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UNIVERSITY OF RIJEKA
FACULTY OF ECONOMICS AND BUSINESS

Ivan Gržeta

EFFICIENCY DETERMINANTS AND REGULATORY IMPACT ON BANKING OPERATIONS IN THE EU

DOCTORAL THESIS

Rijeka, 2019

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Mentor: prof. Saša Žiković, PhD

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SVEUČILIŠTE U RIJECI
EKONOMSKI FAKULTET

Ivan Gržeta

DETERMINANTE EFIKASNOSTI I UTJECAJ REGULACIJE NA POSLOVANJE BANAKA U EU

DOKTORSKI RAD

Rijeka, 2019

Supervisor of the thesis: Prof. Saša Žiković, PhD

The doctoral thesis has been defended on November 25th 2019 at University of Rijeka, Faculty of Economics and Business, before the Committee of the following members:

1. Prof. Mario Pečarić, PhD, Committee Chair, Faculty of Economics and Business, University of Rijeka, Croatia
2. Prof. Marko Košak, PhD, member, School of Economics and Business, University of Ljubljana, Slovenia
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SUMMARY

Strong banking regulation and supervision creates a stable and secure banking environment with the aim of avoiding the negative effects that bank failure can have on the overall economy. However, the impact of the banking regulatory framework remains a much- researched topic since its refinements and changes have significant implications on the operations of individual banks. The latest regulatory framework introduced globally in the form of Basel 3 and its implementation into the legislation of EU Member States has aroused interest in identifying the determinants of efficiency, as well as in analysing the impact of regulation on banks' operations, i.e. its impact on their efficiency and profitability. The aim of this doctoral dissertation is to show how, depending on size, the relative efficiencies of commercial banks differ across EU countries, and to analyse the impact of the latest regulatory framework on the efficiency and profitability of commercial banks in the European Union (EU28). The analysis was conducted on the basis of 433 commercial banks from all European countries, over the period from 2006 until 2015. The impact of the new regulatory framework on the banking industry (Basel implementation in EU legislation) was conducted in 2-stage analysis. In the first stage, the relative efficiency was calculated based on the widely used non-parametric Data Envelopment Analysis method. Since most economic variables exhibit dynamic behaviour, the second phase, or the impact of regulation on banks' operations, is performed using dynamic panel data. The results of the analysis of relative efficiency show that relative efficiencies differ significantly among the countries of the European Union, and that significant differences are also visible in the relative efficiencies of banks depending on their size. An analysis of the impact of regulation on bank operations shows interesting results. Namely, regulation negatively affects the efficiency of all banks, regardless of their size, has no significant impact on the profitability of large and medium-sized banks, while the impact on the profitability of small banks is negative and significant. Such results suggest that large and medium-sized banks have skilfully adapted to the new regulatory environment because, although their efficiency has been deteriorated, the impact on their profitability is absent. Small banks, on the other hand, suffer from a decline in their efficiency, as well as a decline in profitability, which can certainly lead to their closure or merger with larger banks. Such a trend is worrying as it leads to greater concentration of the banking sector. This doctoral dissertation contributes to the existing literature in terms of the impact of regulation on the relative efficiency and profitability of banks, and contributes to the conclusion that regulation should not be implemented in same way to all banks,

that is, a distinction should be made between small and large banks when introducing new regulatory environment.

KEYWORDS: European Union, bank regulation and supervision, bank profitability, bank efficiency

SAŽETAK

Regulacija i supervizija nad bankama omogućuje stabilan i siguran bankovni sustav s ciljem izbjegavanja negativnih učinaka koje propast banaka može imati na cjelokupnu ekonomiju. Utjecaj bankarskog regulatornog okvira na poslovanje banaka često je u fokusu istraživača, te je stoga široko istraživana tema obzirom na to da njegove dorade i promjene imaju značajne implikacije na poslovanje kako individualnih banaka, tako i cjelokupne ekonomije. Posljednji regulatorni okvir uveden na globalnoj razini u obliku Basela 3 i njegova provedba u zakonodavstvo zemalja članica Europske Unije probudio je interes u identificiranju determinanti efikasnosti, kao i u analizi utjecaja regulacije na poslovanje banaka, odnosno utjecaja na njihovu efikasnost i profitabilnost. Cilj ove doktorske disertacije je pokazati kako se, ovisno o veličini, relativne efikasnosti komercijalnih banaka razlikuju u zemljama Europske Unije, te analizirati utjecaj zadnjeg regulatornog okvira na efikasnost i profitabilnost komercijalnih banaka u Europskoj Uniji (EU28). Analiza je provedena na uzorku od 433 komercijalne banke iz svih europskih zemalja, kroz vremenski period od 2006. do 2015. godine. Utjecaj novog regulatornog okvira na bankarski sektor (implementacija Basela u zakonodavstvo Europske Unije) je analiziran u 2 faze. U prvoj fazi se proveo izračun relativne efikasnosti temeljem neparametarske metode analize omeđivanja podataka (eng. Data Envelopment Analysis). Obzirom na to da većina ekonomskih varijabli pokazuje dinamično ponašanje, u drugoj fazi se analizirao utjecaj regulacije na poslovanje banaka korištenjem dinamičke panel analize (eng. dynamic panel data). Rezultati analize relativne efikasnosti pokazuju da se relativna efikasnost znatno razlikuje među zemljama Europske Unije, te da su značajne razlike vidljive i u relativnoj efikasnosti banaka ovisno o njihovim veličinama. Analiza utjecaja regulacije na poslovanje banaka pokazuje zanimljive rezultate. Naime, regulacija negativno utječe na relativnu efikasnosti svih banaka, neovisno o njihovim veličinama, no s druge strane, regulacija nema signifikantnog utjecaja na profitabilnost velikih i srednjih banaka, dok je utjecaj na profitabilnost malih banaka negativan i signifikantan. Takvi rezultati upućuju na zaključak da su se velike i srednje banke uspješno prilagodile novom regulatornom okruženju, jer iako im je smanjena efikasnost, negativan utjecaj na njihovu profitabilnost je izostao. Male banke, uz pad svoje efikasnosti, trpe i pad profitabilnosti što može voditi prema njihovom daljnjem zatvaranju ili pripajanju većim bankama. Takav trend je zabrinjavajući obzirom na to da dovodi do veće koncentracije bankovnog sektora. Ova doktorska disertacija doprinosi postojećoj literaturi vezano uz utjecaj regulacije na relativnu efikasnost i profitabilnost banaka, te doprinosi zaključku

da se regulacija ne smije bazirati na jednakom pristupu prema svim bankama, odnosno da se treba napraviti razlika između malih i velikih banaka prilikom kreiranja novog regulatornog okruženja.

KLJUČNE RIJEČI: Europska unija, regulacija i supervizija banaka, profitabilnost banaka, efikasnost banaka

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1. INTRODUCTION

Efficiency and its measurement have always been central topic of every successful business entity or company, because on business efficiency depends the end result, and therefore it deserves a lot of attention from researchers and managers. A lot of research papers were made on that subject with different ways of efficiency measurement, where main focus in their calculation is how efficient are companies from different industries in transforming their inputs to their respective outputs.

The banking industry is no exception. A well-functioning banking system is considered to be a generator of economic growth and development (Barth *et al.*, 2013). Economy depends on the availability of funds that can currently be lacking by the investor or physical entities, which are necessary for their business operations and personal development. The amount of available funds on the market depends on the banking skill of converting excess cash into placements, i.e. their efficiency. For this reason, calculating the relative efficiency of banks in 28 European Union countries is the central theme of this dissertation.

Banks in the European Union are specific for one reason. Namely, they are subject to the same regulations that was enacted at European level. Although essentially all commercial banks are engaged in similar business, unified regulations will affect banks differently, depending on their size. The impact of the regulation will be mostly reflected in two banking business segments, their efficiency and profitability. The database of EU banks from 28 countries serves as an attractive and useful pool from which to analyse this issue.

Following chapters of the Introduction are in standard form. First will be explained problem and object of research, then research hypotheses, research aim, scientific methods used in the dissertation and structure of thesis.

1.1. Problem and object of research

Banks have always played a major role in the economy as they financially stimulated household consumption, entrepreneurship, the labour market, investments, financial markets, etc. With the development of financial products and derivatives, the link between banks and the real economy only deepened further, as banks thus can provide customers with new types of products that they

use for their own well-being. Security and strength of the banking system is crucial to safeguard the interests of investors, individuals and the overall financial market (Bouheni *et al.*, 2014) and financial intermediaries play an important role in the functioning of any modern economy. Health of the financial sector is crucial to the health of the overall economy. (Bucevska and Hadzi Misheva, 2017)

Throughout the history, there were always different views on sound business between commercial banks and the supervisory body. While banks wanted to pursue as much as free operation business model as possible, there was always the regulator who controlled their business, sometimes even too harsh. Problem in the regulation lies in differences between goals of the banks and goals of the supervisory bodies who impose rules and regulations. Starting in 1933, after Great Depression that arose in 1929 after stock market crash followed by massive commercial banks failure, two members of Congress passed the bill known under the name of Glass-Steagall Act. This Act separated investment banking from commercial banking activities, and the reason behind it was that commercial banks where too much involved in investment banking activities that are considered riskier, using the funds gathered from depositors. Such Act lasted up until 1999, when it was replaced by the Gramm-Leach-Bliley Act which eliminated restrictions imposed by Glass-Steagall Act between commercial and investment banks. After passing the new bill, commercial banks rushed back in risky investment with one thought on mind - to boost profits. Many believes that this particular action resulted in subprime lending crisis that lead to the 2008 financial crisis which had massive impact on the world economy that can still be felt to this very day. It can be seen that supervisory body has certain impact on the banking industry, making it more prone to risk or stability.

In last thirty years has been made a lot to set unique business standards for the banks, in a sense of corporate governance, international financial report standards (IFRS), reporting standards, as well as by setting unique standards for banking supervision. All these changes have been made in order to make the financial sector safer and more stable. Problem with such view of the regulation lies in the fact that new regulatory framework and regulations mostly affect entire banking industry, regardless of the size of the bank, as well as the country of origin. Smaller banks can have their specific business activity that make them operate in profitable way, however, wanting to limit the operations of large banks, regulator mostly gives unique rules making it harder for smaller banks

to cope with such demands in a way that they remain profitable. Different business model and market niche of small and large banks make them inadequate for the application of unique rules. Relative efficiency of the banks, in a way of transferring inputs into outputs, as well as their profitability, can vary depending on the size of the bank or country of banks' origin. What is certain is that the same regulation is applied on their business, and that all should obey national or above national rules and guidelines.

The impact of the new regulatory framework on the European banking industry, more specifically, on banking operations, is the field of research of this doctoral dissertation. All of the European banks are obligated to comply with the common European banking regulatory framework, regardless of their size or country of origin. In addition to the above stated, the doctoral dissertation will also provide a theoretical analysis of new European regulatory framework which is based on Basel 3 framework. The focus of the dissertation will be on the effect of such regulation on European banking operations, specifically their profitability and relative efficiency.

In this scientific research, banking regulation and their influence on the operations will be done for all of the 28 European Union countries. The impact of new regulatory framework (implementation of Basel 2 and Basel 3 guidelines in the European Union) on the banking industry will be analysed using 2-stage analysis process. The first stage is the calculation of relative bank efficiency on individual basis using Data Envelopment Analysis (DEA) method. In the second stage dynamic panel data analysis will be employed to analyse the impact of new regulation on the efficiency and profitability of banks.

First step in this research is to define which banking determinants are the most appropriate for the efficiency analysis, and later to examine which banks in EU28 states have highest efficiency (with respect to their size). Main research question is the impact of regulation on banking operation (relative efficiency and profitability).

Given the above stated, problem of this scientific research can be defined as follows:

Regulatory bodies should impose strong regulatory framework for banking operations, considering that the free will of the banks can cause broad negative effects on the entire economies, not just their individual performance. However, different characteristic of the banks depending on their size should be taken into consideration. Identical or similar regulatory requirements can lead to poor

performance of small banks resulting in their disappearance or merger with larger banks. In order to make an adequate decision regarding financial institutions, policymakers need to have accurate information on all aspects of the banks they supervise, including the impact of regulation on banks, depending on their size. In addition to the above stated, the doctoral dissertation will also provide a theoretical analysis of new European regulatory framework which is based on Basel 3 framework. The focus of the dissertation will be on the effect of such regulation on European banking operations, specifically their profitability and relative efficiency.

1.2. Research hypotheses

Based on previously stated introduction, the main research hypotheses can be set as follows:

Global banking regulatory framework (Basel 2 and Basel 3) have considerable negative effects on banking operation within European Union.

There is substantial amount of empirical research on the effect of regulation to the banking operations. Some of the authors analyse impact of regulation on lending operations, like (Cerutti, Claessens and Laeven, 2015; Boissay and Collard, 2016; Roulet, 2017), where they analyse the effect of regulation on the credit supply and growth, while others focus on relative efficiency or profitability as a proxy for banking operations, like (Pasiouras, 2008; Pasiouras, Tanna and Zopounidis, 2009; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; Psillaki and Mamatzakis, 2017; Triki *et al.*, 2017) and others. For the impact of regulation on the loans, general conclusion is that the credit supply decrease in quantity, but it increases in quality. On the other hand, impact of the regulation on the relative efficiency differs from author to author, as well the impact of regulation on profitability (will be discussed later in dissertation).

Such research hypotheses imply several auxiliary hypotheses:

AH1: Under the current regulatory framework bank relative efficiency depends on the size of the bank

AH2: Under the current regulatory framework bank relative efficiency depends on the country of origin

AH3: Size of the bank is one of the key features driving the effect of regulation on banking efficiency and profitability

Relative efficiency in the banking industry is widely used, but mostly for the banks in specific area, or for selected banks. (Pasiouras, 2008; Pasiouras, Tanna and Zopounidis, 2009; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; Psillaki and Mamatzakis, 2017; Triki *et al.*, 2017). This doctoral dissertation will certainly complement the existing literature on the relative efficiency of banks, given that the sample is made up of banks from EU28 Member States, separated by size and country of origin.

1.3. Research aim

Based on the problem and object of research, as well as research hypotheses, research aim is given in continuation.

Research aim is to analyse the impact of the latest European banking regulatory framework on the relative efficiency and profitability of commercial banks in European Union (EU28), while taking into account their size, as well as to show how relative efficiencies differ due to their size and across EU Member States. Due to the complexity of the regulatory framework and the lack of data, the aim of the study is to investigate how the introduction of new regulation (in the form of a dummy variable) affects banks' operations. The new requirements imposed by the regulator relate primarily to the quality of capital and liquidity of banks, in the sense of introducing new measures that were not previously expressed in the operations of banks, and therefore there is no data for them.

The goal of the doctoral dissertation is to analyse the impact of the latest European banking regulatory framework on the efficiency and profitability of commercial banks in European Union (EU28). The analysis will be performed by taking into account the banks' size, focusing on the changes in the relative efficiencies due to variations in size and country of operations.

This research provides empirical insight into the efficiency determinants for a sample of banks operating in EU, and the impact of regulatory framework on banks' efficiency and profitability.

Expected scientific contribution is the following:

- to show that banks' relative efficiency differs depending on the size of the bank and the country of bank origin (i.e. headquarters)
- to show that latest banking regulation has disproportional (harming) effects on small banks in comparison to the medium-sized and large banks

Bank efficiency analysis will be calculated for all of the EU countries in period from 2006 to 2015, and it will be determined which EU countries host the most efficient large, medium-sized and small banks. Efficiency analysis will not be performed for just one year, as is usually the case, but will be performed throughout the observation period, giving us a better understanding of the time dynamics and development of efficiency. Furthermore, efficiency score obtained in such a way forms a time variant matrix that will then be used for panel data analysis.

There is a considerable amount of research on the link between banking regulation, supervision and stability of banking system. However, there is limited research on the impact of the latest regulatory environment on bank efficiency and operations. Furthermore, there is limited research on the impact of regulation on the efficiency and performance of banks, depending on their size. Expected contribution of this dissertation is an empirical proof that current banking regulation is size dependent and as such disproportional to market participants. If my hypothesis is proved it will mean that differences in sizes between commercial banks should be taken into account, and have important implication of the regulation of banks, in a sense that regulation should differ for small banks, and for medium-sized and large banks.

For the purpose of solving defined problem and object of research, as well as to test research hypotheses and to achieve research aim, it is necessary to give scientific answer on several research questions, of which most important are:

Does relative efficiency differ, and how volatile is according to the size of the bank?

Does relative efficiency differ, and how volatile is according to the country of origin of the bank?

What are the profitability determinants in the banking sector?

What are the main characteristics of the latest global banking regulation, and how does it transfer to the banking sector in the European Union?

What are the main characteristics of banking regulation and supervision in the European Union?

How does regulation influence the profitability and relative efficiency of the banks in the European Union?

How does regulation influence the profitability and relative efficiency of the banks in the European Union, depending on their size?

1.4. Scientific methods

In theoretical part of the dissertation will be gathered and analysed previous experiences and knowledge from the defined research problem based on the classical scientific methods: inductive and deductive reasoning, methods of analysis and synthesis, abstraction and concretization methods, generalization and specialization methods, proof and objection method, descriptive methods, comparative methods, classification methods, graphical, statistical and mathematical methods, compilation methods and historical methods.

Main dataset used in the dissertation is the banking data from BankScope database provided by Bureau van Dijk and Fitch Ratings, which has comprehensive coverage of banks in the European Union (EU28), and that contain basic data, financial ratios and financial statements. The limitation of taking secondary data is in the accuracy of the data itself. Due to the volume of banks, it was not possible to take financial statements for each bank separately throughout the observed period. All of the data has yearly frequency and are expressed in euro currency. Other required data will be gathered from the statistical office of the European Union – EUROSTAT and from published banks' financial statements.

A part of the relevant research papers that will be used in this dissertation, except the ones already mentioned, are given in the references section. On top of the relevant research papers, EU legislative package (CRD IV package) is essential for this dissertation, since it basically transposes Basel III standards into an EU law. It consists of a regulation and a directive: Capital Requirement Regulation (575/2013) and Capital Requirement Directive (2013/36/EU).

Basic scientific method is Data Envelopment Analysis and panel data. The analysis will be performed using a two-stage approach. In the first stage, the efficiency determinants of commercial banks in Europe will be defined and identified, and afterwards, in the second stage, the impact of regulation on banks' profitability and efficiency will be investigated.

In the first stage, bank efficiency will be calculated using the widely employed non-parametric method Data Envelopment Analysis (DEA), with variable return of scale and input orientation, while in the second stage dynamic panel data analysis will be employed to analyse the impact of new regulation on the efficiency and profitability of banks. Both scientific methods cover timeline of 10 years, from the year 2006 to the year 2015, and all of the 28 European States.

1.5. Structure of thesis

Doctoral thesis is divided on six parts. The Introduction defines the problem, subject and object of the research, the main and the auxiliary hypotheses, the purpose and objectives of the scientific research and the scientific method used in the research. This section gives an insight into the content structure of this paper.

The second part of the presentation entitled Basel Committee on Banking Supervision and Its' Role on European Banks explains the importance of the Basel Committee that is headquartered at the Bank for International Settlement in Basel, and gives an insight into the organization of the Board itself, their powers and scope. In the second part will be explained the purpose of Basel regulation in managing a more stable banking system, as well as the history of changes in the requirements of regulators. It will also be highlighted the most important novelties in the latest regulatory box, as well as their suggestions for further improvements.

Financial institutions and supervision in the EU is the title of the third part of the dissertation, which in detail explains terms and institutions of the complex European Union financial system. Emphasis will be put on different types of regulation that the regulator wants to satisfy in order to maintain safer and more stable banking system. This section will analyse European supervision and the role of the European Central Bank, and how the European Union implemented the Basel Committee guidelines.

Theoretical Background on relative efficiency and profitability in the banking sector is the fourth part of the dissertation. It analyses and highlights the most important findings of numerous researchers on the methodology of calculating relative efficiency in the banking sector, as well as the methodology for calculating the impact of regulation on banks' operations. This part will list

authors who used various determinants of efficiency, as well as authors who used various proxies and ratios to calculate profitability, and will be summarized their research results. This section will clearly define the difference between the research done so far and the research that underlies this dissertation.

Methodology and data is the title of the fifth and central chapter of this dissertation. It outlines the concepts and methods of measuring bank relative efficiency, with an emphasis on data envelopment analysis, as well as a methodology for calculating the impact of regulation as well as other variables on profitability and efficiency. This part will also clarify the relevant methodological aspects of empirical research and will present and interpret the results of the research itself and the motive of proving the hypotheses. First, the inputs and outputs will be defined for the purpose of calculating the relative efficiencies, after which the remaining variables necessary to calculate the impact of regulation on banks' operations will be clarified. The limitations and problems of scientific research will be outlined, the scientific contributions of this paper will be highlighted, the application and implication of research results, as well as recommendations for further research in this field will be given.

The conclusion is the last, sixth, part of the dissertation, where is explained the subject of this paper as well as the justification of the regulatory framework that distinguish between small and medium-sized/large banks.

2. BASEL COMMITTEE ON BANKING SUPERVISION AND ITS' ROLE ON EUROPEAN BANKS

The Basel Committee on Banking Supervision (BCBS) is the first global setter of the macroprudential policies and regulation for the banks worldwide. As emphasized on their official internet page, "*its role is to strengthen the regulation, supervision and practices of banks worldwide with the headquarters at the Bank for International Settlements in Basel, Switzerland*". (BIS, Basel Committee Charter, 2018) The main difference between regulation and supervision is as follows: "*while regulation typically refers to the rules that govern the behaviour of banks, the supervision is the oversight that takes the place to ensure that banks comply with those rules*". (Vianney, 2011)

Regulation helps to improve safety of banking industry. As it is mentioned by (Tchana Tchana, 2014), banks have always been considered sensitive institutions that need government support to develop in a secure environment. Latest legislations had significant impact on the organizational structure of banks, dealing mostly with the risk department section. Supervisory framework set limitations and directions that enhance risk management and stimulate development of internal risk management models. Global legislation under Basel Committee contributed in promotion of sound risk management and development of adequate methodologies for their measurement. At the same time, regulatory framework set powerful incentive for the improvement on the measurement methodology. (Ivanović, 2009). However, even though stricter regulation provides sound management and improves safety in general, it also affects their real credit growth. (Cerutti, Claessens and Laeven, 2015) analysed the use of macroprudential policies (total of 18 different instruments taken from IMF survey called Global Macroprudential Policy Instruments) for 119 countries over 2000-2013 period, and their effect on real credit growth or real house prices credit growth. Their result suggests that macroprudential guidelines have a significant outcome on credit developments, in a way that they reduce the growth rate in credit (this effect is weaker for more developed and financially open economies). Macroprudential policies are related with larger cross-border borrowing, and interestingly, policies function better in the boom of a financial cycle, than in the bust.

Basel standards are not obligatory for the member states. As its decisions do not have legal force, they can only serve as the guidance in the creating of regulations and frameworks.

The Basel Committee on Banking Supervision (BCBS) was founded in 1974 from the group of ten countries (G-10), as a result of serious disturbances on the international currency markets.

The most famous disturbance on the market was failure of German Bankhaus Herstatt in West Germany, when in mid-June German Central Bank (Deutsche Bundesbank) forced it into liquidation. Prior the failure, a number of banks released deutche mark currency to Frankfurt based Herstatt Bank, in exchange for US dollars that was to be delivered in the New York. Due to time difference, US dollars were actually never delivered and therefore resulted in great disturbance on the currency market. (Žiković, 2010). Responding to that cross-jurisdictional implication of Herstatt fiasco, standing committee called Basel Committee on Banking Supervision was formed under the supports of the Bank for International Settlements, with the purpose of providing a platform for central bankers to harmonize mutually useful policies.

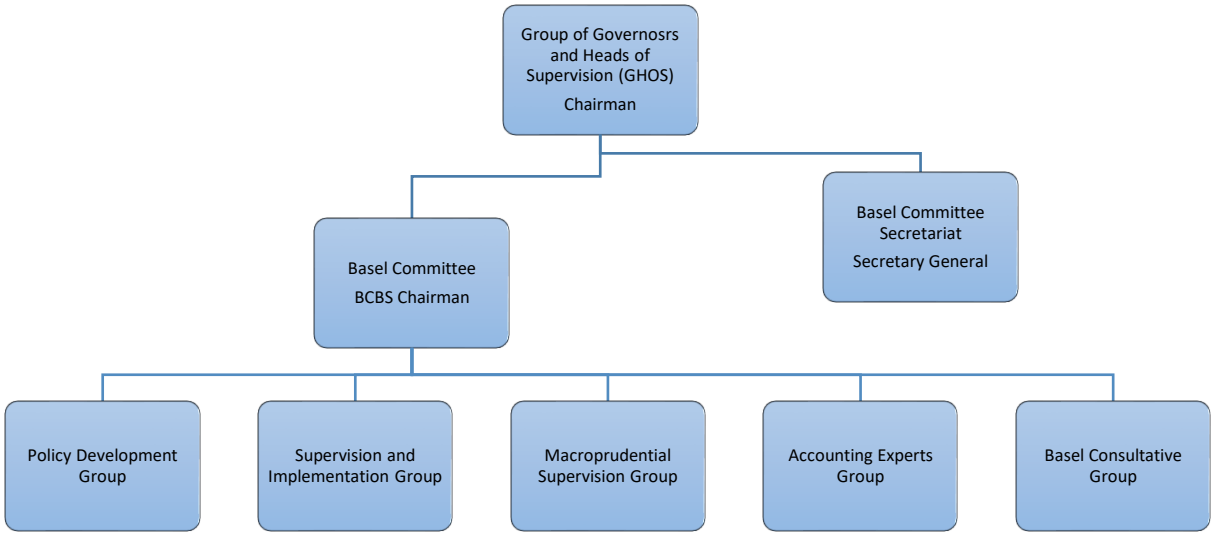
Main aim was to set coverage that no banking institution can escape supervision, and that supervision is consistent and adequate throughout all banking sectors and market. It first started as the groups of G-10 states, while now the Basel Committee on Banking Supervision comprise of 45 members from 28 jurisdictions. Namely, member states are following: United States, United Kingdom, Switzerland, Turkey, Sweden, South Africa, Spain, Saudi Arabia, Singapore, Russia, Mexico, Netherlands, Korea Luxemburg, Italy, Japan, India, Indonesia, Hong Kong SAR, France, Germany, China, European Union, Canada, Belgium, Brazil, Australia, and Argentina, while the observers are United Arab Emirates, Malaysia and Chile. The Committee meetings are held on regular basis, three to four times a year.

