangian multiplier test for random effects, which helped decide between a random effects regression and a simple OLS regression. Furthermore, it was tested to verify if time fixed effects are needed when running a fixed effects model, by using a joint test to see if the dummies for all years are equal to zero. The assumption of normality is tested with Jarque-Bera test, and in the case of group-wise heteroskedasticity it was used the modified Wald test. Furthermore, serial correlation was tested by using Wooldridge test for autocorrelation in panel data. Autocorrelation and heteroskedasticity were corrected in the fixed effects models by using a user written program by Hoechle (2007) which is suitable for unbalanced panel, observing that Driscoll-Kraay standard errors are well calibrated when cross-sectional dependence is present.

III.2.3 Empirical results

III.2.3.1 Summary statistics

We started our assessment with a series of descriptive statistics. Hence, Table III.2 shows some summary statistics on all variables used. All internal and external variables are averaged by country over the period studied.

Table III.2: Descriptive statistics

		Mean	SD	Minimum	Maximum	Obs.
Profitability Soundness	ROAA	0.47	1.98	-22.43	14.49	1972
	ROAE	5.23	40.46	-992.3	570.17	1971
	NIM	2.63	2.02	-3.52	25.35	1967
	Z score	20.32	24.14	-3.34	205.31	1433
Internal factors	CAR	11.81	5.82	-6.00	84.86	1369
	TAC	8.69	5.20	-35.36	91.67	1434
	CRG	10.83	27.87	-165.5	330.02	1846
	NPL	6.83	8.54	0.02	69.15	1479
	LIQ	23.24	16.80	0.01	98.18	1972
	LD	0.97	1.55	0.04	554.61	1937
	POR1	26.04	34.96	0.005	736.74	1423
	POR2	57.92	20.05	2.58	98.09	1973
CIR	64.24	42.53	1.02	950.0	1959	
External factors)	GDPG	1.64	4.07	-14.80	11.60	2056
	INF	2.73	3.04	-10.15	195.23	2056
	INTR	2.36	2.31	0.03	10.25	2065
	HPIC	100.86	15.64	64.19	179.15	1978
	CDS	188.97	374.62	1.75	3060.3	1715
	CCI	-16.64	17.48	-59.33	24.16	1985

⁸⁸ Hausman specification test takes the following form: $H = (b_1 - b_0)' (\text{Var}(b_0) - \text{Var}(b_1))^\dagger (b_1 - b_0)$, where \dagger denotes the Moore-Penrose pseudo-inverse technique.

From Table III.2, we can note that during the period studied, namely 2005-2012, the average return on assets is 0.47pps, while the average return on equity is 5.23pps, though the maximum and minimum values are clearly indicating some inconsistencies. Therefore, extreme values, such as the minimum or maximum return on equity, have been verified with the data reported in the annual reports of each specific commercial bank, and in the cases where we observed extreme and unsubstantiated values, we have excluded them from our analysis. When looking at BP indicators and compare the pre-crisis and post-crisis periods, we have noted important differences, thus after 2008 the EU commercial banks in our sample had suffered severe losses. For example, the pre-crisis EU28 ROAA was around 0.91pps while in the post-crisis period it touched the value of 0.02pps, entering into negative territories in 2009 and 2011. In terms of bank soundness, we can note that in the post-crisis period there has been a slightly improvement in the Z score, which can be motivated by the series of regulatory measures taken by monetary authorities.

Another important element which has worsened in the post-crisis period is the level of nonperforming loans (NPLs), growing with more than 110pps compared to the pre-crisis period. In terms of liquidity, we can detect a tightening of liquid assets in the post-crisis period, while the average for the whole period is 23.24pps. A positive aspect in the post-crisis period is the decrease in the cost-to-income ratio, thus management efficiency has been improving, although the current level is considered a bit disappointing bearing in mind the set of measures taken on management efficiency and bank business models.

From the macroeconomic perspective, the EU economies have been slowly recovering, although the pre-crisis economic peak hasn't been reached in the period of study (2005-2012). Later on, namely in 2014 and in 2015, the EU economy benefited from a double incentive which facilitated an improvement in economic performance (fall in energy prices which boosted consumer spending, and the negative interest rates promoted by the ECB).

In Appendix III.1 it can be found the correlation matrix for the variables in our sample. The empirical results of our analysis on both the whole sample and different regions are shown in Tables III.3 – III.6. In Table III.3 and Table III.4, we can observe the results for the whole sample with different types of modelling applied. According to the Hausman tests the type of effects best suitable for our sample are the fixed effects, thus in Table III.4 we explore more the relationship between different determinants and BP/BS. After disaggregating the sample in two regions, as described above we obtain the results from Table III.5 (extended Euro-area) and Table III.6 (EU non-euro countries), which are discussed in the following.

Table III.3: Empirical results for the whole sample

	ROAA			ROAE			NIM			LNZ			
	OLS	FGLS	GMM	OLS	FGLS	GMM	OLS	FGLS	GMM	OLS	FGLS	GMM	
VarDep.L1	0.22** (0.05)	0.59** (0.04)	-0.11 (0.07)	0.63** (0.10)	0.74** (0.09)	0.44* (0.19)	0.37* (0.03)	0.89** (0.01)	0.54** (0.08)				
ROAE.L1										0.03** (0.01)	0.04** (0.01)	-0.03* (0.01)	
NIM											1.02** (0.30)	0.96** (0.30)	0.11 (0.39)
CAR	0.11** (0.02)	0.06** (0.01)	0.21** (0.03)	5.15** (0.68)	1.23** (0.28)	7.52** (0.85)							
CRG.L1	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.25** (0.09)	0.12 (0.08)	0.29** (0.10)	0.01** (0.01)	0.01* (0.01)	0.01 (0.01)	-0.01* (0.01)	-0.01* (0.01)	-0.01 (0.01)	
NPL.D1	-0.17** (0.02)	-0.19** (0.01)		-2.74** (0.52)	-3.21** (0.48)	-1.63** (0.53)				-0.08* (0.04)	-0.08** (0.04)	-0.02 (0.04)	
NPL.L1			-0.07** (0.02)				-0.01** (0.01)	-0.01 (0.01)	-0.02** (0.01)				
LIQ										-0.08** (0.02)	-0.08** (0.02)	-0.09** (0.03)	
LD				2.17** (0.88)	-0.07 (0.73)	2.50 (9.19)	-0.22** (0.03)	-0.06** (0.02)	-0.15** (0.05)	0.31 (0.36)	0.35 (0.36)	0.07 (0.35)	
POR1	0.01** (0.01)	0.01 (0.01)	0.01# (0.01)	0.70** (0.07)	-0.09* (0.04)	0.30** (0.08)				0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	
POR2.D1							0.01* (0.01)	0.01** (0.01)	0.01** (0.01)	-0.13** (0.02)	-0.14** (0.02)	0.06* (0.03)	
GDPG.L1	0.02# (0.01)	0.01 (0.01)	0.07** (0.01)				0.01** (0.01)	0.02** (0.01)	0.02** (0.01)	0.08** (0.04)	0.08** (0.03)	-0.05 (0.03)	
HPIC.D1	0.01** (0.23)	0.01** (0.01)	0.01 (0.01)	0.24 (0.16)	0.26# (0.16)	0.23 (0.17)	0.01** (0.01)	-0.01# (0.01)	0.01 (0.01)	-0.03* (0.01)	-0.03* (0.02)	0.04* (0.02)	
CDS.D1							0.01** (0.01)	0.01* (0.01)	0.01* (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	
c	-1.27** (0.23)	-0.56** (0.15)	-2.23** (0.35)	-87.50** (9.91)	-13.30** (4.49)	-110.80** (15.19)	1.26** (0.15)	0.43** (0.12)	1.07** (0.21)	21.34** (1.58)	21.95** (2.47)	15.29** (3.38)	
R.sq. within	0.41	0.34		0.40	0.17		0.37	0.29		0.16	0.16		
Testul F / Testul Wald	47.81 (0.01)	769.22 (0.01)	114.77 (0.01)	42.46 (0.01)	258.62 (0.01)	146.17 (0.01)	57.40 (0.01)	5413.92 (0.01)	248.85 (0.01)	7.91 (0.01)	88.30 (0.01)	42.54 (0.01)	
Hausman	289.44 (0.01)			318.71 (0.01)			382.70 (0.01)			41.41 (0.00)			

Note: OLS, feasible GLS and GMM (Arellano Bond estimator). Absolute value of t statistics significant at #10%, *5%, **1%. In parentheses we the standard deviation. D1 represents the first-order difference and L1 the first-order lag.

Table III.4: Empirical results for different model settings

	ROAA				ROAE				NIM				LNZ		
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)
VarDep.L1	0.22** (0.05)	0.22** (0.05)	0.19** (0.05)	0.09** (0.04)	0.63** (0.10)	0.57** (0.10)	0.20# (0.11)	0.16 (0.11)	0.37* (0.03)	0.34** (0.03)	0.25** (0.03)	0.25** (0.03)			
ROAE.L1													0.02** (0.01)	0.02** (0.01)	0.02** (0.01)
NIM													0.42# (0.25)	0.77** (0.24)	0.84** (0.24)
CAR	0.11** (0.02)	0.14** (0.02)	0.13** (0.02)		5.15** (0.68)	5.22** (0.68)									
TAC.L1				0.20** 90.03)			7.51** (1.06)	7.86** (1.09)		0.05** (0.01)	0.03** (0.01)	0.03** (0.01)			
CRG.L1	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.25** (0.09)	0.20* (0.09)	0.23** (0.08)	0.20* (0.09)	0.01** (0.01)	0.01* (0.01)	0.01# (0.01)	0.01** (0.01)			-0.01* (0.01)
NPL.D1	-0.17** (0.02)	-0.17** (0.02)	-0.17** (0.01)	-0.14** (0.01)	-2.74** (0.52)	-3.01** (0.53)	-2.49** (0.44)	-2.53** (0.45)	-0.01** (0.01)	-0.01** (0.01)	-0.01* (0.01)	-0.01** (0.01)	-0.06# (0.03)	0.06** (0.03)	0.05# (0.03)
LIQ				0.01* (0.01)			0.51* (0.25)	0.51* (0.26)					-0.06** (0.02)	-0.09** (0.02)	-0.08** (0.02)
LD		0.07** (0.03)	0.07# (0.03)		2.17** (0.88)	2.16** (0.88)			-0.22** (0.03)	-0.24** (0.04)	-0.11* (0.05)	-0.10* (0.05)			
POR		0.01** (0.01)	0.01** (0.01)				0.70** (0.06)								
POR1	0.01** (0.01)				0.70** (0.07)		0.73** (0.07)	0.73** (0.07)					0.01 (0.01)		
POR2.D1				0.02** (0.01)					0.01* (0.01)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)		-0.11** (0.02)	-0.11** (0.02)
CIR			-0.01** (0.01)			-0.15** (0.06)	-0.14* (0.06)	-0.14* (0.06)			-0.03** (0.01)	-0.01** (0.01)			
GDPG.L1	0.02# (0.01)	0.02# (0.01)	0.02# (.01)	0.03** (0.01)		-0.65 (0.43)		0.65 (0.45)	0.01** (0.01)	0.02** (0.01)	0.01* (0.01)	0.01** (0.01)	0.04 (0.03)	0.05# (0.03)	0.05* (0.03)
INTR						3.87** (1.40)									-0.06** (0.02)
HPIC.D1	0.01** (0.23)	0.01** (0.01)	0.01** (0.01)	0.01# (0.01)	0.24 (0.16)	0.39** (0.16)	-0.11 (0.17)	-0.07 (0.18)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)		-0.01 (0.01)	-0.01 (0.01)
CDS.D1							0.03** (0.01)	0.03** (0.01)	0.01** (0.01)	0.01* (0.01)	0.01** (0.01)	0.01** (0.01)			0.01 (0.01)
Size.D1				1.55** (0.29)			23.48* (10.80)	20.05# (11.32)				-0.46** (0.08)	-0.63** (0.10)		0.01 (0.01)*
c	-1.27** (0.23)	-2.04** (0.30)	-1.42** (0.33)	-1.87** (0.29)	-87.50** (9.91)	-120.24** (11.82)	-84.88** (11.99)	-87.69** (12.33)	1.26** (0.15)	0.96** (0.21)	8.83** (1.38)	11.27** (1.67)	20.33** (0.75)	18.84** (0.71)	18.55** (0.73)
R.sq. within	0.41	0.42	0.46	0.39	0.4	0.42	0.41	0.41	0.37	0.39	0.39	0.41	0.07	0.12	0.12
Testul F / Testul Wald	47.81 (0.01)	43.07 (0.01)	43.66 (0.01)	53.29 (0.01)	42.46 (0.01)	36.15 (0.01)	31.86 (0.01)	28.73 (0.01)	57.40 (0.01)	42.06 (0.01)	34.21 (0.01)	33.49 (0.01)	6.52 (0.01)	10.60 (0.01)	9.00 (0.01)

Note: Regression with Driscoll-Kraay standard errors. Absolute value of t statistics significant at #10%, *5%, **1%. In parentheses we the standard deviation.D1 represents the first-order difference and L1 the first-order lag.

III.2.3.2 Empirical results for bank performance

First, in terms of *internal determining factors*, we have included four major elements, namely: capitalization, asset quality, asset structure and management efficiency.

Capitalization

Considering the most recent regulatory developments in the European financial systems, we have included in our analysis capitalization, being measured by using two ratios, namely capital adequacy ratio (CAR) and total capital ratio (TAC). Although in the literature we observed mixed results, in our sample we have obtained a positive and statistically significant impact of both variables on BP measured by ROAA, ROAE and NIM for the whole sample and for the extended Euro-area region (Table III.3 - III.6). Thus, for this sub-sample banks have a better creditworthiness, engaging in more prudent lending and adopt a less risk-taking behavior. These results are in line with Goddard *et al.* (2004a), Athanasoglou *et al.* (2008), Dietrich and Wanzenried, (2011) and Trujillo-Ponce (2013). For the EU non-euro countries we obtain some contradictory results. Thus we registered a positive and statistically significant impact on ROAE and NIM, while for ROAA the total capital ratio (TAC) had a negative and statistically significant impact on all three models employed (Table III.6). This result is in accordance with the risk-return tradeoff theory, thus a negative relationship implies that an increase in the level of capitalization will reduce the relative risk position that a bank has, which determines deteriorated returns. Though, the relationship capitalization-BP is time-varying and heterogenous across banks and regions, being highly dependent on banks' current capital ratios and banks' business strategies.

Asset quality

In our analysis the quality of assets is measured by the nonperforming loans ratio (NPLs) which had a negative and statistically significant impact on BP in all cases, the results holding when disaggregating the sample into extended Euro-area and EU non-euro countries (see Table III.3 - III.6). This implies that an increase in the doubtful assets which do not accumulate profits, oblige banks to redirect an important part of their profit margin towards loan loss provisions, seriously affecting the overall BP. Moreover, in the recent economic downturn, the situation has actually worsened generating an amplified instability and uncertainty which affected the level of impaired loans, and implicitly BP.⁸⁹

⁸⁹ This results are in line with Angbazo (1997), DeYoung and Rice (2004), Hernando and Nieto (2007), Athanasoglou *et al.* (2008) and Chiorazzo *et al.* (2008), among others.

Table III.5: Empirical results for the extended Euro-area

EURO AREA extended (+DK, SE, GB)												
	ROAA			ROAE			NIM			LNZ		
	OLS	FGLS	GMM	OLS	FGLS	GMM	OLS	FGLS	GMM	OLS	FGLS	GMM
VarDep.L1	0.32** (0.05)	0.56** (0.04)	-0.15** (0.05)	0.48** (0.12)	0.67** (0.10)	0.07 (0.13)	0.42** (0.04)	0.89** (0.01)	-0.02 (0.04)			0.18 (0.15)
ROAE.L1										0.03** (0.01)	0.03** (0.01)	0.04** (0.01)
NIM										0.57 (0.38)	0.50 (0.36)	0.49 (0.49)
CAR	0.14** (0.02)	0.05** (0.01)	0.23** (0.03)	5.11** (0.78)	1.36** (0.37)	7.07** (0.95)	0.01* (0.01)	-0.01 (0.01)	-0.01 (0.01)			
CRG	0.01** (0.01)	0.01* (0.01)	0.01** (0.01)	0.20* (0.11)	0.15 (0.10)	0.26** (0.11)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01# (0.01)	-0.01# (0.01)	0.01 (0.01)
NPL.D1	-0.24** (0.02)	-0.26** (0.02)	-0.15** (0.02)	-4.16** (0.73)	-4.65** (0.66)	-3.12** (0.75)	-0.01** (0.01)	0.01 (0.01)	-0.04** (0.01)	-0.09# (0.05)	-0.09# (0.05)	-0.04 (0.06)
POR1	0.01** (0.02)	-0.01 (0.01)	0.01# (0.01)	0.71** (0.07)	-0.09* (0.04)	0.34** (0.09)				0.01 (0.01)	0.01 (0.01)	0.02 (0.02)
POR2	0.02** (0.01)	0.01 (0.01)	-0.01 (0.01)	0.62* (0.30)	0.06 (0.10)	-0.13 (0.39)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.09** (0.02)	0.09** (0.02)	-0.04 (0.04)
GDPG ^{HP} .L1	0.02** (0.01)	0.01** (0.01)	0.03** (0.01)	-0.26 (0.29)	-0.06 (0.23)	-0.05 (0.30)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.05 (0.04)	0.05 (0.04)	0.08# (0.04)
INF.D1				-1.11# (0.59)	-1.52** (0.61)	-0.46 (0.62)						
HPIC.D1	-0.02 (0.04)	0.01 (0.03)	-0.10** (0.04)	0.55* (0.24)	0.07 (0.09)	0.66* (0.28)	-0.03* (0.01)	-0.04** (0.01)	-0.02# (0.01)	0.02 (0.02)	0.02 (0.02)	-0.01 (0.02)
CDS.D1										-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
CCI							-0.01* (0.01)	-0.01** (0.01)	-0.01 (0.01)			
c	-2.71** (0.60)	-0.52** (0.22)	-2.50** (0.73)	-164.70** (30.03)	-20.44# (11.54)	-144.23** (37.29)	1.38** (0.21)	0.43** (0.09)	2.36** (0.20)	12.83** (1.59)	13.13** (2.86)	16.54** (3.52)
R.sq. within	0.55	0.49		0.44	0.21		0.40	0.35		0.09	0.09	
Testul F / Testul Wald	62.04 (0.01)	900.38 (0.01)	318.95 (0.01)	35.68 (0.01)	232.53 (0.01)	153.58 (0.01)	43.29 (0.01)	4914.05 (0.01)	195.47 (0.01)	3.98 (0.01)	37.83 (0.01)	25.39 (0.01)
Hausman	109.38 (0.01)			290.37 (0.01)			188.54 (0.01)			8.41 (0.49)		

Note: OLS, Feasible GLS and GMM (Arellano-Bover/Blundell-Bond estimators). Absolute value of t statistics significant at #10%, *5%, **1%. In parentheses we the standard deviation.D1 represents the first-order difference and L1 the first-order lag.

Table III.6: Empirical results for the EU non-euro countries

EU NON-EURO COUNTRIES												
	ROAA			ROAE			NIM			LNZ		
	OLS	FGLS	GMM	OLS	FGLS	GMM	OLS	FGLS	GMM	OLS	FGLS	GMM
VarDep.L1	0.15** (0.07)	0.61** (0.05)	-0.09 (0.07)	0.53** (0.07)	0.78** (0.05)	0.19** (0.08)	0.33** (0.06)	0.79** (0.04)	0.18** (0.07)			
ROAE.L1										0.04 (0.03)	0.05# (0.03)	0.09** (0.04)
NIM										0.85 (0.61)	0.69 (0.57)	2.85** (0.68)
CAR							0.05** (0.01)	0.01 (0.01)	0.05** (0.02)			
TAC.L1	-0.08** (0.03)	-0.08** (0.02)	-0.10** (0.03)	0.69# (0.43)	1.09** (0.39)	0.49 (0.43)						
CRG	0.01** (0.01)	0.01* (0.01)	0.01** (0.01)	0.11* (0.05)	0.12** (0.04)	0.19** (0.05)	0.01** (0.01)	0.01 (0.01)	0.01* (0.01)	-0.05** (0.02)	-0.03 (0.02)	-0.05* (0.02)
NPL.D1	-0.03* (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.21# (0.12)	-0.28* (0.12)	-0.10 (0.12)	-0.01# (0.01)	-0.01 (0.01)	-0.02** (0.01)	-0.10# (0.06)	-0.08 (0.06)	-0.15** (0.06)
POR1				-0.17* (0.08)	-0.06 (0.05)	-0.43** (0.10)				0.06# (0.04)	0.03 (0.03)	0.04 (0.04)
POR2.D1							0.02** (0.01)	0.03** (0.01)	0.02* (0.01)	0.11* (0.05)	-0.16** (0.05)	-0.07 (0.07)
GDPG ^{HP} .L1	0.01* (0.01)	0.01 (0.01)	0.01** (0.01)	0.03 (0.05)	-0.01 (0.05)	0.04 (0.06)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.04 (0.08)	0.01 (0.07)	0.13 (0.08)
HPIC.D1	-0.08* (0.04)	-0.06 (0.04)	-0.04 (0.04)	-0.72 (0.46)	-0.13 (0.46)	-0.53 (0.46)				0.05 (0.04)	0.03 (0.03)	-0.09* (0.04)
CDS.D1										-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
c	1.25** (0.33)	0.85** (0.20)	1.59** (0.35)	5.97** (2.28)	1.14 (1.62)	14.92** (2.75)	1.77** (0.27)	0.50** (0.19)	2.35** (0.34)	9.58* (4.03)	17.34** (2.93)	16.71** (6.28)
R.sq. within	0.37	0.26		0.58	0.55		0.48	0.38		0.15	0.20	
Testul F /	13.59	256.37	47.12	18.08	332.79	91.67	20.97	539.97	56.97	1.64	18.70	29.17
Testul Wald	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.12)	(0.03)	(0.00)
Hausman	123.61 (0.01)			29.25 (0.01)			75.82 (0.01)			14.56 (0.00)		

Note: OLS, Feasible GLS and GMM (Arellano-Bover/Blundell-Bond estimators). Absolute value of t statistics significant at #10%, *5%, **1%. In parentheses we the standard deviation.D1 represents the first-order difference, and L1 the first-order lag.

Asset structure

From studying the whole sample, we have noticed that credit growth (CRG) together with liquidity ratio (LIQ) had a positive and statistically significant impact on BP (in line with our expectations). These results hold for commercial banks operating in the extended Euro-area and EU non-euro countries. Though, when studying the impact of loans to deposits (LD) on BP measured by NIM, we register a negative and statistically significant impact, highlighting that the benefits from an increased volume of loans is sometimes outweighed by the decrease in bank deposits, implying additional costs related to the funding resources.

In terms of the portfolio orientation of the European commercial banks studied, we can note that POR1 which represents the securities to assets ratio together with POR2 representing the loans to assets ratio, and the general portfolio orientation (POR) have a positive and statistically significant impact on BP measured by ROAA, ROAE and NIM for the whole sample, but also for the extended Euro-area countries.⁹⁰ Though, when evaluating the impact of POR1 on the performance of commercial banks operating in the EU non-euro countries, we can observe a negative and statistically significant impact on ROAE for all models employed, suggesting that in this region, commercial banks opted for more risky securities which in the end affected the general level of profitability.

Management efficiency

Another critical aspect in relation to BP is the efficiency and effectiveness of commercial banks in utilizing their resources. In Table III.4, we can note that the cost-to-income ratio (CIR) had a negative and statistically significant impact on all performance variables, result which is in line with our initial expectations. Though, in the last years we have seen that the increased competition, particularly from non-bank institutions, has put additional pressure on commercial banks to improve their profits and to control their overall costs.

Size

The impact of size on BP is ambiguous, being highly dependent on the BP measure selected. On the one side, bank size (BS) had a positive and statistically significant impact on ROAA and ROAE, while on the other side bank size has a negative impact on NIM. This can be explained by the fact that larger banks obtain a higher share of their income in the form of non-interest income (such as trading income and fees), so large banks appear to be relatively active on the capital markets on both the assets and liabilities sides

⁹⁰ These results are in line with McKenzie and Thomas (1983), Angbazo (1997), Barros *et al.* (2007), Chiorazzo *et al.* (2008), DeYoung and Rice (2004).

of the balance sheet. In various studies it was noticed that banks with large absolute size tend to be more profitable, while they also have a higher bank risk (larger size should allow the bank to obtain economies of scale). For instance, Elsas *et al.* (2010) advocates for a positive relationship between BP and size, while Barros *et al.* (2007) suggests that bigger and more diversified banks are more likely to perform poorly, being less capable of reducing asymmetric information problems associated with lending.

Second, in terms of *external determining factors*, we have included three main aspects, namely: economic development, monetary stance and business environment.

Economic development

The level of economic development, measured in our study by the annual growth rate of GDP (RGDP) has, as expected, a positive and statistically significant impact on BP measured by ROAA and NIM⁹¹ (see Table III.3 and III.4). When disaggregating the sample, we can note that while the results hold for the extended Euro-area, while in the case of the EU non-euro countries the real GDP growth in the previous year only affects ROAA, with no statistically significant impact on the other two performance measures (see Table III.6).

Monetary stance

In terms of monetary policy, we have considered the key interest rate (INTR) and the inflation rate (INF). First, in terms of key interest rates, we can observe mixed results. On the one hand, an increase with 1m.u in interest rate will determine an increase with 3.87m.u in ROAE, result statistically significant at 1pps. On the other hand, the same increase of 1m.u will determine a decrease with 0.06m.u in NIM (see Table III.4). In Table III.5 and III.6, we have disaggregated the sample into extended Euro-area and EU non-euro countries, noticing that inflation was statistically significant just for the former, while for the latter group it was excluded from the equation given the lack of statistical significance for this particular dataset. For the commercial banks operating in the extended Euro-area countries, the impact of inflation is negative, in line with our initial beliefs. Though, the effect of inflation depends on whether banks operating expenses are increasing faster than the inflation rate level, thus sometimes inflation could also positively impact BP, particularly the net interest margin.⁹²

⁹¹ These results are in line with Claessens *et al.* (2001), Bikker and Hu (2002) and Athanasoglou *et al.* (2008) among others.

⁹² Tomuleasa, I., Cocris, V. (2014). Measuring the financial performance of the European systemically important banks, *Financial Studies*, 4(2014), p. 45.

Business environment

Last, we have considered some factors representative for the whole business environment, namely the credit default swaps (CDS), the consumer confidence index (CCI) and the house price index (HPIC). The impact of a change in CDS, measuring the changes in the overall credit risk exposures, was positive and statistically significant for both ROAE and NIM (see Table III.3 and III.4). When including the house price index (HPIC) in our analysis, we obtain some contradictory results. For the whole sample, HPIC has a positive and statistically significant impact on BP, particularly for ROAA, result which is in line with Davis and Zhou (2009). When disaggregating the database we obtain a negative and statistically significant impact of HPIC on ROAA and NIM for the commercial banks operating in the extended Euro-area while in the EU non-euro countries the results hold only when measuring BP by ROAA. When measuring BP by ROAE, we obtain a positive and statistically significant impact of HPIC for commercial banks operating in the extended Euro-area (see Table III.5 and III.6). The consumer confidence indicator (CCI) didn't seem to be particularly relevant when assessing the BP determinants for whole sample, though for the extended Euro-area region, we observed a negative impact of CCI on NIM, suggesting that an amplification of the confidence level implies an increase in the competition which, in the end alters BP.

III.2.3.3 Empirical results for bank soundness

First, in terms of *internal determining factors*, we have included four major aspects considered, namely: profitability, asset quality, asset structure.⁹³

Profitability: First, we concentrate on the results regarding the relationship between BP and BS for the different samples, obtaining some interesting results. First, for the whole sample, the results in Table III.3 indicate a positive relationship between BP and BS using the lnZ-score regardless of the BP measure used. There may be particular reasons for this result, as European commercial banks with less risk of bankruptcy were able to perform better during the period under consideration as they had access to cheaper capital and better quality loans. Our results are in line with those reported in the literature showing that profitability ratios are important determinants of BS (e.g. Bongini *et al.*, 2001). The results also extend to the disaggregated sample, particularly when looking at ROAE for the extended Euro-area, while for the EU non-euro countries the results have less of a statistical significance (these results might vary in statistical significance in relation to the model employed, as shown in Table III.6).

⁹³ In order to avoid endogeneity issues, in the estimation of the determining factors of bank soundness (natural logarithm of Z score), we have excluded ROAA, CAR and TAC from the list of dependent variables, as they have been used in the calculation of Z score. Additionally, management efficiency has been excluded as well given the lack of statistically significant results.

Asset quality and Asset structure: As expected, an increase in the level of NPLs will negatively impact within one time period BS, suggesting that a higher level of impaired loans implicitly increases the volatility of ROA which negatively impacts the solidity of the commercial bank.

Contradictory to the results obtained for BP we can observe that in all empirical settings, an increase in the volume of loans (CRG) will negatively impact BS within one lag. These results are still valid when disaggregating the sample, even though with a weaker statistical significance for the commercial banks operating in the extended Euro-area. Moving towards the liquidity ratio we can notice that the results are statistically significant only for the overall sample, confirming the previously mentioned negative relationship. While the ratio of loans to deposits (LD) and portfolio orientation (POR, POR1) didn't registered a significant empirical impact, the second portfolio orientation (POR2) measuring the share of net loans to assets, has an ambiguous impact on BS. Thus, for the overall sample, the impact of POR2 on lnZscore is negative and statistically significant when employing the OLS and FGLS method, though the influence is positive when employing the GMM method (Table III.3). Moreover, the negative impact holds for the different empirical estimations in Table III.6. When disaggregating the data, we can notice that POR2 has a positive and statistically significant impact on BS for commercial banks operating in the extended Euro-area, both when employing the OLS and FGS, while for the commercial banks operating in the EU non-euro the results tend to be ambiguous, thus registering a positive impact when employing the OLS (though not very significant), and a negative impact when employing the FGLS (statistically significant at 1pps). This implies that banks operating in the EU non-euro area tend to adopt a higher risk-taking behavior in terms of lending, thus affecting bank solidity and implicitly its performance given that they need to build-up more financial buffers depending on the level of risk.

Second, in terms of *external determining factors*, we have included only the level of economic development, given that the other two classes of factors are not statistically significant in the various empirical estimations. In what concerns the level of economic development, measured by the growth rate of GDP, we can note a positive and statistically significant impact for the whole sample, result in line with our initial expectations. Though, when applying the HP filter to GDPG and disaggregating the sample into the two sub-samples, we don't obtain any statistically significant result.

In the majority of cases we confirm the expected impact observed from reviewing the literature in the previous chapters. Though, in some cases we register heterogenous results which amplify when disaggregating the sample in relation to the EU region, highlighting several differences between commercial banks operating in the extended Euro-area and those operating in the EU non-euro area. Consequently, we consider that a realistic picture on the performance and soundness of European

commercial banks can be achieved only if the particularities of each region and type of bank are considered. Moreover, from the four types of models employed, namely the OLS, the regression with Driscoll-Kraay standard errors, the Feasible GLS and the GMM, we observed that the best results were obtained when using either the regression with Driscoll-Kraay standard errors or the GMM (with the two different estimators).

III.3 Conclusions

Generally, the EU financial system is still recovering from the 2008 international financial crisis, which severely affected the majority of European banks proving that crisis episodes can be extremely expensive in relation to direct fiscal costs and alternative costs for the real economy. In light of these negative consequences of the crisis, regulators embarked in an ambitious regulatory reform programme, with the main purpose of increasing the resilience of European banks. In this respect, important progress has been registered in the EU countries, particularly regarding capitalization, where we observed that the average common equity Tier 1 capital ratio rised with approximately 16pps in 2012, compared to 2008.

Though, the new trends in the regulatory framework are not the sole challenge that European banks have to face, thus another challenge determined partially by the crisis was and still is the financial fragility of the European banking sector and the rapid development of the shadow banking system which put additional weight on the European banks. Moreover, the recent discussions among regulators, academia and the private sector are dominated by the emergence of the new technological developments in relation to financial products and services. An optimal example of such technology is the distributed ledger technology, which could easily facilitate intra- and inter-banking payments through the creation of virtual currencies, the corporate and retail banking through peer-to-peer lending, syndicated loans, and mortgage valuation systems, or even trading financial transactions through settlement coins. Consequently, the revision of banks' business models to the new operating environment is vital for ensuring sustainable profitability and long-term soundness, observing that a particular role will be played by their ingenuity, efforts and competences to become more efficient in an evolving world. Additionally, we consider that there isn't an optimal and exclusive business model which can be applied to all types of financial institutions, but the future business models should be fit for purpose by considering the particularities of each bank and the national environment where it operates.

The empirical results obtained by employing three different statistical methods confirm the large disparities existing among EU28 countries, thus we identified a heterogenous impact of various control variables on the performance and soundness of the European commercial banks analyzed. These differences

are dictated by national and regional particularities but also by the size of banks as well as the stringency of the economic and monetary policies promoted. The recent economic crisis impacted severely the European banks, determining a worsening of the nonperforming loans, which negatively impacted the performance of European commercial banks. Under these circumstances, a vital role was played by capitalization which managed to improve the solvency of European commercial banks and made them more resilient to external shocks, although in some cases it affected the profit margins. In addition, the business strategy or the asset structure of a commercial bank was also an important element in our analysis, registering mixed results. On the one side, factors such as credit growth had a positive and statistically significant impact on the performance of European commercial banks both for the whole sample and for the disaggregated sample. On the other side, for two different portfolio orientation we have registered ambiguous results, particularly for the commercial banks operating in the EU non-euro countries. From the macroeconomic point of view, a higher level of economic development will positively impact the performance and soundness of European commercial banks, while an increase in the real estate market characterized by higher house prices is not always beneficial for BP and BS, particularly when studying different EU regions.

The most important disparities among the two regions studied, namely the extended Euro area and the EU non-euro countries, have been registered when measuring the impact of various factors on BS. These results suggest that commercial banks operating in the extended Euro-area are more resilient to shocks compared to the ones operating in the EU non-euro countries. Though, these results cannot be generalized considering that a series of commercial banks operating in the extended Euro-area are more internationally exposed and are bigger and more developed than the ones operating in the EU non-euro countries, thus benefiting from know-how, and also informational and technological advantages.