The Board regulates the standards of banking supervision, measurement of capital adequacy and risk management, as well as helping non-member countries to adopt and implement these standards into their banking systems. Their activities include exchanging information on banking sector in order to develop and improve global financial system, to improve cross-border cooperation with exchanging of ideas, techniques, models and other tools that can resolve supervisory issues, to promote global standards and sound practices, monitor of the implementation of standards, consult even with the non-member central banks and others. (BIS, Basel Committee membership, 2016)

BCBS organizational structure comprises of the Committee, different working groups, the Chair and the Secretariat. The Committee is the final decision-making body whose main responsibility is

to establish, guide and monitor the BCSB work programme provided by Group of Governors and Heads of Supervision (GHOS). (BIS, Basel Committee organisation and governance, 2019)

Figure 1: Governance structure of the Basel Committee



Source: Author, based on BIS, Basel Committee organisation and governance, 2019 BIS

Entire work of Basel Committee on Banking Supervision is mainly organized in groups, working groups, virtual networks and task forces. Such groups report to the Committee and are mainly composed of experts in different fields to handle specific tasks and situations. The Secretariat provide support and assistance to Committee, the Chair and the groups.

The main management bodies of the Bank for International Settlements (BIS) are:

1. Assembly of BIS Central Bank Member
2. Board of Directors
3. BIS Management.

The Bank for International Settlements states that the capital of the bank is in the hands of central banks. Sixty Central Banks and Monetary Authorities, members of BIS, have the right to vote and

sit on assemblies. The Board of Directors is responsible for establishing the BIS strategy and policy, overseeing BIS, and meeting the tasks set out in the Bank Statute.

This committee is also considering important issues such as budgeting and spending, human resources and IT.

The Board of Directors may have a maximum of 21 members, including six governors of central banks of United States, Italy the United Kingdom, Germany, Belgium and France. The BIS Management answers to the Board of Directors.

The Bank for International Settlements has three major departments. Two departments deal with the main BIS activities - policy and banking analysis, and the third part provides general internal support. These departments are:

1. Monetary and Economic Department that conduct research and analysis to form understanding of political matters in relation to central banks. Also, this department offers support and arranges meetings of senior central bankers and other representatives in charge of financial stability. In addition, the Monetary and Economic Department gathers, studies and distributes statistical data on the international financial system.
2. The Banking Division provides a range of financial services to support central banks in managing foreign exchange and gold reserves, and investing in BIS capital.
3. The General Secretariat provide a series of services to the entire organization; from legal services, facility management, human resources, security, finance, communications IT and others

The BIS Legal Service, as well as risk control units, internal auditing, alignment and operational risk, additionally support these three departments.

Within the framework of the Bank for International Settlements there are also a number of permanent and temporary committees. These committees have pooled experts from central member banks who are analysing and looking for optimal solutions for some central banking issues about stability and optimal functioning of the international financial system.

Among the committees, the following ones are highlighted (BIS, 87th Annual Report, 2017) :

- “Basel Committee on Banking Supervision”

- “Committee on Payments and Market Infrastructures “
- “Committee on the Global Financial System”
- “Markets Committee”

The Basel Committee on Banking Supervision consists of experts for banking supervision of central bank member states. This committee looks at questions and answers on bank supervision issues. This committee develops global regulatory standards for banks worldwide and looks after strengthening macro-prudential and micro-prudential oversight. The document that was created under the authority of this commission is the Basel Capital Accord.

Committee on Payments and Market Infrastructures monitors and analyses domestic and international payment systems and their impact on the international financial system. It also promotes the security and efficiency of payments, clearing, settlement and related contracts, thereby supporting financial stability and the economy. (EUR-Lex, 2017), and serves as a central bank's forum for linking oversight, policy and operational issues, including providing central bank services.

The Committee on the Global Financial System reviews and analyses topics related to financial markets and systems,

The Markets Committee oversees developments in the financial markets, financial innovations or new financial instruments, and their impact on central bank operations. This Committee continuously compiles, analyses and publishes statistical data on activities in international banking and financial markets. Experts of this commission exchange market views. To facilitate its discussions and improve market transparency, the Markets Committee publishes information on the monetary policy and business of its members on the market.

The Bank for International Settlements (BIS), although formally-legal in the form of a joint stock company, represents an international organization. Although a member of a central bank, it has an international legal entity with all its privileges and immunities. This status of the Bank for International Settlements was also confirmed by the Central Bank Agreement concluded between BIS and the Swiss Federal Council in 1987. In accordance with legal status, BIS is subject to international law with the competent Arbitral Tribunal in charge. Assets, as well as all deposits and funds entrusted to the Bank for International Settlements, in the Peace and War era are exempt

from the expropriation, requisition, seizure, confiscation, prohibition or limitation of import and export of gold and money and other similar measures. It means that the national legal regulations (including Swiss legal provisions, such as the Companies Act and the Banking Act) are not applied to the BIS. The assets of the Bank for International Settlement are in the jurisdiction of the ordinary judiciary and may be subject to enforced execution. (Srkalović, 1997).

The "Administrative Tribunal of the Bank for International Settlements (ATBIS)" was established in 1987 and has sole and final jurisdiction in resolving disputes between the Bank and its officials. The Arbitration Court is provided for by The Hague Agreements. The Secretariat of the Arbitral Tribunal is at the Permanent Court of Arbitration in The Hague (The Netherlands).

Sixty Central Banks and Monetary Authorities, currently members of BIS, have the right to vote and represent General Assembly. The Annual General Meeting decides on the usage of the dividend and the profit of the BIS, makes adjustments on the payment of the members of the board, approves the annual report and the accounts of the Bank and selects an independent auditor of the Bank.

The Bank for International Settlements has adapted its operations over time. According to (Srkalović, 1997, p. 43). the Bank's activities today focused on four basic functions:

1. the promotion of international monetary co-operation;
2. providing banking services to central banks;
3. serves as the Centre for Monetary and Economic Research;
4. serves as an agent and guardian in the performance of various international financial arrangements.

The Bank's main objective for international settlements is to achieve international financial stability. In the international market, BIS acts as a Bank and provides short-term financial assistance to its members, i.e. national central banks, and cooperates with Bretton Wood Institutions, the Organization for Economic Co-operation and Development (OECD), The World Bank, the International Monetary Fund and the European Union.

According to the information from the Bank's website, Bank for international settlements helps central banks with managing foreign exchange reserves and receives a vista deposits, time deposits for a specified time in all currencies and gold deposits. Central banks deposit their foreign exchange

reserves with the BIS due to creditworthiness and high liquidity of funds. BIS also deals with the purchase and sale of foreign currency, the management of foreign currency liquidity and reserves, and the provision of short-term loans to members with payment securitizations.

According to the Bank for International Settlements, financial statements have been prepared in accordance with the Bank's Statute and Accounting Policies. The Bank's accounting policies are based on "International Financial Reporting Standards", which is conducted in accordance with the decisions of the Board of Directors. Each year, on March 31, BIS publishes its audited annual reports that provide a broad overview and breakdown of the Bank's balance sheet, profit and loss account, and other financial statements as well as capital adequacy reports and risk management.

2.1. History of Basel legislative

By signing The Hague Agreement on January 20, 1930, the Government of seven countries (Switzerland, United States of America, United Kingdom, Japan, Italy, Germany, France and Belgium) made a decision on the need to establish an international organization. The organization's goal would be to play the role of the chief agent in paying war damages from World War I and to promote co-operation among central banks. (Srkalović, 1997, p.40).

The Bank for International Settlements (BIS), founded on May 17, 1930, is the oldest international financial organization in the world, involving 60 members of central banks, representing countries around the world with about 95% of the world's gross domestic product (GDP). BIS is headquartered in Basel (Switzerland), and two representations are located in Hong Kong (China) and Mexico City (Mexico). The BIS mission is to provide the central banks with the financial and monetary stability they are looking for, which is a prerequisite for sustainable economic growth and prosperity, and to foster international cooperation in these areas acting as a bank for the national central banks.

The Bank for International Settlements has provided the general public free of charge part of their work, including: own analyses on financial and monetary stability issues, financial statistics and international banking, scientific research and public hearings. Compared to BIS banking activities, BIS users are central banks and international organizations. They are constantly working to align

the best banking regulation practices in order to ensure a sufficient and uniform level of capitalization of the global banking system.

First ever paper issued by the Basel Committee was the one in 1975, known as Concordat. With the title "Report to the Governors on the supervision of banks' foreign establishment", its main goal was "*to set certain guidelines for co-operation between national authorities in the supervision of banks' foreign establishment and to improve its efficiency*". Such document set foundations for sharing supervisory responsibilities for subsidiaries, joint ventures and foreign branches between host and parent supervisory authorities. Main emphasis was put in the areas of direct transfers of information between parent (where the institution headquarters are) and host (where institution is doing business) supervisory authorities, then in the area of direct inspection by parent authorities of their domestic bank's foreign establishment, and indirect inspection of foreign banks establishments by parent authorities through the agency of host authorities in case where host authorities do not allow direct inspection by parent authorities. Importance of the liquidity was even back then emphasized in a way that the foreign banks should oblige to local regulation and practices, should not be judged for the individual bank, but for the bank as a whole, while if bank has subsidiaries abroad, local authorities should take into account possibility that such bank can lend its funds to its "daughter" banks. (Basel Committee on Banking Supervision, 1975)

In 1983 Concordat was revised and "Principles for the supervision of Banks' foreign establishments" was published. It replaces Concordat, 1975, and its main provision is the subsequent acceptance of Governors that Supervisory body cannot accept soundness of individual bank without taking into account bank business worldwide through the technique of consolidation. (Basel Committee on Banking Supervision, 1983)

2.1.1. Basel 1

As the result of internationally set regulation and supervision, main emphasis was put on capital adequacy, therefore the capital ratio. In order for the bank to be considered stable, it should have enough own capital for coverage of expected and unexpected losses. Internationally framework was set to avoid inequality in competitiveness of the banks worldwide, depending on the capital requirement rules set from domestic countries. After first consultation paper on such topic, finally

in July 1988, the capital measurement framework known as “Basel Capital Accord” was released to the Banks after G10 Governors approval. Minimum regulatory capital, or capital ratio, has been formulated as regulatory capital to risk-weighted assets (RWA). In the Accord, minimum capital ratio (risk-weighted-assets to capital) was set to 8%, and was supposed to be implemented by 1992. Capital ratio of 8% is still on power, which means that it proved itself to be sufficient for the banks worldwide. In this early Accord only credit risk was considered, but later it was modified to include market risks. (Basle Committee on Banking Supervision, 1988)

Empirical analyses showed that that the capital ratio can be increased in several ways after the release of the Accord, so the regulator need to consider what response they want to elicit when formulating new regulations(Wall and Peterson, 1996). (Jackson *et al.*, 1999) suggests that there is no evidence that banks decided to hold more capital than they otherwise would, and that there are no rules whether banks met their capital ratio by increasing capital, or by reducing lending and therefore shrinking their assets, because it depends on the business cycle and bank’s financial situation. However, largest banks tend to use regulatory capital arbitrage, and therefore their ratios are more difficult to interpret and are less meaningful, which was the weakness of Basel 1 Accord.

In the Accord several fundamental definition of capital is set: (Basle Committee on Banking Supervision, 1988)

1. Capital features:
    a. Tier 1 capital
        i. Paid-up common stock or share capital: permanent shareholder’s equity composed of ordinary shared and continuous non-cumulative preference shares
        ii. Reserves: allocation of retained earnings such as general and legal reserves, share premiums and retained profit
    b. Tier 2 capital
        i. Undisclosed reserves: accumulated after-tax surplus that can be maintained as an undisclosed reserves and are accepted by the supervisor
        ii. Asset revaluation reserves: revaluation of fixed assets or long-term share holdings valued at historic purchasing cost

iii. General loan-loss reserves and general provisions: reserves for yet unknown losses. Provisions or reserves ascribed to specific item in balance sheet should be excluded from the calculation
iv. Hybrid (debt/equity) capital instruments: instruments that both have characteristics of debt and equity capital. They should be unsecured, subordinated and fully paid-up, not redeemable, available to participate in losses, it should allow service obligations to be deferred
v. Subordinated debt: conventional unsecured subordinated debt capital instrument with a minimum maturity of five years and limited life redeemable preference shares

Another important element of this Accord is risk weights. The Committee considers that a weighted risk ratio is an appropriate method of assessing the adequacy of the bank's capital, where bank capital is set in ratio to the several categories of balance and off-balance sheet items, weighted according to broad categories of relative riskiness. It means that different items in balance sheet have different riskiness that should be considered when calculating risk-weighted-assets. It ranges from 0% (e.g. cash) to 100% (e.g. claims on the private sector). The sum of products of the asset value in each group and weight of the group, provides risk-weighted assets – an amount to which regulatory capital is set. Ratio of regulatory capital and risk weighted assets should be higher or equal to 8%, for the bank to be considered safe and well capitalized. Basel 1 was focusing exclusively on the credit risk, and its standards were accepted with more than one hundred countries.

Adaption period of Basel 1 regulatory framework is presented in following table.

Table 1: Transitional arrangements for Basel 1 Accord

	Initial	**End-1990**	**End-1992**
Minimum standard	The level prevailing at end-1987	7.25%	8.0%
Measurement formula	Core elements plus 100%	Core elements plus 100% (3.625% plus 3.625%)	Core elements plus 100% (4% plus 4%)
Supplementary elements included in core	Maximum of 25% of total core	Maximum 10% of total core (i.e. 0.36%)	None
Limit on general loan-loss reserves in supplementary elements	No limit	1.5 percentage points or, exceptionally up to 2.0 percentage points	1.25 percentage points or, exceptionally and temporarily up to 2.0 percentage points
Limit on term subordinated debt in supplementary elements	No limit (at discretion)	No limit (at discretion)	Maximum of 50% of tier 1
Deduction for goodwill	Deducted from tier 1 (at discretion)	Deducted from tier 1 (at discretion)	Deducted from tier 1

Source: (Basle Committee on Banking Supervision, 1988)

One of the disadvantages of Basel 1 was its insensitivity to individual risk, the treatment of overall credit risk as the sum of individual credit risks without taking into account the effect of diversification, as well as limitations on the application of advanced method and modelling for the risk assessment and management. The main reason for the capital regulation is the security of business for both the bank and the banking system. Regulation of capital through a simple ratio of

capital to assets can induce banks to have riskier loan portfolios in their balance sheets. (Behn, Haselmann and Wachtel, 2016). As will be clear in the coming years, banks have taken advantage of the fact that the regulator is asking them to apply universal risk weights to the balance sheet items. According to Basel I, banks preformed so called regulatory arbitrage - they exploited the difference between the actual risk of certain positions and the risks calculated through risk-weighted assets ratio. It paid off to remove loans from the portfolio, for example using securitization, whose real risk was lower than the one calculated using regulatory method, and simultaneously hold on loans with higher real risk that yielded higher interest income (due to higher risk). Such calculation made banking portfolios riskier than formally reported exposure, and made them unrealistic from the risk point of view as well as in terms of capital adequacy. At the end, their balance sheet was riskier in reality and they had higher profit margins since they could apply higher interest rates on troubled loans.

2.1.2. Basel 2

First Basel Capital Accord was on power for more than 10 years. In 1999, Basel Committee issued proposal to change regulatory framework elaborated in the Accord.

To cite Committee declaration of the need to redesign old Accord (BIS, 1999): "*The world financial system has witnessed considerable economic turbulence over the last two years and, while these conditions have generally not been focused on G-10 countries directly, the risks that internationally active banks from G-10 countries have had to deal with have become more complex and challenging. This review of the Accord is designed to improve the way regulatory capital requirements reflect underlying risks. It is also designed to better address the financial innovation that has occurred in recent years, as shown, for example, by asset securitization structures. As a result of this innovation, the current Accord has been less effective in ensuring that capital requirements match a bank's true risk profile. The review is also aimed at recognizing the improvements in risk measurement and control that have occurred*."

As a result, after a long consultation period, in June 2004 was issued capital framework known as Basel 2. Apart from changes made in capital adequacy, supervisory review and market discipline were introduced in form of so-called three pillars. Basel 2 presented a more complex structure in

accordance to previous Accord, mainly through inclusion of credit, market and operational risk in risk-weighting computation, while definition and the value of capital ratio remained the same as before.

New and revised capital framework consist of three pillars: (Basel Committee on Banking Supervision, 2004)

1. "Minimum Capital Requirements"
2. "Supervisory review (rules set for supervisory monitor of capital adequacy and internal assessment process)"
3. "Market discipline (disclosure of banking business to general public)"

In the first pillar, Minimum Capital Requirements, there is in details described calculation and monitoring of capital adequacy, calculation of credit risk (based on standardized and advanced or internal ratings-based approach, as well as securitization framework for determining necessary capital requirements for exposures from securitization), as well as operational and market risk issues.

In the second pillar is stressed the importance of supervisory review over banks. As a result, four key principles of supervisory review are set:

1. Banks ought to have an assessment procedure of their overall capital adequacy according to their risk profile, as well as strategy for preserving their capital levels
2. Supervisors should review and assess bank Internal Capital Adequacy Assessment Process (ICAAP) and to ensure their compliance with different capital ratios. If bank is not in line with different measures, supervisory body should take appropriate measures of supervisory action to correct those results
3. Supervisors should ensure that banks operate above minimum capital ratios, as well as encourage them to have capital in excess of the prescribed minimum
4. Supervisory bodies should have methods to intervene in banking operations at early stage in order to prevent capital to fall below necessary minimum, and should ensure that banks take immediate actions to increase their capital if it is not adequately maintained

In the third pillar is defined market discipline of banks. The banks should disclose publically the necessary information to interested parties. Such information is both of qualitative and quantitative

nature, and are concerned on capital and risk exposure and assessment (credit risk, market risk, operational risk, equities, interest rate risk etc.)

Compared to the previous Accord, Basel 2 made it possible for the banks to apply their own internal methods of risk assessment as opposed to predefined unified measures of risks. It also offered greater flexibility through a choice of different risk assessment approach, as well as it suggested more complicated rules and higher sensitivity to risk. Moreover, the Basel 2 regulatory framework provided for capital charges for individual loan, depending on the risk assessment based on an internal risk calculation model developed by the bank itself. (Behn, Haselmann and Wachtel, 2016)

Basel 2 allowed banks to choose approach in estimation of their exposure to risk: standardized approach or more advanced internal rating based approach where parameters used in risk exposure calculation are developed by banks (internal rating based foundation or internal rating based advanced approaches). Banks that used IRB approach, in general, experienced a decrease in the amount of capital needed to hold, in comparison to the banks that adopted standardized approach, and it was significant especially for larger banks who could afford the costs of developing an internal model. (Hakenes and Schnabel, 2011), unlike the small banks who used standard approach due to high cost of such implementation. Although such flexibility is better for the banks and financial system in general, among banks is created distinction on ones who can afford to apply more advanced risk assessment approach and therefore reduce their risk exposure and capital requirement, and those who cannot afford to implement advanced risk measurement and will have higher risk exposure with higher capital requirement for the coverage of potential losses that can occur from identified risks. Small banks believe that the capital requirements are overloading for them (the weights are too high for small and medium-sized clients that are prevalent, dominating in small banks). Small banks do not have experts for the application of advanced internal methods, and neither the amount of resources for needed technology, while in large banks new standards will increase available capital or reduce provisions for risks and will have more potential for consolidation in the banking sector. Another Basel 2 deficiencies is the procyclicality of capital requirements. As the economic cycle deteriorates, level of needed capital to satisfy these requirements grows. For this reason, they might decide to reduce risk exposure, instead of increasing the amount of capital. Raising funds in unstable market conditions can be challenging and costly, so adapting to capital requirement can lead to reduction in real sector lending (Tanda,

2015), especially for banks that use internal methods instead of fixed risk weights (Behn, Haselmann and Wachtel, 2016)

2.2. Latest global regulatory framework

Liquidity was one of the main issues during financial crises. On top of that, a problem was detected in capital requirement, so in 2009 the Committee issued updated documents to strengthen existing Basel 2 capital framework, especially the treatment of securitization positions, off-balance sheet items and exposures of trading books.

Latest global, voluntary regulatory framework was introduced in 2010, as the answer on global financial crises and failure of Lehman brothers in September 2008. The demise of the Lehman Brothers led to a sudden and dramatic change in the economic situation, causing a sharp fall in real sector expectations, bank failures, liquidity crisis and a credit crunch. Even before collapse of Lehman brothers, it was evident that some changes in existing regulatory framework should be made (which will be discussed in following section). Those changes are mainly in the area of liquidity and capital requirements, which were evident that are insufficient in earlier, Basel 2 regulatory framework. Mispricing of credit and liquidity risk with the combination of deterioration of capital requirements and huge leverages was very dangerous and resulted with the excessive credit growth, and eventually world financial crises. Basel Committee responded very quickly on the crises, so they published in 2008, on the same month Lehman Brothers collapsed, the document called "Principle for sound liquidity risk management and supervision". In that document was defined 17 principles which dealt with governance and supervision of liquidity risk, such as "*essential principle for the management and supervision of liquidity risk, governance of liquidity risk measurement, measurement and management of liquidity risk, public disclosure and the role of supervisors*". (Bank Committee on Banking Supervision, 2008)

In September 2010, prior the official introduction of the regulatory framework, Group of Governors and Heads of Supervision pronounced higher global minimum capital standards for commercial bank which was introduction to new framework. In November 2010, new liquidity and capital recommendation were approved by the G20 Leaders' Summit in Seoul, and was settled in December Basel Committee meeting. (BIS, History of the Basel Committee, 2018)

2.2.1. Financial crises 2007: reason for Basel 3 introduction

The global financial crisis has led to the collapse of many developing countries, with serious consequences on unemployment. investments and personal consumption. (Bouheni *et al.*, 2014). For this reason, economists and policy makers have come to the common conclusion that reforming the banking system is necessary through improving regulatory and supervisory measures to make banks stronger and more resilient to unexpected economic downturns.

The banking industry is not so keen to scope its operations in order to protect themselves from adverse movements on market. In fact, they are more prone to rely on regulated safety nets they think are sufficient. Such safety net instruments can be classified in several categories: provisions (reserves that are deducted from profits and can be drawn down when necessary), capital buffers (surpluses of regulatory capital), capital requirements (to ensure enough capital in the case of liquidation), deposit insurance fund (funded through insurance premiums, where bank clients can get their money back in case of liquidation) and early intervention (different restrictions and actions taken by supervisors). These five instruments, used as safety nets, were meant to prevent bank exposures to aggregate shocks, as well as systemic risk. However, banks found a way to bypass costly regulation, so during the period from beginning of 21st century until crises, loan provisions started to decrease. Reason of financial crises, that started in 2007 and lasted until 2009 was combination of accelerated deterioration of the safety nets in most of the countries and the shock that arose from subprime sector. (Cannata, F. and Quagliariello, M., 2011)

On the long run, regulatory prescribed safety nets reduce the probability of banking crises and overall negative effect on the economy. However, managers and shareholders have no incentives to be in line with regulation, because in short-run, such safety nets reduce current profitability, and therefore the amount of bonuses received by managers and dividends payed to the owners. Banks used several mechanisms for the avoidance of high loan provisions. One was the emergence of hybrid instruments that have features of both debt and equity. Because it was a part of Tier1 capital in Basel 2 framework, it was easier for banks to get funds using these instruments, then by issuing new shares. Therefore, they were still in line with the regulation, while the real quality of such Tier 1 capital actually deteriorate. They also used risk transfer mechanisms such as securitization and credit derivatives to transfer the portion of their assets from high capital charge (by regulation) banking book to lower capital charge trading book. In general, the trading book was one of the

most effective tools of, can be said, virtual reduction of risk, in order to reduce capital charges. Shadow banking was also something that bank used to avoid costly regulation. Shadow banking includes either instruments or firms that mimic banking operation, but are not a subject to strict regulation, for example, deposit insurance system. To avoid payment of insurance premiums, banks used shadow banks (that also have maturity and credit risk transformation) to collect deposits and perform banking business. Such shadow banking entities are money market funds, asset backed commercial paper issuers, finance companies, structured investment vehicles etc. Due to such behaviour, at certain point it became clear that such operations are not sustainable on the long run. It all started in 2007 with consecutive write-downs and losses reports of major banks of their subprime assets and then collapse of Lehman Brothers which deepened crises with run-offs on money market funds. National authorities decided to prevent further deterioration with unconventional monetary injections such as approval of liquidity lines, introducing new capital requirements measures and credit risk insurance through governmental guarantee programs, to both bank and non-bank shareholders.

To justify introduction of stricter regulatory framework, we can refer to the paper of (Tchana Tchana, 2014). He estimated the impact of banking regulation (deposit insurance, capital adequacy requirement, reserve requirement and entry restriction entry restriction) on the duration of crises in the Indonesian banking system, and find evidence that capital adequacy requirement increases safety and stability, and decreases the expected duration of banking crises, which is important since the most emphasis in Basel 3 is set on the liquidity and the quality of capital.

Although the financial reforms reduce the likelihood of systemic crises, the increase in competitiveness brought by such reform may in fact increase the non-systemic crises. (Shehzad and De Haan, 2009)

(Roulet, 2017) analysed impact of regulation on the lending of banks, after the financial crises of 2008, on the sample of 301 European banks from 22 countries over the period 2008-15. Capital ratios, such as the ratio of Tier 1 capital and Tier 2 capital to risk-weighted assets have negative effect on credit growth for large European banks, which means that new, stricter capital adequacy rules encourage banks to move out of retail and other types of loans, into risk-free assets, such as liquid government bond securities. Liquidity ratio, or non-required amount of stable funding to total assets (according to Basel 3 definition) have positive impact on commercial lending growth

and negative impact on retail lending and other lending growth, suggesting that banks, amid pressure to shrink their assets and increase the level of liquid assets, may favour dropping their low-yield, semiliquid and risky loans, such as retail loans and other similar loans, instead of commercial loans. Results suggest that universal regulatory framework can eventually be unproductive or even detrimental, and the impact of new capital and liquidity regulation framework applicable to all banks could have counterproductive effects on bank lending growth following financial crisis. In that case regulators should take into consideration heterogeneous bank characteristics and behaviours to determine what type of regulation should they implement.

Banking industry and financial system faced crisis with too little capital, not adequate capital buffers, as well as valuation and capital regime that had expressed procyclical nature. Economic condition at the time before crisis, with the loopholes in the regulation led to the imprudent risk taking in the financial sector.

Following the credit crunch that began in the US due to the subprime crisis and the US housing bubble, the effect of the crisis spilled over into numerous economies around the world because banks were over-exposed to the risks associated with derivative instruments. To protect the banking system, governments and policymakers have proposed a series of measures to make the banking system more stable. However, due to the stronger effect of the crisis than expected, such proposals failed and many banks lost money and went bankrupt. As (Bouheni *et al.*, 2014) points out, the delayed response of policy makers, central bank status, and the rest of central banking policy and financial regulation have made interventions less effective and the impact of the crisis much deeper. The response of policymakers to the crisis is to find the answer to where it went wrong and what regulatory reforms can do to improve the banking system's functioning. (Barth *et al.*, 2013)

Although the new regulatory framework introduced additional requirements for banks in the form of a minimum capital adequacy, supervisory review and market discipline, they were not sufficient to control banks in their risky behavior. Namely, in order to maintain adequate distribution of capital in relation to their risky business, banks have introduced a new business strategy where high assets are divided into holding companies that were not influenced by the regulatory framework, that is, they shifter their risky assets through the process of securitization outside of such regulation, thus avoiding the need to report the true risks of their business. In this process of the introduction of new regulation, smaller banks had greater obligations to the regulator, which affected their

operations, while large banks successfully bypassed tight regulation and maintained their profitability. However, such a business strategy led to a global financial meltdown. This behavior of the banks has forced global regulatory drivers to change regulatory requirements, make it more stringent, which they did in the form of the new Basel 3 regulatory framework.

2.2.2. Basel 3

Following the global financial crisis, banking security and stability have become imperative for all banking system stakeholders, starting with regulators, academics and policy makers. Particular emphasis was placed on maintaining stability by holding an adequate amount of capital buffers and liquidity. The result of these efforts and consultations is the introduction of a new regulatory framework emphasizing the importance of capital in both qualitative and quantitative terms, the importance of stable financing and the liquidity of banking assets. The new regulatory framework has emerged as a result of a firm belief that banks with adequate capital, liquid assets and stable financing can sustain their operations more effectively and efficiently due to negative and sudden economic shocks. (Kim and Sohn, 2017). As mentioned by (Schmaltz *et al.*, 2014), the most direct regulatory response to the financial crisis is a new regulatory framework for banks called Basel 3. Basel III represents the entire package of measures with the aim of advancing the regulations, supervision and risk management in banking sector. Regulatory framework standards were set in the December 2010 as two documents: "Basel III: International framework for liquidity risk measurement, standards and monitoring" and "Basel III: A global regulatory framework for more resilient banks and banking systems". Previous standards were not rejected or eliminated with the introduction of new standards, but are revised, strengthened and extended in several areas. To quote Ben Bernanke (2012), chairman of the Federal Reserve, "this framework would require banking organizations to hold more and higher quality capital . . . improving the resilience of the U.S. banking system in times of stress, thus contributing to the overall health of the U.S. economy."

In following years few changes were made, so "Basel III: International framework for liquidity risk measurement, standards and monitoring" was replaced by 2013 "Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools" and 2014 "Basel III: the net stable funding ratio", while "Basel III: A global regulatory framework for more resilient banks and banking systems" from 2008 was revised in 2011 by the same name.

Basel 3 introduced a stricter definition of capital for both quantity and quality of capital, and an updated methodology used for the calculation of capital ratios. As highlighted by (Tanda, 2015), "the new regulation introduces a number of liquidity risk management measures, imposes higher requirements for systemically important financial institutions (SIFI), controls bank growth and introduces capital buffers that help banks overcome economic shocks".

Reforms under Basel 3 regulatory framework have two main goals:

- to strengthen the capital and liquidity that should make banks more resilient to market swings
- to enhance the capability of the banking sector to overcome the shocks that are a result of financial and economic market stress, in order to decrease the risk of those shocks spreading from financial sector to real economy

To achieve these goals, Basel 3 proposition is divided in three main categories. Most of the reforms are not meant to be implemented immediately, but have a phase-in adjustment period from 2013 to 2019. These reforms are: (BIS, History of the Basel Committee, 2018)

- Capital reforms
    - stricter regulatory capital requirements for both quality and quantity of regulatory capital (emphasis was put on common equity, or ordinary shares), for the purpose of more quality, consistency and transparency of capital
    - a countercyclical capital protective layers (buffers), which restricts banks to big exposures during the boom economy period
    - control of financial leverage - ratio between capital and all of the banks' balance and off-balance sheet exposures regardless of their risks
    - coverage of all risks
- Liquidity reforms
    - Short-term liquidity: Liquidity Coverage Ratio (LCR); minimum liquidity ratio that aims to provide bank enough liquidity to cover their funding needs over a stressed period of 30 days
    - Long-term liquidity: Net Stable Funding Ratio (NSFR), is created to address mismatch in maturity for the whole balance sheet in period longer than one year

- Elements related to the general improvement of the stability of financial system (systemic risk etc.)
    - additional requirements for systemically important banks that includes additional measures for largest banks
    - higher capital for the exposures within the financial sector
    - higher amount of capital for derivative products[1] and exposures within the financial sector

Particular emphasis in the new regulatory framework has been placed on liquidity and capital, with the aim of mitigating credit and liquidity risk. According to (Imbierowicz and Rauch, 2014), most of the failures of commercial banks during the last financial crisis are due to the common occurrence of liquidity and credit risk, which play a major role for banks in maintaining their stability and security.

The regulatory framework in place with regard to capital and liquidity requirements will certainly contribute to the internalization of the negative effects of leverage or maturity mismatch for each individual bank, but as (Boissay and Collard, 2016) question, the overall impact on the economy may be reduced if these claims are mutually reinforcing and affecting each other unexpectedly. There is also the issue of so many capital and other requirements that together could have a more severe effect on banks and the economy than planned.

The Basel 3 regulatory framework introduces measures that mitigate the effects of the pro-cyclicality of the economy. One of these measures is countercyclical capital protective layers (buffers) that force banks to hold additional capital when adverse economic conditions are in place. (Behn, Haselmann and Wachtel, 2016) highlight the possible disadvantage of such buffer. Namely, they say that such buffers will reduce the impact of pro-cyclicality only if the regulator has a quality and correct assessment of the future movement of the economy. Unexpected market shocks in terms of credit risk are not foreseeable, and regulators cannot adjust to apply one of the countercyclical capital protective layers (buffers) on time.

In the following table is presented phase-in period of Basel 3 reforms.

[1] "Derivative is financial instrument whose value is determined by the specific features of the underlying asset or instrument" (Koch, T. and MacDonald, S., 2014, p. 732)

Table 2: Basel 3 phase-in arrangements, 2013-2019

Phases		2013	2014	2015	2016	2017	2018	**2019**
Capital	Leverage ratio		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015				Migration to Pillar 1	
	Minimum Common Equity Capital Ratio	3,5%	4,0%	4,5%				**4,5%**
	Capital Conservation Buffer				0,625%	1,25%	1,875%	**2,5%**
	Minimum common equity plus capital conservation buffer	3,5%	4,0%	4,5%	5,125%	5,75%	6,375%	**7,0%**
	Phase-in of deductions from CET1		20%	40%	60%	80%	100%	**100%**
	Minimum Tier 1 Capital	4,5%	5,5%	6,0%				**6,0%**
	Minimum Total Capital	8,0%						**8,0%**

Table 2 (continued)

Phases		2013	2014	2015	2016	2017	2018	**2019**
Capital	Minimum Total Capital plus conservation buffer	8,0%			8,625%	9,25%	9,875%	**10,5%**
	Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital	Phased out over 10-year horizon beginning 2013						
Liquidity	Liquidity coverage ratio – minimum requirement			60%	70%	80%	90%	**100%**
	Net stable funding ratio						Introduction of minimum standard **100%**	

Source: Author based on BIS, Basel III phase-in arrangements, 2013)

As shown in the table above, Basel Committee expressed not only one capital ratio to be hold, but several, depending on the quality of capital. From banks is required that they hold more capital in relation to assets, which would mean reduction in balance sheet, and thus the reduction in possibility to use financial leverage and consequently the profitability. The proposal of Basel Committee for the increase of the minimum amount of capital, as a percentage of assets, from 2% to 4.5%, with which the total Common Equity Capital Ratio would amount 7% with included Capital Conservation Buffer. The amount of 7% is minimal but it's predicted that it will further

increase. Because of increased requests for the capital, banks will become less profitable in the future. By 2019, the highest quality components of capital (ordinary shares, retained earnings/losses and different reserves + preference shares) should represent at least 6% of risk weighted assets (RWA), of which at least 4.5% of RWA should be held as common equity or regular shares. Remaining percentage, or 2% of RWA can be in form of Tier 2 capital in which are components such as hybrid deposits, subordinate debts etc. Basel Committee introduced different capital conservation buffers, whose main goal is building quality capital in the time of economic rise.

The new regulatory framework, alongside the new definition and calculation of regulatory capital, introduced new measures that can achieve stability of the banking system. Purpose of these measures is managing liquidity risk, "since it is a key risk characterizing banking activity and therefore can be of considerable concern during crises". (Tanda, 2015). As shown in the table above, two ratios are introduced: Liquidity coverage ratio, whose main goal is to face liquidity shortage in a 30-day time period by holding a stock of high quality liquid assets, and net stable funding ratio whose goal is to ensure that bank have sustainable maturity structure of assets and liabilities in one-year time horizon.

New regulation technique for the risk assessment is the leverage ratio that aims to limit banks in excessive use of leverages, regardless of the riskiness of bank exposure. Leverage ratio serves as a backstop in banks' operations if they have underestimated their risk exposure in their own asset risk analyses. (Kiema and Jokivuolle, 2014) analysed whether such ratio increase bank stability. In their analysis, they took on the specialized banking sector where there are banks with high-risk loan portfolios and banks with low-risk loan portfolios. Banks with high-risk portfolios are not directly influenced by LRR since their capital requirements are in any case above the required levels, while for banks with low-risk portfolios, LRR is a limiting factor. They showed that if such ratio is below average risk-based capital requirement, then volumes of low-risk and high-risk remain unchanged, while if it is above that threshold, then the volume of high-risk loans decreases. In essence, relatively low ratio of 3% could even decrease bank stability, and the suggestion is that the leverage ratio should be raised to a level where the LRR is equal to the average risk-based capital requirement in the banking sector. Such increase in the leverage ratio should not generate

additional cost considering that banks can get in line with the ratio just by reshuffling loans, which will eventually result in improved bank stability.

However, as it is emphasized by (Behn, Haselmann and Wachtel, 2016), the effectiveness of such measures is manifested only in the ability of competent authorities to accurately assess economic developments and the future likelihood of an economic shock. (Andrle *et al.*, 2018), also fear the effects that new regulatory measures may have on the real economy. Namely, in order to meet regulatory requirements while maintaining the same level of profitability, banks may increase the spread between the interest rates they issue on loans and those that pay for their sources of funds, or they could reduce the value of their balance sheets by reducing assets and loans. Both strategies will have a negative impact on the real economy, since they can trigger a credit crunch. Banks with adequate profitability can adapt to the new regulatory requirements by increasing their retained earnings, while paying dividends to shareholders and increasing the balance sheet value. However, non-profitable banks cannot take this opportunity to raise funds by issuing new equity or reduce the riskiness of their assets. Such a reduction in the riskiness of assets can only be achieved by decreasing lending activates of banks, that is, by carefully choosing to whom they will lend, which in turn will lead to a decrease in the balance sheet. In this case, banks are unquestionably safer and more stable, but the problem arises with their profitability and the very existence of such banks. According to (Behn, Haselmann and Wachtel, 2016), if banks have difficulty raising capital in times of downturn, they will have to decrease their leverage finances by reducing issuing of loans, thereby enhancing the impact of pro-cyclicality.

In addition to the existing Basel 2 requirements, new requirements have been introduced in the new Basel 3 regulatory framework and their key differences are presented in the following table.

Table 3: Regulatory standards comparison

Requirements	**Basel 2**	**Basel 3**
Capital requirements		
Leverage ratio	None	3%
Minimum Common Equity Capital Ratio	2%	4,5%
Capital Conservation Buffer	None	2,5%
Minimum Tier 1 Capital	4%	6%
Minimum Total Capital	8%	8%
Liquidity requirements		
Liquidity coverage ratio – minimum requirement	None	Adequate amount of high-quality liquid assets to withstand bank's total net cash outflow over period of 30 days
Net stable funding ratio	None	100%

Source: Author based on BIS 1999, BIS 2011, BIS 2013, BIS 2014

The table above shows clearly how current regulatory requirements have increased at all levels compared to previous regulatory requirements. In addition to the increased capital requirements compared to previous ones, Leverage Ratio and Capital Conservation Buffers have been introduced, as well as brand new Liquidity coverage ratio and Net stable funding ratio whose aim is to manage banking liquidity.

As latest global financial crises showed us, large and interconnected institutions, or SIFIs (systematically important financial institutions), that are "too big to fail" have significant impact on the global economy. Therefore, the new regulation considers the size of the banks and imposes stricter capital requirements to preserve market stability, in order to avoid bailing banks out by governments. Nevertheless, (Košak *et al.*, 2015) found a positive link between ownership and

government support. Specifically, government ownership of banks has a positive effect on the volume of loans issued during the financial crisis, which confirms the benefits of state ownership in risk mitigations for the banks during credit crunch. State-owned banks can provide liquidity and support from government funds during a crisis so that they can continue their operations smoothly.

Early papers dealing with the optimal transition from Basel 2 to Basel 3 was by (Schmaltz *et al.*, 2014). In their paper is discussed how new Basel 3 regulatory framework drastically increases the complexity of bank management, mostly due to the introduction of new constraints and ratios, through which all of the products are affected. Their paper is interesting because it was among first of its kind, in which they stated how few of the banks are in line with this new regulatory framework. They made suggestions on the most optimal achievement of regulation compliance which is usable for both bank management and regulators. The best way to achieve compliance with Basel 3 is by restructuring the funding mix in a way to substitute capital market funding and "other" funding by capital and retail deposits, and on the asset side of the balance sheet, to increase the level of liquidity reserves at the expense of retail lending.

(Andrle *et al.*, 2018) examined bank-level adjustment to Basel 3 reform, mainly the adaption to higher capital requirements. They focused on the sample of nine EU emerging markets with five largest banks, and found “that all banking sectors raised capital adequacy ratios by about 6.5 pp on average, mainly through retained earnings and new equity issuance”. (Committee on Banking Supervision, 2010) carried out estimation that a 1pp increase in capital implies higher lending spreads, leading to a decline in the output lending compared to the baseline. Such estimation proves occurrence of shrinkage in the balance sheet in order to meet stricter requirements. However, (Andrle *et al.*, 2018) in their paper concluded that higher capital leading to a shrinkage of balance sheet affects only banks that struggles with the profitability. As it currently stands, the banks that struggles the most with profitability are in most cases small banks. The introduction of stricter capital requirements will in this case have the most negative impact on small banks, since they fall into the category of banks struggling to maintain profitability.

According to (Bouheni *et al.*, 2014), the Basel 3 regulatory framework was established with the aim of better control over commercial banks, limiting banks' business activities with a focus on risky activities, improving banking control instruments and managing risks. Such measures are the main reason for the direct or indirect impact on bank profitability, risk management, and

consequently on bank performance. If banks operate profitably and have an adequate and stable employee structure, according to their conclusion, they will not be greatly influenced by the introduction of new regulatory rules. The new regulatory framework will certainly affect their business, but relatively speaking, this impact will be less than that of small banks. It is for this reason that the impact of regulation on the efficiency and profitability of banks is one of the key research questions addressed by many researchers and is a fundamental issue in this dissertation.

2.3. Which way forward (Basel 4…)?

Basel 3 regulatory framework introduced the amount of core Tier1 capital ratio for all banks to be minimum 6%, as well as made it more stringent for different instruments to be included in Tier 1 capital. In essence, banks' must have enough ordinary or preference shares to be considered safe and stable under new framework. Official phase-in arrangement of Basel 3 framework is by the end of 2019. However, Basel Committee, under recent developments in the banking sector, have suggested even stricter changes and rules in 2017. Even though Committee proposed that these reforms are complement of previous, already accepted reforms, banking sector is prone to call it Basel 4 due to significant increase in capital, so they suggested that they should be treated as new reform.

While the first phase of Basel 3 emphasized quality of capital for the capital ratio calculation, latest reforms are dealing with the risk-weighted-assets (RWA) of such calculation. In order to calculate credit risk[2], most of the banks around the world use standardized approach. Under the reforms from 2017, changes are made in the calculation of credit risk using internal ratings-based approach (IRB) that allows banks to estimate risk by themselves. In some cases, advanced internal ratings-based approach is removed, such as for exposures to financial institutions and large corporate clients, while all IRB approaches are removed for equity exposures. For the equity exposures, only standardized approach is applied. In cases where IRB approach is retained, minimum levels are

[2] Credit risk is "the risk of loss due to borrower being unable to repay a debt in full or in part" (Žiković and Gojak, 2011)

applied, which means that credit risk cannot be reduced under 72,5% of standardized requirement approach, which limits bank's benefit of applying internal based model approach to 27,5%. [3]

Latest financial crisis pointed out shortcomings in calculating capital requirements for operational risk[4]. When there is disturbance on the market, internal models can hardly predict losses, and therefore some changes needed to be made on that field. Suggested 2017 reforms replace four current approaches in calculating capital requirement for operational risk with single standardized approach. In such approach, operational risk capital is equal to the multiple of progressive measure of income that increases with bank size with risk-sensitive component that captures a bank's own internal losses over 10 years.

Leverage ratio, which is introduced with Basel 3, acts as non-risk based calculation of the banking leverage. Under this requirement, Tier 1 capital of the bank must be at least 3% of total of on-balance and off-balance sheet exposures. Under the new reform, Global Systemically Important Banks [5](G-SIBs) should have leverage ratio buffer of 50% of its risk-based capital. For example, if Global Systemically Important Bank has 3% risk-based buffer, then it must have 1,5% leverage ratio buffer (instead of required minimal of 3%, they will have to maintain at least 4,5%). (Basel Committee on Banking Supervision, 2017). Such a measure may reduce the impact of pro-cyclicality on banks' operations. But as already mentioned by (Behn, Haselmann and Wachtel, 2016), using leverage ratio the link between capital charges and the real risk of the assets disappears.

As has been the case with the introduction of the new regulatory framework so far, banks will have a period of adjustment and gradual introduction of new standards. The model and period for introducing new reforms is given in the table below.

[3] Aggregate output floor is used in calculating capital requirements where banks can still use internal models. Under this requirement, banks will not be able to reduce credit risk below 72.5% by 2027 over the standardized approach, based on internal models.

[4] Operational risk is "the risk of loss due to inadequate or failed banking processes, and include internal fraud, external fraud, employment practices and workplace safety, client, products and business practice, damage to physical assets, business disruption and system failures and execution, delivery and process management people and systems or from external events" (Žiković, 2010, p. 9-10)

[5] Global Systemically Important Banks (G-SIBs) are "banks designed on supervisory judgement and following indicators: cross-jurisdictional activity, size, interconnectedness, substitutability/financial institution infrastructure, complexity". (BIS, Global systemically important banks: updated assessment methodology and the higher loss absorbency requirement, 2013) In 2017 there were 29 G-SIBs worldwide. (Financial stability board, 2018)

Table 4: Basel 3 transitional arrangements, 2017-2027

		2017	2018	2019	2022	2023-2027
	Leverage ratio		2014 exposure definition		Revised exposure definition G-SIB buffer	
Risk coverage	Capital requirements for equity investments in funds and exposures to CCPs	Implementation				
	Standardized approach to counterparty credit risk	Implementation				
	Revised securitization framework		Implementation			
	Interest rate risk in the banking book		Implementation			
	Large exposures framework			Implementation		
	Revised standardized approach for credit risk				Implementation	
	Revised IRB framework				Implementation	
	Revised CVA framework				Implementation	

Table 4 (continued)

		2017	2018	2019	2022	2023-2027
Risk coverage	Revised operational risk framework				Implementation	
	Revised market risk framework				Implementation	
	Output floor				50%	55%-72,5%

Source: Author based on BIS, Basel III transitional arrangements, 2017

The Basel Committee was led by three main principles in concluding these reforms: (Basel Committee on Banking Supervision, 2017)

1. further strengthening the regulation, supervision and practices of banks worldwide, because only risk resilient bank will maintain financial stability and therefore will be able to support real economy during economic downturns
2. inclusion the wide range of stakeholders during consultation process
3. real effect on the banking system and economy as a whole

Except few of the reforms, such as the treatment of operational risk, most of the reforms should have higher impact on larger banks, i.e. the ones that use internal based models or are considered to be global systemically important banks.

The new regulatory framework thus set out should have some implications for banks' operations. Certain banks that have heavily used their own internal models may experience an increase in minimum capital requirements. Such an increase will affect the profitability of those banks that have kept their capital levels at the legal minimum, but given that most banks keep their capital above the legal minimum, only small amount of banks will need to rationally plan their use of profits, reduce assets risk, etc. It is to be assumed that banks will maintain a internal model of capital adequacy calculation where the legislative framework still allows it. As experience has shown, small banks will not benefit from these procedures since few have opted to use complicated internal measurement models.

The greatest impact on the operations of banks could be the requirement for data upgrades and internal and external reporting. In addition to other reforms concerning credit, market, operational risk, the introduction of the aggregate output floor, and credit valuation adjustment (CVA)[6] will certainly increase the amount of the capital requirement. Such increases in credit requirements could have a similar impact as Basel 3, when the new regulatory framework most affected banks that are struggling with profitability, that is, small banks. The impact of recent BIS regulatory requirements are yet to be analyzed, since their research requires data that goes beyond the data of this doctoral dissertation, that is, data by 2027 (or at least until 2017 when the process of

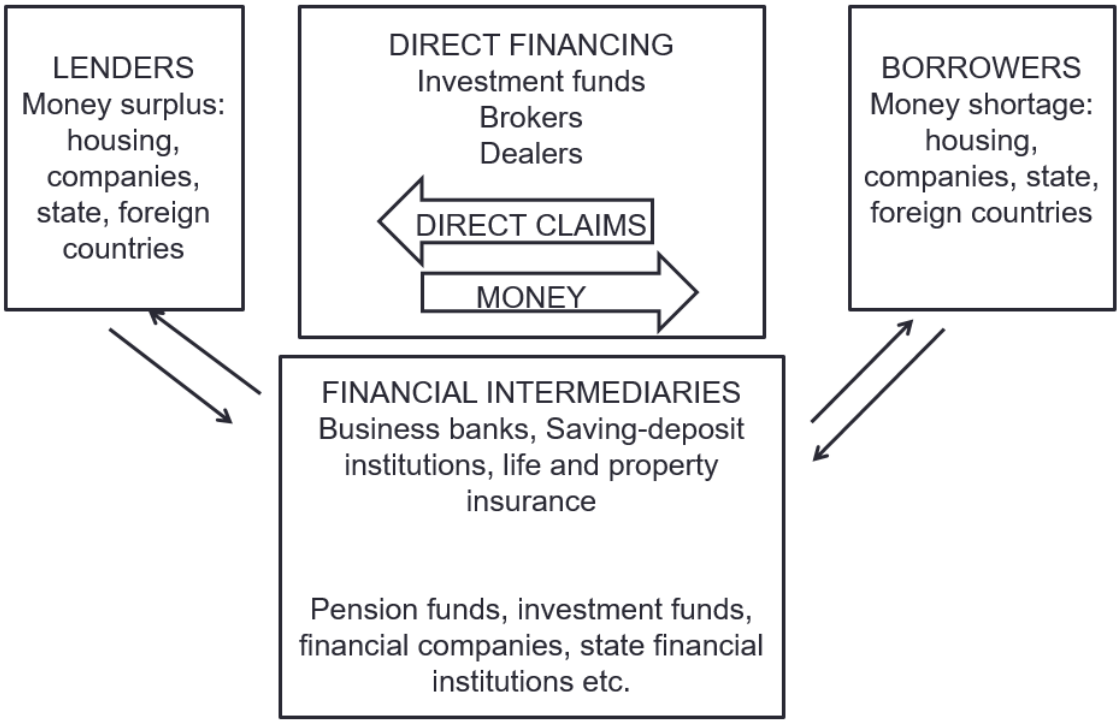
[6] The CVA calculates the difference between the value of the portfolio that contains the bankruptcy risk of the issuer of the bank and the risk-free portfolio, and essentially represents the market value of counterparty credit risk.

introducing this new standard began). The calculation of new standards on bank operations will definitely be the subject of future research, since this topic is always interesting among scientists and practitioners. While it may seem that the new requirements will only make it difficult for large banks to do business (since internal risk measurement models are being excluded), the real effects can only be calculated at a later date. As stated several times up until now, large banks find it easier to adapt to all requirements imposed by the regulator.