After a long successful period, the European banking systems are facing historical challenges, being necessary to reconsider the pillars of the banking system as a whole. Overall, we consider that the significant expansion of banks' balance sheets, the deepening of the sovereign debt issues, and the necessity of an EU harmonized regulatory and supervisory framework, impose the need for a banking system's reconfiguration, in particular for the EU non-euro countries. This reconfiguration should follow four major directions, namely: the *economic direction* (the current fragilities of the EU banks); the *regulatory direction* (uncertainty in the EU regulatory agenda); the *Fintech direction*; and last, incorporating the previous elements, the *new business models* direction.

Appendix Chapter III

Appendix III.1: Correlation matrix

	ROAA	ROAE	NIM	Tier1	TAC	CRG	NPL	POR1	POR2	LIQ	CIR	LD	GDPG	INF	CDS	HPI	INTR	CCI	Z score
ROAA	1																		
ROAE	0.93	1																	
NIM	0.30	0.18	1																
CAR	0.11	0.04	0.10	1															
TAC	0.09	-0.02	0.51	0.47	1														
CRG	0.33	0.31	0.18	-0.18	-0.06	1													
NPL	-0.58	-0.55	0.14	0.06	0.25	-0.39	1												
POR1	-0.02	0.03	-0.07	-0.06	-0.19	0.02	-0.01	1											
POR2	0.02	-0.02	0.23	-0.02	0.47	0.03	0.09	-0.25	1										
LIQ	0.01	0.07	-0.20	0.4	-0.34	0.03	-0.10	0.03	-0.74	1									
CIR	-0.42	-0.41	-0.20	-0.12	-0.08	-0.13	0.26	-0.02	-0.07	0.06	1								
LD	0.03	0.02	-0.02	0.05	0.12	0.06	-0.05	0.10	0.24	-0.16	-0.05	1							
GDPG2	0.05	0.03	0.01	0.06	0.05	0.17	0.01	0.02	-0.02	0.01	-0.01	0.05	1						
INF	0.12	0.09	0.30	0.01	0.12	0.24	0.01	-0.09	0.02	0.07	0.07	-0.05	0.45	1					
CDS	-0.20	-0.22	0.27	-0.01	0.19	-0.15	0.31	-0.08	0.16	-0.03	-0.02	-0.04	-0.10	0.12	1				
HPIC	0.16	0.14	0.13	-0.07	-0.01	0.29	-0.18	-0.10	0.05	0.10	-0.03	-0.07	0.12	0.46	0.14	1			
INTR	0.15	0.13	0.37	-0.07	0.09	0.21	0.01	-0.05	0.08	-0.03	-0.07	-0.01	0.21	0.47	0.13	0.27	1		
CCI	0.04	0.07	-0.35	0.05	-0.16	0.09	-0.30	0.04	-0.09	0.03	0.09	0.07	0.41	0.07	-0.48	0.01	-0.17	1	
Z score	0.19	0.14	-0.07	0.12	0.05	0.03	-0.24	-0.04	0.07	-0.09	-0.30	0.10	0.01	0.01	-0.14	-0.14	0.10	0.02	1

Note: Red colour represents a positively moderate or strong relationship, while the blue colour represents a negative moderate or strong relationship.

CHAPTER IV: Navigating in uncharted waters – The impact of Economic Freedom, Regulation, Corruption and Transparency on European banking⁹⁴

As a result of the subprime financial crisis and subsequent Euro-area crisis, considerable institutional and regulatory changes have been enacted, driving policy makers and monetary authorities to rethink their approach to the banking sector. Above all, the need to ensure a proper level of regulation, supervision and transparency in the banking and financial sector has been a high priority. Consequently, the role of regulation and transparency in evaluating bank performance and soundness is a topic of interest for different actors in the financial system. This chapter examines the impact of economic freedom, regulation, corruption and transparency on bank performance (BP) and bank soundness (BS) using a sample of 681 European banks in 33 European countries over the period 2000-2012. Using unbalanced panel data and 2SLS estimation, our results show that BP and BS are negatively related, but economic freedom, regulation, corruption and transparency tend to have mixed effects at the aggregate level depending on the performance and soundness measures used. More noticeable differential effects can be detected when we disaggregate the data between the Euro-area, the non-euro European Union (EU) countries and the EU candidate countries, the size of banks, the level of country income, the timing of entrance into the EU enlargement process and the specialization of banks. Our results suggest that policies promoting greater economic freedom, reducing regulation, reducing corruption and enhancing transparency need to be more targeted to reflect the diversity of the banking sectors in Europe.

⁹⁴ This chapter represents an essay written with **Keith Pilbeam** (City University of London, United Kingdom) and **Dimitrios Asteriou** (Oxford Brookes University, United Kingdom) and is currently under review at *The European Journal of Finance*. A version of this chapter, entitled “*The Impact of Economic Freedom, Business Regulation, Corruption and Transparency on Bank Profitability and Bank Stability: Evidence from Europe*”, was presented at the London School of Economics, Oxford Brookes University and City University of London, as well as at several conferences.

IV.1 Introduction

The financial crisis that erupted in the United States in 2007 and spread rapidly to international markets has had a considerable impact on the banking sector. Moreover, the tensions from the subprime crisis contributed to triggering a sovereign debt crisis, affecting many of the European countries. The 2008-2010 period witnessed higher volatility in the financial markets, a negative impact upon the bank risk ratings and other negative repercussions for the financial sector including demands for greater regulation, stricter rules on proprietary trading, and greater scrutiny of banking activities and products (see for example Michalak and Uhde, 2012; Elliot *et al.*, 2013a; Slimane *et al.*, 2013; and Milani, 2014). As Mayes (2005) pointed out prior to the financial crisis, problems in the banking sector impact not only the financial system but also the entire economy. As a result of the 2008-2010 financial crisis and subsequent Euro-area crisis substantial institutional and regulatory changes have been enacted, forcing bank supervisors and regulators to rethink their approach to the banking sector. In particular, the need to ensure a proper level of regulation and transparency in the banking and financial sector has been a high priority. Consequently, the role of regulation and transparency in evaluating BP and BS is a topic of interest for different actors in the financial system, especially for policy makers, bank managers and customers, but also for the general public.

In this chapter we argue that the economic system of a country as measured by the degree of economic freedom, transparency and level of corruption are likely to have an impact on the banking sector. This chapter provides an empirical investigation of the role of economic freedom, regulation, corruption and bank transparency on banking activity in terms performance and soundness. In particular, the role of economic freedom on the banking sector has not been greatly studied in the existing literature, except in the studies by Sufian and Habibullah (2010ab) that look at the cases of China and Malaysia. There are reasons to think that BP and BS are to some extent related to the overall economic system and environment within which banks operate. Clearly some countries have more or less economic freedom, regulation, corruption and banking transparency than others and so examining the impact of these variables on banks overall performance and soundness (BP and BS) is an issue that merits attention.

This chapter is motivated by recent developments in the European banking sector and it contributes to the literature in a number of important ways. First, we develop a framework that examines the role of economic freedom, regulation, corruption and transparency on both BP and BS. The studies by Sufian and Habibullah (2010am) look only at developing countries and focused mainly on profitability measures. To the best of our knowledge this is the first analysis that

attempts to examine the issues of economic freedom on both BP and BS in a combined framework at the European level including the EU candidate countries. Another novelty is that we apply several different criteria to our sample based on region, institutional size, the income level of the country, time of entrance into the EU and bank specialization. Our analysis uses both pre- and post-crisis data on all these measures making it possible to examine the effect of the recent economic crisis on the EU banking sector.

IV.2 Literature review

While regulatory and supervisory framework of the banking sector has been extensively studied, the role of economic freedom has only recently attracted the interest of researchers. In the period before the subprime crisis, a consensus was built around the idea that if the burden of regulation was reduced the banking system would operate more efficiently and perform better. In addition, there was a misdirected believe that self-regulation is better than the national (mandatory) regulation. This idea fell into disrepute as a result of the crisis, which showed that bankers left largely unregulated can cause havoc to the banking sector with resulting financial instability. The post-crisis literature has tended to emphasize the need for regulatory and supervisory reforms to ensure banking and financial stability with enhanced regulation, monitoring and improved bank disclosure. In their study Chortareas *et al.* (2012b) evaluate bank supervision, regulation and efficiency among a sample of 22 EU countries. Their results show that an increased regulatory and supervisory framework has a positive impact on BP, through various channels, including a decline in the likelihood of financial distress, a reduction of agency problems and reduced market power.

IV.2.1 The impact of Economic Freedom

While the influence of economic freedom on the the whole economic sector has been broadly discussed in the literature (see for example Adkins *et al.* 2002; Altman, 2008; Bergh and Karlsson, 2010; Heckelman and Knack, 2009) its influence on the banking sector has only recently attracted the attention of researchers and only then in the context of developing countries (Sufian and Habibullah, 2010ab). There are a number of reasons to think that economic freedom can have a positive impact on BP and BS. In the first instance, banks are likely to lend more as there are more firms competing in the economy and this means banks have the capacity to lend more funds to a wider range of domestic companies. Also greater economic freedom means that there will be more scope for banks to lend to foreign companies and foreign banks which should ensure greater

diversification and a better risk return trade-off for the banking system. Greater economic freedom is likely to lead to a better environment for business and stronger economic growth and improved BP and BS. In addition, the higher the level of economic freedom is, the higher the real income is (Holmes *et al.*, 2008). This implies a higher demand for banking products and services. As well, a higher degree of economic freedom should lead to lower inflation and more stable macroeconomic environment. In the context of developing countries, it has been noted that there tends to be greater state control of bank lending decisions and this ultimately means banks tend to lend more to less creditworthy companies than would happen in a private sector controlled banking system and this ultimately undermines BP.

Of course, there could be some ways in which greater economic freedom might undermine BP and BS. Easier entry into the sector and greater competition within the sector could undermine the average profitability and solidity of banks. In addition, greater economic freedom may allow for greater competition for the banking sector from shadow banking such as hedge funds, shadow banks and private equity which may also impact on BP and BS since they compete for banks deposits and also to fund businesses which could lower BP and BS. So the impact of economic freedom on BP and BS is fundamentally an empirical issue. The empirical analysis of Sufian and Habibullah (2010ab) specify a positive connection between economic freedom and profitability in the cases of both China and Malaysia but there are no studies for developed nations.

IV.2.2 The impact of Regulation

Many studies have accentuated the positive impact of regulation, especially the role of capital adequacy requirements in preventing bank failures, protecting customers and the entire economic system from detrimental externalities (see for example, Rochet, 1992; Dewatripont and Tirole, 1993b; Gorton and Winton, 1995; Hovakimian and Kane, 2000; and Chortareas *et al.*, 2012b). In their study Peltser *et al.* (2016) show that increases in bank capital ratios whilst hitting short run stock performance nonetheless enhance the ability of banks to survive during a crisis. Despite the benefits of regulation it is important to find an optimal level since excessive regulation can obstruct the efficient operation of banks by increasing costs and restricting useful bank's activities. In this respect, Jalilian *et al.* (2007) point out that banks may try to counteract the pressure of a severe regulatory framework by engaging in riskier operations and investments and finding ways to circumvent regulation which can negatively impact upon BP and BS. A study by Barth *et al.* (2004) evaluates the impact of a specific regulatory and supervisory strategy on bank development, performance and soundness using survey data for an international sample of 107

countries. Their results point out that restrictions on bank activities could be detrimental for BP and could amplify the likelihood of a banking crisis. Likewise, Dermirgüç-Kunt *et al.* (2004) study the impact of bank regulations, market structure and institutions on net interest margin (NIM) and the cost of financial intermediation using an international dataset based on over 1,400 banks from 72 countries. The results obtained indicate that tighter regulation on banking activity will generate an increase in the cost of financial intermediation, which can adversely affect net interest margin and BS. Moreover, Barth *et al.* (2012) evaluate the evolution and impact of bank regulations on a dataset of 125 countries. Based on an extended analysis of the pros and cons of a wide range of regulations, they argue that the existing evidence does not suggest that a tighter regulatory framework will improve BS, enhance the efficiency of intermediation or diminish the level of corruption. By contrast, Fernandez and Gonzalez (2005) using the same time span and a similar sample, stress that in countries with low accounting and auditing requirements, more control by supervisory authorities can diminish managers' risk taking behavior, while amplified restrictions on bank activities can decrease the probability of a banking crisis. Similarly Agoraki *et al.* (2011) who focus on a sample of 546 European banks suggests that increased regulation, through higher capital requirements and activity restrictions in combination with a higher level of market power reduces both credit risk and the risk of default.

IV.2.3 The impact of Corruption

Looking at the banking sector, corruption can be manifested through dishonest practices of bank managers and/or bank officials. A significant number of economists argue that corruption has a negative impact upon the banking and economic system. At the macroeconomic level, corruption can deform the structure of public expenditure, dampen potential foreign direct investment, increase unproductive foreign debts, lessen the efficiency of economic activity and result in a lower level of national income and higher rates of poverty.⁹⁵ Additionally, at the microeconomic level, corruption is accompanied by low institutional quality, inefficient institutions in terms of BP and BS, and higher costs of doing business (see for example Asiedu, 2003; Méndez and Sepulveda, 2006; and Diaby and Sylwester, 2015). Consequently, the level of corruption has the potential to undermine BP and BS. Mongid (2007) shows that banking crises are positively related to a higher level of corruption and poor legal enforcement. On the other hand, Pagano (2008) shows that corruption together with a high participation of government in the banking environment significantly influences bank lending rates, with increased government

⁹⁵ For example: Mauro (1995), Gastanaga *et al.* (1998), Asiedu (2003) and Kunieda *et al.* (2014), among others.

participation raising lending rates while corruption lowers lending rates and that corruption helps explain the cross-sectional dispersion of the lending rates sensitivities in the banking sector.

The literature on corruption is more mixed on the issues of BP and BS. Generally speaking a higher level of corruption can negatively influence the functioning of the entire financial sector and economy. La Porta *et al.* (2002) argue that countries with higher government ownership of banks are associated with lower levels of GDP per capita, to the extent that greater government control of the banking system is related with greater corruption; this suggests a negative impact of corruption on BP. More recently, Park (2012) evaluates the influence of corruption on the soundness of the banking sector using an international dataset. The results show that corruption can be associated with a higher proportion of bad loans in the banking sector. In addition, corruption increases the allocation of bank funds from normal to bad projects, which as well as undermining BS will also negatively influence the economic activity. Similar conclusions are reached by Weill (2011a) and Zheng *et al.* (2013). However, Lalountas *et al.* (2011) and Weill (2011ab) point out that in countries with a high degree of risk aversion in the banking sector there could be benefits in terms of increased bank lending due to corruption and in the short term corruption can potentially increase BP. However, the observation, that corruption can positively influence bank lending, does not necessarily mean that corruption will bring welfare gains. For instance, if an expansion of banking activity is accompanied by an increase in non-performing loans it increases risk and ultimately raises the cost of borrowing for a bank and its customers. In general, the legal system is the main source of variation in corruption levels across the regions studied, the higher the effectiveness of the judicial system, the less corruption there will be.

IV.2.4 The impact of Transparency

In the financial system, transparency plays an important role, in terms of increasing the effectiveness of monetary and fiscal policies, increasing the expectedness of Central Bank decisions and endorsing the independence of the Central Bank. Transparency is essential both for Central Banks in relation to the communicating monetary policy (Winkler, 2000), and the banking system as a whole not only because it augments democratic responsibility, but also because it improves public confidence regarding the financial sector. For example, Diamond and Verrecchia (1991) develop a theoretical model, which demonstrates that diminishing asymmetric information by revealing information to the public lessens a firm's cost of capital. Other papers, such as Baumann and Nier (2004), Nier and Baumann (2006), Akhigbe *et al.* (2013), and Barakat and Hussainey (2013) estimate the impact of transparency on the banking sector by constructing a bank

disclosure index. Overall increased transparency can translate into better financial performance, reduce the chance of severe banking problems, enhances overall BS, and better link senior executive remuneration to BP.

In the literature there are various concepts regarding transparency, particularly concerning the impact of transparency in relation to the moment in time when it is promoted. As explained by Nier (2005), transparency can be beneficial *ex ante* by enhancing market discipline. By contrast, *ex post* disclosure can have a negative impact on BP and BS by highlighting when a bank is already in difficulty. This latter situation was observed in the recent financial crisis period when banks were required to ensure a higher transparency level. A higher transparency by helping to overcome information asymmetry can improve liquidity in a bank's shares and can reduce a bank's cost of capital as shown in Diamond and Verrecchia (1991). In addition, Lang and Lundholm (1993) show that increased disclosure by firms by reducing information asymmetry can also help reduce stock price volatility and hence improve a firms' cost of capital. Tadesse (2006) argues that higher bank disclosure has benefits for the stability of the financial system and because it improves market efficiency by facilitating price discovery it can help uncover concealed costs and provide protection for investors by enabling a better understanding of the risks in the banking sector associated with financial products.

While transparency generally has a positive impact on banking activity, too much transparency can have negative effects. Bushee and Noe (2000) argue that increased disclosure can affect the level of institutional holding of a firm's shares but at the same time increase the percentage of "transient" institutional holders of the firm's shares which can actually increase the price volatility of a bank's shares. Cordella and Yeyatti (1998) and Furman *et al.* (1998) argue that the disclosure of financial information can also have negative implications at times when a bank is already in distress by increasing the risk of bank runs. Excessive transparency can also lead to confusion if the level of financial education is poor due to the risk that the general public does not understand or cannot process very detailed information provided by banks. It is important to mention that one of the main benefits of greater regulation and transparency strategy is that it helps limit the scope for corruption and financial fraud in banking.

The complexities of modern banks, the greed and naivety of some bank clients and the lack of financial education among ordinary people can facilitate financial fraud and corruption. Lack of transparency and poor financial education can also enable providers of financial services to exploit their customers. For example, Papademos (2008) and Blinder *et al.* (2008) debate the potential harm that a lack of transparency can have on individuals with poor financial education or lack the ability to understand and interpret financial information provided. In addition, Kolstad

and Wiig (2009) argue that a lack of transparency makes corruption less risky and implicitly more attractive, leading to certain employees in the financial sector exploiting their positions at the expense of established social norms and trust.

IV.3 Data selection

The main source of our data is Bankscope and World Bank databases. However, in several cases the data were extracted from the annual reports of the banks and were converted into euros to ensure accounting uniformity (see Table V.1).

Table V.1: Variable definition and sources

Variables		Definition	Data sources
Bank performance	Return on average assets (ROAA)	Net income divided by average total assets	Bankscope Annual Reports
	Return on average equity (ROAE)	Net income divided by average total equity	Bankscope Annual Reports
	Net interest margin (NIM)	The difference between the interest income produced by banks or other banks, and the volume of interest paid out to their lenders relative to the volume of their assets	Bankscope Annual Reports
Bank stability	Natural logarithm of Z score (Z score)	Natural logarithm of [(Equity/Assets + ROAA)/ Variance of ROAA]	Authors' calculations
	Financial System Soundness Index (FSSI)	This index is assessing the degree of soundness of a given system, and provides an <i>ex ante</i> measure of soundness. The index is composed of 2 variables: capital adequacy ratio and the inversed ratio of NPLs, weighted by the intermediation ratio. It was computed using the methodology of Das <i>et al.</i> (2004).	Authors' calculations
Economic freedom	Economic Freedom (EF)	The heritage index of economic freedom an index from 0 to 100 measuring economic freedom based on 10 dimensions, with higher number corresponding to greater economic freedom.	Heritage
Regulation	Business Regulation (REG1)	The degree to which business regulation represents and obstacle to the overall economic activity (1-no obstacle, 2 -minor obstacle, 3 -a moderate obstacle, 4 -major obstacle)	WBES
	Availability of regulation (REG2)	Availability of laws and regulation. It takes values from 1 to 6, from a reduced level of laws to a developed level of laws and regulation	WBES
Corruption	Corruption (CORR1)	Corruption of bank officials as an obstacle for the operation and growth of the business (1-no obstacle, 2 -minor obstacle, 3 -a moderate obstacle, 4 -major obstacle)	WBES
	General constraint-corruption (CORR2)	Represents the overall value of corruption, and it takes values form 1 to 4 (1-no obstacle, 2 -minor obstacle, 3 -a moderate obstacle, 4 -major obstacle)	WBES
Transparency	Disclosure index (DISCL)	Measures the level of detail which banks provide on 17 dimension of accounting information in their public accounts. For each sub-index, a 0 was assigned if there was no entry in any of the corresponding categories and a 1 otherwise. The variables were computed using the methodology of Nier (2005) as explained in Appendix IV.1	Authors' calculations

Note: WBES stands for World Business Environment Survey (2000).

Wherever possible, we have used consolidated banking data. After excluding banks and/or periods with missing or zero values, we were left with a sample of 681 banks. The sample covers the period 2000-2012 on an annual basis for 33 European countries. The time period was selected to ensure coverage of the recent financial crisis period on BP and BS. In many of the selected countries the banking sector plays a very important role, being the main component of their financial systems (Beck *et al.*, 2005). Table V.1 provides definitions and sources of all variables used in our econometric analysis.

IV.3.1 Measurement of Bank performance

In many academic studies, the concept of performance is related to the notion of profitability.⁹⁶ Profitability can be represented by three indicators: namely Return on Average Assets (ROAA), Return on Average Equity (ROAE) and Net Interest Margin (NIM). ROAA indicates the returns generated by bank's assets and is calculated as a ratio of net income to average total assets. ROAE shows the return on shareholder's equity and is calculated as net income to average total equity. NIM is defined as the difference between the interest income generated by banks or other banks and the amount of interest paid out to their lenders relative to the amount of their interest earning assets. We use all three measures of BP in our study to check for the robustness of our results. The first two variables are extensively used in the literature as profitability ratios, representing a bank's ability to generate earnings from its investments (see for example, Nier, 2005; Demirgüç-Kunt *et al.*, 2004; Pasiouras, 2008a; and Naceur and Omran, 2011). In addition, we also consider, NIM, similar to Demirgüç-Kunt *et al.* (2004) and Chortareas *et al.* (2012a).

IV.3.2 Measurement of Bank soundness

The issue of bank soundness relates to bank's capability to endure adverse events, such as banking crises, major policy changes, financial sector liberalization and natural disasters. Among the academic writings, the most frequently used variable to evaluate bank soundness is the Z-score. The Z-score is inversely linked to the probability of a bank's insolvency (Boyd and Runkle, 1993). More detailed, the Z-score reveals the number of standard deviations that a bank's return has to

⁹⁶ For example: Bourke (1989), Molyneux and Thornton (1992), Staikouras and Wood (2004), Park and Weber (2006), Pasiouras and Kosmidou (2007), Athanasoglou *et al.* (2008), Albertazzi and Gambacorta (2009), Cornett *et al.* (2010), Dietrich and Wanzenried (2011), and Kanas *et al.* (2012) among others.

drop below its expected value, to deplete equity and make the bank insolvent.⁹⁷ The probability of insolvency is defined as the probability that losses π exceed equity E , as we can see in the following:

$$P[\pi \leq -E] = P[ROAA \leq -K] = \int_{-\infty}^{-K} f(ROAA) \sigma(ROAA) \quad (IV.1)$$

Where ROAA is the return on average assets; K is the share of equity capital to total asset (capital adequacy) and $\sigma(ROAA)$ is the volatility (standard deviation) of the mean return on average assets.

As shown in De Nicolo (2000) this probability satisfies the following inequality:

$$P[ROAA \leq -K] \leq \frac{\sigma^2(ROAA)}{(ROAA+K)^2} = \frac{1}{Z^2} \quad (IV.2)$$

$$\text{Where: } Z \text{ score} = \frac{ROAA+K}{\sigma(ROAA)} \quad (IV.3)$$

A rise of the Z-score corresponds to a reduced risk of insolvency. More specifically, Z-score is increasing with a higher profitability and capital adequacy and is decreasing with increased income volatility (see Boyd and Runkle, 1993; Beck *et al.*, 2006; Lepetit *et al.*, 2008b; Laeven and Levine, 2009 and Fu *et al.*, 2014). Theoretically, the Z-score permits a time-varying measure of BS that does not experience endogeneity issues. However, since ROAA and the standard deviation $\sigma(ROAA)$ are mined from different distributions, this could generate an inconsistency issue. Laeven and Levine (2009) and Houston *et al.* (2011) advocate the use of the natural log of the Z-score ($\ln Z$) over the traditional Z-score on the basis that the latter's distribution is heavily skewed, whereas the former's is not. In fact, Lepetit and Strobel (2015) show that the traditional Z-score is providing a less effective upper bound of the probability of insolvency suggesting that the natural log of Z-score is an improvement of this traditional measure without imposing any further distributional assumptions. As such we use the natural log of the Z-score as an insolvency risk measure.

Another strand of the literature has focused on various measures of BS such as financial strength ratings or on banks' stock prices (for example, Bharath and Shumway, 2008; Nier, 2005; Demirgüç-Kunt *et al.*, 2006; Fiordelisi *et al.*, 2011; Huang *et al.*, 2012; Elliot *et al.*, 2013b; and López-Espinosa *et al.*, 2013). Other researchers have examined the role of financial fragility, which is proxied by two different measures. One strand of the literature has used the financial

⁹⁷ For example: Boyd and Runkle (1993), Lepetit *et al.* (2008ab), Laeven and Levine (2009), Chortareas *et al.* (2012b), Sufian and Habibullah (2012), Bertay *et al.* (2013), Bourkhis and Nabi (2013), Pasiouras and Gaganis (2013), Tabak *et al.* (2013), Anolli *et al.* (2014), and Fu *et al.* (2014) among others.

stress indices (for example, Illing and Liu, 2006; Hakkio and Keeton, 2009; Misina and Tkacz, 2009; and Hollo *et al.*, 2012). A different strand has focused on bankruptcy prediction by employing the probability of bankruptcy as an indicator of individual bank fragility, for example, Bharath and Shumway (2008) and Fu *et al.* (2014). In their paper, Fu *et al.* (2014) compute the probability of bankruptcy using the Black and Scholes (1973) and Merton (1974) contingent claims approaches and they conclude that the market-based measure of stability has more advantages than the accounting-based models which provide variable information depending on the firms' accounting policies.

For our second measure of BS we use a modified version of the financial system soundness index ($FSSI_{ij}$) developed by Das *et al.* (2004) and measures the degree of financial soundness providing also an *ex ante* measure of soundness. This index is composed of two main variables, the capital adequacy ratio plus the inverse of the ratio of nonperforming loans to total loans both of which are weighted to reflect the country's degree of financial intermediation. The index takes the following form:

$$FSSI_{ij} = \frac{TL_i}{GDP_i} \left[\frac{1}{2} (CAR_{ij} + 1/NPL_{ij}) \right] \quad (IV.4)$$

Where TL_i is the total loans granted by banks in country i ; GDP_i is the gross domestic product for a specific country i ; CAR_{ij} is the capital adequacy ratio for a bank j in country i ; NPL_{ij} is the ratio of nonperforming loans of a bank j in country i . A higher FSSI indicates greater BS.

IV.3.3 Measurement of Economic Freedom

To examine the role of economic freedom we have used the Heritage index which is commonly used in the literature and is composed of ten dimensions grouped into four pillars, of economic freedom: (i) Rule of Law (property rights, freedom from corruption); (ii) Limited Government (fiscal freedom, government spending); (iii) Regulatory Efficiency (business freedom, labour freedom, monetary freedom); and (iv) Open Markets (trade freedom, investment freedom, financial freedom). These 10 factors are equally weighted to create a composite index taking values from zero to 100 with a higher value indicating greater economic freedom.

IV.3.4 Measurement of Regulation

To measure the impact of regulation in the economy as a whole, we have used two variables. The first regulation variable (REG1) is based on the World Business Environment Survey (WBES)

which uses a scale of one to four, with one being no business regulation obstacles and four representing major obstacles that limit business entry, diminish competition and may also influence BP and BS through spill-over effects. Regulatory obstacles to entry can result in a reduced level of competition by reducing new companies entering into a business (Ciccone and Papaioannou, 2007; Klapper *et al.*, 2006; Pasiouras, 2008a; Barth *et al.*, 2009; Mamatzakis *et al.*, 2013). Severe business regulations and an excessive amount of laws and regulations can also have harmful implications for the overall performance of companies and adversely affect debt service repayments to the banking sector. Secondly, we use the WBES availability of laws and regulations measure (REG2) which uses a scale of one to six to measure the degree of regulation with a low score representing a low level of regulatory development and a high score a higher level of regulation.

IV.3.5 Measurement of Corruption

To measure corruption we use two variables, the corruption level of bank officials (CORR1) and a general value of corruption (CORR2). The corruption of bank officials can be measured either by the Corruption Perception Index developed by Transparency International (see for example, Barth *et al.*, 2009; Lalountas *et al.*, 2011; and Weill, 2011ab) or by the indices developed by World Business Environment Survey (WBES). In this chapter we choose the two indices developed by WBES due to the need to cover our entire sample. The first WBES index CORR1 measures the corruption of bank officials as an obstacle for the operation and growth of business and is used in Beck *et al.* (2006b), Barth *et al.* (2009), Houston *et al.* (2011), Weill (2011a), and Zheng *et al.* (2013) among others. While the second WBES index CORR2 is a more generalised index of corruption, and it has a national covering. A higher level of these corruption indicators describes a higher level of corruption.

IV.3.6 Measurement of Transparency

To measure transparency, we have computed a composite disclosure index (DISCL) using the methodology developed by Nier (2005). This index was calculated for each bank after extracting the necessary information from Bankscope and annual reports of the banks.⁹⁸ The composite disclosure index measures the level of detail which banks provide on 17 dimensions of accounting information in their published accounts relating to both the asset and liability sides of

⁹⁸ The methodology for constructing this index is described in Appendix IV.1.

a bank's balance sheet, memorandum items, income statement and sources of funding. The disclosure index is normalized to take a value of between 0 and 1, with a higher value representing a higher level of disclosure. The implications of transparency on the banking market are ambiguous. If applied *ex ante*, disclosure may be beneficial for a bank with reference to the reduced likelihood of a crisis, a decreased likelihood of information contagion and a higher level of market discipline. However when applied *ex post* transparency can negatively impact upon BP and BS.

IV.4 Model setup

In this section we discuss the econometric approach developed to evaluate the impact of economic freedom, regulation, corruption and transparency on BP and BS in Europe. The empirical work on the determinants of BP and BS can theoretically suffer from an inconsistency problem, determined by omitted variables, an endogeneity bias or highly persistent revenues (see Poghosyan and Hesse, 2009; and Naceur and Omran, 2011). We used several estimation methods including the Arellano and Bond (1991) and Arellano-Bover/Blundell-Bond (Blundell and Bond, 1998⁹⁹) but ultimately we settled on reporting the results from two-stage least squares regression (2SLS). We preferred this technique, mainly because we found evidence that the dependent variable's error terms were correlated with the independent variables.¹⁰⁰ After applying a series of tests for cross-sectional dependence, serial correlation, stationarity and heteroscedasticity, we have identified some potential problems with the heteroscedasticity test (Modified Wald test) mainly caused by measurement errors. The two basic estimated models are defined as follows:

$$Prof_{ik,t} = \alpha_i + \beta_0 Prof_{ik,t-1} + \beta_1 Stab_{ik,t} + \beta_2 EF_{i,t} + \beta_3 REG_{i,t} + \beta_4 CORR_{i,t} + \beta_5 BT_{ik,t} + \varepsilon_{it} \quad (IV.5)$$

$$Stab_{ik,t} = \alpha_i + \beta_0 Stab_{ik,t-1} + \beta_1 Prof_{ik,t} + \beta_2 EF_{i,t} + \beta_3 REG_{i,t} + \beta_4 CORR_{i,t} + \beta_5 BT_{ik,t} + \varepsilon_{it} \quad (IV.6)$$

where $Prof_{ik,t}$ is the profitability of the bank k in country i during the period t , and is measured in our study by three alternative measures (ROAA, ROAE and NIM); $Stab_{ik,t}$ is the soundness of the bank k in country i during the period t , and is measured in our analysis by the natural log of the Z-score and the financial system soundness index; $EF_{i,t}$ stands for Economic

⁹⁹ Building upon the work of Arellano and Bover (1995).

¹⁰⁰ Appendix IV.2 shows that the correlation amongst the variables is reasonably low helping to reduce the problem of multicollinearity.

Freedom, expressed through the Heritage index, general regulation REG and availability of laws and regulation represented by two variables $REG1_{i,t}$ and $REG2_{i,t}$; $CORR_{i,t}$ stands for corruption and is measured by two alternative indexes; corruption of bank officials CORR1 and general corruption CORR2; $BT_{i,t}$ represents bank transparency for bank k in country i during the period t being represented by the disclosure index.

We conduct an empirical analysis on the overall sample, but for reasons of robustness of the analysis we also break the sample to five different sub-samples by:

- ❖ *Region.* The sample was divided in three main regions, namely the Euro-area (N=379 banks), the non-euro EU countries (N=181 banks), and the EU candidate countries (N=121 banks);¹⁰¹
- ❖ *Size of a bank.* This indicator was computed as the natural logarithm of total assets according to the last available year. We then took the maximum and minimum values of the logarithm of total assets (4.41 and 18.2) divided this into three equal intervals to obtain three groups, namely small institutions (N=178), medium institutions (N=326) and large institutions (N=177);
- ❖ *Country income level.*¹⁰² In this case, the countries were classified in two sub-categories using the World Bank definition, namely: high income countries (N=528 banks) and middle income countries (N=153 banks);
- ❖ *Timing of entrance into the EU enlargement process.* We had the following four groups: founding members including the first enlargement of UK, Ireland and Denmark (1957-73, N=270), EU enlargement group A (1981-95, N=91), and EU enlargement B (2004-2014, N=199) and candidate countries e.g. those that had candidate status in 2014 (N=121);
- ❖ *Specialization of a bank.*¹⁰³ According to this, we classified the banks in the following groups: commercial banks (N=423), cooperative banks (N=39), investment banks

¹⁰¹ The countries selected are the **Euro-area countries** (Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, Spain), the **non-euro EU countries** (Bulgaria, Croatia, the Czech Republic, Hungary, Poland and Romania, Denmark and United Kingdom), and the **EU candidate countries** (Albania, Macedonia, Iceland, Montenegro, Serbia and Turkey). Sweden was not included in the analysis due to data unavailability for at least 5 consecutive years in computing the transparency indicator.