3. FINANCIAL INSTITUTIONS AND SUPERVISION IN EUROPEAN UNION

The European Union's banking system has undergone numerous changes over the last decades. European integration and the recent financial crisis have had considerable implications for the structure and operations of banks. The first steps towards European integration were made in 1957, when the Treaty of Rome laid the foundations for a single banking market in the European Union. Most of the financial institutions are financial intermediaries that transfer their sources of funds, in a way of deposit, taken loans or capital, to the loans or other type of assets with similar characteristics. Other financial institutions operate on financial markets and don't have that intermediary role. Financial institutions have broad meaning, so financial intermediaries, brokerage firms or investment banking can all be considered as a financial institution.

Figure 2: Financial institutions and their intermediary role



Source: Author based on Saunders and Cornett, 2014

Financial institutions[7] in European Union are divided in five group of institutions: (ECB, Lists of financial institutions, 2018)

1) Monetary financial institution (MFIs): credit institutions defined by the European Union law, whose business is of credit nature, which means taking deposits from physical, legal or other entities that are not necessary monetary financial institutions, and which grant loans or make investments in securities for their own account. Such institutions are central banks (national and European central bank), credit institutions, money market funds and other deposit-taking institutions. As of May 2019 (ECB, Number of monetary financial institutions (MFIs) in the non-participating Member States: May 2019, 2019), total number of MFIs in European Union is 6.913, of which 29 National Central Banks (including European Central Bank), 6.089 Credit institutions, 544 money market funds and 251 other deposit taking corporations. Most of the Credit Institutions, that are not part of the Euro area, comes from Poland, where is 639 Credit Institutions. Lowest number of Credit institutions, as a non-Euro area country, come from Croatia with only 25 Credit institutions.
2) Investment funds (IFs) are "undertakings that invest in financial and non-financial assets with the capital raised from public in a way that units are repurchased directly or indirectly from the undertaking's assets". Money market funds and pension funds are not included in this group, as they are included in Monetary financial institution
3) Financial vehicle corporation (FVC) are undertakings "which primarily carry out securitization[8] transactions and are isolated from the risk of bankruptcy, or can issue securities, securitization fund units or other debt instruments or derivative that are sold to public"
4) Payment statistics relevant institutions (PSRIs) are "payment service providers such as electronic money institutions, European Central Bank and national central banks, post office giro institutions, credit institutions, payment system operators, member states and payment institutions responsible for the functioning of the payment system"

[7] Financial institution is "a company involved in the business that is dealing with monetary and financial transactions such as loans, currency exchange, deposits and investments" (Investopedia, Financial Institution (FI), 2019)
[8] Securitization is "process of pooling loans into packages and selling the pooled assets by issuing securities collateralized by the pooled assets" (Koch. and MacDonald, 2014, p. 747), i.e. securitization is setting aside a group of income-earning assets and issuing securities against them in order to raise new funds (Rose and Hudgins, 2013, p. 709)

5) Insurance companies are financial companies involved in financial intermediation as a result of pooling of the risks, mostly in the area of direct insurance or reinsurance. The services that such companies deal with are life insurance, non-life insurance and reinsurance

Banks operate in a market that is heavily regulated by competent institutions. (Pasiouras, Tanna and Zopounidis, 2009). In response to the financial crisis, several changes were made in the supervision of financial institutions within European Union. Main network for financial supervision is in operation since 2011 and is called European System of Financial Supervision. Its main goal is to ensure consistent and appropriate supervision through both macro-prudential supervision and micro-prudential supervision. (ECB, European System of Financial Supervision, 2019).

With the development of the financial sector and society, and due to the significant negative effect that the banking industry has on the world economy, the need for sound regulatory frameworks and for more supervisory institutions has developed. While there is a general consensus that strict regulation is required in the banking industry, the question is whether such overcomplicated regulatory framework and supervision is truly needed. Many financial institutions have expressed dissatisfaction with this way of controlling banks, as it greatly affects their business by overburdening their staff who must deal with strict standards rather than looking at how to improve their business and client operations. It is for this reason that there is a problem in the creation of regulation, which must be neither too simple nor too complicated. It must be simple enough not to interfere with the normal business of the bank, but it must also be sufficiently complicated to completely avoid future potential adverse effects not only on the bank's operations but also on the overall banking system. Standardization of bank operations will certainly lead to an equal pattern of business that all banks must respect and follow, but the problem may arise from the fact that such regulation limits the freedom of banks to create innovative products that can lead to the common good. In this case, there are two opposing parties - on the one hand we have policy makers and authorities aimed at strong standardization and regulation to avoid future negative effects on the economy, while on the other we have banks and financial institutions to which these rules apply and which aim to have as much free decision-making in their business as possible. Banks and other financial institutions will be happy to embrace the regulation that benefits them and their business

policies, while fiercely fighting the regulation that disrupts their business. One of the types of banks that oppose the new regulation is also small banks, not because of the complexity of their business (such as some other bank whose main business is securities and derivatives), but because of the burden placed on them to monitor business and compliance with legal norms. Strong regulation leads to an increase in the number of employees engaged in a narrow segment of compliance with regulatory provisions, in which case there is a danger of losing a broad view of the bank's business and purpose, namely its own profit and an increase in the economy and economic standard of its clients.

The following will outline ways of supervision, and bodies and authorities dealing with banking supervision in the European Union.

Under micro-prudential regulation, banks are financed from deposits covered by the deposit insurance system, thereby reducing bank runs. The deposit insurance system can encourage so-called moral hazard among banks, since banks can opt for riskier investments knowing that the government is behind their clients' deposits. For micro-prudential regulation, banks are required to take appropriate steps to return the capital ratios to the statutory minimum in the event of instability in their business. Macro-prudential policy, on the other hand, aims at reducing the financial impact on the economy as much as possible, should banks decide to sell off their assets at the same time to cover current costs, resulting in a significant reduction in the value of assets in the financial market. For this reason, it is the regulator's main task to control the banking system from both aspects: macro-prudential and micro-prudential.

The following table presents the main differences between the macro-prudential and the micro-prudential approach to regulation.

Table 5: Macro and micro prudential perspectives compared

	Macroprudential	Microprudential
Proximate objective	limit financial system-wide distress	limit distress of individual institutions
Ultimate objective	avoid output (GDP) costs	consumer (investor/depositor) protection
Model of risk	(in part) endogenous	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: (Borio, 2006)

According to (Borio, 2006), the goal of the macro-prudential approach is to limit financial imbalance with significant losses to the real economy as a whole, while the goal of the micro-prudential approach is to limit the financial imbalance of an individual institution, regardless of its impact on the overall economy. He emphasizes the importance of an individual instrument in considering risk at the macro or micro prudential level. While for macroprudential it emphasizes GDP and the importance of correlation between institutions, it is not so important for regulatory instruments dealing with Microprudential policy, where he emphasizes the importance of individual bank clients.

After the financial crisis, it became evident that the financial sector and real sector have really closed links, not only in specific Member State, but can spill over national borders as well. For that reason, Banking Union is formed as a step toward Monetary and Economic Union that allows specific application of banking rules in Member States. Banking Union enables more transparent, unified and safer European banking. (ECB, Banking union, 2019).

3.1. European System of Financial Supervision

European System of Financial Supervision is system, network, or framework for macro-prudential oversight and micro-prudential supervision, which includes three supervision authorities (ESAs) and European System Risk Board (ESRB). Its main goal is to provide consistent and comprehensible financial supervision in European Union. Micro-prudential supervision, or supervision for individual institution, is in the jurisdiction of three European Supervisory Authorities (ESAs): "European Banking Authority (EBA)", "European Insurance and Occupational Pensions Authority (EIOPA)" and "European Securities and Markets (ESMA)". All of these authorities are advisory bodies of the European Commission, the European Parliament and the Council of the European Union, that, based on their research, give special legal, technical or scientific advices to help shape regulatory framework. Its main tasks are developing of single rulebook to ensure consistent application of individual financial institutions in EU Member States, and to assess risks and weaknesses in the financial sector. (ECB, European System of Financial Supervision, 2019)

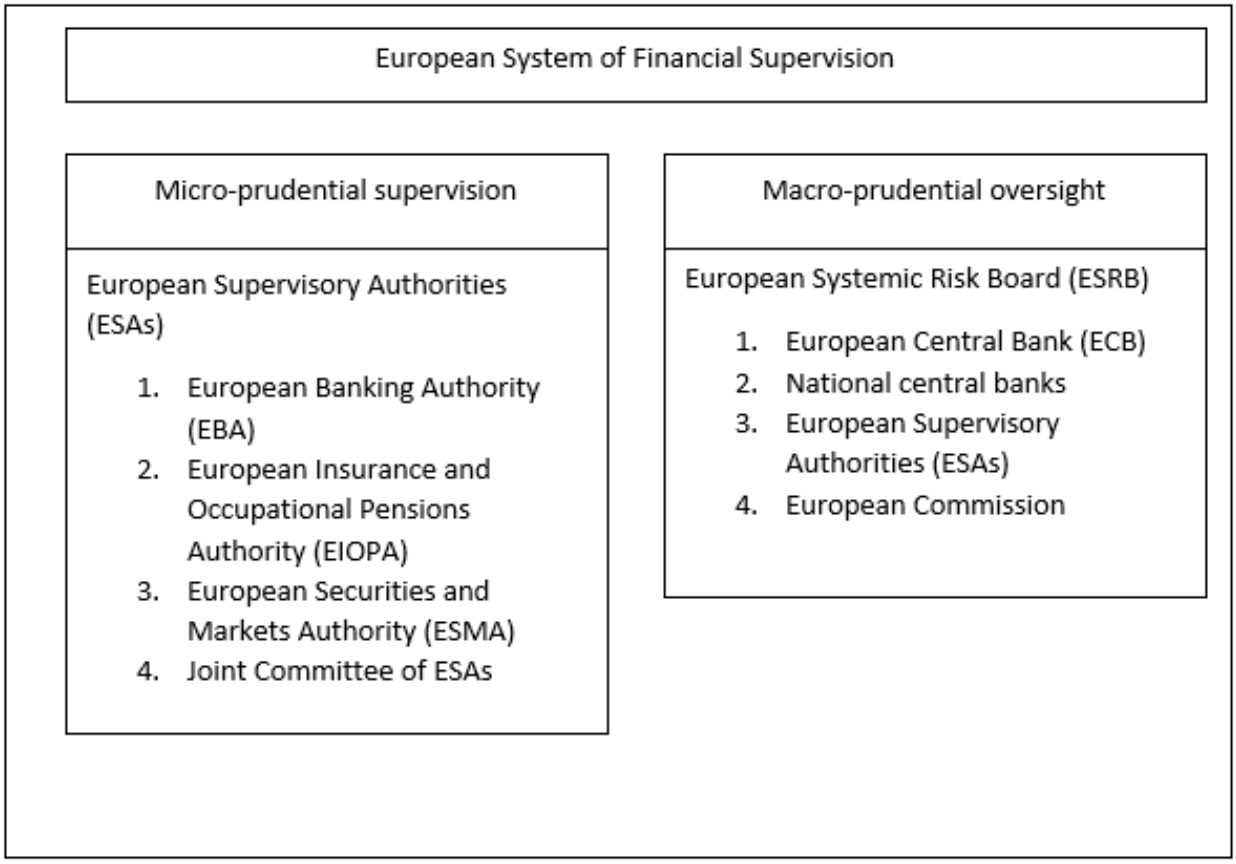
"European Banking Authority (EBA)" is independent body whose aim is "*to ensure effective and consistent prudential regulation across European Union"*, and to contribute in creation of Single rule book for banking sector. Its overall objective is to maintain stability, integrity and efficiency in functioning of the banking sector, as well as to assess the risks and vulnerabilities in the EU banking sector. (EBA, 2019)

"European Insurance and Occupational Pensions Authority (EIOPA)" is independent body whose main aim is "*to support the stability of the financial system, transparency of markets and financial products as well as the protection of policyholders, pension scheme members and beneficiaries*". (EIOPA, 2018). It is responsible for protecting insurance policy holders and pension members.

European Securities and Markets (ESMA) is independent authority that ensures stability of financial system by "*assessing risks to investors, markets and financial stability, completing a single rulebook for EU financial markets, promoting supervisory convergence and directly supervising credit rating agencies and trade repositories*". (ESMA, 2018). It is responsible for investors and traders in the securities markets, and for supervising credit rating agencies.

Macro-prudential oversight of the whole financial system is performed by "European Systemic Risk Board (ESRB)", whose goal is to prevent or mitigate systemic risk[9] since it entered into force in 2010. European Systemic Risk Board, in their mission of macro-prudential control and supervision, oversight banks, asset managers, insurers, shadow banks[10], financial market infrastructure and other financial institutions and markets. As an independent body of the European System of Financial Supervision, it is hosted and supported by European Commission, European Supervisory Authorities (ESAs), European Central Bank (ECB) and National Central banks.

Figure 3: European System of Financial Supervision



Source: Author based on ECB, European System of Financial Supervision, 2019)

[9] Systemic risks are "those related to the volatility of economic and financial conditions affecting the stability of the entire global system". (Rose and Hudgins, 2013, p. 710) Systemic risks cannot be diversified away, so "a default by one financial institution will lead to defaults by other financial institutions". (Hull, 2012, p.611)

[10] Shadow banking system is "the group of financial intermediaries facilitating the creation of credit across the global financial system but whose members are not subject to regulatory oversight." (Investopedia, Shadow Banking System, 2019)

Although each authority deals with the specific financial system submission segment, there are certainly overlaps. Heavily regulated and complicated regulatory environment can lead to overflow of information and neglect of a particular model that is important for the business of the bank itself.

3.2. European Banking Union

Latest global financial crisis made clear that financial difficulties can easily spill over to the real sector, regardless of national borders. Banking Union, established in 2014, allows consistent application of banking rules throughout European Union. The purpose of Banking Union is to make banking more transparent in a way that the common rules and administrative procedures of supervision, rescue and resolution of banks are consistently applied, and to make banking more unified in a way of treating banks as a group of connected entities, and to make banking safer through detecting early problems in banking sector in the Union as a whole, not just in specific Member States.

The Banking Union is an EU level monitoring and remediation system operating on the basis of rules applied throughout the EU. Its goal is to make the banking sector in the European and the wider EU area safe and reliable and to ensure that banks whose survival is threatened are sanctioned without the use of taxpayers' money and with minimal impact on the real economy. The Banking Union is made up of all European countries and those Member States outside of the European region that they decide to join. Countries outside the European area can join the banking union by establishing closer cooperation with the European Central Bank. Unique rules form the backbone of the banking community and the legislative arrangement of the financial sector in the EU at all. It consists of a set of legislative texts that apply to all financial institutions and all financial products across the EU. These rules include special capital requirements for banks, improved deposit insurance systems and rules for the management of declining banks. Uniform rules have been established to ensure that banking operations are regulated according to the same rules in all EU countries in order to avoid distorting the single market and ensuring financial stability throughout the EU. (European Council, 2018)

The goal of the banking union is:

- to ensure bank resilience and make them capable of dealing with all financial crises in the future
- to prevent situations in which the taxpayer's money is used to rescue failing banks
- reduce market fragmentation by aligning rules to the financial sector
- improve financial stability in the European area and the EU as a whole.

The banking union has two pillars: “Single Supervisory Mechanism (SSM)” and “Single Resolution Mechanism (SRM)”, that lies on the foundation of single rule book. Single Supervisory Mechanism is system of banking supervision that comprises of ECB and national supervisory authorities of Member States. A single supervisory mechanism is the supra-national body for the supervision of banks in the EU where the European Central Bank has a responsibility for supervision of financial institutions in close cooperation with national supervisory bodies.

The main objective of this mechanism is to ensure the stability of the European financial sector by conducting regular and thorough bank state audits. These checks are carried out on the basis of rules that are the same for all EU countries.

Single Resolution Mechanism goal is to enable efficient resolution of falling banks with minimal costs for tax payers and with minimal effect to the real economy. The unique remedy mechanism is the system for efficient and effective rehabilitation of financial institutions whose survival is endangered. It is made up of the central body for remediation (the Unified Refining Committee) and the Single Rescue Fund. The fund is intended for use in bankruptcy cases and is fully funded by the European banking sector. European Central Bank, as the supervisor of this Resolution, can, if necessary, decide that the bank should undergo resolution, and by swift decision-making procedures, it can be resolved over a weekend. (ECB, Banking union, 2019)

3.3. System of central banks in EU

In the system of central banks from 28 EU Member States, there are European System of Central Banks (ESCB) and Eurosystem. European System of Central Banks (ESCB) consists of European Central Bank (ECB) and central banks from EU 28 member states, while the Eurosystem consist of European Central Bank and central banks from the 18 states that have the Euro.

The main goal of the ESCB is to preserve price stability. Without compromising this main goal, the ESCB shall promote the European Union general economic policy in order to support their policy objectives. Within the framework of the ECSB and the Eurosystem, they carry out tasks and activities in accordance with the guidelines of the Statute of the ESCB and ECB, as well as Treaty on the Functioning of the European Union.

Unlike central banks who are members of the Eurosystem and which follow the common monetary policy, the central banks of countries that have not adopted the Euro act to maintain competences in the defining and implementation of foreign and monetary exchange policies, as well as other tasks that are given to them under national laws. (CNB, European System of Central Banks, 2016).

As long as there are Member States that still uses different national currency then Euro, European System of Central Banks and Eurosystem will continue to coexist. All banks within European system of Central Banks cooperate in development of mutual matters, such as single payment system (TARGET2)[11] or collecting statistical data. "Central banks of the Member states that belong to Exchange Rate Mechanism (ERM2)[12] cooperate with the Eurosystem in the field of exchange rate and monetary policy". (Eesti Pank, European System of Central Banks, 2018)

Eurosystem will have the main role regarding the euro, on condition that there are still Member States that did not adopt single currency. The Governing Council of the European Central Bank (ECB) is its main decision-making body in the Eurosystem, which decides what monetary policy will be in the euro area. Due to geographically large area and cultural diversity, national central banks have responsibility to guarantee balanced functioning of the Eurosystem, and therefore, it is better solution than just single central bank. Key tasks of the Eurosystem include conducting foreign exchange operations, holding and managing foreign reserves, development and implementation of monetary policy, maintaining the continuity of payment system operations, monitoring of compliance with prudential norms for financial institutions and guaranteeing financial stability, pooling of statistics and statistical data, issuance of euro banknotes and guarantee of their security and international cooperation. Activities of the Eurosystem's central

[11] TARGET 2 is the "*real-time gross settlement (RTGS) system owned and operated by the Eurosystem. TARGET stands for Trans-European Automated Real-time Gross settlement Express Transfer system*" (ECB What is TARGET2?, 2019)

[12] Exchange Rate Mechanism (ERM2) was set up *"to ensure that exchange rate fluctuations between the euro and other EU currencies do not disrupt economic stability within the single market, and to help non euro-area countries prepare themselves for participation in the euro area"*. (ECB, ERM II – the EU's Exchange Rate Mechanism, 2019)

banks are performance of monetary policy operations, managing European central bank's foreign reserves, managing their own foreign reserves, collection of "various economic and financial data that are necessary for the implementation of monetary policy and the fulfilment of the Eurosystem's other tasks, managing the infrastructures of payment systems and perform supervision over them, issuance of banknotes in cooperation with the European Central Bank, and other tasks". (Eesti Pank, Eurosystem, 2018)

The ECSB and the Eurosystem are ran by the decision-making bodies of the European Central Bank: The Executive Board, the Governing Board and the General Council.

The European Central Bank (ECB) is the central institution of the ECSB and the Eurosystem, founded on June 1st 1998. ECB is autonomous in the exercise of its duties and has full legal personality accordingly with the international public law. The headquarters of the ECB is in Frankfurt am Main in Germany. The ECB and the national central banks cooperatively carry out the tasks trusted to them under the ESCB. ECB has three decision-making bodies, which also manage the ESCB and the Eurosystem: The Steering Board, the Executive Board and the General Council. The ECB Steering Board is the main decision making body. It forms the monetary policy of the European area and provides the decisions and guidelines needed to ensure the execution of tasks assigned to the ECB and the Eurosystem. The ECB Executive Board is the working body of the Eurosystem and the ECB, which carries out the monetary policy of the European Bank in the agreement with the Governing Council's decisions, and manages the ECB's ongoing operations. The ECB General Council was established as the third body responsible for ECB decision-making. It has a transient character and will be so long as all EU member states do not introduce the euro.

The ECB Supervisory Board was established after the ECB's Single Supervisory Mechanism (SSM) assigned specific tasks regarding prudential supervision over credit institutions with the goal of ensuring the reliability of the banking system and contributing to financial stability. The Supervisory Board comprises of the President, the Vice President, the four ECB representatives, as well as representatives of national supervisory bodies from the European Union countries and other Member States who choose to participate in the SSM. More on the European Central Bank and its bodies will be discussed in the following chapter.

In carrying out their tasks, the Boards, Subcommittees and Working Groups of the Eurosystem / ESCB are assisted by decision-making bodies, whose members are experts from national central

banks and ECBs. Each of the committees as well as their substructures is specialized in a specific task within the ESCB, and their duty is to provide expert advice to the Steering Board and the Executive Board, thus facilitating the decision-making process.

3.4. European Central Bank (ECB)

European Central Bank is the central bank of the 19 European Union countries that uses euro, and together with the Central Banks of member states, it creates Eurosystem whose main objective is price stability and safeguarding the value of euro in order to preserve purchasing power of single currency. European Central Bank contributes to the safety and soundness of the banking system, mainly through the prudential supervision of credit institutions positioned in the Euro area, as well as credit institutions from participating Member States of the non-euro zone. (ECB, ECB mission, 2019).

In order to maintain price stability, central banks must, according to (Vujcic, 1999), have complete personal, financial and instrumental independence. He underlines that there is no research to indicate that such independence has a negative effect on higher growth rates, which is the ultimate goal of economic policy. The central banks of the Member States must maintain their independence in order for the candidate country to become a precondition for joining the European Monetary Union. Due to differences between countries, in terms of political influences, financial industry, various industry pressures, institutional capacities, etc., the central bank is considered the best institution to implement macroprudential policies. (Cerutti, Claessens and Laeven, 2015)

The European Central Bank assumes a central position within the European Central Bank System. It was established in 1998 under the European Union Treaty. It is a supranational body that runs the common monetary policy of the European Union. Monetary policy is carried out partly by itself, and partly through national central banks. The development of the European Central Bank is closely related to the establishment of the European Monetary Union and the stages of its development. “Economic and Monetary Union - EMU is the name for the process of harmonizing the economic and monetary policies of the member states of the European Union with a view to introducing a common euro currency.” (Arrigo and Casale, 2005)

Three are three phases in the formation of the Economic and Monetary Union. (Mintas Hodak, 2010)

The first phase began on July 1, 1990, and it included:

- eliminating all barriers to free flow of capital between the states,
- introduction of new modalities of co-operation between national central banks through the incorporation of this mandate into the Rules of the Governing Board of the Central Banks of the Member States (the Board of Governors has existed since 1964),
- freedom to use the European Currency Unit, ECU, the forerunner of the euro
- strengthening economic convergence among member states.

The second phase lasted from January 1st 1994 until December 31st 1998. At this stage, the European Monetary Institute was founded, the forerunner of the European Central Bank. In addition, this phase included the incorporation of the ban on central banks direct lending to the Member States legislation, strengthening monetary policy co-ordination of Member States, strengthening the economic convergence of the Member States, incorporating legal provisions on the independence of central banks in national legislation and no later than the establishment of a European the central bank system, the formation of the European Exchange Rate Mechanism and the Stability and Growth Pact, and the preparation for the third phase.

The third phase started on January 1st 1999. This phase involves the "birth of the euro", including the irrevocable fixing of national currencies, the introduction of the euro as deposit money, the management of a single monetary policy within the European Central Bank System, the entry into force of the European Exchange Rate Mechanism, the entry into force of the Stability Pact the exchange of currency in circulation of national currencies with the euro since January 1st 2002.

With the introduction of the euro in 1999, the ECB assumes full responsibility for monetary policy in the Eurozone. The main reason for the establishment of the ECB was the creation of a monetary union with a single euro currency. Main goals for the adoption of euro are better connection between member states, unique market, free-flow of capital, goods, people etc., smaller transaction costs, easier trade among member states, better resilience to crises, more stable economy and growth, bigger investments and increased labour market and elimination of foreign currency risk States participating in the Monetary Union have delegated the powers of monetary policy to the

European level or the Central Bank. The ECB monitors the amount of money in circulation, manages the exchange rate of the euro, takes care of the functioning of the payment system and, together with the central banks of the Member States, maintains and manages the official foreign exchange reserves.

Main objective of the European Central Bank is to maintain price stability and thus boosting job creation and economic growth. (European Commission, Economic and monetary union and the euro, 2014). To achieve this objective, there should be strict inflation control which implies that the annual increase in consumer prices should be less than 2%.