¹⁰² Appendix IV.3 is describing the sample in relation to the country income level and timing of entrance into the EU.

¹⁰³ In order to avoid a duplication of banks, we have verified that the banks included in our sample are mutually exclusive. Bankscope divides banks by specialisation, as follows: Commercial banks, Savings banks, Investment banks, Real Estate and Mortgage banks, Cooperative banks, Credit banks, Islamic banks, Non-Banking Credit institutions, Bank Holdings companies, Central Bank, Specialised Governmental Credit institutions, and Multilateral Government banks. In terms of the distinctions between the six different types presented in the table, *Commercial banks* are regarded as the banks which are owned by stockholders pursuing various lending activities to increase their profits. *Cooperative banks* are banks organized on a cooperative basis. *Investment banks* are underwriters that serve as intermediary between issuer of securities and the investing public. *Real Estate and*

(N=34), real estate and mortgage banks (N=38), savings banks (N=55), and other banks (N=92).

The idea behind the above categorization is that the European Banking sector is quite heterogeneous with banks operating in countries with different degrees of economic freedom, income levels, different banking models and banks themselves varying in size as measured by total assets. In addition as shown by Bandelj (2016) the geographical location of banks in Europe can affect their cost of capital.

IV.5 Empirical findings

IV.5.1 Summary statistics

In Table IV.2 we report the summary statistics of the key variables used in our analysis for all the countries in the sample. We can see from Annex IV.2 that the correlation amongst the variables is reasonably low.

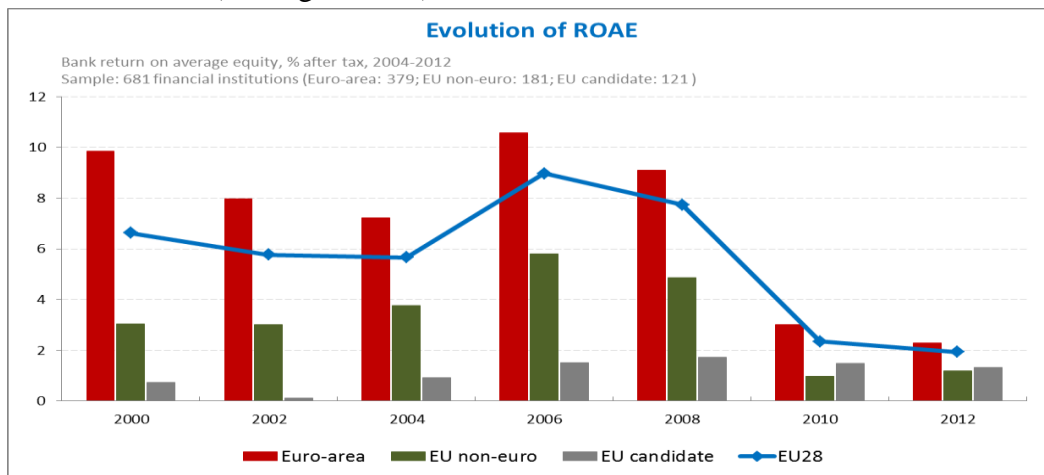
Table IV.2: Descriptive statistics

Variable	Obs.	Mean	Min	Max
ROAE	6093	4.88 (9.69)	-87.59	84.97
ROAA	6096	0.62 (2.74)	-43.68	36.00
NIM	6094	3.23 (3.05)	-3.01	50.88
Z-score	6204	19.27 (22.16)	-9.66	243.15
FSSI	6197	0.24 (0.94)	-13.86	30.17
EF	8564	66.37 (7.43)	43.50	82.60
REG1	3900	2.08 (1.15)	1.00	4.00
REG2	3922	3.09 (1.47)	1.00	6.00
CORR1	3922	1.58 (1.01)	1.00	4.00
CORR2	3922	2.17 (1.15)	1.00	4.00
DISCL	6098	0.82 (0.16)	0.00	1.00

Note: Obs. stands for the number of observations; in parentheses we have standard errors.

Mortgage banks are specialized on real estate lending. *Savings banks* are focused on accepting deposits and payin interest on those deposits. **Other banks** cover the following: bank holding and holding companies, clearing institutions, finance companies, Islamic banks, micro-financing institutions, private banking and asset management, specialized governmental credit and other credit institutions

Within our sample, the BP indicators suggest that, on average, the profitability of the analyzed banks is characterized by positive returns, although these returns have considerably decreased in the aftermath of the crisis, particularly for the banks operating in the Euro-area and EU non-euro countries (see Figure IV.1).



Source: processed after Bankscope

Figure IV.1: Evolution of ROAE for the sample analyzed

In this analysis, the indicators of BS are represented by log Z-score and FSSI, and as represented in Figure IV.2, there has been a slightly increase in solidity particularly because of the measures taken by policy makers to strengthen banks.

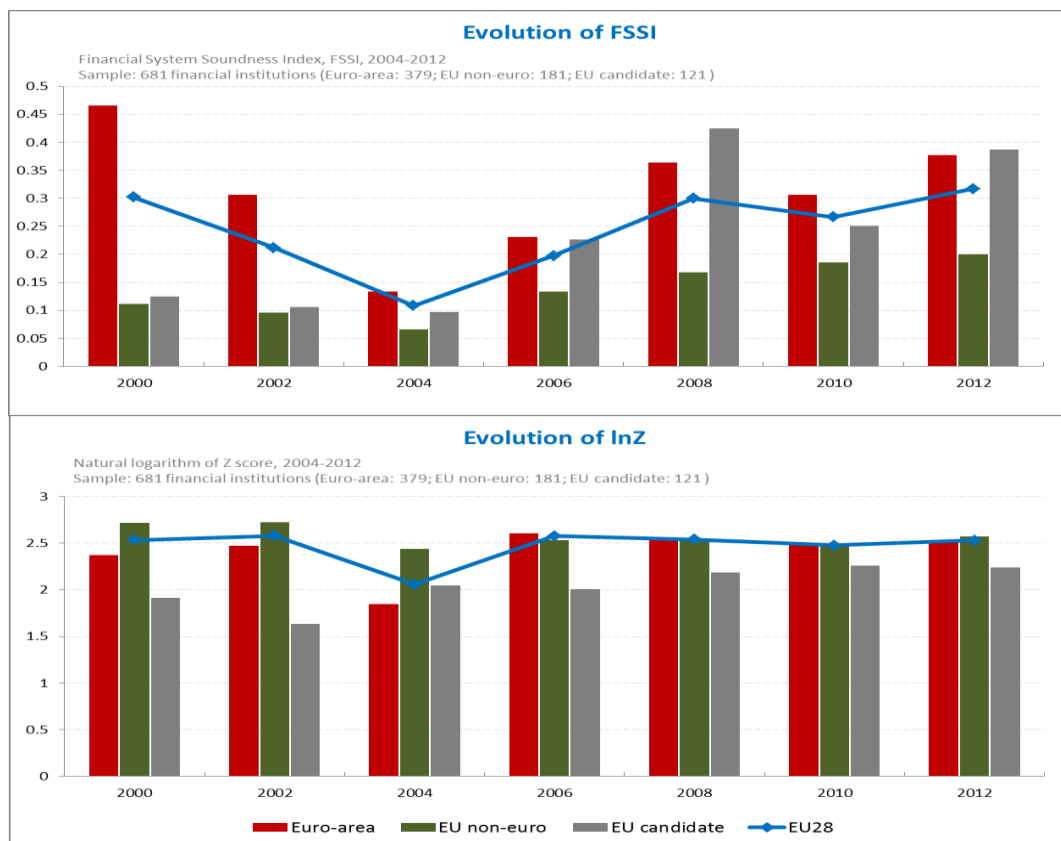
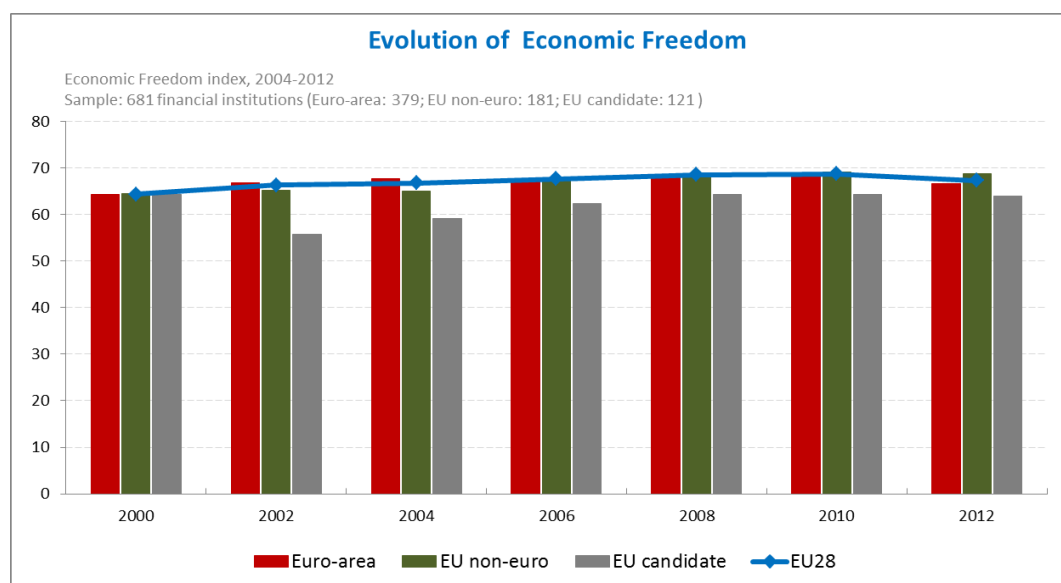


Figure IV.2: Evolution of soundness indicators for the sample analyzed

This strengthening has been accentuated in the EU candidate countries, given their determination to align to the EU standards. Though, these graphs represent the average per group, disregarding outliers in the sample and national particularities.

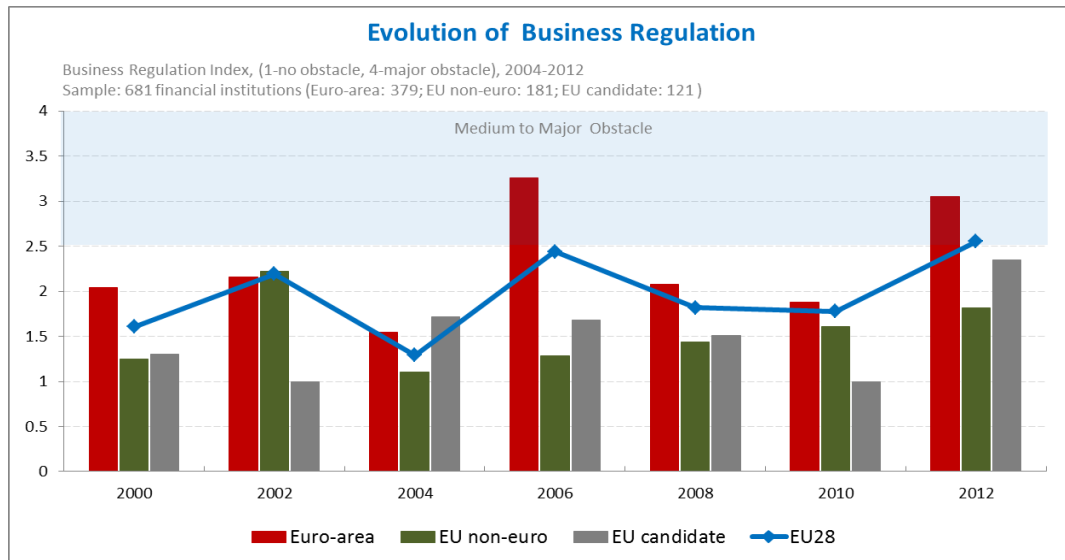
The Economic Freedom indicator has a wide range from 43.5 in the case of Montenegro and Serbia in 2003, to 82.6 in the case of Ireland in 2007 (as shown in Table IV.2). The evolution captured in Figure IV.3 shows an constant trend for the Euro-area and EU non-euro countries, while in the EU candidate countries there has been a slightly increase in the indicator starting from 2004.



Source: processed after Heritage

Figure IV.3: Evolution of Economic Freedom for the sample analyzed

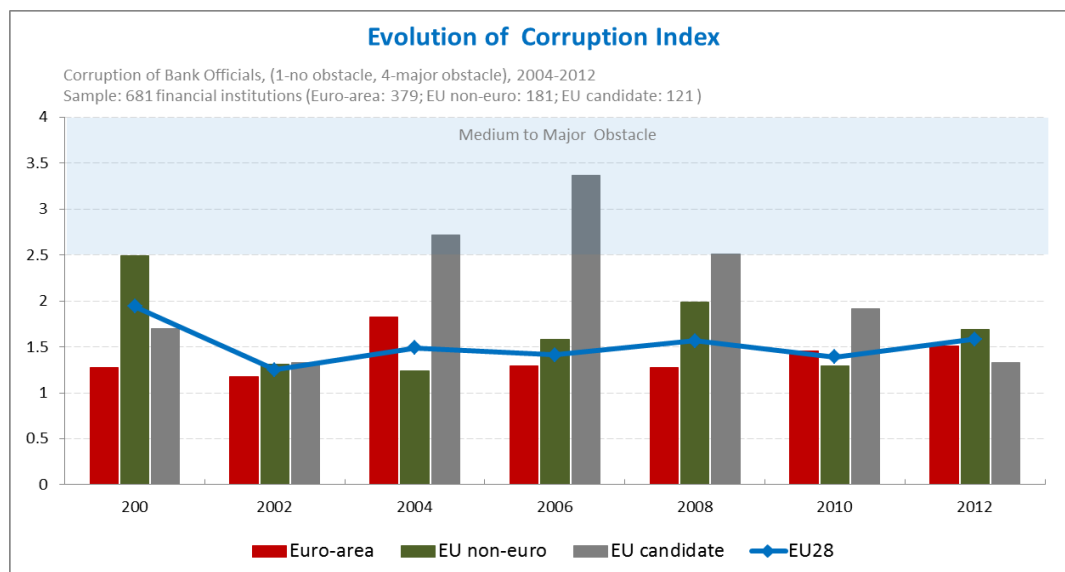
In terms of regulation, Figure IV.4 captures the evolution of the regulatory framework in the EU member and candidate countries. The Business Regulation Index measures the degree in which business regulation represents an obstacle in the development of economic activities. It takes values from 1 to 4, where 1 stands for the lack of an obstacle and 4 stands for a major obstacle. If in the period 2010-2011, this indicator didn't represented a major problem in the development of economic activities, though in 2011-2012, the situation changed, so the regulatory framework started to restrict the general economic activities, representing, at least for the Euro-area, an important obstacle in economic growth.



Source: processed after World Bank Database

Figure IV.4: Evolution of Business Regulation for the sample analyzed

In terms of corruption, in Figure IV.5 it was represented the evolution of Corruption of Bank Officials Index, which similarly to the Business Regulation index, takes values from 1 to 4, where 1 stands for the lack of an obstacle and 4 stands for a major obstacle.



Source: processed after World Bank Database

Figure IV.5: Evolution of Corruption for the sample analyzed

As it can be noted, corruption of bank officials is an important issue in the EU candidate countries, reaching its peak in 2006. Though, given the numerous measures taken to tackle with corruption in these countries, the level of the index has considerably decreased since 2006,

reaching in 2011 a level comparable with the EU average, while in 2012 it has actually surpassed the Euro-area and EU non-euro countries.

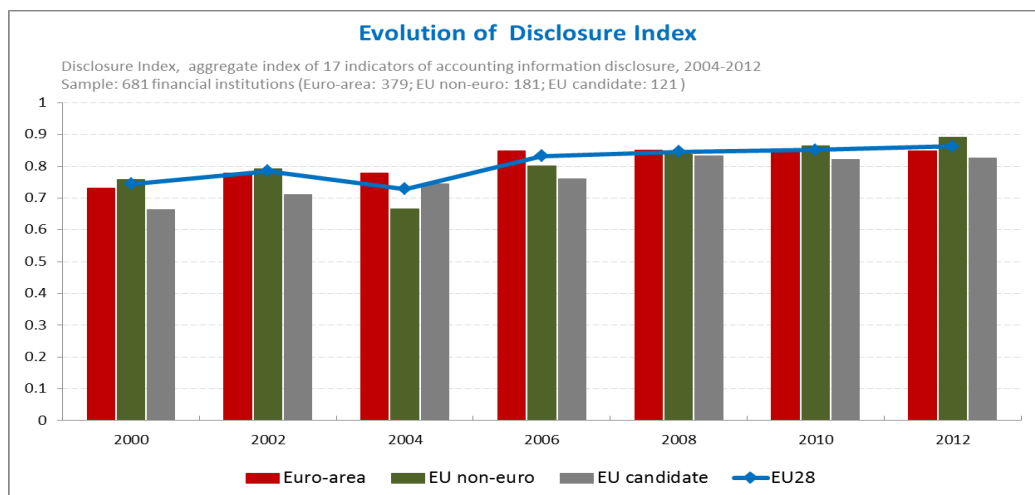


Figure IV.6: Evolution of Transparency for the sample analyzed

Finally the disclosure variable is quite high giving a reading of 0.82 on a scale of 0 to 1 (see Table IV.1). Moreover, from the evolution of this index we can note a slightly increase in the period 2006-2012, which signifies a higher disclosure of accounting information provided by banks (see Figure IV.6).

IV.5.2 Empirical results

The results of the empirical analysis are presented in Tables IV.3 to IV.9, for the overall sample, for the three different regions, for the size of the banks, for high and middle income countries, for the timing of entrance into the EU enlargement process and for the specialization of the bank, respectively.

IV.5.2.1 The Relationship between Bank Performance and Soundness

First, we concentrate on the results regarding the relationship between BP and BS reported in Table IV.3. Models (1) to (5) use different dependent variables.

More specifically, models (1), (2) and (3) are estimated versions of equation (5) using for the Profit dependent variable three alternative proxies: ROAA, ROAE and NIM respectively. While models (4) and (5) are estimated versions of equation (6) that have as the dependent variable the soundness of the banks ($Stabik,t$) using the natural log Z-score and the FSSI respectively. The results from models (1), (2) and (3) clearly indicate a positive relationship between BP and BS using the $\ln Z$ -score regardless of looking at ROAA, ROE or NIM. There may be particular reasons

for this result, as European Banks with less risk of bankruptcy were able to perform better during the period under consideration as they had access to cheaper capital and better quality loan books. Our results are in line with those reported in the literature showing that profitability ratios are important determinants of bank distress as discussed in Bongini *et al.* (2001). The results also extend to the FSSI measure of BS which shows a similar significant impact on ROAA, ROAE or NIM. On the other hand, regarding models (4) and (5) we also find that profitability as measured by the ROAE and NIM impact positively on BS as measured by the lnZ-score and FSSI measures.

Table IV.3: Empirical results for the entire sample (2SLS)

Variables	Model specification				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					0.04** (0.01)
ROAE				0.03** (0.01)	0.01 (0.01)
NIM				0.03** (0.01)	0.03** (0.01)
ln Z	0.48** (0.05)	2.01** (0.15)	0.24** (0.04)		
FSSI	0.41** (0.08)	1.82** (0.67)	0.74** (0.14)		
EF	-0.03** (0.01)	0.13** (0.02)	-0.06** (0.01)	-0.04** (0.01)	0.03** (0.01)
REG1	-0.09** (0.03)	0.48** (0.12)	-0.32** (0.04)	0.08** (0.01)	-0.02** (0.01)
REG2	-0.03 (0.02)	-0.17* (0.08)	-0.14** (0.03)	0.04** (0.01)	-0.03** (0.01)
CORR1	0.03 (0.04)	-0.61** (0.12)	-0.01 (0.06)	-0.06** (0.02)	0.01 (0.01)
CORR2	0.04 (0.03)	-0.65** (0.12)	0.53** (0.05)	0.03* (0.02)	-0.01 (0.01)
DISCL	-0.88** (0.19)	-1.64** (0.69)	-1.39** (0.37)	0.94** (0.14)	0.29** (0.02)
c	1.52** (0.41)	-5.70** (1.44)	7.37** (0.53)	1.98** (0.20)	-0.48** (0.07)
R sq	0.09	0.10	0.11	0.10	0.05
F test/Wald	203.38	772.89	556.73	295.74	242.91
Chi2	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	3893	3891	3892	3895	3892

Note: Instrumental variables (2SLS) regression; * denotes statistical significance at 5% and ** denotes statistical significance at 1%. Values of standard errors in parentheses.

It is important to mention that we find similar results when we divided our sample into sub-samples. We have applied a regional differentiation criterion to our sample, and Table IV.4 shows the results of the same models for the three regional sub-samples: Euro-area, non-euro EU and EU candidate countries. BS has a significant positive role in the profitability of the banking sector in all three regions in all cases for models (1), (2) and (3) but the results are somewhat stronger for Euro-area and Non Euro-area countries than for the EU candidate countries (where the FSSI measure is deemed as non-significant). Also, we observe that the profitability indicators have a positive effect on the degree of BS for the Euro-area and for the non-euro EU countries depicted

in models (4) and (5) as was observed for the overall sample. However, ROAA is significant only for the non-euro EU group; ROAE affects significantly all groups but only for the lnZ-score case; while NIM is non-significant for the Euro-area countries.

Table IV.5 presents results regarding the size of a bank. For all categories of banks (large, medium and small), the results reveal a significant positive impact of BP indicators on BS (with the sole exemption of ROAA for the large sub-sample). Similar results are obtained concerning the influence of BS indicators on BP (there is only one negative non-significant coefficient for FSSI on ROAA for the large group). Finally, after dividing the sample into the other three cases: by country income, moment of entrance into the EU and specialization of the bank (see Tables IV.6, IV.7, IV.8 and IV.9); our overall results seem to be very robust on all alternative cases suggesting a very strong positive relationship as it was expected from the theoretical predictions.

IV.5.2.2 The role of Economic Freedom

Regarding the economic freedom variable, the overall results in Table IV.3 suggest a significant negative impact on BP as measured by ROAA and NIM but a significant positive impact on ROAE. When looking at BS we detect mixed results, since there is a significant negative impact on the risk of insolvency, but also a significant positive impact on financial soundness as measured by the FSSI.

When it comes to splitting the sample into Euro-area, EU non Euro and EU candidate countries in Table IV.4, the results suggests: no impact of economic freedom on BP for the Euro-area countries; negative impact for two cases of the EU non-Euro (for ROAA and NIM) but positive for ROAE; while for the EU candidates it is negative for ROAA and positive for ROAE and NIM. The results for BS reveal that, in general, economic freedom has a strongly positive relationship for all regional cases and for both specifications (ln-Z and FSSI) with the exemption of the Euro-area where for the ln Z-score it is found to be negative and significant.

Table IV.4: Empirical results by region (2SLS)

Variable	Model specification														
	EURO-AREA					EU NON-EURO					EU CANDIDATE				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					0.01 (0.01)					0.03** (0.01)					0.01 (0.01)
ROAE				0.02** (0.01)	0.01 (0.01)				0.04** (0.01)	-0.01 (0.01)				0.13** (0.02)	0.01 (0.01)
NIM				0.01 (0.01)	0.01 (0.01)				0.04** (0.01)	0.03** (0.01)				0.09** (0.01)	0.03** (0.01)
ln Z	0.33** (0.04)	1.82** (0.23)	0.10** (0.03)			0.58** (0.07)	1.89** (0.28)	0.28** (0.08)			1.12** (0.32)	1.84** (0.18)	1.39** (0.19)		
FSSI	0.28** (0.08)	1.81* (0.83)	0.27** (0.08)			0.94** (0.15)	0.55 (0.72)	3.16** (0.35)			-0.18 (0.43)	0.26 (0.47)	1.18 (0.73)		
EF	0.01 (0.01)	0.02 (0.06)	-0.03 (0.02)	-0.06** (0.01)	0.03** (0.01)	-0.03** (0.01)	0.17** (0.02)	-0.08** (0.01)	0.03** (0.01)	0.04** (0.01)	-0.11* (0.05)	-0.07 (0.04)	0.16** (0.04)	0.03** (0.01)	0.02* (0.01)
REG1	-0.06* (0.03)	0.06 (0.18)	-0.18** (0.03)	0.06** (0.01)	-0.06** (0.01)	-0.04 (0.05)	-0.64** (0.16)	0.26** (0.10)	0.04 (0.03)	0.01* (0.01)	0.52** (0.18)	0.21 (0.18)	-0.74** (0.20)	0.11* (0.06)	0.07** (0.03)
REG2	-0.08** (0.03)	-1.07** (0.16)	-0.05 (0.03)	0.06** (0.02)	-0.03** (0.01)	0.12** (0.04)	0.54** (0.08)	-0.18** (0.06)	-0.02 (0.03)	-0.01* (0.01)	0.02 (0.08)	-0.02 (0.09)	-0.06 (0.12)	0.04 (0.03)	0.01 (0.01)
CORR1	-0.07 (0.04)	-0.85** (0.28)	0.07 (0.06)	-0.12** (0.03)	-0.01 (0.01)	0.18** (0.05)	-0.36** (0.09)	-0.01 (0.11)	0.02 (0.03)	0.01 (0.01)	-0.14 (0.19)	-0.44** (0.14)	0.46** (0.16)	-0.04 (0.05)	0.06** (0.02)
CORR2	-0.01 (0.04)	0.44 (0.27)	-0.09 (0.05)	0.15** (0.03)	-0.02 (0.01)	-0.01 (0.05)	-0.07 (0.12)	0.39** (0.10)	0.05 (0.03)	-0.01 (0.01)	-0.43** (0.14)	-0.31 (0.19)	0.25 (0.17)	-0.10* (0.05)	-0.03 (0.02)
DISCL	-0.78* (0.40)	-4.71 (2.73)	-2.20** (0.59)	0.99** (0.31)	0.61** (0.09)	-1.26** (0.23)	-3.05** (0.75)	-1.29** (0.43)	1.05** (0.16)	0.21** (0.02)	1.40 (0.78)	2.34** (0.72)	1.26 (1.15)	-0.67** (0.24)	0.15** (0.05)
c	0.50 (0.52)	8.95* (4.22)	6.16** (0.76)	4.91** (0.40)	-1.12** (0.27)	1.41** (0.50)	-10.57** (1.17)	8.92** (0.75)	1.19** (0.24)	-0.30** (0.05)	5.02 (3.85)	1.39 (2.07)	-9.89** (2.86)	0.54 (0.83)	-1.14** (0.30)
R.sq	0.07	0.08	0.04	0.12	0.08	0.13	0.17	0.13	0.14	0.11	0.23	0.34	0.29		0.17
Wald χ^2	77.12 (0.00)	177.43 (0.00)	101.88 (0.00)	234.45 (0.00)	95.27 (0.00)	153.03 (0.00)	359.94 (0.00)	441.24 (0.00)	139.14 (0.00)	196.47 (0.00)	51.48 (0.00)	148.65 (0.00)	158.60 (0.00)	176.18 (0.00)	48.24 (0.00)
Obs.	1999	1998	1999	2000	1999	1533	1532	1532	1534	1532	361	361	361	361	361

Note: Instrumental variables (2SLS) regression* denotes statistical significance at 5% and # denotes statistical significance at 1%. Values of standard errors in parentheses.

Table IV.5: Empirical results by banks' size (2SLS)

Variable	LARGE					MEDIUM					SMALL				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					-0.01 (0.01)					0.01 (0.01)					0.04** (0.01)
ROAE				0.06** (0.01)	0.03** (0.01)				0.03** (0.01)	0.02* (0.01)				0.01** (0.01)	-0.01 (0.01)
NIM				0.04** (0.01)	0.04** (0.01)				0.01 (0.01)	0.02* (0.01)				-0.02 (0.02)	0.01 (0.01)
ln Z	0.69** (0.12)	2.03** (0.27)	0.71** (0.10)			0.43** (0.05)	2.17** (0.23)	0.06 (0.06)			0.44** (0.09)	1.45** (0.37)	0.02 (0.06)		
FSSI	-0.03 (0.11)	2.46** (0.53)	0.69* (0.30)			0.30** (0.09)	2.43** (1.00)	0.26** (0.09)			1.06** (0.25)	4.04* (1.83)	0.93** (0.29)		
EF	-0.05** (0.01)	0.05 (0.04)	-0.01 (0.01)	0.01 (0.01)	0.03** (0.01)	0.01 (0.01)	0.22** (0.03)	-0.10** (0.01)	-0.04** (0.01)	0.02* (0.01)	-0.01 (0.01)	-0.01 (0.07)	0.01 (0.02)	-0.01 (0.01)	0.01 (0.01)
REG1	-0.01 (0.04)	0.02 (0.16)	- (0.10)	0.04* (0.02)	0.04** (0.01)	-0.04 (0.04)	0.48** (0.17)	-0.33** (0.05)	0.01 (0.02)	-0.04** (0.01)	-0.01 (0.04)	0.18 (0.26)	-0.10* (0.04)	0.11** (0.03)	-0.03** (0.01)
REG2	0.09** (0.03)	0.32** (0.09)	-0.14* (0.06)	-0.03 (0.02)	0.01 (0.01)	-0.04 (0.03)	-0.22 (0.15)	-0.02 (0.05)	0.03 (0.02)	-0.03** (0.01)	-0.14** (0.04)	-1.33** (0.25)	-0.11** (0.04)	0.15** (0.03)	-0.04** (0.01)
CORR1	0.16** (0.05)	-0.26** (0.10)	-0.08 (0.09)	-0.05* (0.02)	0.01 (0.01)	-0.02 (0.06)	-0.72** (0.26)	0.21* (0.09)	-0.07* (0.03)	0.01 (0.01)	-0.03 (0.08)	-0.52 (0.45)	0.01 (0.09)	-0.12* (0.06)	0.02* (0.01)
CORR2	-0.07 (0.04)	-0.23 (0.12)	0.39** (0.10)	0.07** (0.02)	-0.02** (0.01)	0.02 (0.06)	-0.41 (0.24)	0.46** (0.08)	0.04 (0.03)	-0.03 (0.02)	0.01 (0.07)	0.30 (0.42)	-0.18* (0.10)	0.04 (0.05)	-0.03** (0.01)
DISCL	-0.98** (0.26)	-2.69** (0.60)	-1.03 (0.57)	1.07** (0.18)	0.27** (0.02)	-0.42 (0.32)	0.73 (1.42)	-1.71** (0.42)	0.92** (0.22)	0.30** (0.04)	-1.41* (0.62)	-16.42** (4.55)	-2.80** (1.06)	-0.89* (0.40)	0.33** (0.09)
c	2.82** (0.64)	-4.11* (1.96)	3.99** (0.95)	1.11** (0.29)	-0.57** (0.08)	-0.48 (0.68)	-13.64** (2.22)	9.81** (0.74)	3.04** (0.31)	-0.33* (0.16)	1.36* (0.64)	21.85** (5.35)	5.30** (0.85)	3.42** (0.52)	-0.15 (0.14)
R.sq	0.13	0.18	0.06	0.23	0.14	0.07	0.13	0.23	0.09	0.05	0.10	0.08	0.05	0.09	0.11
Wald	132.60	231.65	92.37	196.08	268.24	82.53	427.76	371.31	129.84	79.45	48.91	104.19	48.14	79.85	48.23
Chi2	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	1365	1364	1364	1366	1364	1531	1531	1531	1532	1531	997	996	997	997	997

Note: Instrumental variables (2SLS) regression; * denotes statistical significance at 5% and # denotes statistical significance at 1%. Values of standard errors in parentheses.

When we divide the sample between large, medium and small banks (see Table IV.5) we see a negative impact of economic freedom on BP using ROAA for large banks (the other two cases are non-significant), a positive impact for medium size banks on ROAE but a negative impact on NIM; while for smaller banks we find no effect on BP for any of the three measures. Thus, economic freedom seems to be not-significant for smaller banks but with a mixed effect for the other two cases. The impact of economic freedom on BS is also mixed for large and medium size banks, since it is negative using lnZ for medium banks but positive using FSSI for both large and medium banks. Again for the small banks no significant impact was detected.

When we divide the sample into high income and middle income countries (see Table IV.6) we observe mixed results again. Economic freedom for high income countries has a negative impact on BP when using ROAA and NIM and a positive impact when using ROAE. For middle income countries we detect a negative impact on ROAA but a positive impact on NIM. Also, when we check the impact of economic freedom on the BS measures, for high income countries it is positive when using FSSI but negative when using lnZ; while we detect positive effects for both lnZ and FSSI for middle income countries.

Table IV.7 divides the EU by founding members, Enlargement A and B. The results for Economic Freedom on BP are positive for ROAE but negative for NIM for the founding members; negative for NIM for the enlargement group A and positive for both ROAE and NIM for enlargement group B. The results for economic freedom on BS for the founding members are negative using lnZ but positive using FSSI for both the founding members and enlargement group B but the reverse is true for enlargement group A. This suggests very mixed results for the impact on economic freedom for both BP and BS in the European area.

Finally, the results reported in Tables IV.8 and IV.9 are again quite mixed. For commercial banks it is negative for ROAA and NIM but positive for ROAE; for cooperative banks it is positive using ROAA and ROAE but negative using NIM; while for investment banks we have positive effects for ROAE and NIM only. For real estate banks we have a negative effect on ROAA and for savings banks a positive effect for ROAE but a negative effect for NIM. Finally for other banks we detect a negative effect on both ROAA and NIM. In terms of the impact on BS Economic freedom has a negative impact on lnZ and a positive effect on FSSI for commercial banks, a negative impact on FSSI for investment banks, and a positive impact for both lnZ and FSSI for savings and other banks.