The ECB President presents the Bank at the top European and international meetings. The ECB has the following three decision-making bodies (European Union, European Central Bank (ECB), 2019):

1. The Steering Board: main decision-making body, consists of the Executive Board and the Governors of the national central banks of the European member states. It assesses monetary and economic developments, sets the level of interest rates at which commercial banks borrow from the ECB and determines euro area monetary policy
2. The Executive Board: managed by the ECB's everyday work, consisting of the President and Vice-President of the ECB and four other members nominated by the leaders of the European member states for a term of office of eight years. The Executive Committee conducts monetary policy, manages the daily work and organizes gatherings of the Governing Board
3. The General Council: an advisory and coordination role, consisting of the President and the Vice-President of the ECB and the governors of the national central banks of all EU Member States. It contributes to advice-giving and co-ordination activities and helps prepare for the accession of new European countries.

3.5. European Union legislative package

Banking is one of the most regulated industries in the world, and for this reason financial regulation is a controversial topic among researchers and practitioners. Numerous studies have emphasized the importance of quality regulation in preventing the negative effects of the crisis or in general

economic developments, while on the other hand, regulation affects the efficiency and profitability of banks. Regardless of the reason for which the regulation was introduced, in order to restrict or prohibit a particular type of banking business, banks will find ways to avoid such regulation by investing in riskier assets, which may have an impact on the economy, in order to increase or maintain their efficiency and profitability. The desire of the European Union legislative package is to regulate and supervise banks, without unduly affecting their efficiency and profitability.

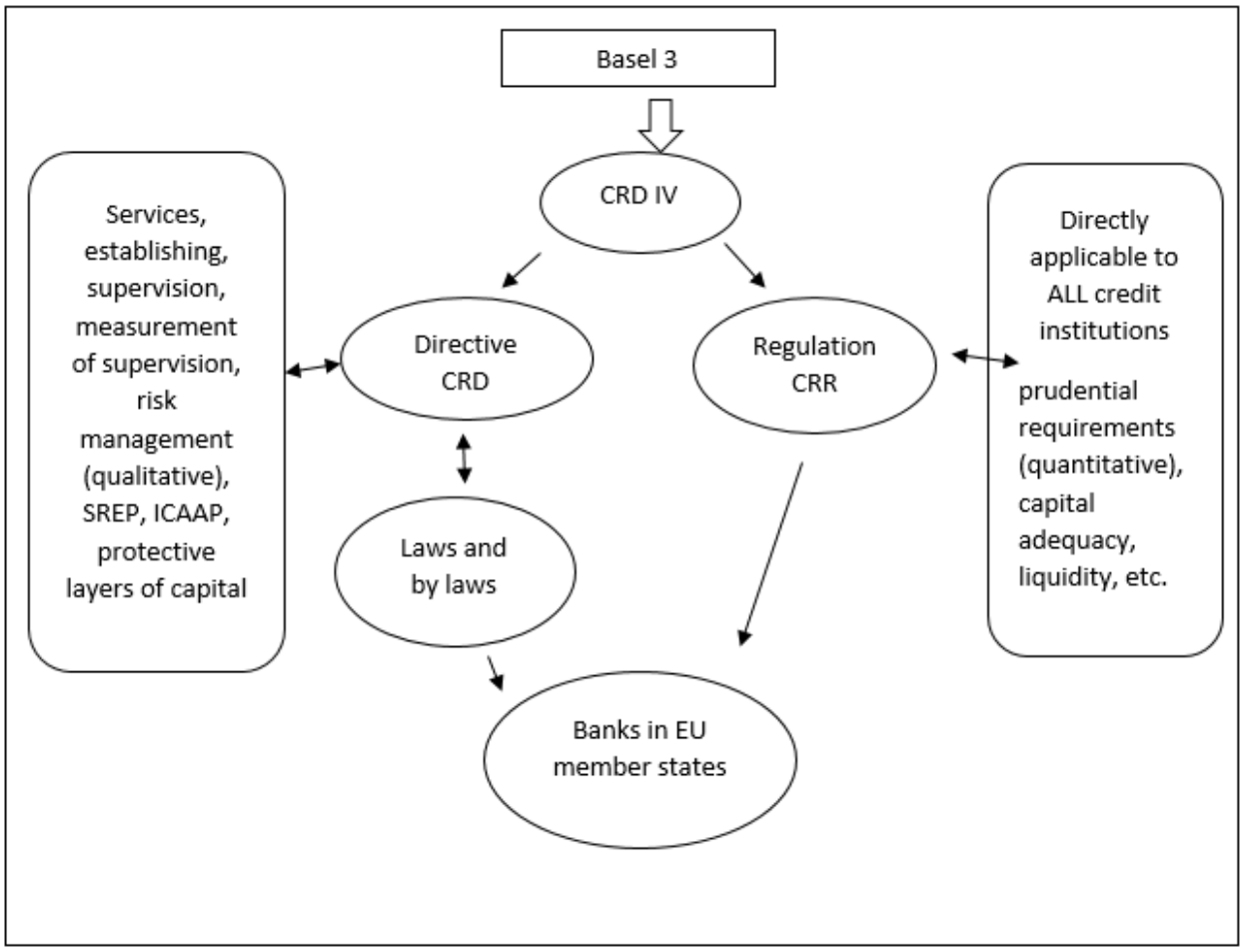
European Union rulebooks on prudential regulation are mainly derived from Basel guidelines, and concern the amount and quality of liquidity and capital banks hold. Goal of such rulebooks is similar to the ones of Basel Committee – to maintain the stability of banks during economic downturns, while ensuring that the banks continue to finance real economy during rough periods.

The European Commission published a proposal for 2011 legislature, entitled "Capital Requirements Directive IV (CRD IV)" which is basically dealing with the content of Basel III. In 2013 they introduced so-called CRD IV package which is comprised of two separate legal acts: the first EU Directive (Capital Requirement Directive, CRD IV) and the second EU Directive (Capital Requirements Regulation, CRR), that all banks, as well as investment firms, are obligated to follow.

In this package main emphasis was set on capital and liquidity, seeing that during financial crisis banks were vulnerable because of quality and quantity of capital and shortage of short-term and long-term liquidity. (European Commission, Prudential requirements, 2019). Latest EU legislative package is setting stronger prudential requirements for banks in the sense of capital reserves and liquidity.

In the implementation of these two proposals, there are some differences – while the directive is implemented through national regulatory frameworks and laws, regulation must (according to the European common law) be directly applicable in all of the EU Member States. Directive can be changed and adjusted to a certain point by each member country, while for the implementation of regulation there is no "room for adjustment" through national legal frameworks.

Figure 4: Implementation of CRD IV in national banking system



Source: Author based on European Parliament (2013a, 2013b)

3.5.1. Capital Requirement Directive

Capital requirement directive 2013/36/EU of the European Parliament and of the Council is about the activities of credit institutions, as well as prudential supervision of credit institutions and investment firms. Official date of entry into force is July 17th 2013, while the rules started applying as of December 31st 2013.

Capital requirement directive 2013/36/EU replaces previous directives, and deals with the deposit-taking activities of banks and investment firms. It deals with topics such as access to the business of banks, establishment of banks and the freedom of providing different services. On top of

covering previous capital requirement directive topics, new features are: (European Parliament, 2013a)

- better governance and transparency in a way that it ensured that management bodies have total oversight, and that the risk management is improved in satisfactory way. Beside better governance, enhanced transparency is expected in a way of disclosing profits, taxes, risk exposures, received subsidies etc.
- reduced reliance on external ratings, which means that banks shouldn't rely solely on external ratings, but should make their own risk assessment
- additional capital (so-called capital buffers) that protect banks' capital on top of capital established by regulation, making better safe-nets in the economic downturns. Capital buffers are set by national countries, and each time bank reduce the amount of capital below that buffer, new stricter limits can be applied
- staff bonuses, whit which are banks prohibited to give huge bonuses, and thus should prevent staff to take high risk. Bonuses can't exceed one annual fixed pay

3.5.2. Capital Requirement Regulation

Capital requirement regulation No 575/2013 of the European Parliament is about prudential requirements for credit institutions and investment firms. Official date of entry into force is June 28th 2013, while the rules started applying as of January 1st 2014.

The main idea of Regulation is to make banking operations more robust and resilient by enhancing prudential requirements. According to Basel 3 guidelines, bank should become more robust if they focus its operations on higher liquidity and safer capital. Regulation is uniformly accepted throughout all of the European member states, and there is no room for adjustment within local laws and bylaws.

So called Single Rule Book aims to ensure few of the specific points: (European Parliament, 2013b)

1. Higher and better capital requirements: bank regulatory capital consists of Tier 1 capital and Tier 2 capital. Tier 1 capital is composed of Common Equity Tier 1 capital (CET1) and Additional Tier 1 capital (AT1). Tier 1 capital, according to Basel accords, is type of high-quality bank capital with the highest loss-absorbing capacity, while tier 2 capital has a lower

loss-absorbing capacity. According to (Behn, Haselmann and Wachtel, 2016), capital adequacy is considered to be the most effective tool for ensuring the safety and stability of a financial institution.

1.1. "Common equity Tier 1 Capital (CET1)" consist of, in general, ordinary shares, retained earnings/losses and different reserves. Instruments, in order to be set as CET1, can't have the return obligation for the bank or any other obligation, and in case of liquidation they are last in line for the repayment

1.2. "Additional Tier 1 capital (AT1)" is mostly composed out of preference shares. For the instrument to be set as a AT1 capital, bank can't have the return obligation, but there is possibility for other type of obligation for banks (such as fixed amount of dividend for preference share). They are also last in line to be payed-for in case of liquidation

1.3. "Tier 2 capital", on the other hand, consist of hybrid deposits, subordinate loans etc. Conditions for the instrument that should be met to be set as Tier 2 capital is that they should have maturity of 5 years, can't be used for the coverage of losses and should also be last in line for repayment in case of liquidation

2. Liquidity measures are set to make sure banks have enough liquidity through stress period. For such calculation, two measures were introduced:

2.1. "Liquidity Coverage Ratio (LCR)" that is designed to ensure that the bank has enough quality liquid assets in stressful situations in short period (30 calendar days). It is calculated as ratio between stock of high-quality liquid assets and net cash outflows over a 30-day period. Ratio of these two variables should be higher or equal to 100%

2.2. "Net Stable Funding Ratio (NSFR)" measures robustness of banks position of financing during one year. It is calculated as ratio between available amount of stable funding (ASF) and required amount of stable funding (RSF), and should be higher or equal to 100%. ASF is the amount of stable funding that banks really hold and are reliable during that period (e.g. capital or time deposits), while RSF is "the sum of steady funding that it is mandatory given the liquidity characteristics and residual maturities of its assets and the contingent liquidity risk arising from its off-balance sheet exposure" (BIS, Net Stable Funding Ratio (NSFR) - Executive Summary, 2018)

3. Leverage ratio aims to limit banks in excessive use of leverages, regardless of the riskiness of bank exposure. It is calculated as ratio of Tier 1 capital to total (not risk-adjusted) on-balance

sheet and off-balance sheet exposures (including derivatives, repos[13] and other securities financing transactions)

The regulatory effect is stronger for those banks that use higher leverage or hold less high-quality liquid assets in their assets such as money, government bonds, bonds of listed companies, etc. If the regulator requires banks to hold high quality capital and that they have liquidity reserves above the optimum levels, then banks can internalize the riskiness of their business or cover in case of unexpected market movements, and consequently increase the quality of issued placements on the market, whether in the form of loans or by buying securities. Liquidity requirements require banks to convert illiquid items into assets for liquid, for example, government bond loans, while capital requirements prevent banks from raising funds in an inadequate or poor-quality manner. Increasing banks' liquidity in this way automatically reduces the risk assets that individual banks hold in their portfolios.

New regulatory frameworks and guidelines provide better resilience for banks during the crisis, as confirmed by a study of (Košak *et al.*, 2015). They conclude that higher quality of bank sources of funds (higher tier 1 capital, higher share of customer deposits that banks must have in their balance sheet etc.), provide better support for banks' lending during crisis times. Tier 1 capital increases bank credit growth during the financial crisis, and enables them to increase their lending activities. Tier 1 capital provides banks with a sort of cushion to absorb the loss, thus protecting them from bankruptcy risk. Banks with higher Tier 1 capital are less sensitive to credit and market risks, while banks with less Tier 1 capital are more sensitive to credit and market risks, thus being more vulnerable to liquidity and solvency issues during crises. In order to avoid breakdown, banks must drastically reduce their lending activities. On the other hand, they do not find significance in lending activities due to the impact of Tier 2 capital, which means that Tier 2 capital does not provide adequate support during the financial crisis, although it has a positive impact on lending behaviour during normal economy times. Such results indicate the positive results of strong banking regulation on banks' operations during the crisis, which is the aim of the new regulation. However, the issue of banks' operations during the growth cycle of the economy is arising,

[13] Repurchase agreement (RPs or REPOs) is "short-term loans secured by government securities and settled in immediately available funds" (Koch, T. and MacDonald, S., 2014, p. 745)

especially for small banks, which are unable to increase their lending activities in such way to maintain an adequate level of capital and liquidity buffers.

The Single rulebook aims to deliver single set of prudential rules which all institutions in European Union must respect, and to create unified regulatory framework for financial sector in Member States, based on Basel 3 guidelines. (EBA, The Single Rulebook, 2018). But as (Chortareas, Girardone and Ventouri, 2012) emphasize, although regulation sets out detailed rules and guidelines, they are often inadequate and misleading. Namely, the rules regarding capital adequacy prescribe the amount of capital that banks must have in their business, but they do not truly reflect the riskiness of the banks themselves, as they can hold either too much or too little capital. Insufficient capital can lead to bank failures due to unexpected market movements, while too much capital puts banks at unnecessary expense for themselves and their clients, which ultimately leads to negative effects on the efficiency of the banking system and the profitability of banks.

Such a complex system of regulation and organization of regulatory bodies can lead to an increase in systemic risk. Specifically, banks have a large incentive to avoid strict regulatory constraints, since they directly affect their profitability and operations. Strict regulation can give the illusion that everything is stable and functioning in the banking system, but as history has shown, not every new regulatory framework can capture a problematic glitch that has not yet been introduced and does not actually exist. Any new regulation is actually a correction of the business of something that has already happened and that has caused market problems. The new and tougher regulatory environment will make it much easier for large banks to adapt, since they can move part of their business beyond regulatory boundaries and thus increase their profitability. This kind of business cannot be afforded by small banks, mainly because of limitations in the number of employees. In essence this should not be the goal of stricter regulation because it does not solve the general problem, which is a maintenance of more secure financial and banking system for all market participants. On the other hand, a looser regulatory framework may treat equally, in terms of risk, items that are seemingly similar but actually very different in terms of risk. Future developments in regulation go in the direction of more complex business operations, which means an immediate negative impact on small banks, and questionable stability of the banking system, given that they have the potential to transfer risks outside the regulatory framework. In this way, the profitability

of small banks is affected, while for medium and large banks the new regulation will not affect the profitability.

4. THEORETICAL BACKGROUND ON RELATIVE EFFICIENCY AND PROFITABILITY IN THE BANKING SECTOR

Calculation of relative efficiency and profitability is popular among scientist in all field of the economy, and finance and banking sector is no exception. Relative efficiency and profitability are the variables which represent banking operations, on which regulatory impact is observed.

The most important papers that have served as the base and source of literature for this doctoral dissertation will be presented below. In addition to papers related to relative efficiency and profitability, papers related to this dissertation in some other way will also be presented, for example, papers in the area of regulation and the impact of regulation on the operations of a particular segment of banks.

There are two basic measures of overall profitability, neither of which is limited to financial firms. One is return on equity (ROE) and the other is return on assets (ROA). Return on equity is the ratio between net profits and shareholder's equity, i.e. the amount of capital contributed by shareholders. It is consequently of particular interest to equity investors as it measures the return on their investment. Return on assets is the ratio between net profits and total assets, which for a bank consist largely of financial assets such as loans. Return on assets indicates how effectively the bank's assets are being managed to generate revenues. In general, the ideal profitability profile is reflected in a bank that consistently generates above average profitability for its peer group, without incurring undue levels of risk. These two measures are mathematically correlated, since net profits is the numerator in both ratios and is differing only by the degree of leverage employed by the bank. Differences between these two measures is reflected in the difference, or ratio, between equity and assets. That difference represents the leverage banks are using, or in another words, how much a bank uses other people's sources of funds that are not their own capital, with a purpose of generating revenues. Return on assets is the measure that most analysts and researchers use, because it can easily be manipulated with the return on equity. In order to quickly increase their return on assets, banks can borrow additional source of funds from the market or from the depositary. This new obligation will not be seen in the return on assets indicator, but will certainly result in an increase in net profit and, consequently, in ROE itself. By separating leverage from profitability, analysts and researchers are able to gain a better understanding of changes in both. Some researches use return on average assets or return on average equity. These two ratios are

calculated similarly as the return on assets and return on equity, except that in the denominators are the averages of assets and equity between the data of current and the previous year. having said foregoing, return on assets is the key indicator for profitability that most of the researchers use. Regardless of that, two points should be kept in mind concerning returns on assets. First, while it ideally should measure repeated profitability, it is easy to neglect exclusion of extraordinary items, such as gains from the disposal of subsidiaries, and thus distorting comparisons. Similarly, when a bank has a high proportion of revenues that are not assets based, such as brokerage commission, the comparative ability of the ratio will be weakened. (Golin, 2011)

Efficiency is one of the basic business indicators of a modern business entity. In order to understand the efficiency that implies numerous "benefits" in business, it is necessary to know and implement in the management process different methods of measuring the relative efficiency of business entities. Given the role of the banking sector in the economy and society, evaluating its efficiency is particularly important. Taking into account the specificity of the banking sector, different methods of measuring efficiency can be applied. However, one of the most widely used methods for assessing efficiency in the banking sector is Data Envelopment Analysis. The fundamental goal of any economic system is to achieve economic efficiency. Efficiency in its broadest sense implies efficiency in the production, consumption and allocation of resources. In this sense, it is not possible to improve the economic position of one entity without simultaneously reducing the economic position of the other entity. An entity is fully efficient if and only if it is not possible to improve any of its inputs or outputs without impairing any of its other inputs or outputs. In other words, the entity is efficient if the output is maximal given the inputs. There are several methods of analysing the relative efficiency of a particular business entity, and they will be presented in the next chapter, along with details about the methodology used in this doctoral thesis. (Cooper, W., Seiford, L., Zhu, J., 2004).

4.1. **Profitability determinants**

Below are some of the most important scientific papers in which the authors used bank profitability as one of their variables. The aforementioned papers emphasize not the impact of regulation on bank profitability, but the frequency of using bank profitability proxies to calculate different relations in banking industry. The presented scientific papers are arranged chronologically.

(Athanasoglou, Delis and Staikouras, 2006) analysed determinants of bank profitability for South Eastern European credit institutions over the period from 1998 until 2002, using unbalanced panel dataset, ranging from 71 banks to 132 banks through years, for the Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia, Romania and Serbia and Montenegro. As proxy for profitability the used return on equity (ROE) and return on assets (ROA), while for descriptive variables the used bank-specific variables such as capital, liquidity, size, credit risk, ownership, operating expenses and market share. For the industry variables they used concentration and EBRD index of banking system reforms, while for macroeconomic variables they used economic activity and inflation. They found that banking concentration has positive effect on profitability, macroeconomic determinants have mixed effect, while the effect of banking reform on their profitability has not been identified. (Dietrich and Wanzenried, 2009) analysed the effect of bank-specific, macroeconomic and industry-specific determinants on profitability for the 453 commercial banks in Switzerland, during the period of 1999 until 2006. They used a wide range of variables; 12 bank specific characteristics and 6 macroeconomic and industry-specific characteristics that represents external factors. (Rezende and Wu, 2012) showed on banks with asset threshold of 250 million dollars and 500 million dollars, that on-site safety and soundness examination from the regulator improves bank performance, as *more frequent examination increase return on equity and lowers several loan loss and delinquency measures*. Like most authors, they used only large banks to calculate profitability determinants. Such an approach certainly leads to more easily interpretable results, but it does not solve the substance of the problem, which is the difference between small and large banks, since the determinants that affect large banks do not necessarily mean that they affect small banks in the same way. (Căpraru and Ihnatov, 2014) analysed leading determinants of bank's profitability in Central Eastern European countries, in the period from 2004 until 2011, on the sample of 143 commercial banks from Poland, Romania, Czech Republic, Hungary and Bulgaria. As profitability proxy they used return on average assets (ROAA) and net interest margin. As the most important factor for bank profitability they assert bank capital adequacy growth and management efficiency. They noticed interesting thing which is that higher the capital adequacy, higher the profitability of the banks. Also, they found that larger the bank is, smaller is net interest margin ratio. They suggest better that the supervisors should have better supervision over credit risk and capital adequacy, while bank management should monitor cost optimization and also credit risk. (Řepková, 2015) used

DEA estimation to estimate efficiency of 15 business banks in Czech Republic, over the period from 2001 until 2012. For the calculation of banking relative efficiency, author used Data Envelopment Analysis methodology. For such calculation it is necessary to define inputs and outputs. Author uses 2 inputs (labour and deposits), and 2 outputs (loans and net interest income). In the second stage is used panel data analysis to see what are the variables that affect the efficiency of banks in the Czech Republic. Panel data analysis results showed that liquidity risk (as a ratio of loans to deposits) and riskiness of portfolio (as a ratio of loan loss provision to total assets) have a positive impact on banking efficiency, while GDP had a negative influence on efficiency of the Czech commercial banks. This paper uses banks from the Czech Republic, which means that smaller banks have also been included in the calculation, but in this way it is not possible to see a broader picture of the impact of determinants on banks' operations at European Union level. (Petria, Capraru and Ihnatov, 2015) analysed the main determinants of bank profitability in EU27 states over the period of 2004 until 2011, on the yearly data of 1098 banks. After applying the panel data analysis with fixed effects, they concluded that bank supervisors and management must pay more attention to credit and liquidity risk. (Mwongeli and Joan, 2016) in their research concluded that there is *no relationship between regulations and financial performance of commercial banks.* Their analysis was made in Kenya, on 43 commercial banks from 2010 until 2015. (Borio, Gambacorta and Hofmann, 2017) investigated how monetary policy (presented as level of interest rates) affects bank profitability, on 109 large international banks from 14 major advanced economies, for the period from 1995 until 2012. They conclude that the positive effects of the interest rate structure outweigh the negative effects that interest rates have on loan loss provision and on non-interest income, which suggests that abnormally low interest rate and abnormally flat term structure erode bank profitability (measured by return on assets or ROA). (Deli and Hasan, 2017) analysed the effect of capital regulations (obtained from the survey of (Barth *et al.*, 2013)) on loan growth, for 125 countries through the period of 1998 until 2011. They concluded that capital stringency or capital regulation has a negative and weak impact on credit growth, the impact of which is completely annulled if banks have sufficient level of capital. In their scientific paper they state that capital requirements related to Basel standards are easily manageable with banks that are well capitalized, especially if such regulations and directives are introduced during normal economic developments. With the introduction of new policies during the normal economic period, banks can relatively easy cope with such requirements without affecting the reduction of issued loans. It

is very important to emphasize that they do not state that the Basel 3 regulatory framework will not harm the real economy through a reduction of issued bank loans. (Kim and Sohn, 2017) analysed the influence of capital on lending depending on the level of bank liquidity for the US commercial banks. They found positive relation between bank capital and liquidity, in a way, that bank capital has a positive and significant effect on lending if they hold sufficient level of liquidity, and that effect is significant only for large banks. Interestingly, this interaction between capital and lending is found to be no significant or is negligibly negative for small and medium sized banks. They suggest that policy actions regarding capital and liquidity should be jointly implemented to achieve full effect, particularly for large banks. *Because banks acts differently during crisis period depending on their size, they "support implementing policy actions and regulations based on size of the banks"*. (Bucevska and Hadzi Misheva, 2017) analysed the efficiency of 127 commercial banks from six Balkan countries, from 2005 until 2009, as well as which determinants has influence on that efficiency. They found that efficiency has positive and significant association with profitability, measured as return on assets and return on equity, while industry concertation is insignificant in explaining profitability. Also, neither inflation nor economic growth has an impact on bank profitability.

Many authors have investigated the impact of determinants on the profitability of banks on an aggregate basis, whether at the country, region or state level. However, the influence of the determinants on the operations of small banks remained questionable in all papers. The ejection of small banks results in clearer and more easily interpretable results, but no answers are given as to what are the key determinants that affect the operations of small banks.

4.2. **Regulatory impact on banks' relative efficiency and profitability**

Some of the authors used two-stage approach in examining regulatory impact on the efficiency and profitability. For example, (Pasiouras, 2008) investigated the impact of Basel 2 regulation and supervision on banking efficiency. He used the sample of 715 banks from 95 and two-stage analysis: Data Envelopment Analysis to estimate technical and scale efficiency, and tobit regression to investigate regulatory impact. The results provide evidence in favour of all three pillars of Basel II that promote the adoption of strict capital adequacy standards, the development of powerful supervisory agencies, and the creation of market disciplining mechanisms, which

means that banks increased their technical efficiency after the introduction of Basel 2. In his later work, (Pasiouras, Tanna and Zopounidis, 2009), using the sample of 615 banks from 74 countries during 2000-2004 period, authors find that Basel 2 regulation (i.e. market discipline mechanisms, official supervisory power and capital adequacy requirements) empower the supervisory control of the authorities' and improve market discipline, which consequently increases both the profit and cost efficiency of banks, while stricter capital requirements reduce profit efficiency but increase cost efficiency. Also, as above-mentioned researches, they focus primarily on larger banks, whereas small banks are not analysed, but that does not mean that they are affected in the same way as large banks, that is, that they also felt an increase of relative efficiency.