Table IV.6: Empirical results by country income level (2SLS)

Variable	Model specification									
	HIGH INCOME COUNTRIES					MIDDLE INCOME COUNTRIES				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					0.03** (0.01)					0.01* (0.01)
ROAE				0.03** (0.01)	0.01 (0.01)				0.18** (0.02)	0.01 (0.01)
NIM				0.01* (0.01)	0.03** (0.01)				0.04** (0.01)	0.03** (0.01)
ln Z	0.38** (0.04)	2.08** (0.20)	0.11** (0.05)			0.94** (0.15)	1.25** (0.11)	0.59** (0.10)		
FSSI	0.34** (0.08)	1.93** (0.74)	0.46** (0.10)			0.43* (0.22)	0.50 (0.27)	2.86** (0.56)		
EF	-0.04** (0.01)	0.16** (0.03)	-0.07** (0.01)	-0.03** (0.01)	0.02* (0.01)	-0.03* (0.02)	-0.02 (0.01)	0.07** (0.01)	0.03** (0.01)	0.02* (0.01)
REG1	-0.10** (0.02)	0.40** (0.15)	-0.31** (0.04)	0.06** (0.02)	-0.04** (0.01)	0.27** (0.08)	0.28** (0.08)	-0.17 (0.10)	-0.01 (0.03)	0.02** (0.01)
REG2	-0.04* (0.02)	-0.48** (0.12)	-0.14** (0.04)	0.05** (0.01)	-0.03** (0.01)	0.10* (0.05)	0.15** (0.05)	0.18** (0.07)	-0.01 (0.02)	-0.01 (0.01)
CORR1	-0.12** (0.04)	-0.38* (0.19)	-0.22** (0.08)	-0.08** (0.02)	0.02* (0.01)	0.09 (0.07)	-0.12 (0.07)	0.02 (0.08)	0.01 (0.03)	0.01 (0.01)
CORR2	0.06 (0.03)	-0.47** (0.16)	0.56** (0.07)	0.06** (0.02)	-0.02 (0.01)	-0.33** (0.08)	-0.25** (0.09)	-0.20 (0.11)	0.06 (0.03)	0.01 (0.01)
DISCL	-0.91** (0.23)	-1.43 (0.98)	-1.65** (0.45)	1.13** (0.15)	0.33** (0.03)	-0.80* (0.41)	-0.88* (0.40)	-0.84 (0.50)	0.57* (0.29)	0.22** (0.04)
c	1.39** (0.34)	-6.46** (1.89)	9.22** (0.67)	2.86** (0.23)	-0.42** (0.10)	1.55 (1.11)	0.64 (0.72)	-0.58 (0.87)	0.10 (0.38)	-0.39** (0.07)
R.sq	0.09	0.07	0.12	0.10	0.05	0.16	0.26	0.15	0.29	0.14
F test/Wald χ^2	157.68 (0.00)	357.54 (0.00)	445.19 (0.00)	242.01 (0.00)	207.01 (0.00)	77.11 (0.00)	194.69 (0.00)	181.76 (0.00)	176.98 (0.00)	105.41 (0.00)
Obs.	2967	2965	2966	2969	2966	926	926	926	926	926

Note: Instrumental variables (2SLS) regression; * denotes statistical significance at 5% and # denotes statistical significance at 1%. Values of standard errors in parentheses.

Table IV.7: Empirical results by timing of entrance into the EU (2SLS)

Variable	Model specification														
	COMMERCIAL					COOPERATIVE					INVESTMENT				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					0.03** (0.01)					-0.08** (0.02)					0.01 (0.01)
ROAE				0.04** (0.01)	0.01 (0.01)				0.03** (0.01)	0.03** (0.01)				0.01 (0.01)	-0.01 (0.01)
NIM				0.03** (0.01)	0.03** (0.01)				0.23** (0.05)	-0.03** (0.01)				0.35** (0.04)	-0.01 (0.01)
ln Z	0.55** (0.06)	2.16** (0.20)	0.28** (0.07)			0.17** (0.07)	1.77* (0.87)	0.36** (0.07)			0.84** (0.15)	1.65** (0.53)	0.83** (0.11)		
FSSI	0.35** (0.08)	1.70* (0.73)	0.44** (0.13)			-0.31 (0.26)	3.17 (3.18)	-1.57** (0.39)			2.36 (2.48)	-5.83 (22.24)	-2.36 (2.13)		
EF	-0.03** (0.01)	0.11** (0.03)	-0.03** (0.01)	-0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.59** (0.12)	-0.08** (0.02)	-0.01 (0.01)	-0.01 (0.01)	0.03 (0.02)	0.38** (0.11)	0.05* (0.02)	-0.02 (0.01)	-0.03** (0.01)
REG1	-0.10** (0.03)	0.73** (0.16)	-0.35** (0.05)	0.06** (0.02)	-0.03** (0.01)	0.08** (0.03)	0.80* (0.36)	-0.10 (0.07)	0.04 (0.05)	0.01 (0.01)	0.15 (0.10)	0.71 (0.68)	-0.09 (0.09)	-0.05 (0.06)	0.01 (0.01)
REG2	0.02 (0.02)	0.03 (0.10)	-0.14** (0.05)	0.02 (0.01)	-0.03** (0.01)	0.02 (0.04)	-0.44 (0.39)	0.13 (0.07)	-0.04 (0.05)	-0.02* (0.01)	-0.17* (0.09)	-1.14 (0.63)	0.15* (0.08)	-0.04 (0.05)	0.02* (0.01)
CORR1	0.07 (0.04)	-0.71** (0.14)	0.03 (0.08)	-0.06** (0.02)	0.01 (0.01)	-0.15** (0.06)	-0.34 (0.55)	-0.66** (0.18)	0.18* (0.09)	-0.01 (0.02)	0.34 (0.27)	0.38 (1.29)	-0.18 (0.20)	-0.20 (0.13)	0.01 (0.01)
CORR2	-0.03 (0.04)	-1.03** (0.15)	0.51** (0.07)	0.05** (0.02)	-0.01 (0.01)	0.14** (0.04)	0.61 (0.49)	0.59** (0.17)	-0.12 (0.08)	0.01 (0.01)	0.19 (0.19)	-0.51 (0.92)	0.13 (0.14)	0.02 (0.09)	-0.01 (0.01)
DISCL	-0.88** (0.22)	-2.15** (0.78)	-1.12** (0.43)	0.85** (0.14)	0.31** (0.03)	1.09 (0.61)	13.23* (7.02)	-0.41 (1.04)	-3.12** (0.86)	-0.01 (0.20)	-2.65** (0.58)	-4.51 (2.65)	-1.41** (0.56)	2.19** (0.18)	0.03** (0.01)
c	1.51** (0.50)	-4.22** (1.80)	5.84** (0.68)	2.05** (0.23)	-0.56** (0.10)	-3.46** (0.96)	-50.31** (11.63)	6.29** (1.62)	5.89** (1.33)	0.21 (0.25)	-0.96 (1.39)	-14.19 (8.56)	-2.23 (1.52)	1.54 (0.97)	0.06** (0.02)
R.squared	0.10	0.12	0.07	0.10	0.05	0.16	0.22	0.32	0.20	0.15	0.36	0.10	0.39	0.43	0.08
Wald χ^2	149.48 (0.00)	561.02 (0.00)	239.76 (0.00)	216.70 (0.00)	195.82 (0.00)	40.22 (0.00)	49.33 (0.00)	141.77 (0.00)	67.78 (0.00)	27.37 (0.00)	56.68 (0.00)	39.54 (0.00)	87.72 (0.00)	342.53 (0.00)	28.30 (0.00)
Obs.	2523	2522	2523	2524	2523	225	225	225	225	225	151	151	151	152	151

Note: Instrumental variables (2SLS) regression; * denotes statistical significance at 5% and # denotes statistical significance at 1%. Values of standard errors in parentheses.

Table IV.8: Empirical results by the specialization of a bank (2SLS)

Variable	FOUNDING MEMBERS					Model specification EU ENLARGEMENT – A					EU ENLARGEMENT – B				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					0.01 (0.01)					-0.03 (0.02)					0.01 (0.01)
ROAE				0.03** (0.01)	0.01 (0.01)				0.01 (0.01)	0.03** (0.01)				0.03** (0.01)	0.02* (0.01)
NIM				0.14** (0.03)	-0.02** (0.01)				0.14** (0.04)	0.01 (0.01)				0.04** (0.01)	0.01 (0.01)
ln Z	0.34** (0.04)	2.73** (0.35)	0.25** (0.03)			0.31** (0.11)	0.67* (0.31)	0.25** (0.06)			0.68** (0.07)	0.95** (0.14)	0.52** (0.08)		
FSSI	-0.05 (0.09)	-0.62 (1.28)	0.69** (0.12)			0.22** (0.08)	3.66** (0.88)	0.06 (0.11)			0.42** (0.11)	2.45** (0.94)	0.34* (0.17)		
EF	0.01 (0.01)	0.16** (0.06)	-0.05** (0.01)	-0.04** (0.01)	0.02* (0.01)	0.02 (0.04)	0.07 (0.25)	-0.14** (0.06)	0.16** (0.03)	-0.02* (0.01)	-0.01 (0.01)	0.11** (0.04)	0.02* (0.01)	-0.03** (0.01)	0.02* (0.01)
REG1	0.01 (0.04)	0.28 (0.31)	-0.11** (0.04)	-0.04 (0.03)	-0.01 (0.01)	0.10* (0.05)	1.13** (0.31)	-0.04 (0.05)	0.01 (0.05)	-0.02 (0.02)	-0.08 (0.05)	0.12 (0.20)	-0.07 (0.09)	0.03 (0.02)	-0.02 (0.01)
REG2	-0.05** (0.02)	-1.13** (0.25)	0.14** (0.03)	0.02 (0.02)	0.01 (0.01)	-0.12* (0.06)	-0.89** (0.38)	0.08 (0.07)	-0.10 (0.06)	0.03 (0.02)	0.14** (0.04)	0.22* (0.10)	-0.01 (0.06)	-0.02 (0.02)	-0.01 (0.01)
CORR1	-0.08 (0.05)	-0.54 (0.55)	-0.14** (0.06)	-0.15** (0.05)	-0.01 (0.01)	-0.04 (0.09)	-0.27 (0.52)	-0.12 (0.10)	0.11 (0.07)	-0.01 (0.03)	0.09 (0.05)	-0.58** (0.15)	-0.25** (0.09)	-0.02 (0.02)	-0.02 (0.01)
CORR2	0.07 (0.04)	1.21** (0.50)	-0.01 (0.06)	0.07 (0.05)	0.01 (0.01)	-0.12 (0.09)	-0.78 (0.54)	0.11 (0.11)	-0.11 (0.08)	0.03 (0.02)	-0.05 (0.04)	-0.69** (0.15)	0.37** (0.09)	0.10** (0.02)	-0.03** (0.01)
DISCL	-0.66** (0.24)	-7.54** (2.39)	-1.56** (0.28)	1.14** (0.25)	0.12** (0.03)	-1.06 (0.71)	-3.14 (4.43)	-0.40 (1.04)	1.93** (0.69)	1.45** (0.22)	-1.18** (0.27)	-0.08 (0.56)	-0.99* (0.49)	0.91** (0.18)	0.31** (0.03)
c	-0.21 (0.39)	-2.29 (4.49)	5.86** (0.56)	3.88** (0.48)	-0.11 (0.09)	0.08 (2.66)	6.14 (16.67)	10.48** (4.01)	-9.15** (2.20)	0.22 (0.74)	-0.05 (0.63)	-4.37* (1.99)	2.03* (0.94)	2.12** (0.27)	-0.77** (0.17)
R.sq	0.09	0.09	0.15	0.15	0.04	0.11	0.14	0.07	0.12	0.14	0.12	0.13	0.04	0.09	0.10
F	113.84	109.36	325.74	175.85	127.72	18.95	73.25	38.87	58.94	88.35	106.93	176.53	73.81	117.13	179.30
test/Wald χ^2	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	1485	1485	1485	1487	1485	392	392	392	392	393	1655	1653	1654	1655	1653

Note: Instrumental variables (2SLS) regression; * denotes statistical significance at 5% and # denotes statistical significance at 1%. Values of standard errors in parentheses.

Table IV.9: Empirical results by the specialization of a bank (2SLS)

Variable	Model specification														
	REAL ESTATE AND MORTGAGE					SAVINGS					OTHER BANKS				
	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI	(1) ROAA	(2) ROAE	(3) NIM	(4) ln Z	(5) FSSI
ROAA					-0.01 (0.01)					0.06** (0.02)					0.01 (0.01)
ROAE				0.05** (0.02)	0.01 (0.01)				0.03** (0.01)	-0.03** (0.01)				0.03** (0.01)	0.02* (0.01)
NIM				0.27** (0.04)	-0.04** (0.01)				-0.03 (0.02)	0.03** (0.01)				0.08** (0.02)	0.02* (0.01)
ln Z	0.23** (0.06)	2.06** (0.08)	0.38** (0.08)			0.21** (0.07)	1.20** (0.49)	-0.16 (0.15)			0.55** (0.14)	2.07** (0.47)	0.21** (0.06)		
FSSI	-1.82 (2.40)	7.74 (10.53)	-3.20* (1.52)			1.77** (0.30)	-0.39 (1.38)	4.89** (0.72)			0.49 (0.35)	4.99** (1.59)	0.62 (0.37)		
EF	-0.06** (0.02)	-0.13 (0.12)	-0.06 (0.03)	-0.01 (0.02)	-0.01 (0.01)	0.01 (0.01)	0.39** (0.06)	-0.14** (0.03)	0.05** (0.01)	0.03** (0.01)	-0.05* (0.02)	0.04 (0.08)	-0.10** (0.02)	0.03** (0.01)	0.02* (0.01)
REG1	-0.27 (0.22)	-1.03 (0.64)	0.05 (0.13)	-0.19* (0.09)	-0.02* (0.01)	-0.03 (0.03)	0.51* (0.27)	-0.13 (0.07)	-0.01 (0.03)	-0.01 (0.01)	0.02 (0.08)	0.54 (0.41)	-0.27** (0.08)	0.06 (0.05)	-0.03** (0.01)
REG2	-0.15 (0.13)	0.13 (0.41)	-0.30** (0.12)	0.03 (0.08)	-0.01 (0.01)	-0.02 (0.03)	-0.24 (0.19)	0.05 (0.09)	-0.01 (0.03)	-0.01 (0.01)	-0.06 (0.07)	-0.70** (0.30)	-0.04 (0.06)	0.07* (0.03)	0.01 (0.01)
CORR1	-0.22 (0.41)	0.53 (0.92)	0.01 (0.19)	-0.51** (0.16)	-0.01 (0.01)	-0.01 (0.08)	-0.77* (0.38)	-0.18 (0.18)	-0.04 (0.05)	0.01 (0.02)	0.04 (0.12)	-0.52 (0.37)	0.02 (0.11)	-0.05 (0.05)	-0.01 (0.01)
CORR2	0.13 (0.10)	-0.81 (0.65)	0.73** (0.20)	0.02 (0.10)	0.03** (0.01)	-0.01 (0.07)	-0.01 (0.40)	0.35* (0.16)	-0.06 (0.05)	0.02 (0.02)	0.16* (0.08)	-0.02 (0.32)	0.38** (0.09)	0.01 (0.05)	-0.01 (0.01)
DISCL	2.81* (1.29)	3.40 (4.74)	-0.44 (1.28)	0.86 (0.71)	0.11** (0.02)	-1.34** (0.40)	-0.49 (2.68)	-2.29 (1.87)	1.31** (0.32)	0.39** (0.10)	-1.38 (1.02)	6.61 (4.60)	-1.31 (0.77)	-0.16 (1.56)	0.39** (0.11)
c	2.77 (1.90)	7.38 (8.56)	5.07* (2.42)	2.11 (1.50)	0.05 (0.05)	0.31 (0.75)	-21.16** (3.46)	13.20** (1.70)	-0.83 (0.61)	-1.19** (0.15)	3.49 (2.02)	-6.21 (5.46)	9.22** (1.17)	0.72 (1.21)	-0.58** (0.22)
R.sq	0.07	0.15	0.36	0.28	0.12	0.26	0.14	0.32	0.21	0.43	0.10	0.10	0.21	0.10	0.10
Wald χ^2	33.01 (0.00)	28.28 (0.00)	105.89 (0.00)	77.75 (0.00)	67.07 (0.00)	67.43 (0.00)	106.84 (0.00)	111.86 (0.00)	72.09 (0.00)	147.59 (0.00)	50.49 (0.00)	93.96 (0.00)	165.98 (0.00)	45.12 (0.00)	23.95 (0.00)
Obs.	194	194	194	194	194	325	324	324	324	324	475	475	475	476	475

Note: Instrumental variables (2SLS) regression; * denotes statistical significance at 5% and # denotes statistical significance at 1%. Values of standard errors in parentheses.

IV.5.2.3 The impact of Regulation

When it comes to the impact of regulation in Table IV.3 we generally detect a strong negative impact of regulation on BP from both the REG1 and REG2 variables, there is however one exception and that is when we use ROAE where the REG1 has a significant positive impact. Overall, our results are in line with those obtained by Demirgüç-Kunt and Huizinga (1999) showing that higher levels of regulation impose higher expenses on banks and/or limit revenues raising activities. In addition, an effective regulatory framework may also reduce the risk premia on bank lending which can negatively affect BP. The impact of regulation on BS is positive using the lnZ-score but negative using the FSSI coefficient in the overall sample showing the importance of different definitions of BS.

The negative results of regulation on BP (as shown in Table IV.4) are particularly strong in the case of the Euro-area economies but mixed results are obtained in the case of the non euro EU and EU candidate countries. For the EU non-Euro group REG1 is significant and negative for ROAE, significant and positive for NIM and non-significant for ROAA; while REG2 two has a significant positive effect for the two first measures (ROAA, ROAE) but significant negative effect for NIM. For the EU candidate countries we detect a positive impact from REG1 on ROAA but a negative impact on NIM and REG2 is now not-significant. When it comes to BS for the Euro-area we have a positive impact from both REG1 and REG2, using the lnZ-score but a negative impact using FSSI. For the non Euro-area group countries we obtain non-significant effects of both REG1 and REG2 on lnZ, while for FSSI it is significant and positive for the case of REG1 and significant but negative for the case of REG2. Finally, for the EU candidate countries we detect a positive impact of REG1 on both lnZ and FSSI while REG2 appears to be non-significant.

Regulation has mixed effects on BP when we examine the financial institutions by size in Table IV.5. We observe a negative impact on NIM using both REG1 and REG2 though we detect a positive impact on ROAA and ROAE from the REG2 variable for large institutions. For medium size institutions REG1 has a positive impact on ROAE and negative for NIM; while REG2 is non-significant for all three profitability definitions. For smaller banks the REG2 definition has a negative impact on all three measures of profitability and REG1 is significant and negative only for NIM. When it comes to BS there are some differences, for large banks REG1 has a positive impact on ln Z and FSSI, while for medium banks the impact is negative but positive for ln Z for small banks. The REG2 variable also has a significant negative impact on FSSI for medium and small banks but no effect is detected for larger banks, however for the lnZ measure of BS we detect a positive impact for small banks.

When it comes to high income level countries the results are again mixed as depicted in Table IV.6. For the high-income group, using the REG1 variable there is a significant negative impact on both ROAA and NIM but a positive effect on ROAE. While using the REG 2 variable gives a negative impact on all three measures of BP. This contrasts somewhat with the results from middle income countries where regulation using REG1 seems to have a significant positive effect on BP as measured by ROAA and ROAE and positive effect on all three measures of BP for REG2. With regards to BS, REG1 and REG2 are significant positive for the lnZ-score but significant and negative for FSSI and for high-income countries; while for the middle-income ones REG1 is positive and REG2 is negative only for the FSSI case (the effect on NIM is totally non-significant).

Additionally, regulation seems to negatively impact BP for REG2 in the case of the founding members of the EU in Table IV.7 with less clear results for the Enlargement groups A and B. For EU enlargement group A we find a positive impact from REG1 on ROAA and ROAE but a negative impact on these two measures of profitability using REG2. However for Enlargement group B for REG2 we find a positive impact on ROAA and ROAE showing that regulation may or may not undermine BP. Regulation seems to have no impact on financial BS for either the founding members or enlargement groups A and B.

When it comes to bank specialization (Tables IV.8 and IV.9) we again see mixed results concerning the impact on BP. For commercial banks there is negative impact of REG1 on ROAA and NIM but a positive impact on ROAE. We also see that REG1 impacts positively on ROAA and ROAE for cooperative banks but REG2 has a negative impact on ROAA and NIM for investment banks. We also detect negative impacts of regulation on BP using REG1 on NIM other banks but a positive effect on ROAE for savings institutions (all other cases are non-significant), while REG2 has a negative impact on NIM for real estate and mortgage banks and on ROAE for other banks (all other cases are non-significant). When it comes to BS we find REG1 has a significant negative impact on lnZ only for commercial banks, while a negative impact was registered for FSSI when considering commercial, real estate and mortgage and other banks. The REG2 variable definition has a negative effect on FSSI for commercial and cooperative banks but a positive impact on FSSI for investment banks and on lnZ for other banks.

IV.5.2.4 The impact of Corruption

Corruption exists in varying degrees in every country worldwide and it is generally regarded as having adverse effects on an economy and the profitability and soundness of the banking sector. However, the academic literature suggests that corruption can actually raise bank BP and BS.

When we check the overall sample (see Table IV.3) we can see that the results on corruption on ROAE are negative for corruption of bank official (CORR1) and general corruption (CORR2) but positive on NIM using the CORR2 variable. We also detect a negative impact on lnZ for CORR1 but a positive effect on lnZ for CORR2 making it hard to conclude how corruption affects banking sector soundness.

When looking at the results by region in Table IV.4 we can see that CORR1 has a negative impact on ROAE for the Euro-area area, non Euro EU and EU candidate countries but a positive impact on ROAA for the non Euro-area EU countries, and for NIM for the EU candidates. In terms of BS the CORR1 has a negative impact on lnZ for the Euro-area but a positive impact on FSSI for EU candidate countries; while CORR2 has a positive impact on lnZ for the Euro-area countries and negative for the EU candidate countries. For the non Euro-area group there is no discernible impact stemming from neither of the two corruption variables definitions.

When we look at bank size in Table IV.5 we find the CORR1 has a negative impact on ROAE for large and medium size banks but a positive effect on ROAA for large banks. The CORR2 produces mixed results having a positive impact on NIM for large and medium size banks but a negative effect in the case of small banks. When it comes to BS we find very mixed results as well with CORR1 having a negative impact on lnZ for large, medium and small banks, while a positive impact of CORR2 on lnZ was observed for large banks. However, we report a negative impact of CORR2 on FSSI for large and small banks.

In Table IV.6 we observe that the influence of CORR1 is negative for all three alternative measures of BP for high income countries with no discernible effects for middle income countries. CORR2 is negative for ROAE but positive for NIM in high income countries; while it is consistently negative for ROAA and ROAE for the middle income countries. When it comes to BS we get a negative effect of CORR1 on lnZ but a positive effect from CORR2 and a positive effect of CORR1 on FSSI for the high income countries; while neither of the corruption variables seem to play a role on the soundness of banks operating in middle income countries.

In Table IV.7 we detect a strong negative impact of corruption as measured by CORR1 in founding members on NIM, while for Enlargement group B, apart from NIM a negative impact was also observed for ROAE. However, when we use the CORR2 we find a positive effect for the founding members on ROAE and mixed results for Enlargement group B with a negative effect on ROAE but a positive effect on NIM. The effects of corruption on BS are mixed with CORR1 having a negative effect on lnZ for the founding members but when it comes to enlargement group B we find CORR2 has a positive effect on lnZ but a negative effect on FSSI.

When we look at the impact of corruption by bank type in Table IV.8 we find a negative impact of CORR1 on ROAE for commercial banks; for ROAA and NIM for cooperative banks and for ROAA for savings banks (all other effects are non-significant). However, the effect of CORR2 is negative only for the case of ROAE of commercial banks and positive for NIM of commercial banks; ROAA and NIM of cooperative banks and others; NIM of real estate and mortgage, and savings banks. When it comes to BS, CORR1 has a negative impact on lnZ for commercial and real estate and mortgage banks, while a positive impact was observed for cooperative banks. Moreover, CORR2 has a positive impact on lnZ for commercial banks, while for real estate and mortgage banks the positive impact was observed for FSSI using the same corruption indicator.

Our mixed results for the impact of corruption contrast with those obtained by Aburime (2008) who shows that an increase in the corruption index implies a decrease in bank profitability for the Nigerian banking market. Likewise, Pagano (2008) finds that corruption is a significant determining factor in evaluating bank lending rates and that at relatively low levels of corruption an increase in corruption leads to a fall in lending rates which decreases bank profitability. However, at high levels of corruption an increase in corruption can actually raise lending rates.

IV.5.2.5 The impact of Transparency

The last issue we discuss refers to the importance of transparency in the banking sector, and its impact on BP and BS. The overall results in Table IV.3 clearly show that transparency as measured by DISCL has a negative impact on BP using all three measures. This negative impact is surprisingly robust across all the tables. There are a few exceptions where DISCL has a positive impact: firstly, on ROAE for EU candidate countries and secondly on ROAE for cooperative banks and on ROAA for real estate and mortgage banks. With reference to BS the results suggest that disclosure has a strongly positive impact upon bank soundness using both the lnZ and FSSI measures. The only instances of negative effects on BS are in the case of EU candidate countries, small banks and cooperative banks when measuring soundness by ln Z coefficient.

Thus, the obtained results overall support the hypothesis that disclosure and information sharing can help reduce adverse selection and moral hazard and can reduce default rates. Our empirical results suggest that there is an overall negative relationship between bank disclosure and BP but a positive impact on BS.

IV.6 Conclusions

The role of the banking sector in the events of recent years shows the importance of looking at how banks are affected by the degree of economic freedom, regulatory framework, degree of corruption and transparency of the countries in which they operate and changes in these variables can undoubtedly help in the process of ensuring the banking sector returns to profitability and greater soundness.

The purpose of this chapter has been to provide some empirical evidence on how these variables impact upon bank performance and bank soundness. Overall, our results indicate that there is a clear trade-off between increasing bank soundness and bank performance. However the impact of increasing economic freedom, increasing regulation, reducing corruption and increasing transparency is less clear-cut and more nuanced at the empirical level. In general, greater economic freedom can decrease or increase profitability or soundness depending on the particular measure used. Increased regulation appears to have a detrimental impact on bank performance and a tendency to reduce the risk of bankruptcy. There was less evidence at the aggregate level that reducing corruption improved bank performance and no evidence that it increased bank soundness. We did, however, detect evidence at the aggregate level that increased disclosure adversely affected bank performance but seems to reduce the risk of bankruptcy and promote bank soundness.

The main contribution of this analysis has been to show that conclusions obtained using aggregate data do not necessarily hold when the data is disaggregated. We find that results at the aggregate level can hide significant and even contradictory results once the data is disaggregated. In the case of greater economic freedom we find that it adversely affects BS in high income countries but is good for BS in middle income countries. We find that for large banks there is some evidence to suggest that greater regulation can improve BS but this is not necessarily the case for medium and small size institutions. Corruption is more of a problem for small and medium size institutions than for larger ones. For the Euro-area countries, the results show that excessive regulation can adversely affect the profitability indicators of the financial sector and that there may be significant gains in increasing financial disclosure rather than in increasing regulation.

In response to the financial crisis and the Euro-area crisis, Europe has begun a process of improving the regulation and supervision of European banks. For example, in December 2010 the European Systemic Risk Board (ESRB) was created as an independent body of the EU with responsibility for macro-prudential supervision of the financial system, and for preventing or reducing risks in the EU financial sector. Our results suggest that the impact of changes in the

regulatory and supervisory framework and the greater degree of harmonization of regulations can have significantly differential impacts on the Euro-area and enlargement groups A and B. These differential effects on BP and BS mean that the harmonization of regulation and supervision needs to be done in a way that recognizes the differential impact. In addition, when stress testing banks across the EU prospective differential changes in the regulatory environment need to be borne in mind, especially as they impact large, medium and smaller size banks in different ways.

Finally, we should note that our analysis has some limitations. The European banking industry has been developing rapidly in the last 15 years in a continuously changing regulatory and economic environment. As such, our results capture a key period in which there was a massive expansion of the sector followed by a major crisis and a prolonged period of dealing with that crisis. Results in the future might be very different should the sector stabilize and bank operations move away from some of the riskier operations of the past. There may also be risks to the financial system as a whole if greater regulation of the banking sector shift activities to the less regulated shadow banking sector.

Appendix Chapter IV

Appendix IV.1: Composite Index of Disclosure

$DISCL = \frac{1}{17} \sum_{i=1}^{17} s_i$; where s_i are the sub-indexes of disclosure.

DISCLOSURE INDICES		
	Sub-index – s_i	Categories
Assets		
Loans	Loans by maturity	Sub three months, three to six months, six months to one year, one to five years, more than five years
	Loans by type	Loans to municipalities/government, mortgages, HP/lease, other loans
	Loans by counterparty	Loans to group companies, loans to other corporate, loans to banks
	Problem loans	Total problem loans
	Problem loans by type	Overdue/restructured/other non-performing
	Securities by type	Detailed breakdown: Treasury bills, other bills, bonds, CDs, equity investments, other investments
Other earning assets		Government securities, other listed securities, non-listed securities
	Securities by holding purpose	Investment securities, trading securities
Liabilities		
Deposits	Deposits by maturity	Demand, savings, sub three months, three to six months, six months to one year, one to five years, more than five years
	Deposit by type of customer	Bank deposits, municipal/government
Other funding	Money market funding	Total money market funding
	Long-term funding	Convertible bonds, mortgage bonds, other bonds, subordinated debt, hybrid capital
Memo lines		
	Reserves	Loan loss reserves (memo)
	Capital	Total capital ratio, Tier 1 ratio, total capital, Tier 1 capital
	Contingent liabilities	Total contingent liabilities
	Off-balance sheet items	Off-balance sheet items
Income statement		
	Non-interest income	Net commission income, net fee income, net trading income
	Loan loss provisions	Loan loss provision

Source: retrieved from Nier (2005).

Appendix IV.2: Correlations matrix

	ROAE	ROAA	NIM	FSSI	Z-score	EF	REG1	REG2	CORR1	CORR2	DISCL
ROAE	1										
ROAA	0.34	1									
NIM	-0.05	0.19	1								
FSSI	0.08	0.07	0.08	1							
Z-score	0.12	0.09	0.03	-0.04	1						
EF	0.10	-0.08	-0.16	0.11	-0.01	1					
REG1	0.09	-0.04	-0.16	-0.07	-0.10	-0.02	1				
REG2	-0.01	-0.03	-0.10	-0.06	0.06	0.18	0.08	1			
CORR1	-0.13	0.01	0.09	0.02	-0.05	0.03	-0.02	0.08	1		
CORR2	-0.15	0.05	0.23	-0.01	-0.02	-0.15	-0.14	0.06	0.53	1	
DISCL	0.03	-0.04	-0.07	0.13	0.06	0.11	0.07	0.04	0.02	0.01	1

Appendix IV.3: Description of the country samples

HIGH INCOME	MIDDLE INCOME	FOUNDING MEMBERS	EU ENLARGEMENT A	EU ENLARGEMENT B	CANDIDATE
Austria	Albania	Belgium	Greece	Bulgaria	Albania
Belgium	Bulgaria	Germany	Spain	Croatia	Iceland
Croatia	Hungary	Denmark	Portugal	Czech Republic	Macedonia
Cyprus	Macedonia	France	Austria	Cyprus	Montenegro
Czech Republic	Montenegro	Ireland	Finland	Estonia	Serbia
Denmark	Romania	Italy		Hungary	Turkey
Estonia	Serbia	Luxembourg		Latvia	
Finland	Turkey	The Netherlands		Lithuania	
France		United Kingdom		Malta	
Germany				Poland	
Greece				Romania	
Iceland				Slovakia	
Ireland				Slovenia	
Italy					
Latvia					
Lithuania					
Luxembourg					
Malta					
Netherlands					
Poland					
Portugal					
Slovakia					
Slovenia					
Spain					
United Kingdom					
528 banks	153 banks	270 banks	91 banks	199 banks	121 banks

Note: For the 2013 fiscal year, low-income economies are defined as those with a GNI per capita, calculated using the *World Bank Atlas method*, of \$1,045 or less in 2013; middle-income economies are those with a GNI per capita of more than \$1,045 but less than \$12,746; high-income economies are those with a GNI per capita of \$12,746 or more. Lower-high income and middle-income economies are separated at a GNI per capita of \$4,125. Founding members: comprise the founding members of 1957 and the first enlargement in 1973. EU Enlargement group A: the 2nd, 3rd and 4th enlargements (1981-1995)

CHAPTER V: Over the cliff - From conventional to unconventional monetary policy¹⁰⁴

The international financial crisis, regarded as the most severe since the 1930s, has forced policy makers and monetary authorities to move swiftly and adopt innovative measures in order to elude a meltdown of the whole financial system. The initial tool used to combat the negative repercussions of the crisis was the conventional monetary policy, which proved to be extremely effective in achieving low and stable inflation. However, this instrument was powerless in preventing asset market bubbles from occurring. As a result, after exhausting the traditional instruments of monetary policy, some central banks (i.e. Bank of Japan, the Federal Reserve System and the Bank of England) resorted to unconventional monetary policy, or more specifically to quantitative easing, with the purpose of improving economic growth by lowering the yields on long-term assets. Consequently, this chapter analyses the implications arising from the responses of the financial sector in the United Kingdom (UK) to the incentives determined by quantitative easing decisions. In a panel vector autoregressive framework, we examine the effects of Bank of England asset purchases on the profitability and disaggregated leverage components for different types of banks, which reflect differences in the sequencing of the quantitative easing strategy. We find that quantitative easing decisions are driven by economic activity, lending rates, and banks' leverage. The transmission channel of quantitative easing on boosting economic growth depends on the degree of banks' leverage and the securities holdings, but with a diverging magnitude on different types of UK banks.

¹⁰⁴ This chapter represents an essay written with **Dionisis Philippas** (ESSCA Ecole de Management, France) and **Stephanos Papadamou** (University of Thessaly, Greece), being currently under review for *Management Science*. A version of this chapter, entitled “*Decomposing leverage in Quantitative Easing decisions: Evidence from the UK*”, was accepted at the World Finance & Banking Symposium in Dubai, December 2016 and at the 16th Annual EEFS Conference in Ljubljana, June 2017 among other conferences, being also presented to the European Commission, the Bank of England and the Central Bank of Chile.

V.1 Introduction

The global financial crisis that started in 2008 and its aftermath, posed significant challenges for monetary authorities. Unconventional monetary policy remains one of the few levers available for policy makers, being most commonly referred to as an extension of their balance sheets by large-scale asset purchases (LSAPs). This process is entitled quantitative easing (hereafter QE). The QE strategy was initially applied by the Bank of Japan with the purpose of controlling the Japanese real estate bubble and the deflationary pressures in the 2000s. After that, the Federal Reserve System (Fed) and the Bank of England (BoE) followed in the late 2000s, acting swiftly in order to evade a meltdown of their financial system.