Below are the papers that most closely address the topic of this doctoral dissertation, which is the impact of regulation on banks' relative efficiency and profitability. The research papers are arranged chronologically. (Naceur and Omran, 2011) examined the impact of financial and institutional development, concertation and bank regulation on commercial bank margins and profitability across a broad selection of North Africa countries (MENA) and Middle East countries, throughout the period from 1989 until 2005. They found that bank-specific variables have substantial impact on banks' cost efficiency, net interest margin and profitability. Macroeconomic variables, except the inflation, have insignificant impact on net interest margin, while bank concertation affects negatively on net interest margin and return on assets. Such results suggest that *the efficiency and profitability of banks depends solely on their internal organization and characteristics, while external effects do not have a significant impact on the banks' operations*. (Chortareas, Girardone and Ventouri, 2012) explored the dynamics between key supervisory and regulatory policies, and various aspects of commercial bank profitability and efficiency, for the period 2000-2008 for 22 EU countries. Their findings show that *strengthening official supervisory powers and capital restrictions can improve the efficiency of commercial banks*, while *interventionist regulatory and supervisory policies*, such as forbidding bank operation in specific sectors or private sector monitoring, *can increase the rate of commercial bank inefficiency*. (Barth *et al.*, 2013) used a sample of 4.050 banks from 72 countries to calculate bank efficiency in the period from 1999-2007 (not all of EU28 states are included in their analysis). They use two-stage analysis. For the first stage they employ Data Envelopment Analysis (DEA), and for the inputs they use funding funds, personnel expenses, total fixed assets and loan loss provision as credit risk/potential costs, and for the outputs; total lending, total earning assets and non-interest income.

Most efficient banks come from countries such as Luxemburg, Switzerland, United Kingdom and United States, while the least efficient banks come from banks such as Sudan, Senegal and Nigeria. In the second stage they used regression with the DEA efficiency measures as a dependent variable. They concluded that tighter bank activity restrictions have a negative impact on bank efficiency, while a higher capital regulation stringency has a marginally positive impact on bank efficiency. Although one of the best researches on this topic, they did not focus on the size of the bank in their research, and with the exception of some EU countries, they used selected worldwide countries which can lead to misleading results. They also used the total average efficiency of the banking system for each country in their further analysis, from which the trend of relative efficiency movements is not visible. The adjustment of banks to the new regulatory framework was certainly not the same in all countries, which cannot be seen from total mean averages. The average for each year can give an overview of the relative performance of banks over a long period of time. (Neyapti and Dincer, 2014) empirically tested on 53 countries the hypothesis that supervision and regulation improve business in the banking sector, in such a way that it affects both the borrower discipline and depositor confidence. Using GMM methodology, they found that investments and deposits show positive and significant link with supervision and regulation, while the link between non-performing loans and supervision and regulation with is negative and significant. (Ozkan, Balsari and Varan, 2014) investigate the influence of regulation on the performance of banking sector in a context of emerging country, specifically, Turkey. Their findings suggest *that regulatory changes* made after financial crises through banking sector restructuring, corporate governance-related banking law and constraint of the full insurance of deposit system *had a significantly positive effect on lending of banks, profitability and asset quality*, thus permitting banks to have a larger contribution to the financing of economic activity. They used dummy variable for the regulation, or 1 from 2006 onward, otherwise 0, thus the idea to use dummy variables in this dissertation which will be elaborated in following chapter. This way of introducing a dummy variable for the influence of regulation will be used in this doctoral thesis as well. (Bouheni *et al.*, 2014) analysed the impact of supervisory and regulatory policies on the profitability and risk-taking of the ten largest banks in six European countries, from 2005 until 2011. Bank performance was counted through five different proxies: return on equities (ROE) and return on assets (ROA) as bank profitability proxies, and distance from insolvency, return on equity volatility and return on assets volatility as bank stability proxies. Their results suggest that strengthening supervision and regulation enhances the

stability of the European banking system and also enhances bank profitability. Restrictions on banking activities reduce profitability, while there is a positive correlation between bank profitability, deposit insurance systems and capital adequacy. Strengthening supervisory power and better regulation reduce banks' risk-taking, which in turn leads to increased banking stability. (Terraza, 2015) investigated what impact bank capital and liquidity ratios have on bank profitability, for a sample of 1270 European banks observed over the period from 2005 until 2012. With the intention of compare European banks based on their size, they considered three panels. For the size of small banks, they used threshold of bellow 1 million EUR of total assets, for medium-sized banks they observed banks between 1 million EUR and 3 million EUR of total assets, while for large banks they used threshold of above 3 million EUR of total assets. The results showed that the bank capital has a positive and significant effect on bank profitability, but the effect on profitability of liquidity ratios (such as liquid assets to customer deposits) differs according the size of the bank. Liquidity has a negative effect on profitability of large banks, while that effect is positive for small banks. Improved bank capital, in a sense of increased liquidity, seems to be size dependent. Their findings suggest that, *there are substantial differences in bank behaviour depending on whether it is a small, medium or large bank.* Such conclusion should have important implications for the regulation and regulatory bodies. Although the author used a bank size threshold to calculate the impact on profitability, such a threshold is set quite subjectively, and varies from author to author. This dissertation will use the ECB's prescribed threshold to produce unique and comparable results at European level, not based on authors' own estimate of bank size. (Kale, Eken and Selimler, 2015) investigated effects of regulations, political events, and macroeconomic changes on the efficiency of the banks in Turkey, for the period of 1997 until 2013. They found that after the 2001 Turkish crisis, internal factors, rather than external, had more effects on productivity, and in general, macroeconomic environment in the sense of regulation, have positive effects on productivity. *Strong supervision, tighter monitoring and regulation, higher capital and new reforms have a positive and significant impact on efficiency*. Such a conclusion contradicts the idea that looser monitoring and deregulation will have a positive impact on bank efficiency through increasing of the profitability. Moreover, the safety and stability of banks is less affected by the importance of regulation and supervision, while the quality of management is the one who has major influence on the banking performance. Their results indicate that *large and small banks are not equally influenced by different macroeconomic environment*, so the small

banks perform better than large banks during a volatile period, while large banks outperform small banks during the stable economic period. (Triki *et al.*, 2017) analysed the impact of regulation on bank efficiency for the forty-two African countries. They view the regulation through several factors, namely, entry restrictions in the banking system, restrictions on banking activities, transparency requirements, overall capital stringency, restrictions on exiting the banking system, diversification and liquidity requirements, price controls (financial repression), quality supervision and availability of financial safety nets. Three inputs and three outputs were used to calculate bank efficiency. Inputs are total costs calculated as the sum of non-interest and interest costs, followed by deposits and short-term financing, with total fixed assets. Other earning assets, total issued loans and non-interest income measured as the sum of commissions and net fees were used as the outputs. They found that *the impact of banking regulations in Africa is significantly related and dependent on the size and risk profile of the bank itself.* As the authors themselves note, there is no theoretical consensus on the impact of capital requirements and regulation on banks' efficiency and operations. In the case of Africa, the biggest losers in price control and the transparency requirements are small banks, while tighter capital requirements increase the efficiency of only large banks. Their results support the theory *that regulation should not be designed in such a way that the same rules apply to all banks, but that it must be adapted to the specificities and risk profile of each bank*. Their results also contribute to the view that the imposed restrictions on the activities and operations of banks reduce and restrict the diversity of income streams, which is reflected in the decrease of bank efficiency. This is consistent with findings reported in (Barth *et al.*, 2013) and (Pasiouras, Tanna and Zopounidis, 2009). (Psillaki and Mamatzakis, 2017) used two stage calculations to evaluate the impact of structural reforms and financial regulation on the cost efficiency of the banking industry in ten Eastern European and Central European countries, in the period from 2004 until 2009. In their two stage calculations, they first used the Stochastic Frontier Analysis (SFA) methodology to evaluate relative efficiency of the banks, while in the second step they used panel regression to assess the impact of regulation on banks' relative efficiency, i.e. performance. They found that economic reforms, or desirable economic conditions in the labour market and business market, were positively related to the cost efficiency of banks, that is, to bank performance, while banking reforms had a negative impact on the cost efficiency and performance of banks.

There are numerous papers dealing with the topic of small banks and their specificities in the banking market. Some of the research papers are as follows. (McNulty, Akhigbe and Verbrugge,

2001) estimated whether small banks have informational advantage in evaluating and supervision of loan quality, based on sample of small Florida bank from period 1986 to 1996. Under Information Advantage Hypothesis (IAH), the loan quality may be grater at small banks because they can easier evaluate loan quality due to their organizational structure, which is important in the era of deregulation where the future of small banks is uncertain. While in theory this is plausible hypothesis, *they found no evidence that small banks have greater loan quality*. Loan loss provisions and net charge offs are low for small banks in non-metropolitan regions, while non-performing loans are higher for small banks. (Mercieca, Schaeck and Wolfe, 2007) analysed the impact of diversification on the bank performance for small European banks from 15 countries in the period from 1997-2003. They find no direct benefits from diversification for small credit institutions, while the size is, along with many other researches on scale economies, positively associated with profitability. Small banks can improve their efficiency by expanding their existing business within the lines in which they have biggest comparative advantages, due to the presence of diseconomies of scope (too many products) within lending activities. Such results *emphasize the importance of the specialization in contrast with the diversification for small banks in Europe*. Apropos regulatory environment, their analyses show the negative relation between restrictions and risk-adjusted performance (which they measured as ration between average ROA and average ROE by their standard deviations). In their analysis the safety of European banks is not increased by diversification of their business, because shift to non-interest income results is an inefficient trade-off between risk and return. *Regulatory guidelines that promote diversification should be taken with care for small banks in Europe, because they neither guarantee higher profitability nor increases safety and soundness of their operations*. Two more papers worth mentioning is the one from (Imbierowicz and Rauch, 2014) and (Boissay and Collard, 2016) whose results emphasize the importance of strict regulation. (Imbierowicz and Rauch, 2014) investigated connection between credit risk and liquidity risk, on all US bank commercial banks during the period 1998-2010, and how this relationship influences banks' probabilities of default (PD). Their conclusions suggest that both types of risk increase the likelihood of bank failure, and that the interaction of credit and liquidity risk depends on the overall level of risk in the bank. Their results suggest that joint credit and liquidity risk management at a bank can significantly contribute to bank stability, and such conclusion supports recent regulatory efforts such as Basel 3, whose goal is to emphasize both qualitative and quantities of banking capital and liquidity. (Boissay and Collard, 2016)

developed a macro-economic model which gave proof that multiple regulations, in a sense of capital and liquidity, is needed. In their model, the regulators face the trade-off, where on the one hand banking regulation improves credit quality and efficiency, while on the other hand banking regulation reduces the supply of loans on the market. Such results suggest that regulation decreases the number of loans issued, but their quality improves.

To conclude this theoretical background, several things should be highlighted that previous authors have not considered. Most authors use the influence of various determinants on the profitability of selected banks in selected countries. Results obtained in this way are easier to interpret, but the influence of the determinants on the banks' operations is not seen depending on their size. While some authors have made the division of banks based on their size, they have done so by subjective judgment and not by the guidelines of the European Central Bank. Furthermore, relative efficiency was analysed either on country-by-country level or as a total average of all years for each country. Such an analysis does not give an adequate overview of the relative efficacy trends over a long period of time for a particular country, which is intended to be done in this doctoral dissertation. Furthermore, the impact of latest regulation, due to lack of data, was not made in the previous researches.

5. METHODOLOGY AND DATA

In this main section will be presented sample data of scientific research, variable characteristics, methodology of the empirical research, and the results of hypotheses, as well as conclusion on empirical result.

5.1. **Definition and description of variables used in dissertation**

Prior empirical analysis that is based on econometric methodology, it is necessary to present the data and variables, as well as to discuss the reason for their selection. Sample data of the research is presented in the following chapter, along with the reason why only commercial banks were selected. After discussing on the sample data, the variables used will be presented and explained.

5.1.1. Sample data of scientific research

In line with the existing body of literature on bank performance measurement, this doctoral dissertation also focuses exclusively on commercial banks. As highlighted by (Saunders and Cornett, 2014), "*commercial banks make up the largest group of depository institutions measured by asset size*". Commercial bank is a type of a financial institution that accept deposits making them a large source of funds for their operation, along with foreign borrowings and own capital. With such stable sources of funds, commercial banks offer products like personal and mortgage loans, savings account to individuals and small businesses etc., making highest percentage of their income and expense dependable on interest rates movement. Commercial bank liabilities usually include several types of non-deposit sources of funds, while their loans are broader in range, including consumer, commercial and real estate loans. Investment banks, on the other hand, help corporations with large and complex financial transactions with issuance of their securities on the market, facilitating mergers etc., so most of their income is created on the fee basis. Due to differences between commercial banks from investment and other types of banks, it is impossible to calculate relative efficiency using same methodology, i.e. input and output variables, that would satisfy such different approaches to banking business. In the later part of the scientific research is calculated the effect of regulation on both efficiency and profitability, depending on the size of the bank. Methodology used for the calculation of relative efficiency is Data Envelopment Analysis, a

widely used method for the calculation of technical efficiency. Obtained results from the calculation of relative efficiency is later used both as dependent and independent variable. Regulatory impact is calculated using panel data, a methodology that have both time and spatial dimension. The exact same time frame is used for the calculation of relative efficiency and for panel data analysis. For the time frame of the research annual data were used, and that from 2006 until 2015. The applicable entry of International Financial Reporting Standards (IFRS) was in 2005, and there were no necessary data available for European banks before this date (Bouheni *et al.*, 2014), so for that reason in this doctoral thesis is used period from 2006 until 2015. For the spatial dimension, bank specific data for all EU28 states are used. Banks' financial statements are obtained from the BankScope database, published by Bureau van Dijk (BvD). The data is collected on the individual level i.e. for each bank in the EU 28 states, for the period of 10 years (yearly data from 2006 to 2015). Initial number of commercial banks, based on these criteria, were 1309 banks, as shown in the following table.

Table 6: Number of banks in EU 28 states

COUNTRY	NUMBER OF BANKS	COUNTRY	NUMBER OF BANKS
AUSTRIA	76	IRELAND	16
BELGIUM	31	ITALY	92
BULGARIA	21	LITHUANIA	10
CYPRUS	20	LUXEMBURG	71
CZECH	21	LATVIA	20
GERMANY	202	MALTA	18
DENMARK	36	NETHERLANDS	32
ESTONIA	8	POLAND	95
SPAIN	54	PORTUGAL	31

Table 6 (continued)

COUNTRY	NUMBER OF BANKS	COUNTRY	NUMBER OF BANKS
FINLAND	29	ROMANIA	24
FRANCE	121	SWEDEN	31
GREECE	8	SLOVENIA	15
CROATIA	32	SLOVAKIA	12
HUNGARY	27	UNITED KINGDOM	156
TOTAL	1309		

Source: Author, based on BankScope database

As can be seen from above table, most commercial banks in European Union are located in Germany (15,43%), while the smallest number of commercial banks are located in Greece and Estonia (0,61%).

When looking at the raw data, the number of commercial banks in EU28 member states, according to the BankScope database, is 1.309. Unfortunately, all of the 1.309 commercial banks cannot be analysed in this research due to a number of reasons but the most frequent ones are: bankruptcy procedures, liquidations, mergers and acquisitions activities as well as lack of reported financial data in the mentioned 10-year period. The sample is shortened on banks that existed in the period from 2006 until 2015, that have all necessary data for the calculation of researched effect, i.e. to prove research hypotheses, and that did not encounter in mergers or acquisitions. Similar data clean-up is done by (Bucevska and Hadzi Misheva, 2017), where they also dropped, due to data unavailability, the banks that went through mergers and acquisitions.

The final sample is composed of 433 commercial banks that have all of the necessary data for the calculation of relative efficiency and regulatory impact on banking operations.

In order to construct the analytical framework, it is necessary to define the size of the banks, and to separate the commercial banks into small, medium-sized and large banks. (Mercieca, Schaeck and Wolfe, 2007) defined the threshold for small banks based on the size of the asset being below

450 million Euro. On the other hand, (Terraza, 2015) set that threshold for small banks to 1 million Euro. Due to large differences and different views on the size thresholds among different authors, in this research is applied the European Central Bank methodology. European Central Bank defines the size of the banks based on the total amount of consolidated assets of all of the EU banks, where the bank is defined as large if the ratio of individual bank assets to total consolidated assets of EU banks is greater than 0,5%, medium-sized if the ratio of individual bank assets to total consolidated assets of EU banks is between 0,5% and 0,005%, and small if the ratio of individual bank assets to total consolidated assets of EU banks is below 0,005% (ECB, Consolidated banking data, 2018).

After the applying European Central Bank methodology, in 2015 given threshold for small banks is 1.550.000 euro, for medium sized banks between 1.550.000 euro and 155.000.000 euro, while large banks are considered those banks that have value of their assets above 155.000.000 euro. In the research, final sample data consist of 37 large banks, 244 medium sized banks and 152 small banks.

The composition of EU banks sample based on the size and country of origin is presented in the following table.

Table 7: Number of banks in EU 28 states based in their size and country of origin

COUNTRY	NUMBER OF BANKS	LARGE	MEDIUM-SIZE	SMALL
AUSTRIA	29	0	18	11
BELGIUM	9	0	6	3
BULGARIA	9	0	7	2
CYPRUS	5	1	4	0
CZECH	10	0	7	3
GERMANY	65	5	34	26
DENMARK	23	3	12	8
ESTONIA	4	0	3	1
SPAIN	14	2	7	5

Table 7 (continued)

COUNTRY	NUMBER OF BANKS	LARGE	MEDIUM-SIZE	SMALL
FINLAND	3	0	2	1
FRANCE	53	7	35	11
GREECE	5	0	2	3
CROATIA	19	0	12	7
HUNGARY	9	3	4	2
IRELAND	4	0	4	0
ITALY	43	4	19	20
LITHUANIA	6	0	3	3
LUXEMBURG	14	3	8	3
LATVIA	11	0	5	6
MALTA	3	0	2	1
NETHERLANDS	6	0	5	1
POLAND	13	1	7	5
PORTUGAL	10	2	6	2
ROMANIA	10	1	6	3
SWEDEN	11	2	4	5
SLOVENIA	7	0	5	2
SLOVAKIA	6	0	3	3
UNITED KINGDOM	32	3	14	15
TOTAL	433	37	244	152

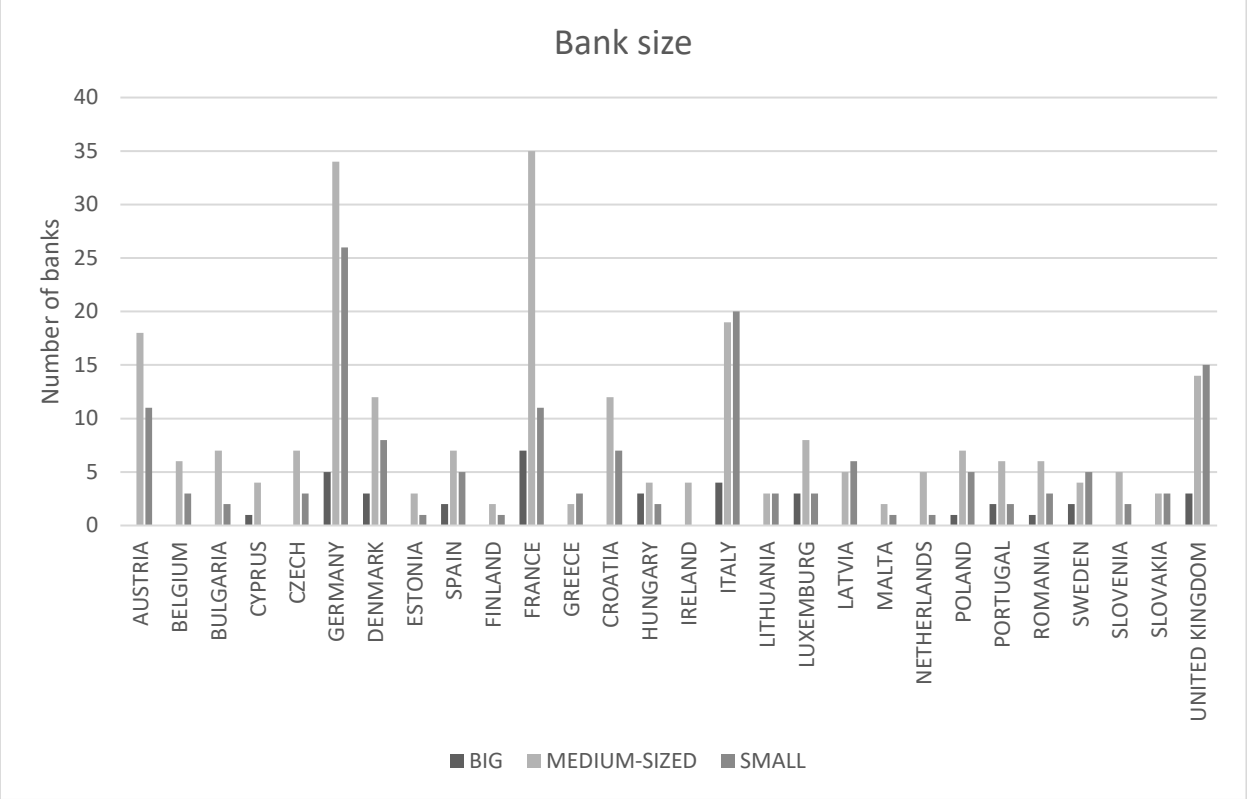
Source: Author, based on BankScope database

From the previous table can be seen that the dataset of 433 commercial banks is divided into 152 small, 244 medium size and 37 large banks. Since the number of large banks is too small for a robust statistical analysis, in this dissertation is jointly analysed medium and large banks, thus forming a sample of 281 large/medium sized banks.

Even though dataset is shortened for more than 65%, the Germany still has the largest amount of commercial banks in Europe with the similar percentage to the total EU28 banks (15,01%), while the lowest number of commercial banks for this shortened dataset come from Finland and Malta (0,69%).

For the better visualization of the number of banks, depending on their size and country, following graph is presented.

Figure 5: Size and country of origin for the analysed banks in EU28 Member States



Source: Author, based on BankScope database

The highest number of large and medium sized banks is located in France, while the highest number of small banks is located in Germany. Germany, Italy and the United Kingdom have developed banking at the regional level, so they are obvious leaders in the number of small banks. The largest number of medium-sized banks are located in Germany, France and Austria, while the largest number of large banks are in Germany, France and Italy. If the number of banks is taken as a relevant source, the most developed banking systems are in Germany, France, Italy and the United

Kingdom. In many other countries, especially the Eastern countries, there are banks whose parent companies are located in one of the above-mentioned countries.

Scientific researches that are focused on time dimension from 2006 until 2015 are very scarce, and most of them are settled in crisis and post-crisis period, so the effect of new regulation, starting in January 2014, is insufficiently researched.

The impact of the introduction of new regulatory requirements has been largely analysed for selected countries on world basis, for selected countries on EU basis, or for individual countries However, to the best of my knowledge, there is no scientific research on the effect of EU regulation for current 28 Member States of European. Considering that EU regulation is affecting to the same extent all of the banks, it would be notably to put it in the context of the effect to the profitability and efficiency for banks that operate only in European Union. The research is expected to give scientific contribution in theoretical and applied sense, as the guideline and landmark for the supervisory and monetary authorities.

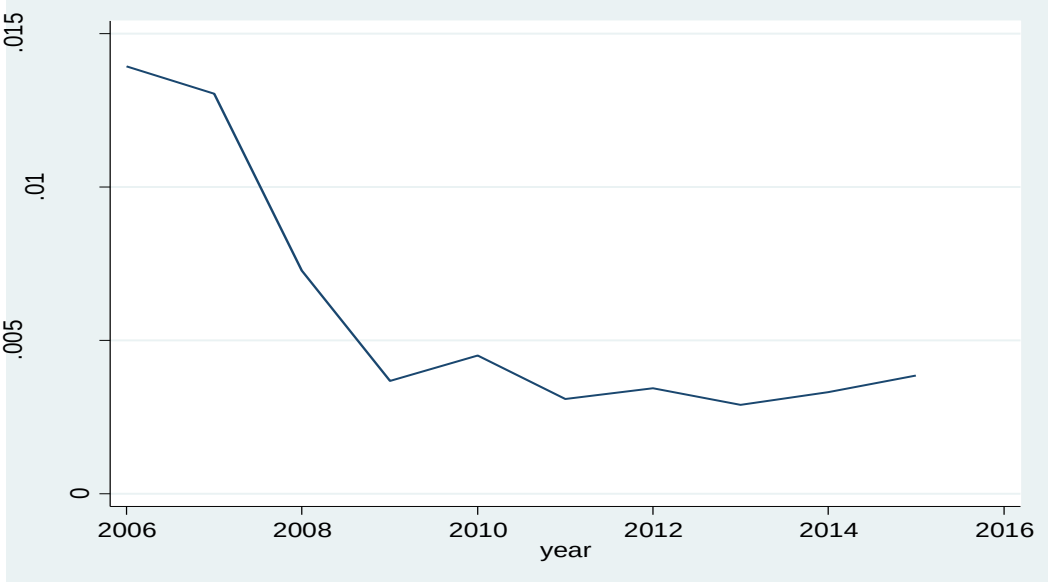
5.1.2. Characteristics of variables used in scientific research

As mentioned at the beginning of dissertation, main hypothesis is that global banking regulatory framework (Basel 2 and Basel 3) have considerable negative effects on banking operation within European Union, with auxiliary hypotheses on the effect of bank size on bank relative efficiency and their profitability. To prove such hypotheses, it is necessary to identify variables used for the calculation of relative efficiency, as well as dependent and independent variables later used in panel data for the calculation of regulatory effect. Values that deviate significantly from the other values in a set of data, i.e. outliers, are corrected using winsorizing, since they can heavily influence on the mean values and distribution. Winsorizing is the transformation of extreme values to the specified percentile of the data, meaning that if the values fall above or below specified percentile, they are transformed to the highest number within the specified percentile. (Baltagi, 2013). Percentile set for winsorization in this research are 5^{th} percentile and 95^{th} percentile.

As dependent variables are taken bank profitability and relative efficiency, variables used by many researchers. As for banking profitability, significant portion of researchers use ROA (return on assets) or ROE (return on equity) (Naceur and Omran, 2011; Rezende and Wu, 2012; Bouheni *et*

al., 2014; Căpraru and Ihnatov, 2014; Imbierowicz and Rauch, 2014; Ozkan, Balsari and Varan, 2014; Terraza, 2015; Borio, Gambacorta and Hofmann, 2017; Bucevska and Hadzi Misheva, 2017; Kim and Sohn, 2017; Roulet, 2017). There are scientific papers in which the authors have used ROAA (return on average assets) or ROAE (return on average equity) (Mercieca, Schaeck and Wolfe, 2007; Dietrich and Wanzenried, 2009; Căpraru and Ihnatov, 2014; Petria, Capraru and Ihnatov, 2015; Terraza, 2015). In this dissertation will be used ROA considering that this type of profitability indicator is more popular in the later years. Return on assets is calculated as profit before taxes divided with total assets (both of these variables are taken from BankScope database). Just as a note at the beginning of this chapter, return on average assets is also calculated (as profit before tax divided with total average assets, where total average assets for current year is calculated as the average of current year and previous year). The correlation of ROA and ROAA equals 98,9% which is highly significant, and therefore only ROA will be used. Reason more why only ROA is used, is that this indicator is used by dividing original data from Bankscope, rather than additionally created total average assets, which can result in miscalculation. In following graphs is shown trend of banking profitability measured as return on assets, and depending on the size of the banks.

Graph 1: Return on assets, all EU28 banks, 2006-2015

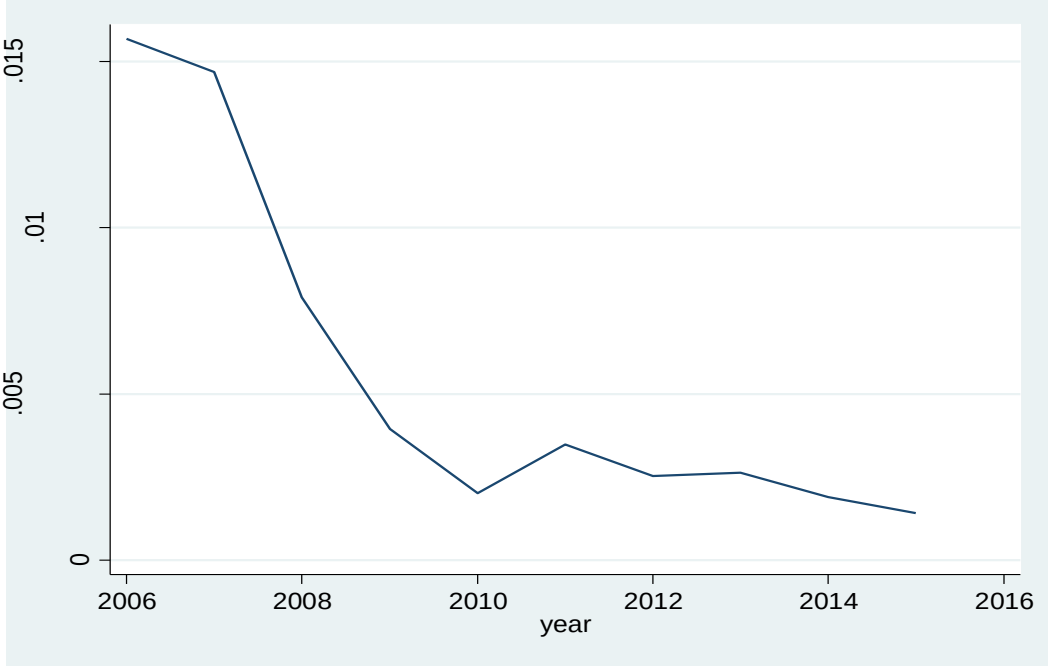


Source: Author, based on BankScope database

Above graph is showing the latitude of negative effects of global financial crisis which significantly deteriorated profitability of all banks in European Union. After some stagnation, improvement can be seen from 2013 onward, just at the time of the introduction of new regulatory framework. Such annual data may lead us to conclusion that the introduction of a regulatory framework is improving banking performance. Therefore, more detailed analysis is needed.

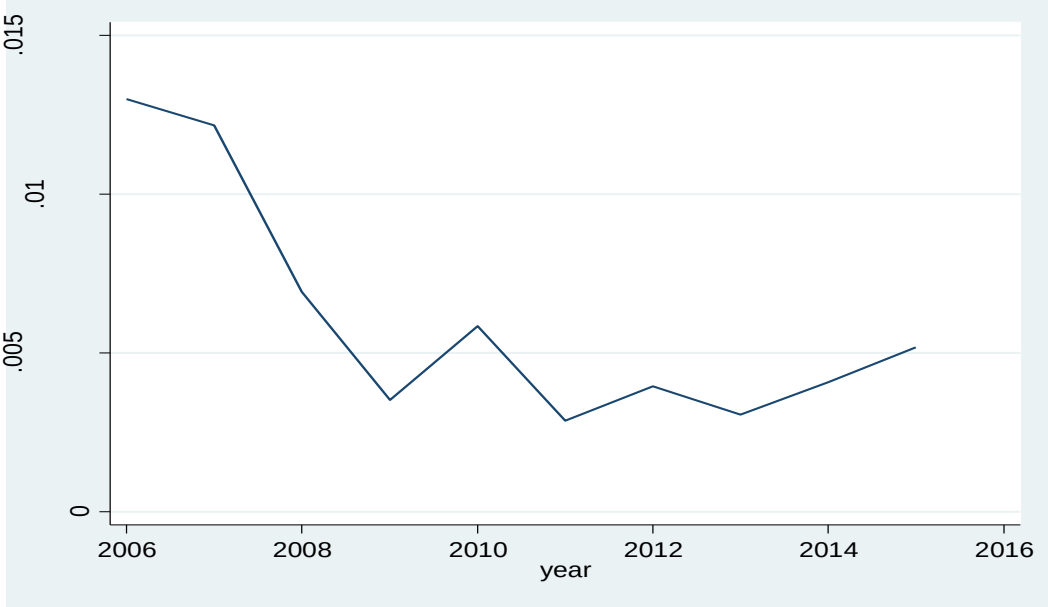
The following Graph 2 and Graph 3 show the profitability of the banks depending on their size and how their profitability has varied over the years.

Graph 2: Return on assets, small banks in EU28, 2006-2015



Source: Author, based on BankScope database

Graph 3: Return on assets, large and medium sized banks in EU28, 2006-2015



Source: Author, based on BankScope database

On the above graphs, it can clearly be seen that financial crisis had significant impact on bank profitability, regardless of their size (except that higher percentage drop is seen at small sized banks). However, the speed of profitability recovery is different. While medium sized and large banks started to recover in 2013 (with some ups and downs after 2009), small banks, starting from 2011, are performing worse year after year, with highest impairments starting around 2013, which coincides with the introduction of a new regulatory framework. The movement of profitability on an aggregate basis and the movement of profitability depending on the size of banks differs and is showing mixed results. Such movement served as an additional motive for this research.

Relative efficiency score is a calculated variable obtained through DEA (Data Envelopment analysis), which is a mathematical programming technique. Data Envelopment Analysis measures the efficiency of a "decision-making unit" (DMU), in this case individual bank, relative to others similar DMUs with the simple constraint that all DMUs lie below or on the so-called efficiency frontier. Data Envelopment Analysis calculates the relative efficiency for each unit relative to all other units by using the actual given values of inputs and outputs for each unit (more on this methodology in following chapters). Due to mathematical nature of Data envelopment analysis,

input and output should be identified. There is an ongoing debate in the banking literature who deals with the correct definition of inputs and outputs.

Following the previous researches on the topic of banking efficiency (Sealey and Lindley, 1977; Sherman and Gold, 1985; Bauer *et al.*, 1998; Athanasoglou, Delis and Staikouras, 2006; Pasiouras, 2008; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; BOĎA and Zimková, 2015; Kale, Eken and Selimler, 2015; Řepková, 2015; Triki *et al.*, 2017), the proposed model for the evaluation of relative efficiency has four inputs and three outputs:

INPUTS:

- funding (sum of deposits, short term funding and long-term funding)
- fixed assets
- personnel expenses
- loan loss provision (risk category)

OUTPUTS:

- loans
- net fees
- other earning assets

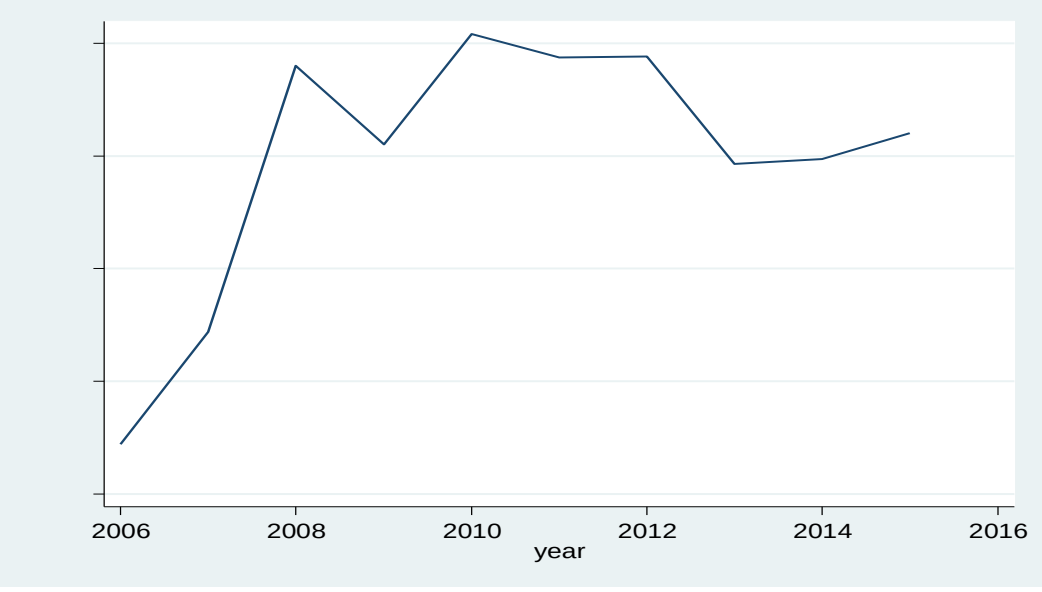
Results of Data Envelopment Analysis calculation are values between 0 and 1 (zero being totally inefficient unit, while value of one has the most efficient unit from given data). The results on relative efficiency will give answer to first and second auxiliary hypothesis, while later they will be used as variable in calculation of the regulatory impact on banking performance.

Development and trends of the variables used for the calculation of relative efficiencies throughout observed period are given in following graphs. First four graphs represent input variables, while other three graphs represent output variables.

Most significant input variable is funding. Funding can be divided by maturity, types and ownership. By maturity, they can be short term and long term, by types they can be deposit, non-deposit and capital and reserves, while by ownership they can be own sources (like capital and reserves) and others sources (like deposits and taken loans). Funding is calculated as the sum of deposits with short term and long-term funding. Deposits can be in various currencies, short term

or long term, of resident and non-resident, from legal of physical entities etc. The deposit money includes cash on different types of accounts and banks' liabilities by issued instruments payments. These are transactional deposits that the account holders serve to perform daily payments and their level on individual accounts varies daily. Despite the volatility of such a source of funds, banks can use them as stable sources for a shorter period of time. Viewed on a group basis, banks can calculate a steady trend, that is, the amount of money from all of the bank clients that was available to the banks in certain prior period. If bank currently has an amount on customer accounts significantly above the calculated steady trend, then the bank keeps that amount as a liquidity reserve while the remaining, stable amount of the deposit accounts, can be issued as a short-term loan. From the point of view of profitability, deposit money enables banks very high earnings on the difference between active and passive interest rates, though it should be emphasized that the costs of banks are also linked to the cost of account management that are fairly high. Savings deposits are mainly current and time deposits in different currencies, and these foreign currency deposits banks use for international payment transactions. Other short term and long-term funding can be various, from issued securities, like bonds and money market instruments, to taken loans from other banks or central banks. Movements of funding for all banks can be seen in the following graph.

Graph 4: Funding, all EU28 banks, 2006-2015

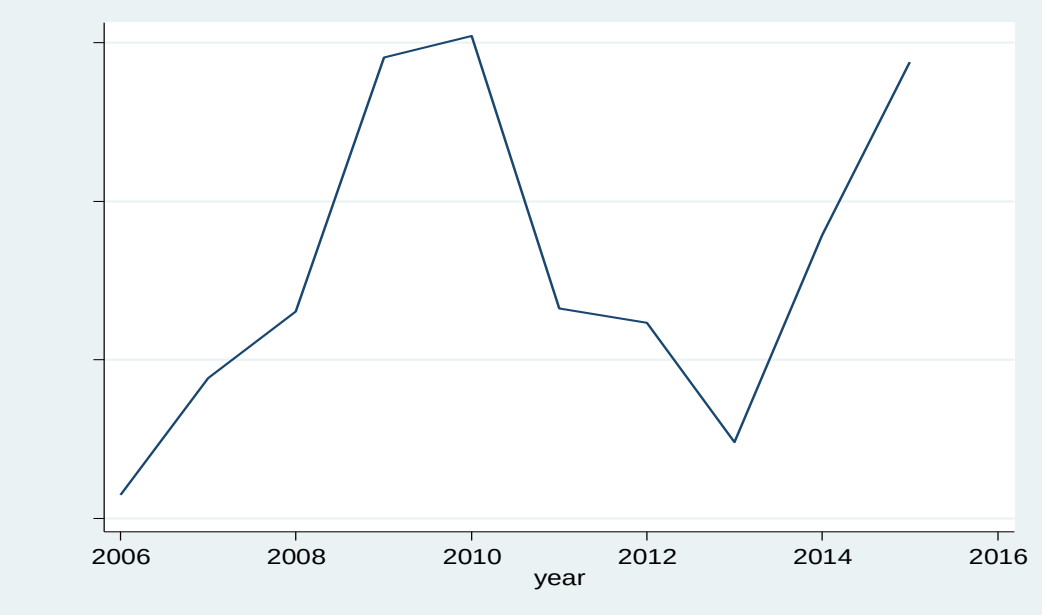


Source: Author, based on BankScope database

Commercial banks use different sources of funds such as deposits, and later issue loans based on them. Commercial banks use financial leverage in this business model, since they use other people's funds to make a profit. Funding represents such sources where is taken sum of deposits, sum of short-term funding and sum of long-term funding. It can be seen that the total amount of funding for all of the commercial banks increased drastically from 2006 to 2008, with smaller volatility from 2008 onward.

Fixed assets are the type of assets that cannot be converted into cash on a regular basis, without interfering with business operations, and is generally held for more than a year. Fixed assets include land, buildings, equipment and long-term investments. Trend of the fixed assets for the commercial banks can be seen in the following graph.

Graph 5: Fixed assets, all EU28 banks, 2006-2015



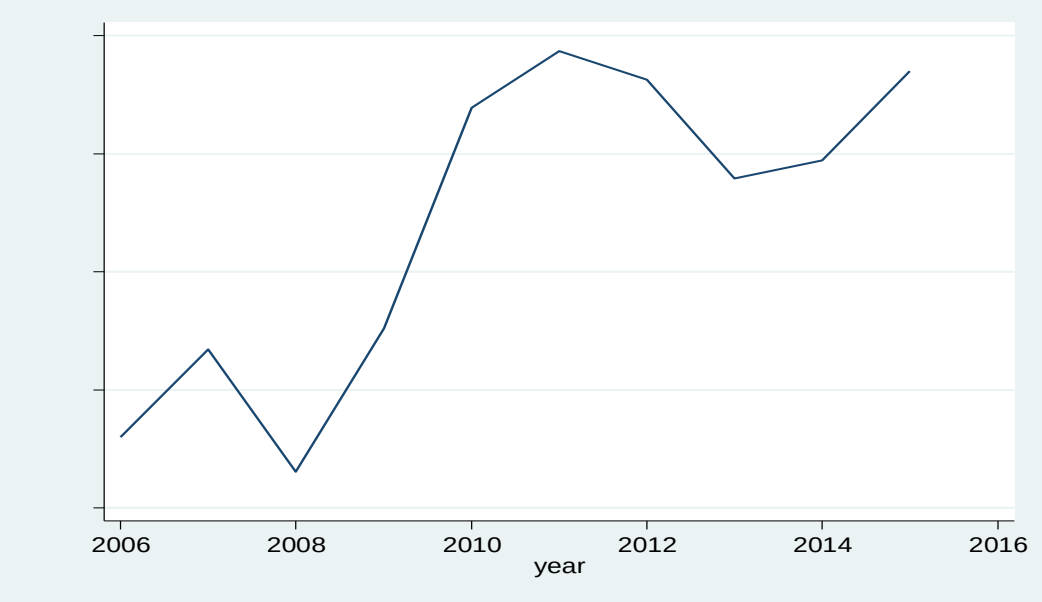
Source: Author, based on BankScope database

Commercial banks in the European Union had significant drop in the value of fixed assets after 2010. In 2013 this downward trend reversed, so in 2015 amount of fixed assets reached the values from the period before the drop.

Personnel expenditure are the salaries of employees in the bank. They consist of net salary, taxes and contributions from salaries and contributions on salary. Purpose of the salary for the employee

is to cover personal needs (net salary) and to give a portion of the income in the form of taxes and contributions for public, local community, self-managing and common needs such as education, judiciary etc. Types of salary can be basic salary, salary depending on experience, salary depending on complexity of work and salary depending on the results.

Graph 6: Personnel expenditure, all EU28 banks, 2006-2015



Source: Author, based on BankScope database

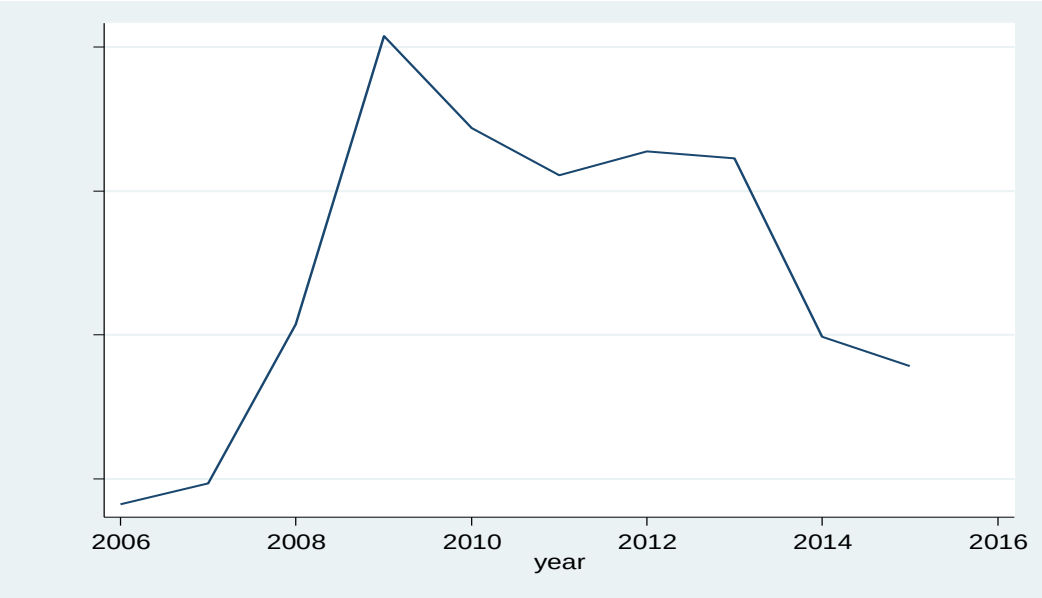
Personnel expenditure decreased in 2007 due to financial crisis, after which increased drastically up until 2011. With the drop in 2012 and 2013, personnel expenditures returned to its all-time high. Interestingly, both small banks and large/medium sized banks had drop in the total amount of personnel expenses after 2011, while these expenses increased significantly starting from 2013, at the same time new regulatory framework started with the phasing in (officially it was introduced in 2014). The increased personal expenditure of banks can be linked to the introduction of a regulatory framework, which requires banks to have additional methods of controlling their operations, leading to an increase in the volume of work and, consequently, an increase in the number of employees Personnel expenditure had the similar trend and can be compared with the funding of the banks.

A loan loss provision is the amount of money set aside that serve as collateral for the issued loans. This provision is used to cover a number of factors affecting credit losses, such as customer failure,

difficult in credit collection, loan refinancing on terms that are worse than originally agreed terms, etc. Loan loss provisions represent a financial outflow, although it is not officially a cash outflow. Loan loss provisions include general provisions resulting from statistical calculations for the loans on group basis, as well as specific provisions relating to the likelihood of losses among classified or problem loans. Loan loss provision on a group basis is calculated as a certain percentage of the total number of issued loans. It applies to loans that are generally repayable, however, there are always some statistical losses that are intended to be covered with this provision. On the other hand, a loan loss provision on a specific basis seeks to cover losses arising from a certain loan for which there is a risk of default and for which the bank has assessed that it must set reservations to a certain amount. Loan loss provision can be viewed as a means to adjust for a bank's inevitable "mistakes" in issuing of loans. In fact, a certain proportion of defaults is expected and should be provided for as cost of doing business. While the principal of setting aside loan loss reserves to account for credit costs is almost universally accepted by banks and bank regulators throughout the world, assessment of the appropriate amount of loan loss provisioning can be difficult. In actuality, banks often underestimate these costs and under-provision. Management often has an incentive to keep these provisioning costs to a minimum in order to prevent profits from being reduced, and thus enable higher bonuses to the management and dividends to the shareholders. In other circumstances, banks may over-provision in order to reduce tax liability. Because of this phenomenon, provisioning is not always undertaken for the purpose for which it is intended. (Golin, J., 2001).

The following graph shows the trend of loan loss provision in EU28 banks.

Graph 7: Loan loss provision, all EU28 banks, 2006-2015

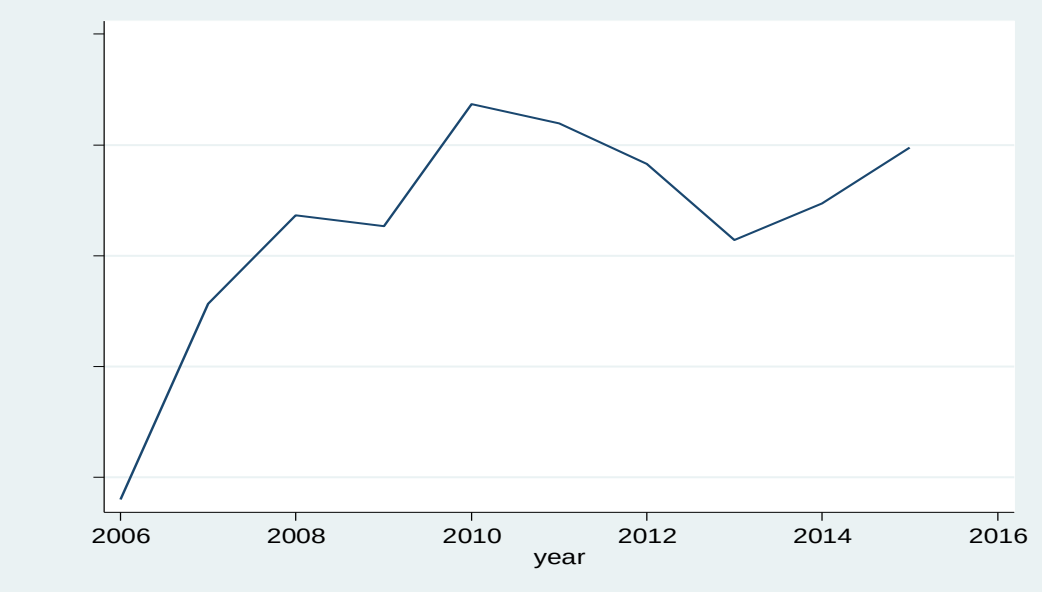


Source: Author, based on BankScope database

Loan loss provision increased drastically following financial crisis and it reached it peak in 2009. One of the reasons for the drastic decrease in profitability from 2006 until 2009 seen in Graph 1 is certainly loan loss provision, which is treated as an expense and thus reduces the profit.

The bank's outputs, loan, net fees and other earning assets are presented in continuation. A loan is an arrangement in which a lender, in this case a bank, grants money to a borrower, and the borrower is obligated to refund the money, usually with interest, at some future time. Generally, the lender takes over the risk that the borrower will not return the loan on time or that the lender will not return it at all. The amount of issued loans from commercial banks can be seen on the following graph.