Traditionally, QE is focusing on buying longer-term government bonds from banks, allowing the sovereign yields to serve as a benchmark for the pricing of riskier privately issued securities (Krishnamurthy and Vissing-Jorgensen, 2011). In this context, the yields on privately issued securities and consequently bank lending rates, are expected to decline in parallel with those on government bonds, with the hope that this stimulates longer-term investments and hence aggregate demand, thereby supporting price stability. However, recent studies underlined the importance of banks on the effectiveness of QE strategy. Bowman *et al.* (2015) argued that there was a positive effect of bank liquidity positions on lending. Additionally, Joyce *et al.* (2012) note that banks may hold onto funds to improve their viability rather than on lending to the private sector, driving the central banks to intervene with the direct provision of credit, in order for its policies to have an impact on financial intermediation.

This chapter analyses the interaction between leverage undertaken by different types of banks and asset purchases by the BoE as part of its QE program and future QE exit strategies, oriented to the UK banks, allowing them to enjoy vast financial conditions.¹⁰⁵ Addressing this issue is a challenge, because it is of great interest to unravel the effects of QE decisions for the UK financial sector. The setting of monetary policy is done under several pressures that could force to abruptly change the policy strategies being promoted, within a wide variety of financial and macroeconomic signals.

Consequently, it is of crucial importance to know to what extent the critical role of the UK financial sector's leverage can ensure the success of quantitative easing. In periods with high

¹⁰⁵ During the first and second QE programs spanning from March 2009 to November 2012, the BoE purchased £375 billion of medium- and long-term government bonds (representing approximately 24% of domestic GDP). As a result, the balance sheet of the UK banks has been significantly expanded due to the liquidity support. In 2013, the UK banking sector is 450% as a share of GDP in 2013 on a residency basis.

deleverage, QE is successful if it reduces the risks of a liquidity shortfall, encouraging banks to extend credit to higher interest-paying parties through the leverage decisions undertaken and thereby boost economic growth, even though the banks are forced to undertake more risks. Nevertheless, given the level of leverage that the banking sector can experience, banks can stop intermediating loans and may not pass on the additional liquidity to the real economy, thereby making the QE policy ineffective.

Even though there is a considerable empirical literature concerning the broader macroeconomic impact of QE via market rates¹⁰⁶, few studies, to the best of our knowledge, examined the impact of QE on the profitability and soundness of banks, focusing mainly on US data (Lambert and Ueda, 2014; Montecino and Epstein, 2014; Mamatzakis *et al.*, 2015; Mamatzakis and Bermpei, 2016). These studies argue that unconventional monetary policy reinforces bank soundness by allowing them to reduce leverage and extend the maturity of their debt. A handful of recent studies attempt to highlight the role of banks' leverage decisions, though focusing on the relationship between the conduct of conventional monetary policy, business cycles and real economic activity in the US (Geanakoplos, 2010; Serletis *et al.*, 2013; Istiak and Serletis, 2016).

In light of the above discussion, it is important to go in further considerations when debating the QE strategic policy interactions. In this chapter we address these issues from a different angle that innovates and contributes by filling some of the existing gaps in the literature in at least two dimensions.

Firstly, we set up a panel vector autoregressive (panel VAR) framework, characterized by cross-sectional heterogeneity and dynamic interdependencies. We make two assumptions within our modelling framework. In the first assumption, we employ different major types of UK banks and discuss to what extent QE has exerted different impacts on their performance. This type of identification tries to shed light on a significant gap for the vital importance of different types of UK banks in studying the implications of QE decisions, without been oriented narrowly on a macroeconomic perspective. In the second assumption, we consider a decomposition of leverage into three main components, namely *gross loans to equity*, the *liquid assets to equity*, and the *securities to equity* components. We then analyse their discrete role on the QE policies implemented and their interactions with the real economic activity for the different types of UK

¹⁰⁶ A strand of the literature has focused on the transmission channels through which asset purchases can affect long-term interest rates by observing the policy signalling channel and portfolio balance channel. Contributors, among others, are the studies of Meier (2009), Joyce *et al.* (2011ab), Christensen and Rudebusch (2012), Hamilton and Wu (2012), Joyce and Tong (2012), D'Amico *et al.* (2012), Gilchrist and Zakrajšek (2013), Steeley (2015) and Neely (2015) among others. Fewer studies try to estimate the macroeconomic effects of unconventional monetary policy measures via the linkages between interest rate spreads and the real economy (Lenza *et al.*, 2010; Chung *et al.*, 2011; Chen *et al.*, 2012).

banks. These types of identification differentiate our paper from other studies employing similar empirical methodologies or addressing related topics.

Secondly, we draw the policy implications based on both directions of impulse and response functions between the QE strategies and the performance of UK banks' balance sheets, assessing the following main research questions. The first question refers to the impulse analysis of QE on the balance sheets and to what extent the financial variables of interest can play a key role on the GDP growth. The second question investigates the QE policy response to different shocks of leverage, profitability and real economic activity. The last question examines the effects of leverage on profitability and the interactions across the leverage components.

The main findings are of great importance to the existing literature by highlighting both directions of impulses and responses between the profitability and leverage of the financial sector and the central bank's QE policies for the real economy. The first finding is that asset purchases by the BoE are not a determining factor that provide banks with the possibility to improve profitability, result which is in line with the study of Mamatzakis and Bermpei (2016). A significant reduction of profitability is identified for almost all types of UK banks, with a diverging magnitude between these types. This differential impact is given by the securities' level and the diversification benefits of other institutions through their involvements in different business areas. Moreover, we observe an interdependency between profitability and leverage and also, an indirect relationship between liquidity and lending, which depends on the type of bank. However, this analysis recognizes that a significant reduction of profitability for Real Estate banks brings significant benefits for the economic activity in the UK.

The transmission channels of QE on GDP growth based on banks' leverage have a significantly positive effect through securities holding, for Commercial banks and Bank Holding companies. This second finding complements previous studies about the positive effect of conventional monetary policy on GDP via leverage in the US (for example, Geanakoplos, 2010; Adrian and Shin, 2010; Serletis *et al.*, 2013; Lambert and Ueda, 2014; Istiak and Serletis, 2016). Commercial banks are considered as important contributors of liquidity and leverage responses to a QE shock, thus a higher leverage is generally credited to higher risk-taking strategies of Commercial banks. Moreover, our results highlight that a negative shock on economic activity determines the majority of UK financial banks, to amplify their leverage level by adopting a higher risk-taking behavior, suggesting potential countercyclical effects. Our result is contrary to the one of Adrian and Shin (2009 and 2010) who stress a procyclical behavior of leverage registered for the US during conventional monetary policy strategies.

The third finding refers to the fact that QE is also transmitted to the real economy via the significant reduction of the retail banking rates, in comparison with other studies focusing only on the transmission via bond rates (e.g. Joyce *et al.*, 2012; Pesaran and Smith, 2016; Weale and Wieladek, 2016). We argue that the BoE reduces asset purchases when lending rates are dropped, economic activity is augmented and leverage of commercial banks is increased. As pointed out by Putnam (2013), QE exit strategies could be awfully challenging for central banks, mainly in terms of their implementation. Furthermore, QE exit strategies have the potential to suspend a return to the normal conduct of monetary policy to the detriment of longer-term economic growth, rational leverage and potential future inflation.

V.2 Data selection

A part of our sample comes from the Bankscope database¹⁰⁷ and covers the annual accounting data of the banks operating in the UK, for a period spanning from 2005 to 2013.¹⁰⁸ However, to ensure potential uniformity, which can be affected by the presence of missing data in Bankscope, in some cases we use the annual reports of the banks for the variables of interest as data sources.

The timespan structure was chosen to segregate the impact of QE rounds and diminish the likelihood of other puzzling factors (e.g., purchases of other asset classes during successive QE rounds). Moreover, it can capture transformations observed in the UK financial sector in recent years. In the period preceding the crisis, UK banks came to increasingly depend on wholesale funding rather than their customer's deposits, an element that placed higher pressure on their structure. At the brink of the financial crisis in the UK, banks ended up having less capital and fewer liquid assets than they had had in the past, given the fluctuations in the UK's financial environment. Thus, our timespan structure can evaluate the overall impact of QE on the UK financial sector without segregating the impact of different QE rounds.

We draw on two accounting quantities, which are associated with the present research study. The first quantity straightforwardly derived from Bankscope is the *returns on assets (ROA)*, used as a key ratio for assessing bank profitability and, as a measurement of the overall performance of a bank regarding its efficiency in utilizing assets to generate profits, given the structure of liabilities

¹⁰⁷ We should bear in mind that accounting data derived from Bankscope may suffer from a drawback, observing that when inferences are drawn from the Bankscope database, there can be an implicit selectivity bias (Corvoisier and Gropp, 2001).

¹⁰⁸ The quarterly frequency could, in principle, give better insight into the link between the accounting ratios and the QE rounds. However, for most banks the quarterly data are not available. On the other hand, the bias in the results obtained using annual data instead of quarterly data appears not to be significant (Gambacorta, 2005).

and equity (Athanasoglou *et al.*, 2008; Garcia-Herrero *et al.*, 2009). The second one is the ratio of *leverage*, measuring the risk associated with non-capital funding of overall balance sheets, and defined as *total assets to total shareholders' equity* and subordinated debt. This definition is similar to the regulatory leverage ratio used by the Office of the Superintendent of Banks (OSFI), being based on total regulatory capital as defined in Basel III, including subordinated debt (Bordeleau *et al.*, 2009) and it is not subject to the model and measurement errors associated with asset-risk calculations. A high leverage indicates a greater vulnerability to adverse shocks that can reduce the overall value of assets. Similarly, it can decrease the long-term availability of funding and, in addition, increase the reliance on volatile short-term sources of funding (e.g., higher funding liquidity risk).

Moreover, we draw on three quantities derived from Bankscope namely: the *liquid assets*, defined as the sum of cash and cash equivalents, public securities, and secured short-term loans; the *gross loans*; and the sum of *securities*, defined as the sum of investments of banks that include bonds, equity derivatives and any other type of securities. We divide all three quantities over total shareholders' equity to derive them as ratios. In this setting, leverage defined above is decomposed in three components, denoted as *liquid assets to equity*, *loans to equity* and *securities to equity*, which reflect to what extent the banks are (de)leveraging within the QE framework effect. This framework of decomposition may expose the financial sector's access to liquidate assets and its resilience to short-term liquidity stress, whether it can provide loans to real economy and to withstand adverse non-performing loans' shocks and, it can measure to what extent a bank should leverage in riskier market securities and financing sources and can adverse market risks, respectively.

In standard quantitative easing framework, it is common to assume that the central bank sets its policy interest rate taking into account real-economy variables, e.g., the real GDP, the output gap, the inflation deviation from target and so on, when deciding upon the amount of QE it will engage in. In this context, we draw on the real GDP derived from BoE and examine to what extent it may have an impact on bank performance due to the fact that the demand for lending increases during cyclical upswings (Athanasoglou *et al.*, 2008). Moreover, we derive the lending rate, as the average long term rate from BoE, to examine the extent the lending between banks is decreasing.¹⁰⁹ This choice of lending rate relies on the hypothesis that certain bank-specific characteristics (e.g., size, liquidity, short-term funding, cost-to-income ratio and capitalisation) only influence the loan supply. Finally, we derive the average annual asset purchases made by the BoE over its total assets

¹⁰⁹ Gambacorta and Iannotti (2007) find that the interest rate adjustment in response to positive and negative shocks is asymmetrical, so that banks adjust their lending rates faster during periods of monetary tightening.

as an indicator of QE, which is commonly used in the literature (Hancock and Passmore, 2011; Chen *et al.*, 2012).

Using the Bankscope database, the types of banks are not always mutually exclusive (Bhattacharya, 2003). Consequently, we have restricted our sample to five main types of banks in the UK, which are mutually exclusive. Even though the analysis is implemented on a total sample of more than 300 banks, the contribution of each type of bank to the QE responses is investigated further, given that each type may reveal significant information. However, due to data availability and low relevance of some banks to QE practices, the empirical analysis is focused on five major types. Table V.1 presents the types and the number of institutions included over the period studied.

Table V.1: Distribution of UK banks

Type of bank	Number of banks	Label
Commercial banks	76	ComB
Real Estate & Mortgage banks	43	RealB
Investment banks	42	InvB
Private Banking & Asset Management companies	32	PrivB
Bank Holdings companies	20	BkHo
Total	213	

Note: The table presents the types and the number of UK banks included over the period studied. Bankscope divides banks by specialisation, as follows: Commercial banks, Savings banks, Investment banks, Real Estate and Mortgage banks, Cooperative banks, Credit banks, Islamic banks, Non-Banking Credit institutions, Bank Holdings companies, Central Bank, Specialised Governmental Credit institutions, and Multilateral Government banks. In terms of the distinctions between the five different types presented in the table, *Commercial banks* are regarded as the banks which are owned by stockholders pursuing various lending activities to increase their profits. *Real Estate and Mortgage banks* are specialized on real estate lending. Investment banks are underwriters that serve as intermediary between issuer of securities and the investing public. *Private Banking and Asset Management* companies are focused on the management of a client's current investments. Finally, *Bank Holdings companies* own or control one or more banks.

Next, we rely on some statistical analysis to provide insights that can further motivate our analysis. The findings here are not decisive for the main conclusions of the analysis, but they offer a preliminary perspective of the data. Table V.2 illustrates the mean and the standard deviation for the variables of interest by type of UK banks.

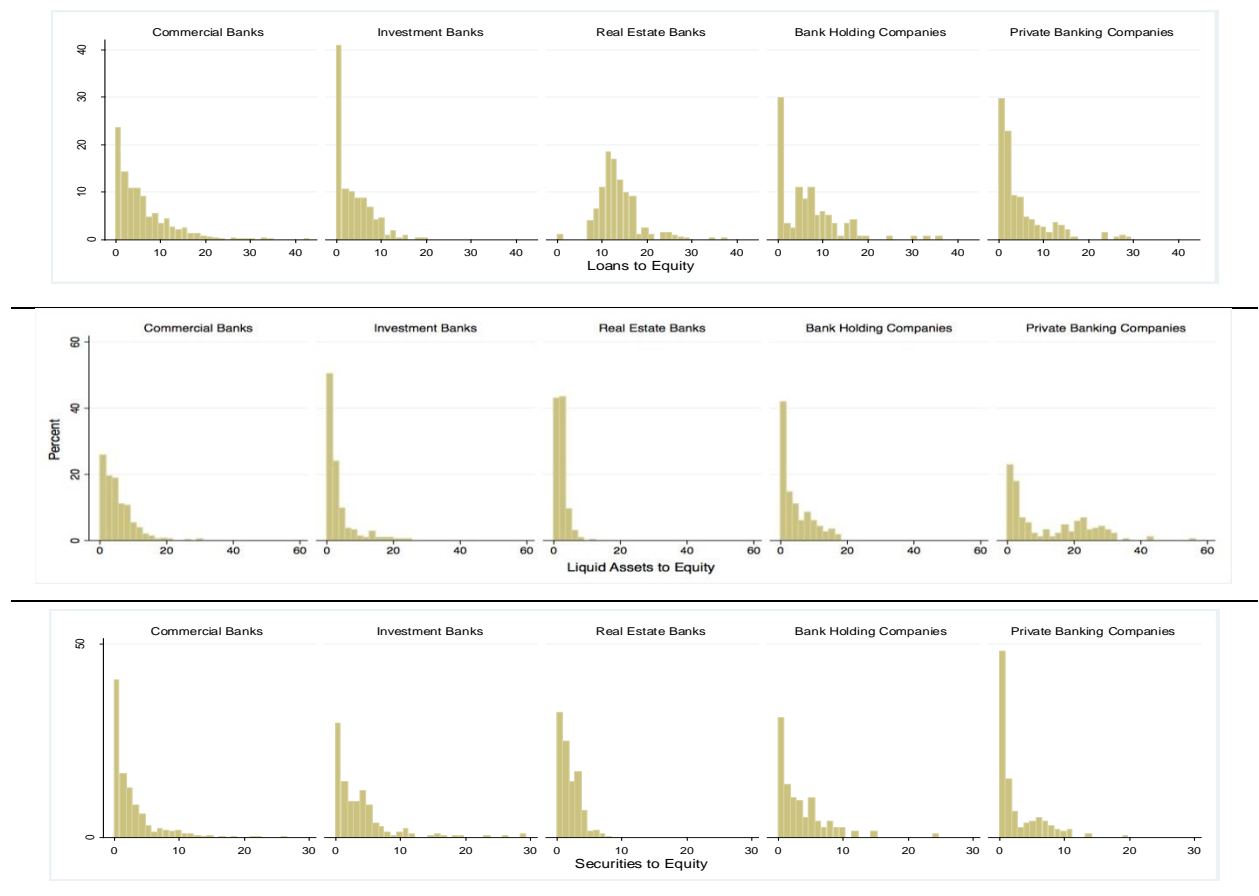
The idea behind this is to examine whether the types of UK banks with comparable averages have heterogeneous deviations from the mean. Comparing the results suggested in Table V.2, we drawn on some interesting findings. Firstly, there is a comparable (or close to) mean value between the types of banks, although their deviations are highly heterogeneous, suggesting that distinguishing banks by type and examining their partial contribution to the QE program can play a key role because they all are quite sensitive to unconventional shocks but differ in their degree of sensitivity.

Table V.2: Descriptive statistics

Ratio	Commercial banks		Investment banks		Bank Holding companies		Private Banking companies		Real Estate banks	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Leverage	13,51	9,27	10,87	8,01	15,03	11,07	19,47	10,49	17,79	5,53
Loans to Equity	5,89	6,01	3,72	3,96	6,92	6,91	4,90	5,85	13,57	4,52
Liquid assets to Equity	4,99	4,39	3,34	4,58	4,55	4,49	11,87	11,49	2,28	1,58
Securities to Equity	2,62	3,41	3,79	4,79	3,56	3,83	2,70	3,39	1,95	1,58
ROA	0,68	1,99	1,13	5,16	1,94	3,67	0,83	2,17	0,39	0,37

Note: The table presents the summary statistics of the accounting ratios of interest for UK banks, namely the leverage and its components *loans to equity*, *liquid assets to equity* and *securities to equity*, and the ROA. The panel illustrates the mean and the standard deviation (SD) of the UK banks by type.

Moreover, the heterogeneity of the leverage's components across the types of banks indicates short-term liquidity stress. To provide further insights about the distribution of the leverage's components that can motivate the comparison of banks by type, we derive the histograms of the three components of leverage for the five types of UK banks, as shown in Figure V.1.



Note: The figure illustrates the histograms of the three components of leverage namely *loans to equity*, *liquid assets to equity* and *securities to equity*, for all types of UK banks.

Figure V.1: Histograms of leverage's components by type of bank

The findings indicate strong evidence of heterogeneity between the different types of banks across the components, indicating the handling of different processes for each type of bank. Moreover, an element that ensures more robustness to our hypothesis is not to consider all banks within the same modelling framework. This adjustment is in line with the White Paper of Vickers Commission (2012) report, even though these measures are planned to enter into force in 2019 and, therefore, the effects will only become visible later on. When reviewing the *loans to equity* component, the majority of banks have values below 10pps, while there are outliers in all bank types with values that exceed 20pps. This implies that they promote a very aggressive growth strategy being accompanied by a correspondingly increased insolvency risk. In the case of the *liquid assets to equity*, there is evidence of a high value crossing the 40pps level for a few cases of Investment banks, Real Estate banks and Bank Holdings companies, indicating that they have high-quality liquid assets that can be converted easily and immediately into cash. This fact can be confirmed by the results obtained for the *securities to equity* component, where it was registered for these institutions a high value of this component, meaning that they deal with creditworthy securities with short-term maturities.

In 2010, the UK Financial Services Authority (FSA) addressed again the issue of liquidity, adopting a tighter regulation with the purpose of withstanding new stress scenarios and to make the financial system more resilient to major risks. This placed additional pressure on the performance of UK banks, such as the economic downturn, borrower defaults, and stress in funding markets, credit conditions and sovereign risk. At a minimum, the conditions for achieving this objective are higher spreads on lending activities and reduced leverage. Achieving these goals would imply a rebalancing of the banks' funding profiles and a more focused approach on the activities that exploit their comparative advantage. In reality, the transition determined a trade-off between deleveraging and revenue generation. Though, as shown in Figure V.1, this regulation framework had an impact, particularly on Commercial banks and Bank Holding companies where a large part of the institutions ensure a minimal level of liquidity.

V.3 Model setup

The panel VAR framework is a coherent approach to estimating interdependencies by treating all variables as endogenous and allowing time lags across variables. Recent relevant studies have used empirical panel VAR modelling frameworks with different structural identification approaches to address a variety of issues such as the transmission of shocks across

units, countries, and time.¹¹⁰ In a panel VAR framework, a cross-sectional dimension is added to the common VAR representation that may reveal additional information about interdependencies. Within a panel VAR approach, we obtain banks' dynamic responses to shocks because of the model's ability to approximate complicated, interdependent adjustment paths with the time-series information. On the other hand, we can control for individual heterogeneity and can specify the time varying relationships between dependent and independent variables.

Without loss of generality, we illustrate the specification of our panel VAR framework, assuming one lag. Let $y_{i,t}$ be the $k_i \times 1$ vector of endogenous variables for each unit i , $i = 1, \dots, N$. The $k_i \times 1$ vector of endogenous variables takes the form $Y_{i,t} = [y'_{1,t} \ \dots \ y'_{N,t}]'$. The panel VAR takes the following form:

$$Y_{i,t} = A_{i,0} + A_i(l)Y_{i,t-1} + u_{i,t} \quad (\text{V.1})$$

where $A_{i,0}$ is the vector of all the deterministic common components (e.g., constants, seasonal dummies, and deterministic polynomial in time) of the data for all units i , t denotes the time parameter where $t = 1, \dots, T$, coefficients $A_i(l)$, and $u_{i,t}$ is the $G \times 1$ vector of contemporaneously correlated random disturbances with zero mean and the non-singular variance-covariance matrix Σ_u .

Assuming that the data generating process features dynamic homogeneity, the pooled estimation approach with fixed effects can be used to estimate the parameters of the model by potentially capturing idiosyncratic but constant heterogeneities across variables and units. However, if different assumptions are imposed in the model specification (e.g., for N and T), the pooled estimation approach is biased. One way to overcome this difficulty is to employ the generalized method of moments (GMM) approach, initially proposed by Arellano and Bond (1991). According to them, when the cross-sectional size (number of units, denoted as N) is large, T is fixed and small and, given the fact that lagged regressors are used as instruments, the first assumption is derived by estimating the model parameters with the GMM procedure, which is consistent when T is small. Nevertheless, the GMM approach also requires differencing model specifications.

In this analysis, we impose two assumptions to obtain plausible results. The first assumption of the panel VAR framework derived herein is that cross-sectional heterogeneity and dynamic interdependencies are assumed by introducing fixed effects, thus allowing for time-variant

¹¹⁰ Contributors, among others, are Canova and Ciccarelli (2009), Beetsma and Giuliodori (2011), Canova *et al.* (2012), Ciccarelli *et al.* (2013), De Graeve and Karas (2014).

individual characteristics.¹¹¹ Therefore, the panel VAR is characterized by dynamic interdependencies where the lags of all endogenous variables of all units enter the model for every unit i , cross-sectional heterogeneity where innovations are correlated contemporaneously, where intercept, the slope and the variance of the shocks $u_{i,t}$ may be unit-specific. In this setting, we impose a block structure on the matrix of contemporaneous coefficients (e.g., short-run restrictions) to compute structural parameters prior to generating impulse-response functions, based on the study of Frame *et al.* (2012).

Under the first assumption and a common set of $L \geq k + l$ instruments, recall equation (V.1) in a compact form:

$$Y_t = Z_t A + U_t \quad (\text{V.2})$$

Where Y_t is the vector of the endogenous variables, $Z_t = I_{NG} \times (A_0 \ y'_{i,t1})$, which contains all the remaining deterministic common components of the data for all units i , $A = (A_i(l))' = (a'_i)'$ with $Gk \times 1$ vectors, and U_t is the $GN \times 1$ vector of innovations serially correlated contemporaneously with zero mean and variance-covariance matrix Σ_u . The individual heterogeneity is endorsed in the levels of the variables.¹¹² Subtracting the means of each variable calculated for each firm-year and by introducing fixed effects, eliminates any bank-specific time dummies that capture aggregate and global shocks which may affect all firms in the same way and preserves the orthogonality between transformed variables. Since A varies with cross-sectional units, it depends on a lower dimension vector that prevents any meaningful unconstrained estimation. For a structural interpretation, we use the following standard linear accounting identity, as:

$$Y_t = \sum_j Z_t \gamma_j \vartheta_j + U_t + Z_t e_t \quad (\text{V.3})$$

Where $Z_t \gamma_j$ can capture any potential common, unit-specific, variable-specific, and lag-specific information in the regressors, ϑ_j are factors that capture the determinants of A , and e_t is the error term of the linearization. The decomposition allows us to measure the common and unit-specific influences for endogenous Y_t . Finally, the equation-by-equation GMM estimation yields consistent estimates of panel VAR, where the joint estimation of the system of equations makes cross-equation hypothesis testing straightforward (Holtz-Eakin *et al.*, 1988). To make the GMM

¹¹¹ One way to address implicit selectivity bias of our accounting data is to use fixed effects in order to ensure robustness in the empirical analysis in relation to non-random selectivity, rather than the random effects estimator.

¹¹² Within this context, if the data generating process features dynamic heterogeneity, both a within- and a between-estimator will give inconsistent estimates of the parameters, even when N and T are large, since the error term is also likely to be correlated with the endogenous regressors.

estimator robust, we test the optimal lag order in both panel VAR specification and moment condition using the moment and model selection criteria (MMSC) for GMM models based on the J statistic of over-identifying restrictions proposed by Andrews and Lu (2001).

The dynamics of the model can be investigated by impulse response analysis (*IRF*). The *IRFs* are informative for the shocks and interactions arising between the endogenous variables of the system. The standard errors of the impulse response functions and confidence intervals are generated using Monte Carlo simulations. The impulse response function is derived to one standard deviation shock to equation j corresponding to variable k at time t on expected values of Y at time horizon $t + h$.

The second model assumption is identifying as a restricted version of the panel VAR framework, and examines dynamic heterogeneity in the responses to shocks that may arise for different consistent formulations of the cross-sectional panel. Suppose we run the model for one type of bank denoted as d , from the full panel sample. Comparing the impulse response functions obtained for the d -type banks each time, allows us to roughly assess the contribution of the d -type institutions. Therefore, the restricted vector to be estimated in equation (V.3) is now specified as:

$$Y_t^* = [y'_{1,d,t} \quad \dots \quad y'_{N,d,t}] \quad (\text{V.4})$$

Where Y_t^* is the $k_{i,d} \times 1$ vector of endogenous variables for unit i , $i = 1, \dots, N$ and d denotes the type of banks examined for the restricted model setup. In addition, suppose we run the model excluding one of the variables in the full endogenous vector, denoted as $(k_i - 1) \times 1$. This form of the restricted model is obtained by the exclusion of the k -variable and it can reveal the contribution of the omitted variable in the impulse response functions of the d -type restricted model. The restricted vector to be now estimated in equation (V.4) is given as:

$$Y_{k,t}^* = [y'^{(k_i-1)}_{1,d,t} \quad \dots \quad y'^{(k_i-1)}_{N,d,t}] \quad (\text{V.5})$$

Where $Y_{k,t}^*$ now is the $(k_i - 1) \times 1$ vector of endogenous variables included in the restricted model setup for unit i , $i = 1, \dots, N$ and $(k_i - 1)$.

We estimate the panel VAR model repetitively, for all five major categories of banks, under the second model assumption. The cross-sectional interactions within the different types of banks can each time reflect the extent to which the institutions are subject to QE imposed by the central bank. Finally, we expect that central banks pay particular attention to the performance of the components in the endogenous vector, compared to all the other type of banks in conducting

monetary easing policies, given their size, number and importance as traditional financial intermediaries.

V.4 Empirical findings

In this section, we present the empirical results from the panel VAR model framework illustrated, and discuss the implications associated with the present research questions. We start by selecting the optimal lag length for a panel VAR framework, using MMSC for the GMM models based on the *J statistic* of over-identifying restrictions (Andrews and Lu, 2001). The first-order lag specification is chosen to insure no serial correlation of residuals in the VARX models after estimating the model. Finally, we bear in mind that when computing the bootstrapped error bands by simulating the model, we use the sample covariance matrix, since the number of endogenous variables in our model is lower than the dimension of the time-series included. Under the model assumptions, our panel VAR framework is repetitively estimated for all types and the *d*-type of UK banks with the analysis focusing on IFRs (one standard deviation).¹¹³

V.4.1 Quantitative Easing impulses and transmission to GDP growth

We start the empirical analysis by setting the QE effect impulses and the transmission to the UK real GDP growth, as shown in Figure V.2. The first important finding is the evidence that during the period of the positive shock of QE, profitability (measured by *ROA*) of Commercial banks and Real Estate banks is reduced significantly, highlighting their role, compared to the others. This finding is in line with Mamatzakis and Bermpei (2016) who identifies a reduction of profitability of US banks during quantitative easing implementation by the Fed.

However, the finding above also contributes to the ongoing debate (e.g., separate banking system reported in White Paper, Vickers Commission, 2012), by stressing the significant difference across different types of UK banks. This effect can be beneficial for the real economy when looking on the effect of a positive shock of *ROA* on real GDP growth after one period for Real Estate banks, Investment banks and Commercial banks.

¹¹³ Analysing the response of the financial sector to shocks resulting from the QE policy, it is implicitly assumed that the variables of interest respond within the period to the BoE QE policy. We simulate the model 5,000 times to obtain confidence intervals and median estimates for the impulse responses. In addition, we perform forecast-error variance decomposition (FEVD) analysis on the dynamics of the model setup under the model assumptions, derived after 5,000 runs. The FEVD is interpreted as the impact accounted for by innovations in each variable in proportion to the total impact of all innovations reported over the horizon ahead selected. The results are not reported but are available to the reader upon request.

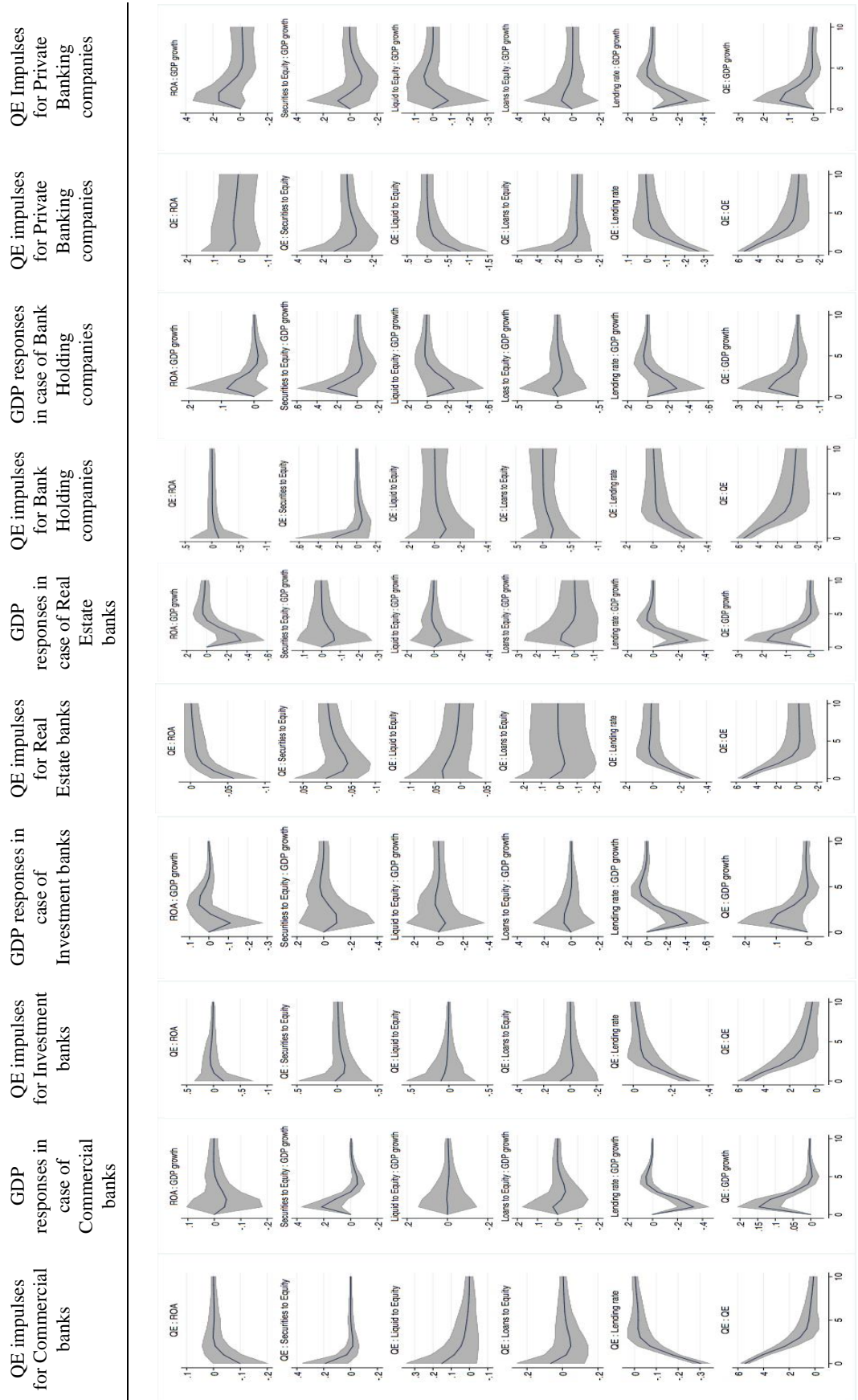


Figure V.2: Impulses of QE and transmission to GDP

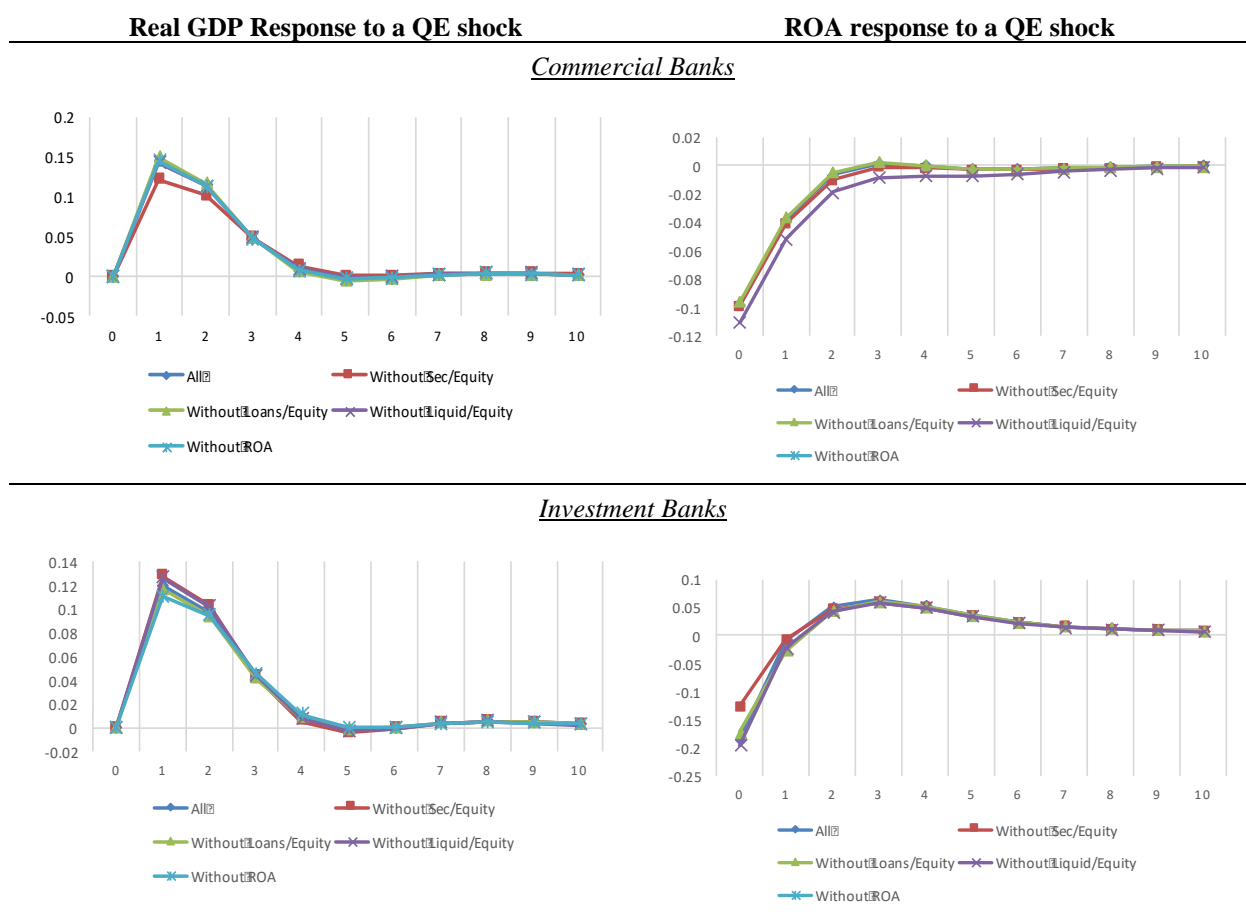
Another significant finding derived from Figure V.2, is the evidence that the positive shock of the QE coexists with the significant increase on the *securities to equity* for Commercial banks

Note: The figure presents the responses of all the financial variables of interest to a quantitative easing shock. The thin black line represents the median estimate of the response. The shadow area around the median estimate line of response represents the 95% Monte Carlo bootstraps resamplings. To avoid any misunderstanding, in the table we denote the leverage components, namely securities to equity, loans to equity and liquid assets to equity as "Securities to Equity", "Loans to Equity" and "liquid to Equity", respectively.

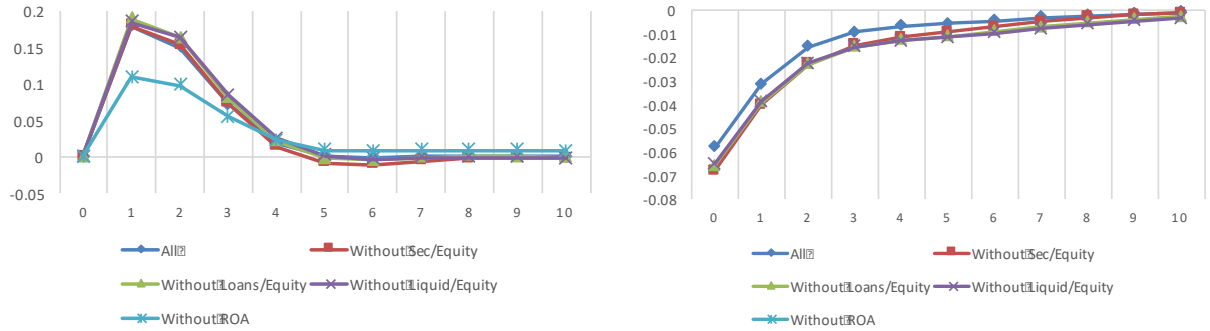
and Bank Holdings companies. Real GDP growth responds positively and significant after one period to a QE positive shock. Therefore, these two types of banks may contribute to the UK real GDP growth, because of their significant activity in terms of asset leverage. Moreover, the drop of *liquid assets to equity* for Private Banking companies and Bank Holdings companies may contribute to the increase of real GDP growth, given the response of the later to a positive shock on the *liquid assets to equity*, for these types of banks. Finally, the results of Figure V.2 provide evidence that the positive shock on QE leads to a significant reduction of lending rate with beneficial effects on real GDP growth for all cases of banks, amplifying the investors' mood, in line with the study of Lutz (2015).

V.4.2 The role of banks' variables on the GDP growth response and QE shock

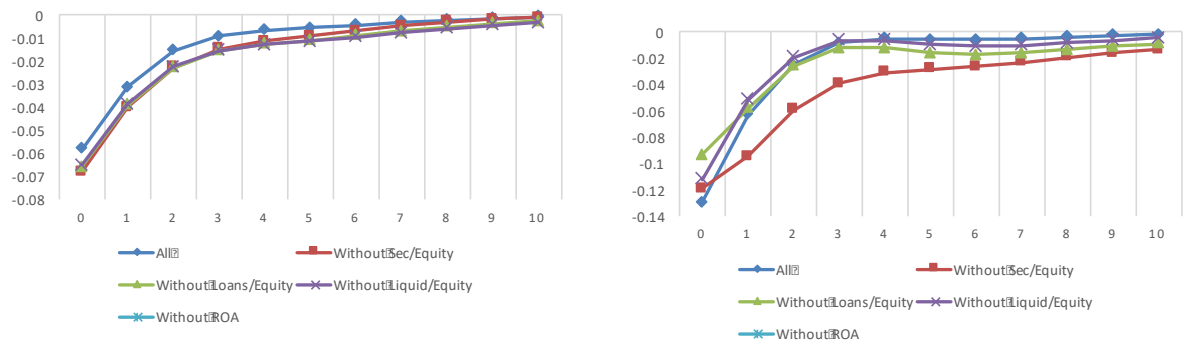
The monetary policy makers keep the net interest margin low for the Real Estate banks which may add to the efficiency of the transmission of monetary policy to the real economy. In the majority of the cases, *ROA* responses to a positive QE shock are negative with the exception of the Private Banking companies (see Figure V.3).



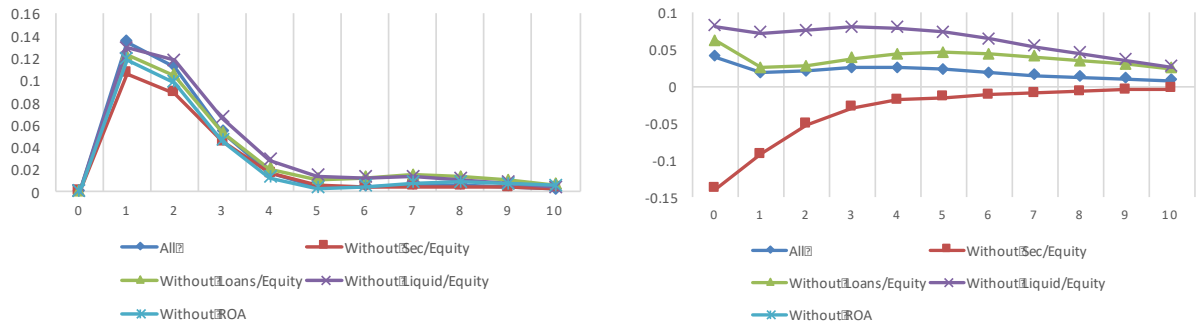
Real Estate Banks



Bank Holding Companies



Private Banking companies



Note: The figure presents the responses of the real GDP and ROA to a positive QE shock for 10 period-horizons ahead. The blue line with rhombuses represents the sample with all banks included, the red line with the squares represents the sample when the *securities to equity* (denoted as Sec/Equity) is excluded, the green line with the triangles represents the sample when the *loans to equity* (denoted as Loans/Equity) is excluded, the purple line with 2-ray asterisks represents the sample when the *liquid assets to equity* (denoted as Liquid to Equity) is excluded and the light blue line with 3-ray asterisks represents the sample when the *ROA* is excluded. Statistical significance is obtained from 5,000 Monte Carlo bootstrap resamplings.

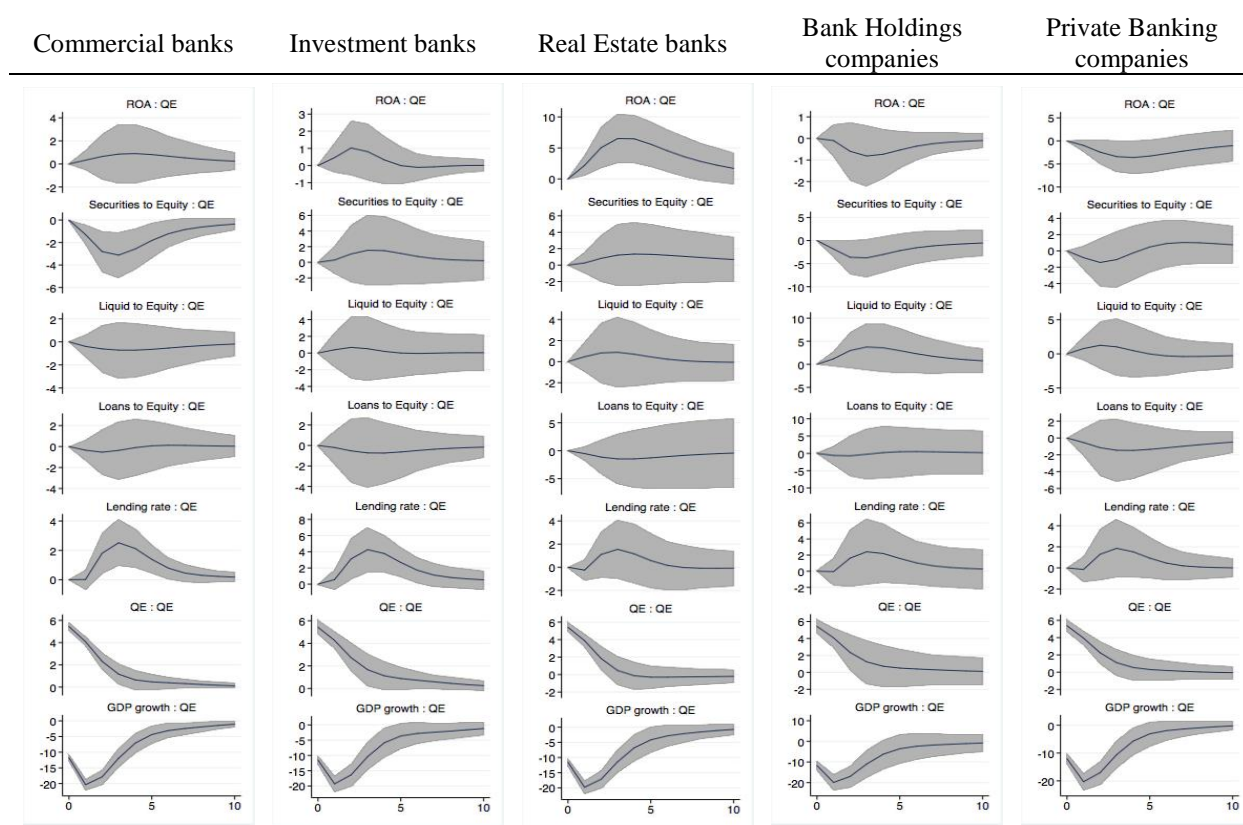
Figure V.3: Responses of the real GDP and ROA to a positive QE shock – Identifying the role of omitted variables for the types of banks

However, when the *securities to equity* is omitted, *ROA* responds in the same manner for Private Banking companies, following the others' *ROA* response to QE. Therefore, the leverage component *securities to equity* is of great importance, providing a tool to the Private Banking companies not to experience a significant reduction on their profitability. In the case of the Bank Holdings companies, the same leverage component has beneficial effect by reducing the negative

effect of QE on ROA. These results have significant implications for bank managers when facing a significant monetary policy easing. A well-diversified bank strategy to interest and non-interest income activities may reduce the negative effect of a QE strategy on bank profitability.

V.4.3 Does QE policy respond to shocks of leverage and profitability?

Figure V.4 shows the responses of the BoE QE policy to leverage and profitability. The findings illustrate that the BoE reduces asset purchases when a positive growth shock occurs and increases asset purchases when a positive lending rate shock exists. Looking into the banks' variables, we observe a significant reduction of asset purchases as evidence after a positive shock on the leverage component *securities to equity* for Commercial banks.



Note: The figure presents the response functions of QE to all type of macroeconomic and financial shocks. The thin black line represents the median estimate of the response. The shadow area around the median estimate line of response represents the 95% confidence bands generated from 5,000 Monte Carlo bootstraps resamplings. To avoid any misunderstanding, in the table we denote the leverage components, namely *securities to equity*, *loans to equity* and *liquid assets to equity* as "Securities to Equity", "Loans to Equity" and "liquid to Equity", respectively.

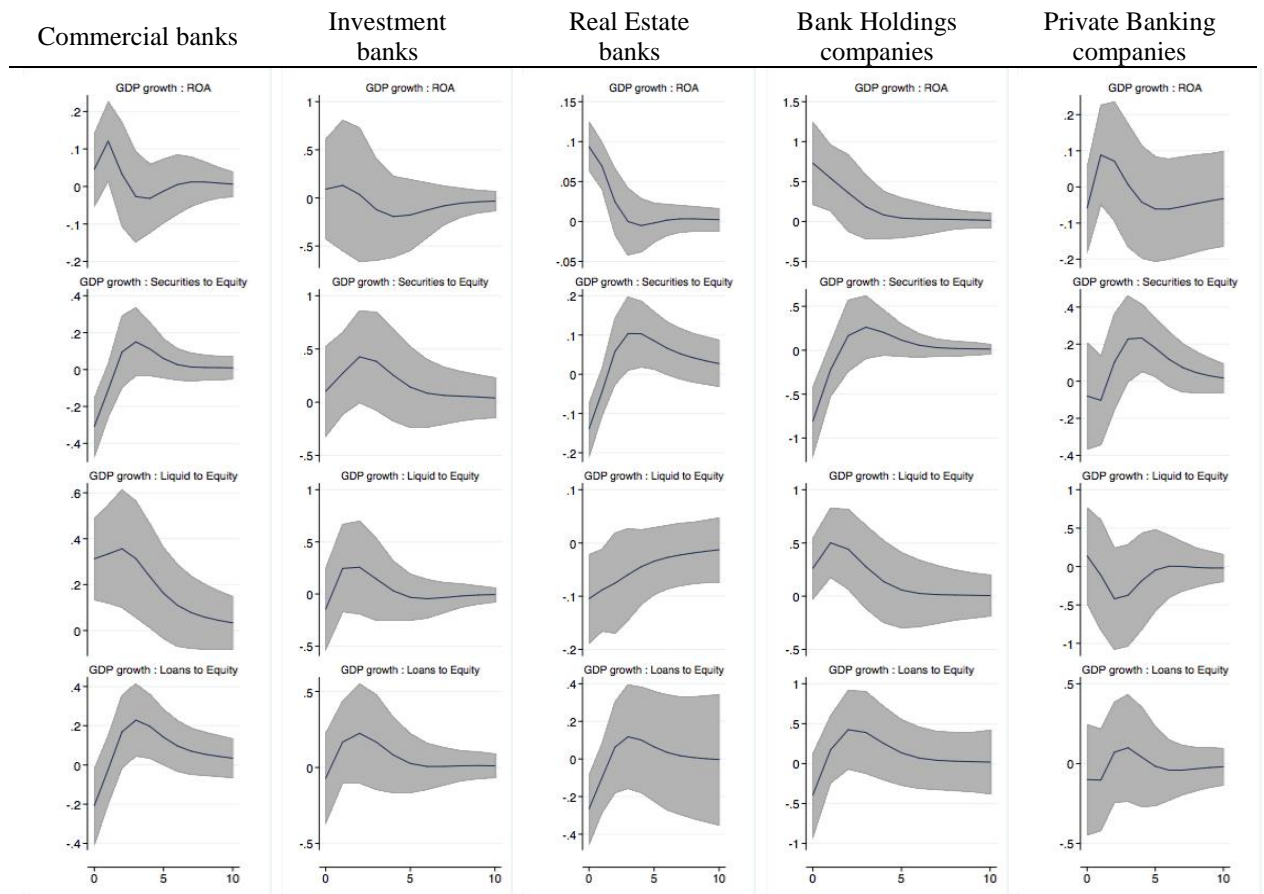
Figure V.4: The BoE QE policy response on leverage and profitability

The same finding holds for Bank Holdings and Private Banking companies but with the absence of the statistical significance. Our findings also provide evidence that the BoE seems to be interested for the increased profitability of Real Estate banks given their importance on the

lending activity and its effect on the real economy. The response of the *QE* variable is positive after a positive shock in profitability for the Real Estate banks, in order to reduce the lending rates and to help the economy boost, given the significant role of this type of banks on housing lending.

V.4.4 Does economic activity affect leverage and profitability?

We address this question by testing the impulses of real GDP growth to the banks' variables of interest. Figure V.5 illustrates the results of IFRs for all the types of banks. The findings are of great interest, indicating a number of aspects. Real GDP growth has a major positive effect on Real Estate banks' and Bank Holdings companies' profitability and to lesser extend on the profitability of Commercial banks and Private Banking companies (first row of Figure V.5). A second main finding is that a negative shock on real GDP growth may increase the *securities to equity* for three out of five types of banks namely Commercial Banks, Real Estate Banks and Bank Holdings companies (second row of Figure V.5).



Note: The figure presents the profitability (*ROA*) responses to a shock from the three components of leverage, across the different types of UK banks, for 10 period-horizons ahead. The thin black line represents the median estimate of the response. The shadow area around the median estimate line of response represents the 95% confidence bands generated from 5,000 Monte Carlo bootstraps resamplings. To avoid any misunderstanding, in the table we denote the leverage components, namely *securities to equity*, *loans to equity* and *liquid assets to equity* as "Securities to Equity", "Loans to Equity" and "liquid to Equity", respectively.

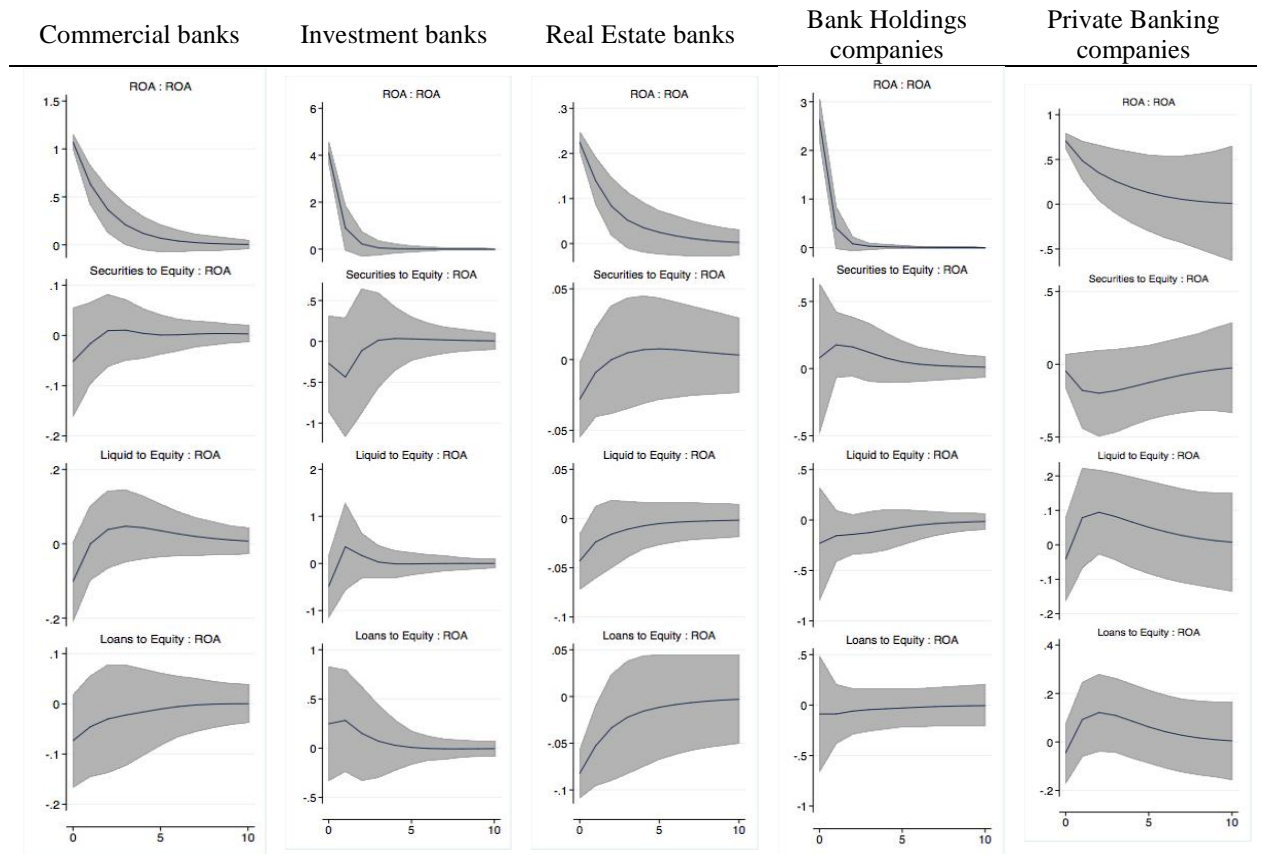
Figure V.5: Effect of economic activity impulses to leverage and profitability

Moreover, the leverage component *loans to equity* increases after a negative GDP growth shock for the Real Estate and Commercial banks adding to their leverage. The *liquid assets to equity* is reduced in case of a negative GDP growth shock for Commercial banks and Bank Holdings companies adding more to their risk profile, while for Real Estate banks is increased (lowering their risk profile). Our results imply that risks are undertaken, when economic conditions are worse. This is especially apparent for Commercial banks and Bank Holding companies. By increasing their leverage, these institutions hope to resist on a potential reduction in their profitability, due to low economic activity. However, this may increase significantly their risk, given that bad conditions in the economic environment leading them to losses. Even though the monetary authorities are afraid of deleverage over weak economic growth, they should take measures for bank capital adequacy due to a possible worsening of economic conditions.

V.4.5 Does profitability responds significantly to leverage components' shocks?

Next in our analysis, we notice some interesting aspects by comparing the magnitude across banking variables (e.g. profitability and leverage components). We start by examining if leverage undertaken increases profitability. Figure V.6 illustrates our findings of *ROA* responses to leverage shocks, for different types of banks.

The majority of our results indicate that there is no evidence of increased profitability due to a leverage shock. A positive shock on the leverage components reduces significantly *ROA* of Real Estate banks. This finding implies that increased leverage leads to non-profitable risky activity. A positive shock on *loans to equity* has a positive though not statistically significant effect on *ROA*, only for in the case of Investment banks and Private Banking companies. Based on this finding managers may have additional information to what extent an increase in *loans to equity* contributes to bank profitability.



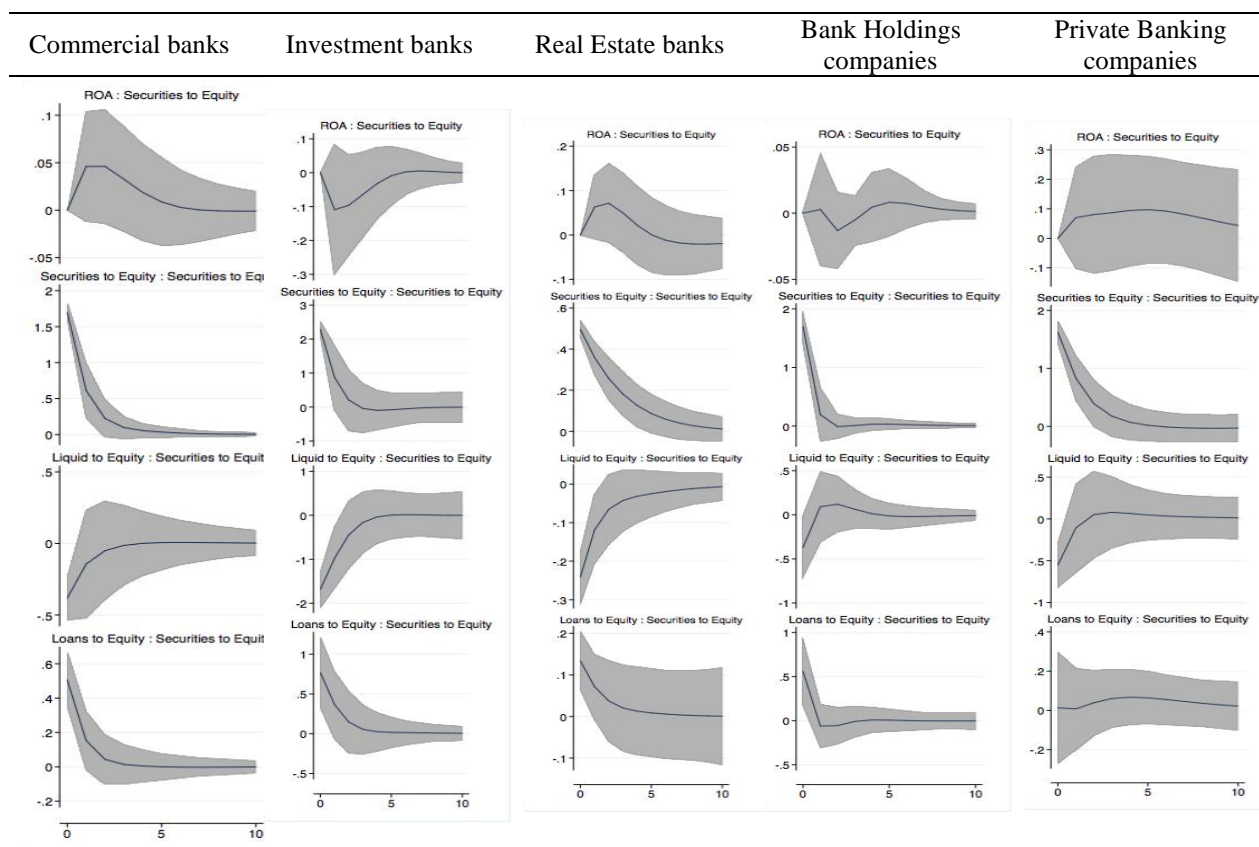
Note: The figure presents the profitability (*ROA*) responses to a shock from the three components of leverage, across the different types of UK banks, for 10 period-horizons ahead. The thin black line represents the median estimate of the response. The shadow area around the median estimate line of response represents the 95% confidence bands generated from 5,000 Monte Carlo bootstraps resamplings. To avoid any misunderstanding, in the table we denote the leverage components, namely *securities to equity*, *loans to equity* and *liquid assets to equity* as "Securities to Equity", "Loans to Equity" and "liquid to Equity", respectively.

Figure V.6: ROA responses to leverage components' shocks

Going more into details, we examine the interaction of leverage components and the effect of *ROA* on these components. The findings are presented in Figure V.7 (panels A, B and C). The results of panel A – Figure V.7 shows some interesting aspects. First, the higher the profitability for Commercial and Real Estate banks the higher their leverage component *securities to equity*. A significant decrease in liquidity leads to higher *securities to equity* for all types of bank, implying a substitution effect between liquidity and securities. Another interesting finding is the positive significant response of *securities to equity* on *loans to equity* for three out of four bank types. Among them, the highest response presented on Investment banks, followed by Commercial banks, Bank Holdings companies and Real Estate banks. Consequently, when a significant amount of loans are given over equity then a significant amount of securities are also bought in terms of equity. Therefore, these two leverage components are complementary for these types of banks. An increased lending to real economy may be used as a signaling indicator of the trend in security markets determined largely by the main types of banks.

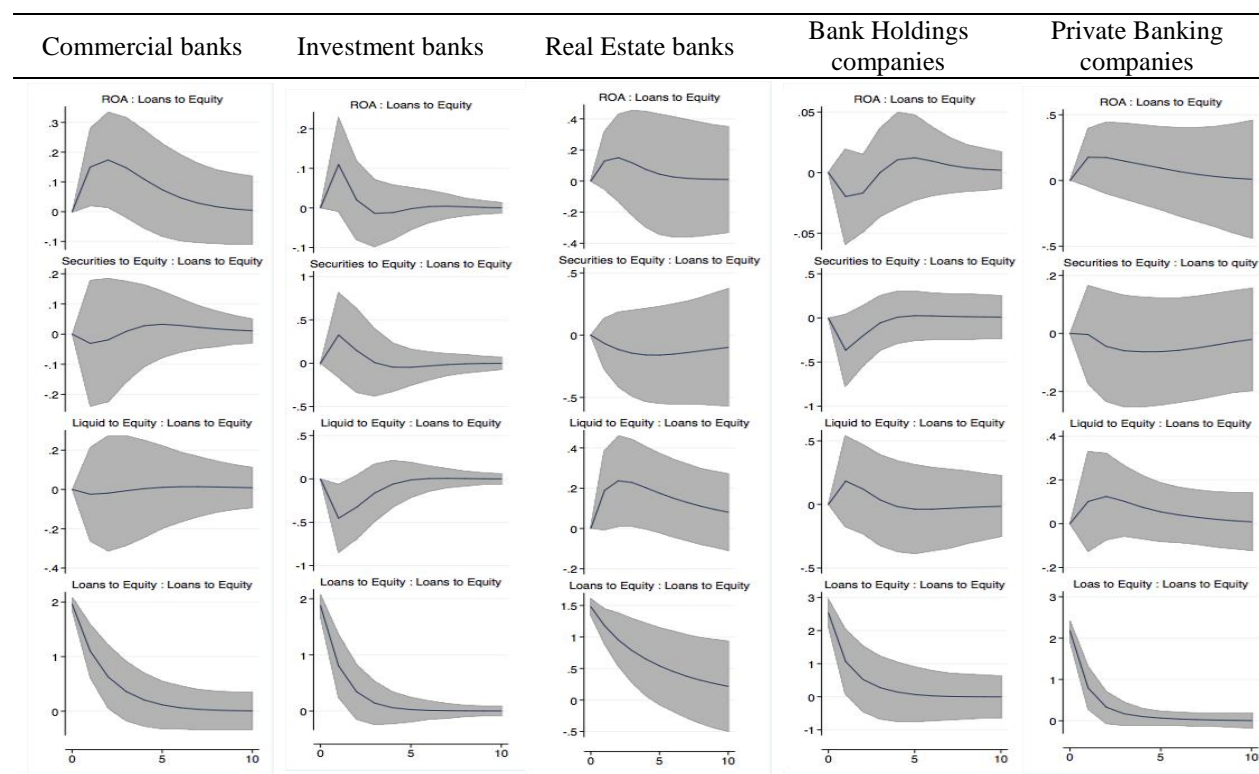
Panel A

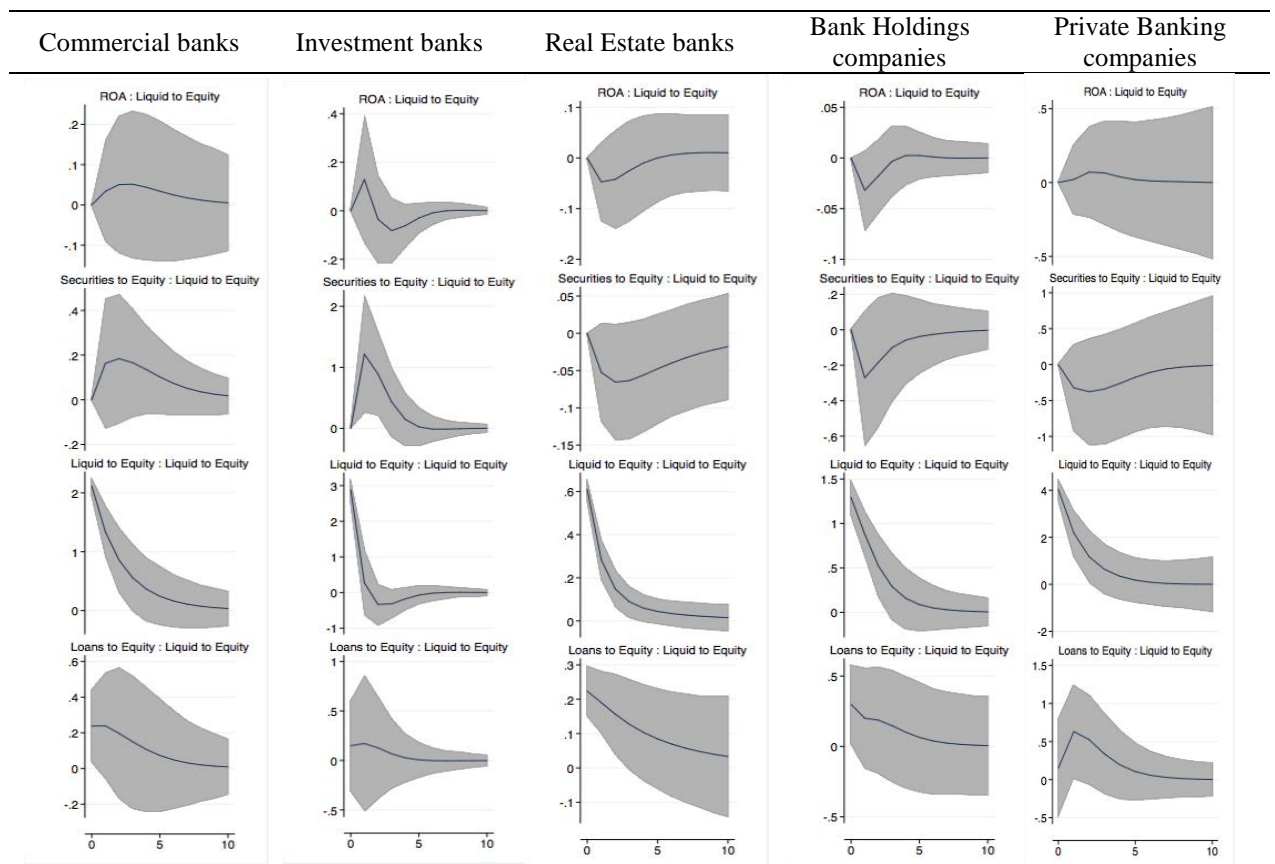
Securities to Equity responses to leverage components and profitability shocks



Panel B

Loans to Equity responses to leverage components and profitability shocks



Panel C**Liquid Assets to Equity responses to leverage components and profitability shocks**

Note: The table (panels A, B and C) presents the interaction between profitability (*ROA*) and the three components of leverage, across the different types of UK banks, for 10 period-horizons ahead. The thin black line represents the median estimate of the response. The shadow area around the median estimate line of response represents the 95% confidence bands generated from 5,000 Monte Carlo bootstraps resamplings. To avoid any misunderstanding, in the table we denote the leverage components, namely *securities to equity*, *loans to equity* and *liquid assets to equity* as "Securities to Equity", "Loans to Equity" and "liquid to Equity", respectively.

Figure V.7: Leverage impulse responses and profitability shocks

We present the response of *loans to equity* to the rest of banking variables shocks at panel B - Figure V.7. There is evidence of a unidirectional effect from *loans to equity* to *securities to equity* shock for all types of banks. This finding implies that the leverage in *securities* is complementary to leverage in loans. Considering profitability effects, higher returns on asset leads to higher *loans to equity* with the exception of Bank Holdings companies. A positive shock on liquidity leads to higher loans after three to four periods ahead for Real Estate banks and lower loans for Investment banks. The implications arising from this finding are of great importance, because it indicates the different banking behaviour in relation to the liquidity usage. Real Estate banks in contrast to Investments banks has a higher contribution to economic growth, leaving space for discretionary policy by the BoE.

We finally turn our analysis to the liquidity impulses and responses. The results are shown at panel C - Figure V.7. There are two main findings emerging from this panel. We note that a

positive shock on *loans to equity* leads all types of banks to increase their cash holdings. However, in the case of Real Estate banks, the response of *liquid assets to equity* to *loans to equity* fades out smoothly and slowly, without being statistically significant after the third period ahead. The second finding is the positive response of *liquid assets to equity* to a positive shock of *securities to equity* for Investment banks. This finding implies a higher level of conservatism compared to other types of banks, a finding also presented in a lower degree for Commercial banks. When the leverage component of securities is increased, it is followed by a higher level of cash holdings, while profitability shocks do not statistically affect profitability.

V.5 Conclusions

Considerable efforts have been made by the central banks in recent years to effectively provide a sufficient monetary stimulus to their economy during the recent global and domestic downturns and ensure the sound functioning of financial sectors. In the UK, banks are the main collectors of funds and suppliers to the non-financial and households' sectors; therefore, a strong understanding of the UK banks' role during the implementation of BoE QE strategy is vital because it raises a series of concerns regarding the economic spin-off that could be triggered through these monetary policy decisions. This chapter gauges how the different types of UK banks' leverage responded to the incentives determined by the QE decisions realized in BoE asset purchases, using a panel VAR framework.

We find that QE decisions are driven mainly by real economic activity, lending rates, and to a diverging degree by the leverage components with different effects on the five main types of UK banks. The findings highlight the crucial role played by Commercial banks in explaining these interrelationships. When the BoE proceeds to a positive shock on asset purchases, the banks' profitability is significantly reduced. Turning to the relationship between unconventional monetary policy and banks' leverage, we find that QE rounds seem to have a positive effect on the leverage components, implying riskier behavior during QE rounds for busting the real economy.

The quantitative easing policies aim to increase the money supply by inundating banks with capital in a struggle to encourage lending and implicitly liquidity. Our analysis presents that during the implementation of QE strategy, the leverage of the banking sector is increased. This indicates credit easing conditions that have disappeared during the manifestation period of the financial crisis. The decrease of banks' profitability implied negative signals from the financial sector to the monetary authorities in order to reduce unconventional easing strategies and assess financial stability, which is the main goal derived from these policies. Moreover, given the high uncertainty

and low interest rates, it can be observed the heightened risk-taking behaviour of banks, as a response to a possible restraint on their policy choices. This attitude pro-risk has a high potential to influence the market price of risk in the economic system. Likewise, a higher level of risk affects financial sector's performance and soundness, particularly if the additional risk is condensed in systemically important banks. As a result, these issues accentuate the policy makers' concerns related to the limitation of bank's risk taking behaviour.

CONCLUSIONS

European experience with bank performance and soundness

The financial system plays a critical role in the modern society, becoming essential in the economic development of a nation. It was stated that an optimal financial system and well-functioning banking sector are commonly considered to be among the most important conditions for a sustainable economic development. Generally, banks are certifying the financing of productive investments and activities, because they mobilize and allocate financial resources, but also because they ensure a money-creation process through lending activities. Consequently, banks play an essential role in the economy, so it is understandable the large and flourishing segment of the literature focusing on bank performance and soundness.

In the last century, distressing economic circumstances have emphasized many deficiencies related to the current banking system structures. Thus, deteriorated economic conditions, weak financial institutions, scarce regulation and lack of transparency are among the main factors standing at the heart of the recent subprime crisis. Moreover, the recent distressing events highlighted the amplified connectivity among banks, which corroborated with tight financial and trade linkages between countries, facilitated spillover effects of financial shocks across sectors and countries.

Perceiving the importance of the banking sector's performance and soundness, particularly in the last century, and considering the lack of consensus among scholars and policy makers in relation to the overall theme, we have focused in this thesis on *bank performance and soundness* bearing in mind the important efforts made by monetary authorities in recent years to provide effectively a sufficient stimulus to the economic sectors during the global and domestic downturns and to ensure a sound functioning of the financial systems. Consequently, the thesis takes a dual approach. On the one hand, it performs a critical and detailed review of the long-standing and rich literature devoted to identifying and analyzing the main indicators, methodological designs and determinants of bank performance and soundness. On the other hand, the thesis explores the role of several bank specific, industry specific and macroeconomic factors on the evolution of European bank performance and soundness, with a particular emphasis on some factors severely affected during the crisis, namely economic freedom, regulation, transparency, corruption and unconventional monetary policy (quantitative easing).

The present study comprises two parts, encompassing five chapters. In *Part I of the thesis* we adopt a theoretical approach. Thus, Chapter I and Chapter II provide a critical and detailed

review of the literature regarding the main indicators, methodologies and determinants of bank performance and soundness. In *Part II of the thesis* we adopt a more practical approach. Thus, Chapter III debates on the current challenges and opportunities that are reshaping the financial world and empirically investigates the main determinants of bank performance and soundness for a sample of EU commercial banks. Continuing, in Chapter IV it is examined in detail the impact of economic freedom, regulation, corruption and transparency on bank performance and soundness using a sample of European countries and disaggregating the sample after several criteria (bank size, bank specialization, country entrance in the EU, country development level). Chapter V analyzes the responses of the UK financial institutions to the incentives determined by unconventional monetary policy (quantitative easing decisions). Last, the thesis is ended with the main findings, as well as recommendations and future research areas.

Main findings

From the *first part of the thesis*, we have learned the following issues. On the methodological side, we observe a polarization of the largest majority of studies on BP around three methods: the Data Envelopment Analysis non-parametric technique, Stochastic Frontier Analysis, a (usually) parametric technique and longitudinal regression analysis. Besides, there seems to exist a positive feedback loop between the developments of these techniques and the need to capture determinants of BP that are better and in greater detail, leading to both methodological developments and better knowledge about BP determinants. In terms of the methodological approaches taken in evaluating BS, we can notice a wide variety of methods of different complexity. Though, more clarity is needed in relation to BS methodological designs, thus there are still numerous barriers to be overcome in order to operationalize these methods (e.g. regulatory restrictions, limited disclosure, reporting discrepancies etc.). On the empirical side, BP and BS determinants are numerous (e.g. microeconomic and macroeconomic; real, fiscal, monetary, and institutional; national and international), and their influence is complex. The complexity of the type of influence (significant or not) and the sign (positive, or negative) of the effect is triggered by several factors including the measure of BP and BS (the same variable can exert conflicting effects on different BP measures); the measure of the determinant (alternative measures of the same variable can exert conflicting effects); the design of the study (e.g. the number of countries, or data frequency); and the economic environment (for example, the level of economic development). Furthermore, we reveal two sets of results. On the one hand, we identified variables that have an unambiguous effect on BP and BS, namely positive (e.g. financial structure; management quality; private ownership), or negative (e.g. non-performing loans; state ownership; bank age; or international financial crises). On the

other hand, many BP and BS determinants exert conflicting effects (even for the same measure of the determinant), suggesting the possible presence of nonlinearities.

From the *second part of the thesis* we have learned the following aspects. The new trends in the regulatory framework are not the sole challenge that European banks have to face, thus another challenge determined partially by the crisis was and still is the fragility of the European banking sector and the rapid enlargement of the shadow banking system which put additional stress on the European banks. Moreover, the recent discussions among regulators, academia and the private sector are dominated by the emergence of the new technological developments in relation to financial products and services. An optimal example of such technology is the distributed ledger technology, which could easily facilitate intra- and inter-banking payments through the creation of virtual currencies, the corporate and retail banking through peer-to-peer lending, syndicated loans, and mortgage valuation systems, or even trading financial transactions. Consequently, the revision of banks' business models to the new operating environment is vital for ensuring sustainable profitability and long-term soundness, observing that a particular role will be played by their ingenuity, efforts and competences to become more efficient in an evolving world. Additionally, we consider that there isn't an optimal and unique business model which can be applied to all types of financial institutions, but the future business models should be fit for purpose by considering the particularities of each bank and the national environment where it operates.

On the empirical side, we identify a clear trade-off between increasing bank performance and bank soundness. Moreover, we observe large disparities existing among EU28 countries, thus we identified a heterogeneous impact of various control variables on the performance and soundness of the European banks analyzed. These differences are dictated by national and regional particularities but also by the size of banks as well as the stringency of the economic and monetary policies promoted. As discussed above, the recent economic crisis impacted severely the European banks, determining an increase in their fragility and implicitly a higher risk-taking behavior. Under these circumstances, considerable efforts have been made by European monetary authorities in recent years to provide effectively a sufficient monetary stimulus to their economy during the recent global and domestic downturns and ensure the sound functioning of financial sectors. These efforts materialized in a set of measures regarding bank liability guarantees, regulatory measures, conventional and unconventional monetary policy and other market interventions. Among these, a crucial role was played by the new regulatory framework and the unconventional monetary policy.

The first action taken by policy makers was to improve the existing regulatory framework promoting a stronger macro-prudential policy, thus in response to the financial crisis and the Euro-

Conclusions

area crisis, Europe has begun a process of improving the existing regulation and supervision of European banks. Our results suggest that the impact of changes in the regulatory and supervisory framework and the greater degree of harmonization of regulations can have significantly differential impacts on the Euro-area and EU enlargement groups. In addition, greater economic freedom can decrease or increase performance or soundness depending on the particular measure used. Increased regulation appears to have a detrimental impact on bank performance and a tendency to reduce the risk of bankruptcy. There was less evidence at the aggregate level that reducing corruption improved bank performance and no evidence that it increased bank soundness. We did, however, detect evidence at the aggregate level that increased disclosure adversely affected bank performance but seems to reduce the risk of bankruptcy and promote bank soundness. These differential effects on BP and BS mean that the harmonization of regulation and supervision needs to be done in a way that recognizes the differential impact. In addition, when stress testing banks across the EU prospective differential changes in the regulatory environment need to be borne in mind, especially as they impact large, medium and smaller size banks in different ways.

Secondly, given that conventional monetary policy proved to be ineffective as it doesn't prevent asset market bubbles, policy makers were forced to innovate in order to evade a meltdown of the financial system. Consequently, after exhausting the traditional tools of monetary policy, some central banks resorted to unconventional measures, regarded as one of the few levers still available for policy makers to boost the economy by lowering yields on long-term assets. Unconventional monetary policy, most commonly known as an extension of central banks' balance sheets by large-scale asset purchases (LSAPs), is also known as quantitative easing (QE). In our analysis, we find that QE decisions are driven mainly by real economic activity, lending rates, and to a diverging degree of the leverage components with different effects on the five main types of UK banks. The findings highlight the crucial role played by Commercial banks in explaining these interrelationships. When the BoE proceeds to positive shock on asset purchases, the banks' profitability is significantly reduced. Turning to the relationship between unconventional monetary policy and banks' leverage, we find that QE rounds seem to have a positive effect on the leverage components, implying riskier behavior during QE rounds for busting the real economy. The quantitative easing policies aim to increase the money supply by inundating banks with capital in a struggle to encourage lending and implicitly liquidity. Our analysis presents that during the implementation of a QE strategy, the leverage of the banking sector is increased. This implies an indication of credit easing conditions that have disappeared during the involvement of the financial crisis. The decrease of banks' profitability implied negative signals from the financial sector to the monetary authorities in order to reduce unconventional

easing strategies and assess financial stability, which is the main goal derived from these policies. Moreover, given the high uncertainty and low interest rates, it can be observed the heightened risk-taking behavior of banks, as a response to a possible restraint on their policy choices. This attitude pro-risk has a high potential to influence the market price of risk in the economic system. Likewise, a higher level of risk affects financial sector's stability and soundness, particularly if the additional risk is condensed in systemically important banks.

Limits

The analyses undertaken in this thesis have some limitations. For example, the European banking industry has been developing rapidly in the last 15 years in a continuously changing regulatory and economic environment. As such, our results capture a key period in which there was a massive expansion of the sector followed by a major crisis and a prolonged period of dealing with that crisis. Moreover, given the high uncertainty and low interest rates, the heightened risk-taking behavior of banks as a response to a possible restraint on their policy choices can be observed. This pro-risk attitude has high potential to influence the market price of risk in the economic system. Likewise, a higher level of risk affects the banking sector's performance and soundness, particularly if the additional risk is condensed in systemically important financial institutions. As such, results in the future might be very different should the sector stabilize and bank operations move away from some of the riskier operations of the past. In addition, additional risks could emerge if an enhanced regulatory framework will force the banking sector to shift a part of its activities to the less regulated shadow banking sector. On the technical side, one of the limits is that the accounting data derived from Bankscope may suffer from a drawback, observing that when inferences are drawn from the Bankscope database, there can be an implicit selectivity bias.

Recommendations

Recommendations on the methodological side

First, studies with similar research questions should start from the same basis, namely the same theoretical models with an initial set of variables, and after that develop a complex structure to achieve their main goals. In this way, it should be easier to understand, clarify and predict phenomena, and to challenge and enlarge the existing knowledge, within the limits of the critical bounding presumptions.

Second, reforms aimed at improving BP and BS should carefully consider both the complex impacts of the many factors on BP and BS and the numerous interconnections between the banking

system and the rest of the economy, as outlined by our thesis. Consequently, we do not recommend to study only one measure of something (e.g. measure of liquidity) because we found numerous examples of different conclusions which might be due to researchers using different measures of the same thing. Additionally, even when trying to learn about only one variable's association with BP and BS, a high attention should be given to all studies that use the same variables, as some of them have reached contradictory conclusions.

Third, generalization of results for one bank type in one country or region during one time period to all bank types, regions and times, should not be done. Many studies found results that differed across various countries and/or bank types and/or time periods. For example, in Chapter IV we find that results at the aggregate level can hide significant and even contradictory results once the data is disaggregated. In the case of greater economic freedom we find that it adversely affects BS in high income countries but is good for BS in middle income countries. As such, the analyses undertaken should be done in such a way that recognize the differential impact of various variables for different countries and/or bank types and/or time periods.

Fourth, the direction of some of the effects of certain determinants on BP and BS can reverse in the long run compared to the short run, or can be affected by extreme events such as the recent financial crisis. For example, we have observed that during the crisis banks adopted a higher risk-taking behavior in order to outweigh the effects of higher capital and liquidity requirements on their performance.

Recommendations on the policy side

First, a revision of banking structures to the new operating environment is more than necessary in order to ensure an optimal level of performance and soundness. This reconfiguration should follow four major directions, namely: the economic direction (the current fragilities of the EU banks); the regulatory direction (uncertainty in the EU regulatory agenda); the Fintech direction; and last, incorporating the previous elements, the new business models direction.

Second, a comprehensive analysis of the emerging risks to financial stability should be undertaken. Among those risks we have observed the following: (i) high household indebtedness (e.g. FI, DK, LU, SK and UK); (ii) overvaluation of house prices (e.g. AT, BE, LU, SE and UK); (iii) long maturity profiles determining vulnerable residential real estate portfolio with high concentration risks or funding gaps (e.g. LU, NL and SE); and (iv) risks specific to foreign currency lending and the weak economic outlook (e.g. AT and FI). As such, tailor-made instruments to tackle with these risks should be embedded in both the national legislation and the European Union one.

Third, the potential developments in the financial market should be anticipated, thus regulators and supervisors should be up-to-speed with the new technological trends, having a full knowledge of the new technologies (e.g. distributed ledger technologies, quantum computing etc.) and their implications. Bearing in mind that regulators and supervisors are almost always behind the curve and that the financial market often pushes the frontiers, the following three directions can be considered the first steps in understanding and preparing for the future changes in the financial markets. First, “learn by studying” implies the creation of specialized working groups that evaluate the impact of new technologies on the financial system and beyond. Second, “learn by seeing” encourages regulators and supervisors to adopt facilitating approaches (sandboxes) enabling financial institutions to develop their own technological solutions. Third, “learn by doing” implies the set up of various pilot projects with the purpose of testing the new technologies in the financial system.

Fourth, lower performing banks with a higher fragility should take every effort in improving the following four aspects: asset quality, capitalization, profitability and customer service. In addition, management efficiency and corporate governance should be ensured, maintained and enhanced in the following years.

Fifth, a reform of the existing regulatory and supervisory framework should be undertaken to increase the efficiency and effectiveness of the existing framework, to simplify the use of risk management tools and to facilitate an optimal policy coordination and peer review process among EU member states. On the one side, the harmonization of regulation and supervision should consider the differential impact it has on different countries and/or bank types and/or time periods. For example, we found that the harmonization of regulation and supervision had a differential impact on the Euro-area and the EU enlargement groups. On the other side, the current EU macro-prudential framework has been constructed in a piecemeal manner, where the major institutional arrangements and procedures have been created before the Banking Union, thus the current structure is not yet fit for purpose. There is still room for improvements, thus we suggest the following: (i) reduce the potential “inaction bias” by some EU member states which adopt less transparent and accountable actions in terms of emerging risks; (ii) streamline the existing toolset, making it more coherent with less burdensome procedures (diminish overlaps within the current macro-prudential toolkit in targeting specific risks); (iii) ensure sufficient clarity by delineating the responsibilities between micro- and macro-prudential supervisory grounds, and by diminishing the potential inconsistencies and overlaps between the two specific toolsets; and (v) create a EU framework for macro-prudential policy beyond banking in order to ensure an effective risk mitigation for the whole financial system.

Conclusions

Sixth, financial integrity should be strengthened at all levels. For example, corruption in bank management, and its interference in the day to day administration should be eliminated to achieve maximum performance and soundness. Additionally, an optimal transparency level should be promoted *ex ante* as it enhances market discipline.

Seventh, considering the high uncertainty and low interest rates, the heightened risk-taking behavior of financial institutions as a response to a possible restraint on their policy choices, should be considered when adopting quantitative easing decisions. We observed that the pro-risk attitude has a high potential to influence the market price of risk in the economic system. Likewise, a higher level of risk affects the financial sectors' soundness, particularly if the additional risk is condensed in systemically important financial institutions.

Future research

The overall results of this thesis could be extended in several directions.

First, the complex relationship between bank performance and soundness in the European Union deserves a more detailed analysis. This tradeoff gave rise to a wide set of intriguing theoretical and empirical questions, all of them being currently under review in the financial analyses and determining thought-provoking avenues for future studies.

Second, future work could focus more on alternative measures or techniques of bank performance and soundness. For example, our analysis revealed that measures such as profit efficiency and capacity efficiency received quite limited attention, particularly with non-parametric approaches. Regarding the latter, more research could be devoted to more flexible techniques, e.g. parametric frontier approaches with bootstrapping or the analytical network technique. Additionally, we have observed the need to operationalize these methods and techniques at the European level by clarifying the cross-country, cross-currency and cross-market linkages and the location of risks in each sector of the financial system.

Third, given the conflicting effects (for example, both positive and negative), the impact of some bank performance and soundness determinants could be explored by allowing for potential nonlinearities. In our study, we include bank-specific determinants (e.g. asset structure, capitalization, banks' size or nationality, or revenue diversification), industry-specific determinants (e.g. competition), macroeconomic BP determinants (e.g. level of economic development, monetary policy, or some institutional factors), or some international BP determinants.

Fourth, subsequent studies could consider additional bank performance and soundness determinants that have not been accounted for so far in the literature, such as house price indexes, more recent regulatory measures (i.e. changes in capital conservation buffers, countercyclical buffers or systemic risk buffers), or the latest technological developments in banking (e.g. the introduction of distributed ledger technologies). As such, the relationship between these issues and the risk-taking behavior of banks, market returns and contagion, could provide fruitful discussions for future research.

Fifth, provisions addressing pro-cyclicality, leverage or even sectorial imbalances need a substantial amount of customization, thus future research could focus more on the particularities of these issues in the banking sector, particularly considering different types of financial institutions. For example, subsequent research could include discussions on how regulation and supervision can be better defined to make bank capital and provisioning less pro-cyclical. Considering that the relationship between bank provisioning and the evolution of the business cycle is based either on static (the current performance of loans) or on dynamic rules (the expected future performance of loans, e.g. Spain or Columbia), future research could assess the efficiency and effectiveness of the dynamic provisioning rules, which were applied *ex ante* the recent financial crisis. Research could also explore the inter-relations between liquidity, capitalization and systemic risk, and their potential effects on bank performance and soundness considering pro-cyclicality. Moreover, further research on the inter-linkages between these issues and the financial cycle could deepen the understanding of the differences between the business cycles and the financial cycles, and what policy options are best for each of them.

Sixth, future academic work could evaluate the quantitative easing strategies for a bigger sample, in order to have a more robust analysis and implicitly more accurate impulse responses. Additionally, other types of unconventional monetary policy measures could be considered to capture the broader context and the differential impact on bank performance and soundness.

Seventh, considering the recent development in the financial sectors, where financial institutions, other than banks and insurance, grew by 42pps for the sole Euro Area, further research could focus on the potential risks arising from the non-banking sector and all categories of financial infrastructures. There is a variety of non-bank entities, with different business models and risk profiles, thus an exhaustive assessment of the risks specific to non-banks and an examination of potential gaps in the current legislative agenda, are going to clarify and improve the existing framework, ensuring a successful Capital Markets Union project which implies even greater involvement of non-bank financial institutions and larger and more interconnected capital markets.

List of Abbreviations and Definitions

I. Abbreviations & Coding

The following table describes the significance of various abbreviations and acronyms used throughout the thesis. Nonstandard acronyms that are used in some places to abbreviate the names of certain white matter structures are not in the list.

Abbreviation	Meaning
BP	Bank performance
BS	Bank soundness
Countries / Regions	
AL	Albania
AT	Austria
BE	Belgium
BG	Bulgaria
HR	Croatia
CY	Cyprus
CZ	Czech Republic
DK	Denmark
EE	Estonia
FI	Finland
FR	France
FYROM (MK)	Macedonia, The Former Yugoslav Republic Of
DE	Germany
GR	Greece
HU	Hungary
IS	Iceland
IE	Ireland
IT	Italy
LV	Latvia
LT	Lithuania
LU	Luxembourg
MT	Malta
ME	Montenegro
NL	The Netherlands
PL	Poland
PT	Portugal
RO	Romania
RS	Serbia
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden
UK	United Kingdom
US / USA	United States of America
TR	Turkey
BRIC	Brazil, Russia, India and China
EU	European Union
EU28	European Union (including 28 member states)
EU non-euro	EU non-euro countries (Bulgaria, Croatia, Czech Republic, Denmark Hungary, Romania, Poland, Sweden and United Kingdom)
GCC	Gulf Cooperation Council countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates)
MENA	Middle and East North Africa
International Financial Institutions/Authorities	
BIS	Bank for International Settlements
BoE	Bank of England
BSC	Banking Supervision Committee
EBA	European Banking Authority

EC	European Commission
ECB	European Central Bank
EIOPA	European Insurance and Occupational Pensions Authority
ESAs	European Supervisory Agencies
ESFS	European Systems of Financial Supervision
ESMA	European Securities and Markets Authority
ESRB	European Systemic Risk Board
Fed	Federal Reserve Bank
FSB	Financial Stability Board
FSOC	Financial Stability Oversight Council
IMF	International Monetary Fund
OECD	Organization for Economic Co-operation and Development
SRB	Single Resolution Board
SSM	Single Supervisory Mechanism
Methods/estimators	
CABM	Computational Agent-Based Model
CGE	Computable General Equilibrium Model
CoVaR	Conditional Value-at-Risk
DEA	Data Envelopment Analysis
DFA	Distribution Frontier Approach
DSGE	Dynamic Stochastic General Equilibrium
FDH	Free Disposal Hull Analysis
FGLS	Feasible Generalized Least Squares
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
HP filter	Hodrick-Prescott filter
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
SFA	Stochastic Frontier Analysis
TFA	Thick Frontier Approach
VaR	Value at Risk
VAR	Vector Autoregression
Indicators/Variables	
CAR	Capital Adequacy Ratio
CCI	Consumer Confidence Indicator
CDS	Credit Default Swap
CIR	Cost to Income Ratio
CORR1	Corruption of bank officials
CORR2	Corruption – general constraint
CRG	Annual Credit Growth
DISCL	Disclosure Index
EF	Economic Freedom
ESI	Economic Sentiment Indicator
FSIs	Financial Soundness Indicators
FSSI	Financial System Soundness Index
GDP	Gross Domestic Product
GDPG	Annual GDP Growth rate
GPM	Gross Profit Margin
HPI / HPIC	House Price Index
INF	Annual Inflation Rate
INTR	Key interest rates
LD	Loans/Deposits
LIQ	Liquidity Ratio
ln Z	Natural logarithm of Z-score
MPIs	Macro-prudential Indicators
NIM	Net interest margin
NPL	Non-performing Loans
P/E	Price-Earnings ratio
POR	Portfolio Orientation
RAROC	Risk-adjusted return on capital
REG1	Business Regulation
REG2	Availability of laws and regulation
ROA	Return on Assets
ROAA	Return on Average Assets
ROE	Return on Equity
ROAE	Return on Average Equity

List of Abbreviations and Definitions

RORAC	Return on Risk-Adjusted Capital
SIZE	Natural logarithm of total assets
TAC	Total Capital Ratio
TSR	Total Share Return
Other terms	
BkHo	Bank Holding Company
CAMELS	Supervisory rating system (Capital adequacy, Assets, Management Capability, Earnings, Liquidity, Sensitivity)
CEPR	Centre for Economic Policy Research
ComB	Commercial Bank
CRDIV	Capital Requirements Directive IV
CRR	Capital Requirements Regulation
DLT	Distributed Ledger Technology
EC	European Commission
EONIA	Euro Over Night Index Average
EMS	European Monetary System
EMU	Economic and Monetary Union
ESCB	European System of Central Banks
G-SIIs	Global Systemically Important Institutions
IAS	International Accounting Standards
ICT	Information and communication technology
IFRS	International Financial Reporting Standards
InvB	Investment Bank
O-SIIs	Other Systemically Important Institutions
M&A	Mergers and acquisitions
MPIs	Macro-prudential Indicators
MUMs	Monetary Union Members
PPS	Percentage points
PrivB	Private Banking & Asset Management
QE	Quantitative Easing
RealB	Real Estate & Mortgage Bank
SD	Standard Deviation
TBTF	Too big to fail

II. Definitions

The following table defines various terms used throughout the thesis (in parentheses it was included the source of the definition).

Letter	Term	Meaning	
A	Asset	General	<i>“A resource controlled by an enterprise as a result of past events and from which future economic benefits are expected to flow to the enterprise” (ECB Glossary).</i>
		Financial asset	<i>Any asset that is (i) cash; or (ii) a contractual right to receive cash or another financial instrument from another enterprise; or (iii) a contractual right to exchange financial instruments with another enterprise under conditions that are potentially favorable; or (iv) an equity instrument of another enterprise (ECB Glossary).</i>
		Intangible assets	<i>“The reputation, name recognition and intellectual property such as knowledge and know-how. Furthermore intangible assets are known as the long-term resources of an entity, but they have no physical existence” (Business Dictionary).</i>
		Liquid assets	<i>“An asset that can be converted into cash in a short-time, with little or no loss in value” (Business Dictionary).</i>
B	Bank Performance	<i>Capacity of a financial institution to generate sustainable profitability and efficiency (European Central Bank, 2010).</i> <i>-Bank profitability: “The state or condition of yielding a financial profit or gain” (Business Dictionary).</i>	

			<p>-Bank efficiency: “Ability of a financial institution to generate revenue from a given amount of assets and make profit from a given source of income” (European Central Bank, 2010).</p> <p>Within this thesis, the term bank performance is referring to both bank profitability and efficiency, unless stated otherwise.</p>
	Banking System (sector)		The structural network of banking and other financial institutions that offer financial services and products within a geographic area.
	Bank Soundness		<p>Refers to a stable and solid (resilient) banking system that is well-regulated and well-supervised, being essential for both domestic and international economic and financial stability (International Monetary Fund, 2015).</p> <p>Within this thesis, the term bank soundness is interchangeable with bank stability and bank solidity (resilience).</p>
	Banking Union		“One of the building blocks for completing Economic and Monetary Union, which consists of an integrated financial framework with a single rule book, a Single Supervisory Mechanism, common deposit protection and a single bank resolution mechanism” (ECB Glossary).
C	Capital	Economic	“Methods and/or practices that allow banks to attribute capital to cover the economic effects of risk-taking activities and is based on financial institution’s internally derived risk measurement methodology and parameters” (Bank for International Settlements, 2009).
		Regulatory	“The amount of capital that a financial institutions needs in accordance with the regulatory framework” (Bank for International Settlements, 2009).
	Capitalization / Undercapitalization		<p>1. Capitalization refers to the structure and amount of long-term equity and debt capitals of a company, commonly portrayed as a proportion of the total capital (equity and debt).</p> <p>2. Undercapitalized stands for the opposite situation, when “a company does not have sufficient capital for covering the size of its operations, or more specifically for conducting normal business operations and pay creditors” (Business Dictionary).</p>
	Central bank independence		“The legal provision which guarantees that a central bank can carry out its tasks and duties without political interference” (ECB Glossary).
	Country	Developed	“A group of industrialized countries with highly developed economy and advanced technological infrastructure” (Business Dictionary). They are also known as high-income countries as defined by the World Bank or advanced countries as defined by the IMF.
		Developing (Less developed)	A category of countries with underdeveloped industrial base, and a low Human Development Index relative to other countries. They are also known as middle-income countries as defined by the World Bank.
Least Developed		“A category of countries that are deemed highly disadvantaged in their development process, for structural, historical and also geographical reasons” (UNCTAD Glossary).	
D	Deposits		“Funds placed into an account at a financial institution to increase the credit balance of the account” (Business Dictionary).
E	Economy	Developed	“An economy enjoying sustained economic growth and security. Some of the common characteristics of a developed economy are high GDP, low birth rate and higher life expectancy, high level of literacy, a well trained workforce, and the export of high value added goods” (Business Dictionary).
		Emerging	“Rapidly growing and volatile economies which promise huge potential for growth but also pose significant political, monetary and social risks. Characteristics of an emerging economy are: intermediate income, catching-up growth, economic opening and

		<i>institutional transformations” (Business Dictionary). They are also known as low-income countries as defined by the World Bank.</i>
	Efficiency	<i>“The comparison of what is actually produced/performed with what can be achieved with the same consumption of resources” (Doing the thing right) (Business Dictionary).</i>
	Effectiveness	<i>“The degree to which objectives are achieved and the extent to which targeted problems are solved” (Doing the right thing) (Business Dictionary).</i>
	Euro	<i>“The name of the European single currency adopted by the European Council at its meeting in Madrid on December 15, 1995” (ECB Glossary).</i>
	Euro area (Eurozone)	<i>“The area formed by the EU Member States whose currency is the euro and in which a single monetary policy is conducted under the responsibility of the Governing Council of the ECB” (ECB Glossary).</i>
	Eurosystem	<i>“The monetary authority of the euro area, which comprises the European Central Bank and the national central banks of the Member States whose currency is euro” (ECB Glossary).</i>
	European Central Bank (ECB)	<i>“The EU institutions, established on June 1, 1997, as the body at the center of the European System of Central banks (ESCB) and the Eurosystem. Together with the national central banks of the EU Member states whose currency is the euro, the ECB defines and implements the monetary policy for the euro area” (ECB Glossary).</i>
	European Commission (EC)	<i>“The EU institution established in 1967 that drafts proposals for new EU legislation, makes sure that EU decision are properly implemented and supervises the way EU funds are spent” (ECB Glossary).</i>
	European Union member state	<i>A country that is a member of the European Union (ECB Glossary).</i> <i>European Union (EU): “is a unique economic and political union between 28 countries, being created in the aftermath of the Second World War to enhance economic cooperation and avoid conflicts” (European Commission).</i>
F	Financial cycle	<i>“A process in which mutually strengthening credit creation and asset price behavior amplifies the business cycle, resulting, under specific conditions, in a financial crisis due to excessive debt manifesting itself as financial stress and major economic disturbances” (Frait and Komarkova, 2011).</i>
	Financial fragility	<i>Refers to the “state in which minor shocks can roll-over the economy into a full blown crisis. To put it differently, financial fragility is an extreme case of excess sensitivity” (Allen and Gale, 2002).</i>
	Financial institutions (Financial intermediaries)	<i>“(A) an undertaking whose business is to receive deposits or other repayable funds from the public and to grant credits for its own account; or (b) an electronic money institution within the meaning of Directive 2000/46/EC of the European parliament and of the Council of 18 September 2000 on taking up, pursuit and prudential supervision of the business of electronic money institutions” (ECB Glossary). Usually there are three types of financial institutions: <u>banking institutions (depository)</u> – deposit taking institutions that accept and manage deposits and make loans (banks of different specializations, building societies, credit unions, and mortgage loan companies); <u>contractual institutions</u> (insurance companies and pension funds); and <u>investment entities</u> (trust companies, underwriters and brokerage firms).</i> <i>Within this group, banking institutions, or shortly banks refer to: “an establishment authorized by a government/monetary authority to accept deposits, pay interests, clear checks, make loans, act as an intermediary in financial transactions, and provides other financial services to its customers” (Business</i>

		<i>Dictionary). There are different types of financial institutions, but in this thesis we consider in this group the following: commercial banks, cooperative banks, investment banks, real estate and mortgage banks, savings banks and other financial entities (bank holding and holding companies, clearing institutions, finance companies, Islamic banks, micro-financing institutions, private banking and asset management, specialized governmental credit and other credit institutions).</i>	
	Financial system (sector)	<i>“The part of an overall economy comprising financial intermediaries (banks and other financial institutions, markets and market infrastructures)” (ECB Glossary).</i>	
	Financial stability	<i>“The condition in which the financial system is capable of withstanding shocks and the unraveling of financial imbalances, thereby mitigating the likelihood of disruptions in the financial intermediation process which are severe enough to significantly impair the allocation of savings to profitable investment opportunities” (ECB Glossary).</i>	
G	Governance	<i>“Procedures through which the objectives of a legal entity are set, the means of achieving them are identified and the performance of the entity is measured. This refers, in particular, to the set of relationships between the entity’s owners, board of directors, management, users and regulators, as well as other stakeholders that influence these outcomes” (ECB Glossary).</i>	
I	Interest rate	<i>“A ratio, which is usually expressed as a percentage per annum, of the amount that a debtor has to pay to the creditor over a given period of time to the amount of the principal of the loan, deposit or debt security” (ECB Glossary).</i>	
	International Monetary Fund (IMF)	<i>An international organization, based in Washington, D.C., with a membership of 188 countries (2015). It was established in 1946 “to promote international monetary cooperation and exchange rate stability, to foster economic growth and high levels of employment and to help member countries to correct balance of payments imbalances” (ECB Glossary).</i>	
L	Lender of last resort	<i>“Central bank of a country that has the authority and financial resources to act as the ultimate source of credit. In emergencies, it extends loans to solvent but illiquid financial institutions whose failure to obtain credit would have a destabilizing effect on the national or regional economy” (Business Dictionary).</i>	
	Liquidity	<i>1. “A measure of the extent to which a company has enough cash to meet immediate or short-term obligations, or has assets that can be quickly converted to cash” (Business Dictionary). 2. “The ease and speed with which a financial asset can be converted into cash or used to settle a liability” (ECB Glossary).</i>	
	Loan	<i>“Agreements for a temporary transfer of a property (usually cash) from its owner to the borrower who promises to return it according to the terms of the agreements, usually with interest for its use” (Business Dictionary).</i>	
	Liability	General	<i>“A present obligation of the enterprise arising from past events, the settlement of which is expected to result in an outflow from the enterprise of resources embodying economic benefits” (ECB Glossary).</i>
		Financial liability	<i>“Any liability that is a legal obligation to deliver cash or another financial instrument to another enterprise or to exchange financial instruments with another enterprise under conditions that are potentially unfavorable” (ECB Glossary).</i>
M	MENA	<i>Middle East and North Africa Region</i>	
	Minimum reserves	<i>“The minimum amount of reserves a credit institution is required to hold with a central bank. In the minimum reserve framework of the Eurosystem, the reserve requirement of a credit institution is calculated by multiplying the reserve ratio for each category of items in the reserve base by the amount of those items on the institution’s balance sheet. In addition, institutions are allowed to</i>	

		<i>deduct a lump-sum allowance from their reserve requirement.” (ECB Glossary).</i>	
	Monetary authority (central bank)	<i>“An institution which, by way of a legal act, has been given responsibility for conducting the monetary policy for a specific area. In most of the cases this is represented by the central bank” (ECB Glossary).</i>	
	Monetary policy	<i>“Action undertaken by a central bank using the instruments at its disposal in order to achieve its objectives” (ECB Glossary).</i>	
	Moral hazard	<i>“The public safety net, providing assistance to financial institutions in distress and protecting the claim-holders from losses, upsurges the tendency of financial institution managers to assume excessive risk” (Freixas and Rochet, 1997; Boot and Greenbaum, 1993; Dewatripont and Tirole, 1993ab; Matutes and Vives, 1995).</i>	
O	Organization for Economic Co-operation and Development (OECD)	<i>The OECD is based in Paris and it was founded in 1961 as the successor to the Organization for European Economic Co-operation (OEEC). It brings together 34 member countries (2015) in an organization that “provides governments with a setting in which discuss, develop and perfect economic and social policy” (ECB Glossary).</i>	
P	Productivity	<i>“A measure of the efficiency of a personal, system, service etc., in converting inputs into useful outputs” (Business Dictionary).</i>	
R	Provisions	<i>“Amounts set aside before arriving at the profit and loss figure in order to provide for any known or expected liability or risk, the cost of which cannot be accurately determined” (ECB Glossary).</i>	
	Reserves	<i>“An amount set aside out of distributable profits, which is not intended to meet any specific liability, contingency or expected diminution in value of assets known to exist at the balance sheet data” (ECB Glossary).</i>	
	Risk	General	<i>“A probability or threat of damage, liability, loss or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action” (Business Dictionary).</i>
		Credit risk	<i>“The risk that counterparties will not settle the full value of an obligation – neither when it becomes due, nor at any time thereafter. Credit risk includes replacement cost risk, principal risk and the settlement bank failing risk” (ECB Glossary).</i>
		Idiosyncratic risk (unsystematic risk)	<i>“The possibility that the price of an asset may decline due to an event that could specifically affect that asset but not the market as a whole” (Business Dictionary). This risk has little or no correlation with market risk, and can therefore be substantially lessened from a portfolio by diversification.</i>
		Liquidity risk	<i>“The risk that counterparties will not settle an obligation in full when it becomes due. Liquidity risk does not imply that a counterparty or participant is insolvent, since it may be able to effect the required settlement at some unspecified time thereafter” (ECB Glossary).</i>
		Market risk	<i>“The risk of losses, in both on- and off-balance sheet positions, arising from movements in market prices” (ECB Glossary).</i>
		Operational risk	<i>“The risk of negative financial, business and/or reputational impacts resulting from inadequate or failed internal governance and business processes, people, systems, or from external events” (ECB Glossary).</i>
		Solvency risk	<i>“The risk of loss owing to the failure (bankruptcy) of an issuer of a financial asset or to the insolvency of the counterparty” (ECB Glossary).</i>
Systematic risk	<i>“The risk inherent in the aggregate market, non-diversifiable, that asset pricing theory predicts requiring compensation for investors</i>		

		to bear (Systematic risk generally refers to market risk). Systematic risk should include systemic risk” (Pennacchi, 2014).
	Systemic risk	“The risk that the inability of one participant to meet its obligations in a system will cause other participants to be unable to meet their obligations when they become due, potentially with spillover effects threatening the stability of or confidence in the financial system” (ECB Glossary). “Systemic risk refers to a breakdown or major dysfunction in financial markets, or more specifically to a particular event” (Hansen, 2012).
S	Solvency / insolvency	1. “Solvency refers to the state of financial soundness whereby an entity can meet its monetary obligations as they fall due” (Business Dictionary). 2. “Insolvency refers, in legal terminology, to the situation where the liabilities of a company exceed its assets. Though, in practice, insolvency is the situation where an entity cannot raise enough cash to meet its obligations, or to pay its debt as they become due for payment” (Business Dictionary).
	Systemically important financial institutions	“Financial institutions whose disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity” (Financial Stability Board, 2010).
	Stock	“A share of a company held by an individual or group. Corporations raise capital by issuing stocks and entitle the stock owners (shareholders) to partial ownership of the corporation” (Business Dictionary).
T	Too big to fail (TBTF)	“Theory that a certain business is so important to the financial system that it would be disastrous if it would be allowed to fail” (Business Dictionary).
	Too connected to fail (TCTF)	“Refers to the financial institutions that are the most important in a financial market; thus these institutions are the net center of the financial system being strongly connected with other financial institutions” (Chan-Lau, 2010).
	Too important to fail (TITF)	“Refers that the size of a financial institution does not capture the important reasons why its failure might create havoc, thus the reasons actually include the connections with other financial institutions, the difficulty of the financial institution’s resolution and a lack of substitutes for the services it provides” (Financial Stability Board, 2010).
	Too many to fail (TMTF)	“The situation when too many financial institutions are discovered to be passive or insolvent, thus it’s less costly to rescue financial institutions than to close large number of them” (Mitchell, 1997).
	Too similar to fail (TSTF)	Refers to “a highly interconnected financial network. More specifically, the majority or the entire part of the financial sector simultaneously face bankruptcy as soon as any institution holding the same or similar risk asset and position goes into bankruptcy or malfunction” (Bianculli, 2014).
	Too systemic to fail	Refers to “the systemic importance of a financial institution in detriment of its size, referring to the impact of failure of a systemic important financial institution on the overall financial system” (Barth, 2012).
	Too big to save	“Refers to the very large and complex financial institutions, which may be too large to be saved (rescued)” (Hüpkens, 2005).

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Note: The sources for the figures, tables and appendixes within this thesis can be interpreted as follows: (i) *retrieved from (...)* – the information was retrieved from the specified source without any changes; (ii) *adapted from (...)* – the information was retrieved from the specified source and changed considerably; (iii) *processed after (...)* – the information was extracted in a numerical form from the specified source and after manipulated to observe some specific trends and relationships; (iv) *no source mentioned* – the information is based on author's calculations.

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CHAPTER II: BANKING SYSTEMS AROUND THE GLOBE: DETERMINANTS OF PERFORMANCE AND SOUNDNESS

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PART II: EVALUATING FINANCIAL CRISES IN THE 21ST CENTURY

CHAPTER III: MEASURING THE PERFORMANCE AND SOUNDNESS OF EUROPEAN BANKS

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CHAPTER IV: NAVIGATING IN UNCHARTED WATERS – THE IMPACT OF ECONOMIC FREEDOM, REGULATION, CORRUPTION AND TRANSPARENCY ON EUROPEAN BANKING

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- ****Bank Tax Law* - Law of 12 July 2012 for introduction of a bank tax, 325 STAATSBLAD. § 325.07.2012 (2012). Available from the Netherlands Government Archives.
- *** *Council Regulation (EU) No 1024/2013 of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions*. § 1024/2013. Official Journal of the European Union, 287/63 (2013). Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013R1024&from=sk>
- *** *Council Regulation (EU) No 1096/2010 of 17 November 2010 conferring specific tasks upon the European Central Bank concerning the functioning of the European Systemic Risk Board*. § 1096/2010. Official Journal of the European Union, 331/162(2010). Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2010.331.01.0162.01.ENG
- ****Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms* amending Council Directive 82/891/EC, and Directives 2001/24/EC, 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU, 2012/30/EU and 2013/36/EU, and Regulations (EU) No 1093/2010 and (EU) No 648/2012, of the European Parliament and of the Council Text with EEA relevance. Official Journal of the European Union, 173(2014). Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0059>
- ****Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institution and the prudential supervision of credit institution and investment firms*, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC. § 26.06.2013 (2013). Official Journal of the European Union, 176(2013). Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013L0036>
- ****Directive 2000/46/EC of the European Parliament and of the Council of 18 September 2000*. § 46.09.2000 (2000). Official Journal of the European Union, 27(2000), 39-43. Retrieved from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0046:EN:HTML>
- *** *Dodd-Frank Wall Street Reform and Consumer Protection Act 2010*. H.R. 4173 – 111th Congress § 21.07.2010 (2010). Retrieved from <https://www.congress.gov/bill/111th-congress/house-bill/4173>
- ****Financial Services (Banking Reform) Act 2013*. §33.10.2015 (2015). Available from the UK National Archives.
- *** *Regulation (EU) No 806/2014 of the European Parliament and of the Council of 15 July 2014 establishing uniform rules and a uniform procedure for the resolution of credit institutions and certain investment firms in the framework of a Single Resolution Mechanism and a Single Resolution Fund* and amending Regulation (EU) No 1093/2010. § 806(2014). Official Journal of the European Union, 225/1 (2014). Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014R0806>

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- *** *Recommendation of the European Systemic Risk Board of 24 June 2016 amending Recommendation ERSB/2015/2 on the assessment of cross-border effects of and voluntary reciprocity for macroprudential policy measures. § 2016/ C 290/01. Official Journal of the European Union, 290/1 (2016). Retrieved from https://www.esrb.europa.eu/pub/pdf/recommendations/2016/ESRB_2016_4.en.pdf*
- *** *Recommendation of the European Systemic Risk Board of 15 December 2015 on the assessment of cross-border effects of and voluntary reciprocity for macroprudential policy measures. § 2015/ C 97/9. Official Journal of the European Union, 97/9 (2015). Retrieved from https://www.esrb.europa.eu/pub/pdf/recommendations/2015/ESRB_2015_2.en.pdf?745f914fd7e1c69f3015a5f1c32589d7*
- *** *Recommendation of the European Systemic Risk Board of 4 April 2013 on intermediate objectives and instruments of macro-prudential policy. § 2013/ C 170/01. Official Journal of the European Union, 170/1 (2013). Retrieved from http://www.esrb.europa.eu/pub/pdf/recommendations/2013/ESRB_2013_1.en.pdf*
- *** *Recommendation of the European Systemic Risk Board of 22 December 2011 on the macro-prudential mandate of national authorities. § 2012/C 41/01. Official Journal of the European Union, 41/1 (2012). Retrieved from [http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32012Y0214\(01\)](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32012Y0214(01))*
- *** *Regulation (EU) No 1092/2010 of the European Parliament and of the Council of 24 November 2010 on European Union macro-prudential oversight of the financial system and establishing a European Systemic Risk Board. § 1092(2010). Official Journal of the European Union, 331/1(2010). Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2010.331.01.0001.01.ENG*
- *** *Volcker Rule - Prohibitions and Restrictions on Proprietary Trading and Certain Interests in, and Relationships With, Hedge Funds and Covered Funds, 17 C.F.R. § 75.01 2014 (2014). Available from Federal Register Online.*
- *** *Treaty on European Union, together with the complete text of the Treaty establishing the European Community (consolidated version). § 326.10.2012 (2012). Official Journal of the European Union, 326(13), 1-390. Retrieved from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012M/TXT>*

Curriculum Vitae

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SUMMARY OF QUALIFICATIONS

- ◆ *Financial analysis skills*: identification, monitoring and evaluation of corporate financial statements in order to understand the structure of the company, its profitability, efficiency, and resilience;
- ◆ *Technical knowledge*: proficiencies include Microsoft Office (Word, Excel, PowerPoint, Outlook), statistical analysis packages (Stata, EViews, SPSS), programming (Visual Basic, C++, Dreamweaver);
- ◆ *Writing skills*: drafting skills of research papers for academic and non-academic public;
- ◆ *Communication and presentation skills*: exceptional interpersonal skills; a very good handling of sensitive matters with tact, poise, and diplomacy; communicate and interact well with individuals at all levels;
- ◆ *Teaching skills*: communication and understanding of others, adaptability and team-work, problem solving, motivational, critical and fair thinking;
- ◆ *Transversal skills*: adaptability and flexibility (via national and international collaborations), learning to learn (critical and analytical thinking, creative, problem solving and achievement focus, decision-taking), cultural awareness and expression (appreciation and enjoyment of the cultural heritage specific to each country), social and civic competences;
- ◆ *Leadership and organizational skills*: project management (planning, resources, budget), organization and coordination of scientific events;
- ◆ *Foreign languages*: Romanian (native language), English (fluent), French (intermediate), Spanish (beginner).

EDUCATION

PhD in Finance, Alexandru Ioan Cuza University and University of Auvergne **2013 - Present**
Clermont Ferrand, France and Iasi, Romania

Viva – September 2016

Thesis title: “*Performance and soundness of European banking systems*”

Thesis supervisors: Prof. Vasile COCRIȘ and Prof. Alexandru MINEA

Academic fields of interest: profitability, efficiency, soundness and financial stability, empirical methods applied in finance, regulation, conventional and unconventional monetary policy

Master in Finance “Banks and financial markets”, Alexandru Ioan Cuza **2011- 2013**
University

Iasi, Romania

Dissertation title: “*The communication policy of central banks and its role in increasing monetary policy efficiency*”

Bachelor in Economics, Alexandru Ioan Cuza University **2008 - 2011**

Iasi, Romania

Dissertation title: “*Evolutions and perspectives of the Romanian banking system*”

Bachelor of Law, Alexandru Ioan Cuza University **2009-2014**

Iasi, Romania

Dissertation title: “*Bankruptcy fraud*”

WORK EXPERIENCE

EUROPEAN COMMISSION

Economic analyst in Directorate General for Financial Stability, Financial Services and Capital Markets Union

October 2016 –
April 2017

- Contributed to the Review on the EU Macro-prudential policy framework (impact assessment, public consultation, feedback statements, public hearing etc.);
- Contributed to the country-specific work on macro-prudential policy implementation;
- Contributed to the work stream regarding the impact of technology on bank performance and stability (more specifically DLT Distributed Ledger Technologies);
- Acquired sound knowledge and practical experience of EU macro-prudential policies and missions, rules, procedures and activities of the Commission, particularly in the area of financial stability.

ESSCA ECOLE DE MANAGEMENT

Teaching assistant, Paris

January 2016 -
Present

- Prepared course and seminar material, bulletin board displays, exhibits, equipment and demonstrations (Bachelor program);
- Held weekly seminars, to provide student support and guidance, formative course assessment, and student evaluation for the intensive course “Financial Management”;
- Evaluated and graded tests and exams, and computed and recorded results, using answer sheets or electronic marking devices.

EUROPEAN COMMISSION

Blue Book Trainee in Directorate-General Competition, Brussels

March-July 2016

- Contributed to the work of the Task Force Digital Single Market through the application of specific competence and educational background;
- Acquired sound knowledge and practical experience of EU policies and missions, rules, procedures and activities of the Commission, especially in the area of antitrust, competition advocacy and merger control;
- Participated in meetings at different levels and collaborate in organizational, information, documentation, administrative and logistic tasks of value for the service.

ECONOMIA ONLINE MAGAZINE

Contributing Editor, Iasi, Romania

2013 - 2015

- Wrote and reviewed articles and other materials as assigned;
- Collaborated with the editor-in-chief to review and develop the context of publications.

Unpaid Trainee

➤ **NATIONAL BANK OF ROMANIA , Bucharest, Romania**

August 2015

Topic – Determinants of profitability for European commercial banks

➤ **ESSCA ECOLE DE MANAGEMENT, Paris, France**

April – June 2015

Topic – Unconventional monetary policy in UK and its impact on bank profitability

➤ **HELLENIC OPEN UNIVERSITY, Athens, Greece**

October 2014 –
January 2015

Topic – Regulation, transparency and corruption in the European banking sector

- Comprehensively reviewed and analyzed academic and grey literature related to the topic of the research;
- Collected and analyzed quantitative data using robust methods and interpreted, described and tested the overall results;
- Produced a high quality report based on the analysis of data and literature with a clear and engaging writing style, focusing on a specific theme;
- Presented the results of independently performed research analysis to a group of specialists, and collected the general feedback with various critics and suggestions.

ALEXANDRU IOAN CUZA UNIVERSITY

Research and Teaching Assistant, Iasi, Romania

November 2013 –
February 2014

- Held weekly seminars, provided student support and guidance, formative course assessment, and student evaluation for the intensive course “Topics of Financial Integration and the European Single Currency”.

CARPATICA COMMERCIAL BANK

Corporate Relationship Manager, Iasi, Romania

August 2012 –
February 2013

- Set up meetings with old and new corporate clients, and created a new database of potential clients;
- Discussed complex information clearly and simply, understanding customer needs recommending suitable products and services;
- Found new sales opportunities and new clients;
- Performed financial analyses for corporate clients, based on the financial statements from the last two year and established their profitability, efficiency and solvency level;
- Managed a large and complex portfolio of loans granted to corporate clients.

EXTRACURRICULAR ACTIVITIES

Vice-President of ASECU Youth Organization from Greece	2013 -Present
Member Student4Excellence Association from Austria	2012-2013
Member AEGEE Organization from Romania	2012-2013
Audit Responsible ASECU Youth Organization from Greece	2011-2013
Unpaid Trainee , UniCredit Tiriac Bank Romania	2010-2011
Unpaid Trainee , Piraeus Bank Romania	2010
Unpaid Trainee , BRD Groupe Societe Generale	2009

AWARDS

Lauréate de la Bourse Municipale Award granted by the Municipality of Clermont Ferrand, France	2015-2016
Best Paper Award International Conference “Improving Business and Socio-Economic Environment for Enhancing Competitiveness”, Belgrade, Serbia	2015
Best Paper Award International Conference “Socio-Economic regional development in the context of European integration”, Rzeszów, Poland	2014
Best Paper Award International Summer School on Knowledge Economy - impact on sustainable development of the countries from East and South East Europe, Kotor, Montenegro	2013
1st place National Competition in Economic. Section: Finance and Financial institutions, Romania	2013
Excellence Award for outstanding academic performance Société Générale Romania	2012

REFERENCES

PhD Supervisors	Cocriș Vasile	Professor, PhD – Deputy Dean of Faculty of Economics and Business Administration, Alexandru Ioan Cuza University of Iasi, Romania E-mail: vcocris@uaic.ro , Telephone: (+40) 232.201.451
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Mentors	Pintilescu Carmen	Professor, PhD - Deputy dean of Faculty of Economics and Business Administration, Alexandru Ioan Cuza University of Iasi, Romania E-mail: carmen.pintilescu@uaic.ro , Telephone: (+40) 232.201.627
	Philippas Dionisis	Professor, PhD - ESSCA Ecole de Management, France E-mail: dionisis.philippas@essca.fr , Telephone: (+33) 014.186.2003
European Commission	Maes Stan	Deputy Head of Unit - European Commission, DG FISMA, Brussels, Belgium E-mail: stan.MAES@ec.europa.eu , Telephone: (+32) 229 - 80301
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List of Publications and Scientific Events

1. LIST OF RESEARCH ARTICLES

I. ISI articles

- Minea, A., Mustea, L., & Tomuleasa, I. (2015). Croissance économique et chômage en Roumanie: Une analyse de loi d'Okun régionale. *Canadian Journal of Administrative Sciences*, 36 (3,) 366-379. doi: 10.1080/02255189.2015.1059319

II. Articles indexed in Conference Proceedings (ISI Proceedings)

- Tomuleasa, I. (2015). Macroprudential policy and systemic risk: An overview. *Procedia Economics and Finance*, 20 (2015), 645-653. doi: 10.1016/S2212-5671(15)00119-7
- Tomuleasa, I. (2015). Central Bank Communication and its Role in Ensuring Financial Stability. *Procedia Economics and Finance*, 20 (2015), 637-644. doi: 10.1016/S2212-5671(15)00118-5
- Roman, A., & Tomuleasa, I. (2013). Analysis of Profitability Determinants: Empirical Evidence of Commercial Banks in the New EU Member States. *Proceedings of 14th International Conference on Finance and Banking*, Ostrava, Czech Republic, 372-383.

III. Articles published in national journals or international databases

- Tomuleasa, I., & Cocriș, V. (2014). Measuring the financial performance of the European systemically important banks. *Financial Studies*, 4 (2014), 31-51.
- Tomuleasa, I. (2014). Bank performance and soundness in the new EU member states. *Management Intercultural*, 16 (2), 499-512.
- Tomuleasa, I. (2014). The Soundness of the Financial Systems in CEE Countries. *Network Intelligence Studies*, 2 (2), 295-304;
- Tomuleasa, I. (2014). The Soundness of the Banking System during the Global Financial Crisis. *SEA – Practical Application of Science*, 3 (1), 598-608.
- Tomuleasa, I. (2013). Macroprudentialitatea și stabilitatea financiară, *Management Intercultural*, 29 (2013), 353-365.
- Avadanei, A., & Tomuleasa I. (2013). Coordinates of a New European Banking Model. In “Probleme actuale ale economiei globale” (Current problems of global economy), *Ovidius University Annals*, 13 (1), 132-137.

IV. Articles published in conferences volumes (abstract or extenso)

- Cocriș, V., Tomuleasa, I. (2014). *Performance and Efficiency of the European Banking Sector*, volume „Recent issues in economic and business doctoral research”, Iași: Alexandru Ioan Cuza University Publishing.
- Apătăchioae, A., Tomuleasa, I. (2014). *Measuring systemic risk of the European Banking Sector*, Proceedings of „21st International Economic Conference”, „Lucian Blaga” Sibiu University, Romania, 152-162.
- Tomuleasa, I. (2014). *Measuring the financial performance of the European banking sector*, Proceeding of the International Conference “Socio-Economic regional Development in the context of European Integration”, 15-18 July 2014, Rzeszów, Poland, 236-251.
- Tomuleasa, I. (2013). *Bank performance and efficiency during the global financial crisis: a comparative case study*, Section 6: Financial Market Innovations, Fotografika Publishing, Podgorica, Montenegro, 335-344.
- Tomuleasa, I. (2013). *Bank Performance in Emerging Europe: A Cross-Country Analysis*, Section 2: Economics and Management, Zilina University Publishing Zilina, Slovakia, 243-246.
- Tomuleasa, I. (2012). *Monetary policy: a Journey from Micro to Macroprudential Framework*, volume „Economic Growth in Conditions of Globalization”, Chișinău, Moldova.

- Tomuleasa, I. (2012). *Implications of Current Global Financial Crisis on the Financial System in the Countries of Central and South Europe*, volume, „Relevant Issues of Development of World Economy and Economy of Countries of the Southern and Eastern Europe”, RSUE Publishing, Rostov on Don, Russia, 190-194.
- Tomuleasa, I. (2012). „The role of macroprudential policy in ensuring financial stability: An Overview”, volume „Ethics and Business in 21st Century. Impact and implications of the Global Financial and Economic Crisis”, Yerevan, Armenia.

2. LIST OF WORKING PAPERS

- Hofler, R., Minea, A., Tomuleasa, I. (2014-2017). *Assessing the performance and stability of banking systems: A survey*;
- Asteriou, D., Pilbeam, K., Tomuleasa, I. (2014-2017). *The role of economic freedom, regulation, corruption and transparency on bank profitability and soundness: Evidence from Europe*;
- Philippas, D., Papadamou, S., Tomuleasa, I. (2015-2017). *The role of financial sector on quantitative easing decisions: Evidence from UK*.

3. LIST OF CHAPTERS IN BOOKS

- Tomuleasa, I. (2016). Topics related to efficiency in European banking. In V. Cocriș, & A., Roman (Eds.), *Dynamics of European Banking Integration*. Iași, RO: Alexandru Ioan Cuza University Publishing.
- Andrieș, A., & Tomuleasa, I. (2012). Comunicarea transparentă este mai eficientă decât anunțurile surpriză pentru activitatea băncilor centrale. In V. Cocriș, D. Chirleşan, & A. Angela (Eds.), *Băncile centrale, mediul economic și guvernarea în contextul mondializării*. Iași, RO: Junimea Publishing.
- Andrieș, A., Tomuleasa, I. (2012). Politica monetară și stabilitatea financiară: lecții ale crizei internaționale actuale. In A. Angela, & D. Chirleşan (Eds.), *Sistemul financiar-bancar și politica monetară: evoluții și tendințe*. Iași, RO: Junimea Publishing.
- Tomuleasa, I. (2011). Impactul crizei financiare globale actuale asupra sectorului bancar din România. In M. Mureșan, D. Chirleşan, & A. Roman (Eds.), *Băncile, politica monetară și stabilitatea financiară sub impactul crizei globale actuale*. Iași, RO: Junimea Publishing.
- Tomuleasa, I. (2011). Poate cadrul european pentru menținerea stabilității financiare stopa transmiterea crizei financiare între statele: Portugalia, Italia, Grecia și Spania? In M. Mureșan, D. Chirleşan, & A. Roman (Eds.), *Băncile, politica monetară și stabilitatea financiară sub impactul crizei globale actuale*. Iași, RO: Junimea Publishing.

4. LIST OF CONFERENCES & WORKSHOPS

2017	<ul style="list-style-type: none"> ▪ International Conference “26th European Financial Management Association”, 28 June – 01 July 2017, Athens, Greece; ▪ International Conference “15th Infiti Conference on International Finance”, 12-13 June 2017, Valencia, Spain; ▪ Workshop “How to use the ORBIS database – for beginners and advanced users”, 24 January 2017, European Commission, Brussels, Belgium;
2016	<ul style="list-style-type: none"> ▪ International Conference “World Finance & Banking Symposium”, 14-15 December 2016, Dubai, UAE; ▪ Workshop “Early warning systems”, 1 December 2016, European Commission, Brussels, Belgium; ▪ Workshop “Essentials of financial stability”, 29-30 November 2016, European Commission, Brussels, Belgium; ▪ International Conference “What next for Europe’s banking system?”, 15 November 2016, Bruegel, Brussels, Belgium; ▪ International Conference “Sustainable micro and macro-financial policies in a minimal growth scenario”, 9 November 2016, European Commission, Brussels, Belgium; ▪ Workshop “Knowledge Hour – EU Financial Integration after the crisis: Building a Capital Markets Union”, 14 October 2016, European Commission, Brussels, Belgium;

	<ul style="list-style-type: none"> ▪ International Conference “<i>Structural and conjectural features of SME financing in Europe</i>”, 13 October, 2016, European Commission, Brussels, Belgium;
2015	<ul style="list-style-type: none"> ▪ International Conference “<i>Improving Business and Socio-Economic Environment</i>”, 12-17 July 2015, Belgrade, Serbia; ▪ International Conference “<i>Euro and the European Banking System: Evolutions and Challenges</i>”, Iasi, Romania, 4-6 June, 2015; ▪ National Conference “<i>Cunoasterea sociala – inte fictiune euristica si coroborare factuala</i>”, 23-24 April 2015, Bucharest, Romania; ▪ <i>1st International Conference in Applied Theory, Macro and Empirical Finance</i>, 6-7 April 2015, Thessaloniki, Greece;
2014	<ul style="list-style-type: none"> ▪ „<i>International Conference of European Economy</i>”, 15-19 December, Warsaw, Poland; ▪ International Conference “<i>SEA Network Intelligence. The 1st NORD Conference</i>”, 28-29 November, Iasi, Romania; ▪ National Conference “<i>Cercetarea de excelență, cunoaștere științifică, progress social</i>”, 30-31 October 2014, Bucharest, Romania; ▪ “<i>Annual International Scientific Conference- Financial and Monetary Economics –FME 2014</i>”, 24 October, Bucharest, Romania; ▪ International Conference SEA “<i>Exploring creativity – Practices and Patterns</i>”, 17-18 October, Brasov, Transilvania University of Brasov, Romania; ▪ <i>Annual Scientific Conference of Romanian Academic Economists from Abroad (ERMAS)</i>, 18-22 August 2014, Cluj-Napoca, Romania; ▪ International Conference “<i>Socio-Economic regional Development in the context of European Integration</i>”, 15-18 July 2014, Rzeszów, Poland; ▪ 21st International Economic Conference – IECS 2014 “<i>Prospects of Economic Recovery in a Volatile International Context: Major Obstacles, Initiatives and Projects</i>”, 16-17 May 2014, Sibiu, Romania;
2013	<ul style="list-style-type: none"> ▪ International Conference GEBA „<i>Globalization and Higher Education in Economics and Business Administration</i>”, 24-26 October 2013, Iași, Romania; ▪ International Conference IFCB, „<i>14th International Conference on Finance and Banking: Financial Regulation and Supervision in the After-Crisis Period</i>”, 16-17 October 2013, Ostrava, Czech Republic; ▪ International Conference of ASECU Youth: <i>Knowledge Economy – Impact on Sustainable Development of the Countries from East and South East Europe</i>, July 15-20 2013, Kotor, Montenegro; ▪ International Conference TRANSCOM – <i>10th European Conference of Young Researchers and Scientists</i>, June 24-26, 2013, Žilina, Slovakia.
2012	<ul style="list-style-type: none"> ▪ International Conference GEBA „<i>Globalization and Higher Education in Economics and Business Administration</i>”, October 18-20, 2012, Iasi, Romania; ▪ IEFS Conference– <i>Economic growth in conditions of internationalization</i> , October 18-19, 2012, Chisinau, Republic of Moldavia; ▪ International Conference “<i>Current challenges of the global economy</i>”, July 12-14, 2012, Iasi, Romania.
2011	<ul style="list-style-type: none"> ▪ YES Summit „<i>Ethics and Business in 21st Century. Impact and implications of the Global Financial and Economic Crisis</i>”, November 28-December 3, 2011, Yerevan, Armenia; ▪ International Conference of ASECU Youth „<i>Relevant Issues of Development of World Economy and Economy of Countries of the Southern and Eastern Europe</i>”, September 12-18, 2011, Rostov on Don, Russia.

5. LIST OF SUMMER SCHOOLS

- | | |
|-------------|---|
| 2015 | <ul style="list-style-type: none"> ▪ 5th International Summer School of ASECU Youth, University of Belgrade, Faculty of Economics, Belgrade, Serbia; |
| 2014 | <ul style="list-style-type: none"> ▪ 4th International Summer School of ASECU Youth, University of Rzeszów, Faculty of Economics, Rzeszów, Poland; |
| 2013 | <ul style="list-style-type: none"> ▪ Summer School in Introductory Econometrics, Utrecht University School of Economics, Utrecht, Netherlands; ▪ 3rd International Summer School of ASECU Youth, Faculty of Economics Podgorica, Montenegro. |