Graph 8: Loans, all EU28 banks, 2006-2015



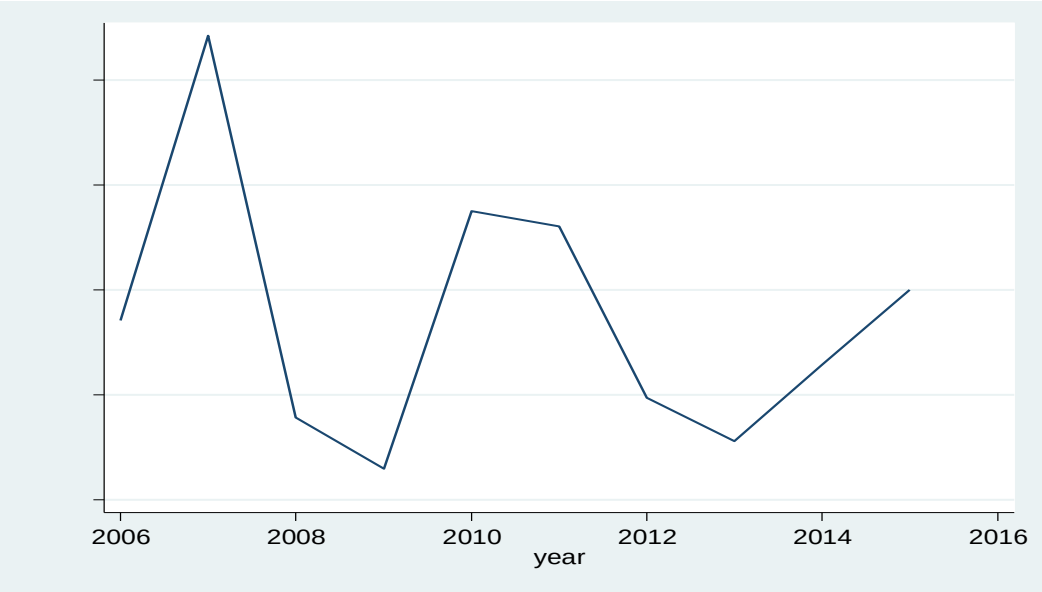
Source: Author, based on BankScope database

Lower interest rates that followed after financial crisis, as well as increasing of the funding, resulted in more loans issued by commercial banks. The amount of total loans issued reach its peak at the 2010 after which it had the drop and later recuperation in 2013.

Other earning assets and net fees had expressed volatility during observed period. In the following graph is shown their trend.

Fee revenue represents revenue from the commissions and sales of financial services to clients. The amount of such commission and fees is agreed in advance with the client. Fee revenue is desirable for banks because it represents a stable source of income independent of market risks. This revenue is additionally attractive to banks because it offers the opportunity to sell an additional product to an already existing customer base without additional exposure to market and credit risk. Fee income contributes to the diversification of commercial bank revenue base. (Choudhry, 2012) The amount of commercial banks net fees can be seen on the following graph.

Graph 9: Net fees, all EU28 banks, 2006-2015

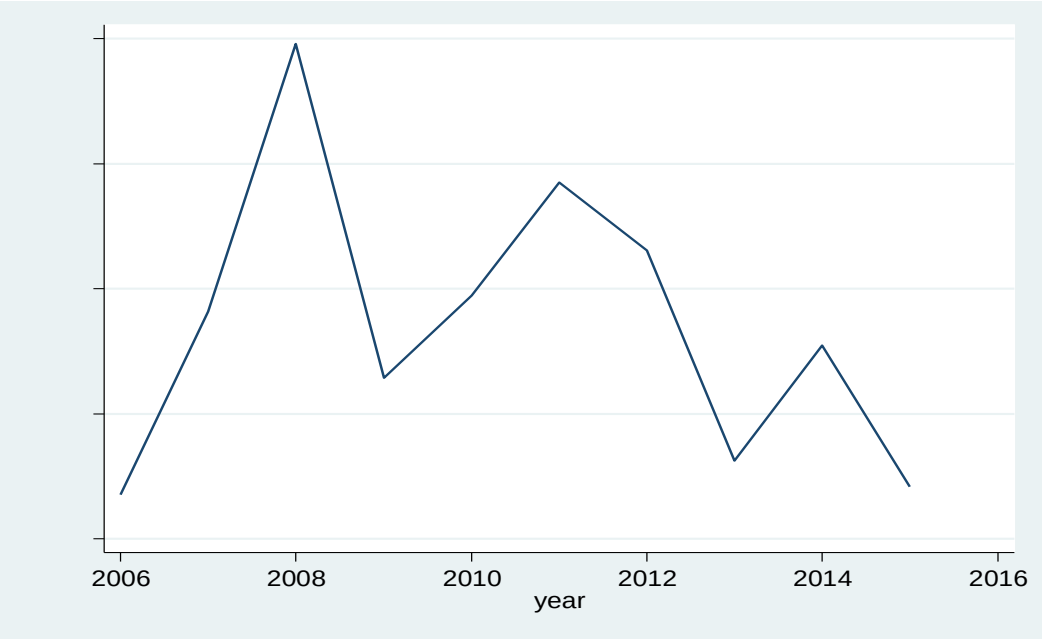


Source: Author, based on BankScope database

Net fees considerably dropped during the financial crisis, following downfall in issuing non-traditional banking products that are main source for this type of income. During observed period, net fees were quite volatile with the upward trend in last observed years.

Other earning assets represents items in assets that contribute to an increase in income. Most of the income for commercial banks is an income generated from the issued loans. Given that the loans were placed as a separate output for this efficiency calculation, other earning assets are taken to capture the remainder of the assets contributing to revenue generation. Other earning assets can be different types of financial instruments or products such as bonds, stocks, certificate of deposits, income from rental property etc. The value of commercial banks other earning assets can be seen on the following graph.

Graph 10: Other earning assets, all EU28 banks, 2006-2015



Source: Author, based on BankScope database

Other earning assets dropped significantly following the financial crisis. Such turn of the events is not surprising considering that the one of the most responsible triggers for the crisis was derivative financial instruments that are the items inside other earning assets. Following recuperation in the economy, the amount of other earning assets increased, however, it remained volatile.

These were the variables used in the calculation of relative efficiency, while the variables used in the panel data analysis will be presented below. Independent variables are divided on bank specific, macro (monetary) variables and dummy variable for regulation.

Due to problem endogeneity, variables used in the estimation of relative efficiency cannot be used in the panel data analysis. For this reason, variables used in the panel data analysis are:
Bank specific variables

- liquidity (Athanasoglou, Delis and Staikouras, 2006; Mercieca, Schaeck and Wolfe, 2007; Borio, Gambacorta and Hofmann, 2017)
- bank size (Pasiouras, 2008; Dietrich and Wanzenried, 2009; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; Căpraru and Ihnatov, 2014; Petria, Capraru and Ihnatov,

2015; Borio, Gambacorta and Hofmann, 2017; Roulet, 2017; Triki *et al.*, 2017; Bucevska and Hadzi Misheva, 2017; Deli and Hasan, 2017; Kim and Sohn, 2017)

Macro (monetary) variables

- long term interest rate (Shehzad and De Haan, 2009; Roulet, 2017)
- real GDP growth rate (Pasiouras, 2008; Dietrich and Wanzenried, 2009; Pasiouras, Tanna and Zopounidis, 2009; Shehzad and De Haan, 2009; Chortareas, Girardone and Ventouri, 2012; Borio, Gambacorta and Hofmann, 2017; Bucevska and Hadzi Misheva, 2017; Deli and Hasan, 2017; Roulet, 2017)
- Herfindahl–Hirschman Index (McNulty, Akhigbe and Verbrugge, 2001; Athanasoglou, Delis and Staikouras, 2006; Naceur and Omran, 2011; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; Căpraru and Ihnatov, 2014; Ozkan, Balsari and Varan, 2014; Petria, Capraru and Ihnatov, 2015; Řepková, 2015; Triki *et al.*, 2017; Bucevska and Hadzi Misheva, 2017)
- inflation measured by the Harmonized Index of Consumer Prices (HICP) (Athanasoglou, Delis and Staikouras, 2006; Pasiouras, 2008; Pasiouras, Tanna and Zopounidis, 2009; Shehzad and De Haan, 2009; Naceur and Omran, 2011; Barth *et al.*, 2013; Bouheni *et al.*, 2014; Ozkan, Balsari and Varan, 2014; Bucevska and Hadzi Misheva, 2017; Deli and Hasan, 2017)

Bank liquidity is the ability of a bank to cover current and upcoming costs. The bank achieves adequate liquidity in a manner that reconciles the amounts and maturities of liabilities with receivables, and by forming an adequate liquidity reserve. Many of the authors, such as (Ozkan, Balsari and Varan, 2014), use cash, trading securities, deposits, money market securities and other as liquidity proxies. Due to missing data in the database used, for the liquidity is taken ratio between loans and total assets, following the researches from (Athanasoglou, Delis and Staikouras, 2006; Mercieca, Schaeck and Wolfe, 2007; Borio, Gambacorta and Hofmann, 2017). Higher the percentage of loans to total assets, higher profitability and relative efficiency is expected. The movement trend of bank liquidity, calculated as a ratio between loans and total asset, can be seen on the following graph.

Graph 11: Bank liquidity, all EU28 banks, 2006-2015



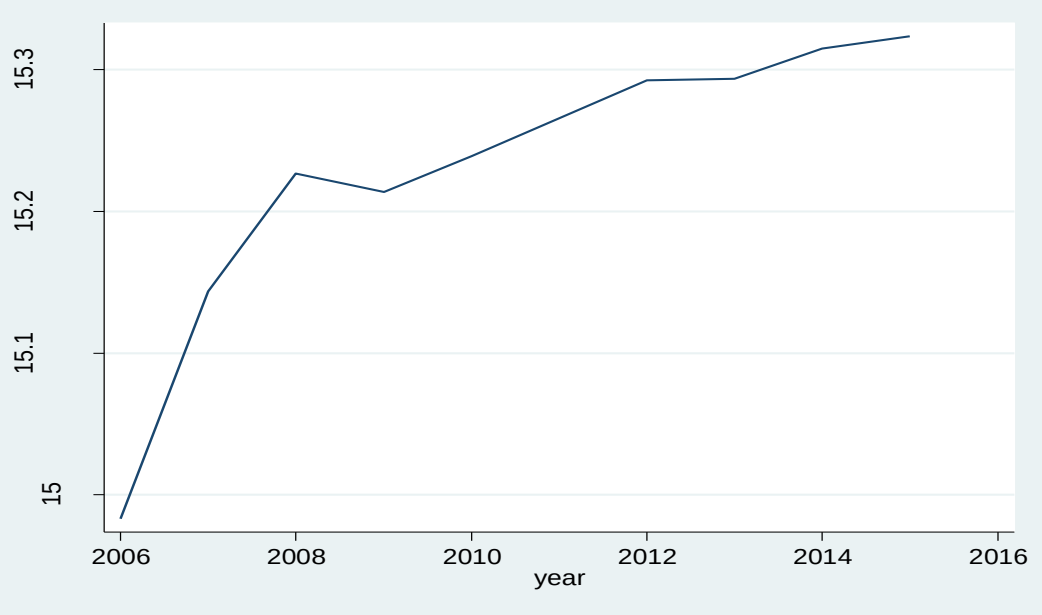
Source: Author, based on BankScope database

The graph shows the trend of liquidity movement over the observed 10 years. Before financial crisis this ratio increased significantly, while later on it dropped, meaning that banks are getting rid of bad loans, and thus improving liquidity. Resolving bad loans, banks channelled funds into a smaller number of quality loans or cash equivalents, both ow which were considered as stable placements.

Bank size is calculated as natural logarithm of total assets (Pasiouras, 2008; Dietrich and Wanzenried, 2009; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; Căpraru and Ihnatov, 2014; Petria, Capraru and Ihnatov, 2015; Borio, Gambacorta and Hofmann, 2017; Roulet, 2017; Triki *et al.*, 2017; Bucevska and Hadzi Misheva, 2017; Deli and Hasan, 2017; Kim and Sohn, 2017). Size of the bank is considered to have positive impact on both return on assets and relative efficiency of the banks. Some of the authors, such as (Petria, Capraru and Ihnatov, 2015) suggest that size of the bank can have negative influence on the performance. They emphasize that greater size can generate economies of scale and improve business performance, but at the same time, larger organizations can be affected by bureaucracy, inertia or rigidities, that may reduce business performance A question that needs to be asked for such view is whether their opinion can be put in the perspective of new regulatory environment for banks, as newly imposed regulatory framework

have the influence on small banks as well. As mentioned by (Kale, Eken and Selimler, 2015), small banks can outperform large banks during unstable period. The movement trend of the bank size, calculated as natural logarithm of total assets, can be seen on the following graph.

Graph 12: Size of the banks, all EU28 banks, 2006-2015



Source: Author, based on BankScope database

Throughout observed period only slightly increase in the bank size is noticed, with highest increase prior global financial crisis. After 2008, the size of the banks in EU28 grow slightly.

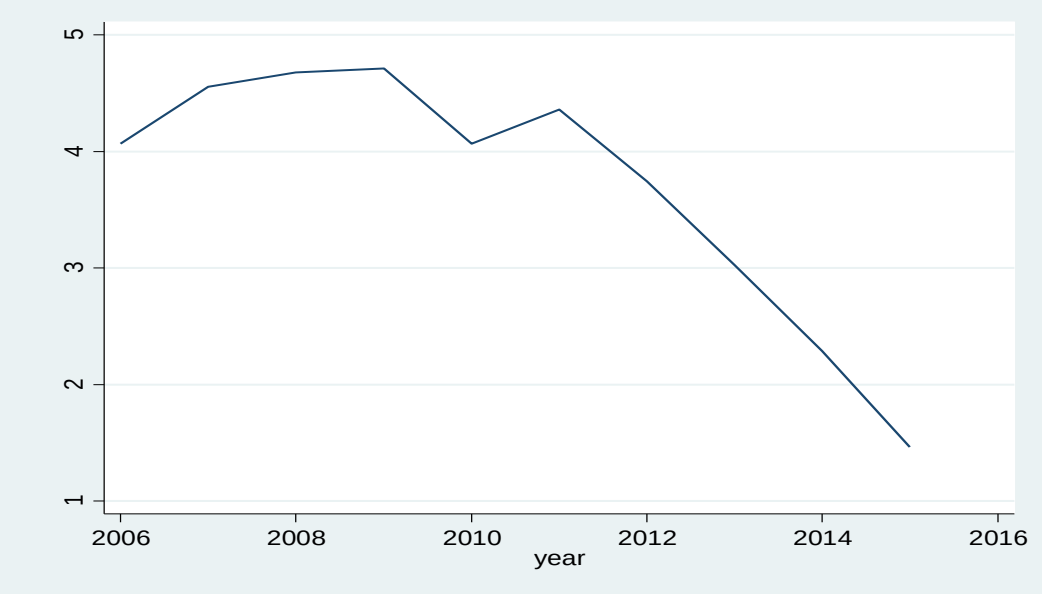
In addition to bank-specific characteristics, it is also very important to account for macroeconomic conditions.

Bank lending behaviour in response to central bank monetary policy is captured by movements in the values of market interest rates. (Shehzad and De Haan, 2009; Roulet, 2017)

For the purpose of long-term interest rate, in this doctoral dissertation is used Maastricht criterion bond yields. Maastricht criterion bond yields "*are long-term interest rates used as a convergence criterion for the European Monetary Union, based on the Maastricht Treaty"*. (Eurostat, EMU convergence criterion series - annual data, 2018). As stated on the official website, *"selection guidelines require data to be based on central government bond yields on the secondary market, gross of tax, with a residual maturity of around 10 years."* (Eurostat, Maastricht criterion interest

rates, 2018). The data for this variable are only available on a monthly basis, so the annual averages are created to fit the model. The movement of Maastricht criterion bond yields can be seen on the following graph.

Graph 13: Maastricht criterion bond yields, 2006-2015



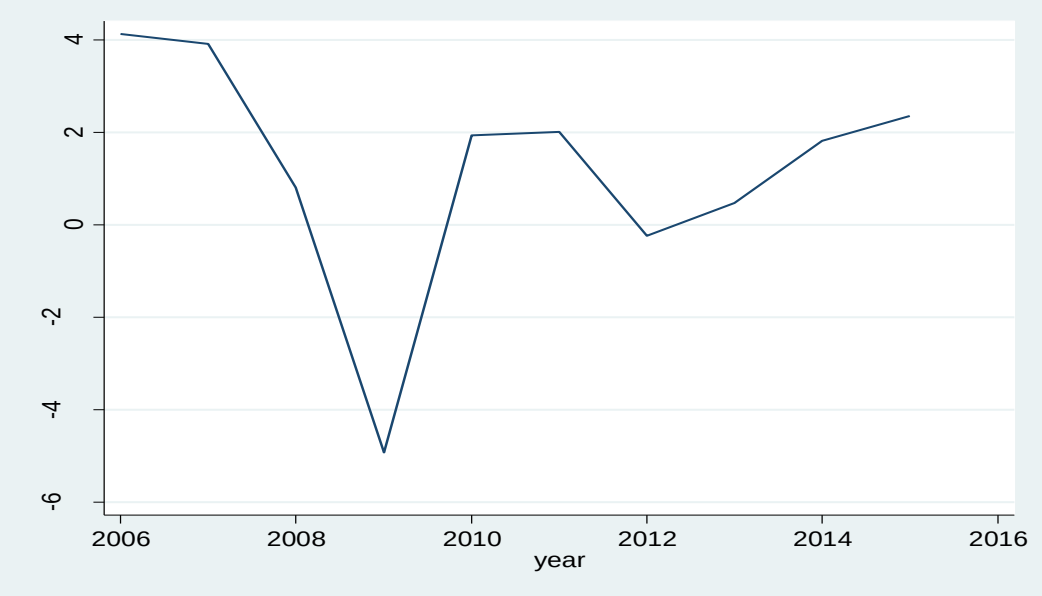
Source: Author, based on Eurostat database

After the financial crisis, there was significant drop in the interest rates measured based on Maastricht criterion bond yields during the entire observation period. The fall in interest rates is not only specific to this indicator, but it was also present in all other reference interest rates, such as EURIBOR. (Euribor rates, 2018)

Gross domestic product (GDP) is widely used variable for macroeconomic effect. Gross Domestic Product (GDP) is the value of all final services and goods produced within a country. It includes the value of services and goods produced by foreign factors of production in the country, but does not include the value of external production that is arising from domestic production factors. Nominal GDP expresses the value of production at current prices, so it contains price and volume changes. Gross Domestic Product is the total value of all products and services available for final consumption produced in the territory of a country over a given period, regardless of whether income from such products and services is acquired by resident or non-residents. Gross domestic product (GDP) is a measure of economic activity, defined as the difference between value of all

services and goods produced, and the value of services and goods used in their creation. Calculating the annual GDP growth rate allows comparison of the dynamics of economic development between economies of different sizes and over time. Following (Pasiouras, 2008; Dietrich and Wanzenried, 2009; Pasiouras, Tanna and Zopounidis, 2009; Shehzad and De Haan, 2009; Chortareas, Girardone and Ventouri, 2012; Borio, Gambacorta and Hofmann, 2017; Bucevska and Hadzi Misheva, 2017; Deli and Hasan, 2017; Roulet, 2017) in this doctoral dissertation is used real GDP growth rate, as a yearly percentage change on previous year. The movement of real GDP growth rate can be seen on the following graph.

Graph 14: Real GDP growth rate in EU28, 2006-2015



Source: Author, based on Eurostat database

Gross domestic product encountered a considerable decline after global financial crises, after which it on average increases for the European market.

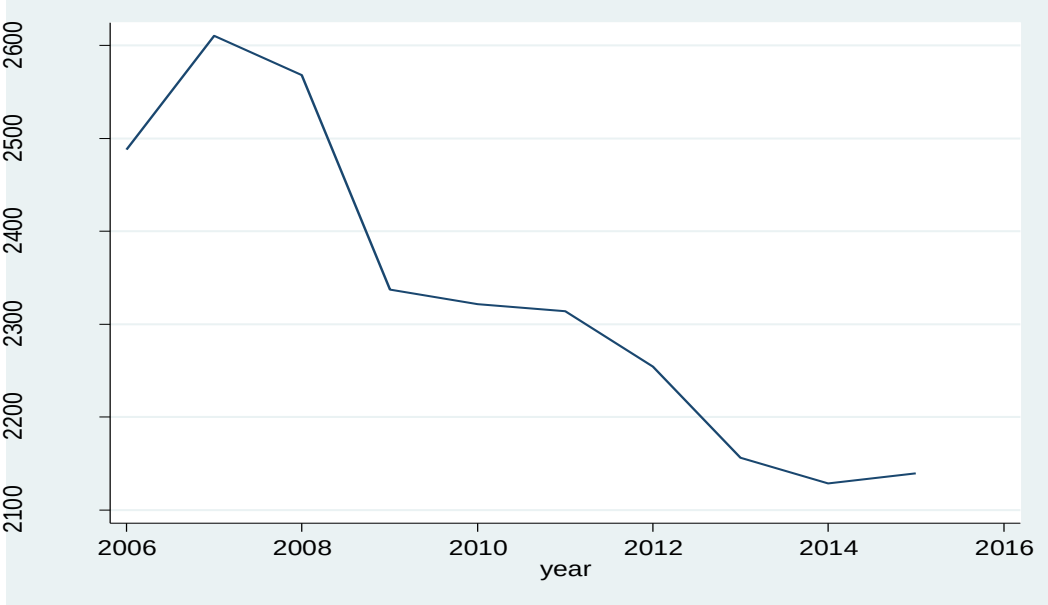
For the macroeconomic control of market competition is used Herfindahl–Hirschman Index (HHI), following the research papers from (McNulty, Akhigbe and Verbrugge, 2001; Athanasoglou, Delis and Staikouras, 2006; Naceur and Omran, 2011; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013; Căpraru and Ihnatov, 2014; Ozkan, Balsari and Varan, 2014; Petria, Capraru and Ihnatov, 2015; Řepková, 2015; Triki *et al.*, 2017; Bucevska and Hadzi Misheva, 2017). Herfindahl-Hirschman Index shows market competitiveness and is commonly used measure of market

concertation. Herfindahl-Hirschman Index is defined as the sum of the squared shares of bank total assets to the total assets within a given country and multiplied by 10.000:

$$HHI = \sum_{i=1}^{N} TA_i^2 * 10.000 \quad (1)$$

where TA_i represents the share of individual bank assets to total assets and N is the number of banks within the observed country. If HHI values are below 100 it indicates a highly competitive industry, if it is below 1.500 it indicates an unconcentrated industry, if it is between 1.500 and 2.500 it indicates moderate concertation, while if it is above 2.500 it indicates high concentration. Total market, for which the HHI is calculated, is defined as the sum of banking assets for all of the observed banks in the EU28 area. The movement of Herfindahl-Hirschman Index can be seen on the following graph.

Graph 15: Herfindahl-Hirschman Index, 2006-2015

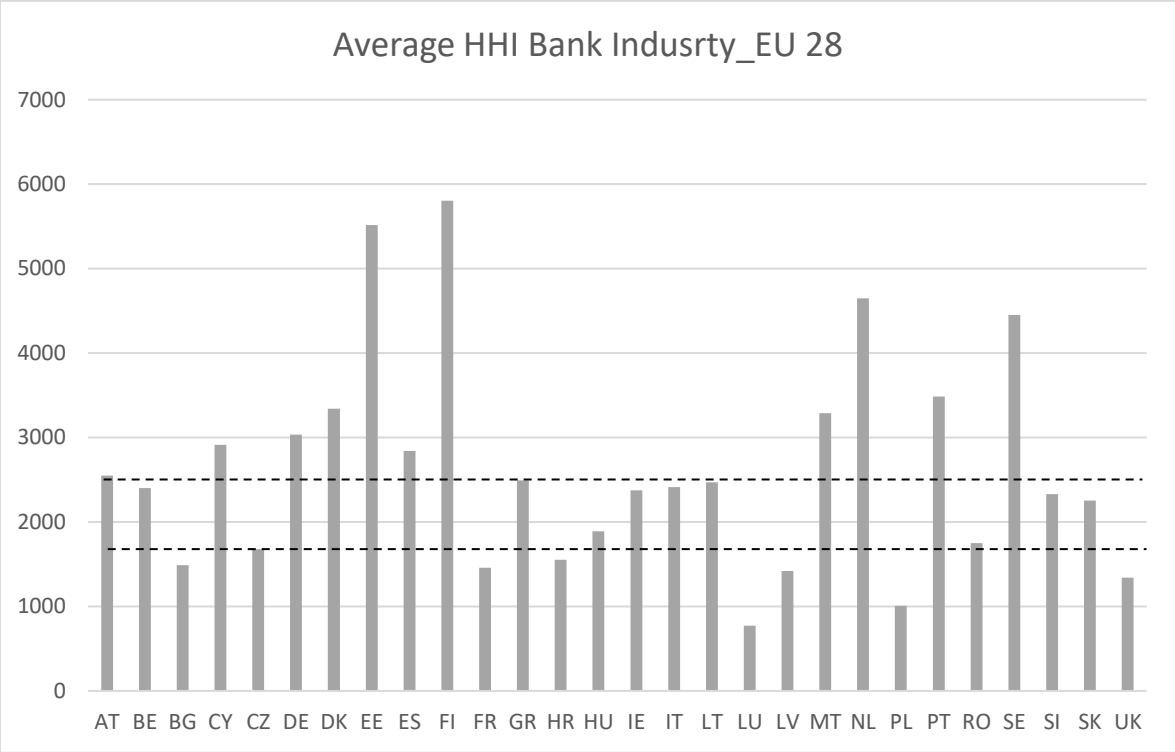


Source: Author, based on BankScope database

On average, concertation of banking industry at the level of EU28 countries is decreasing, with the Herfindahl–Hirschman Index falling below 2.200 in year 2013 and later. This downward trend in the bank concentration can be seen for both small-sized and large banks.

For a better understanding of the concentration of banks in the European Union, the table below shows the average concentration of banks in all EU28 member countries.

Figure 6: Average HHI index for EU28, from 2006-2015



Source: Author, based on BankScope database

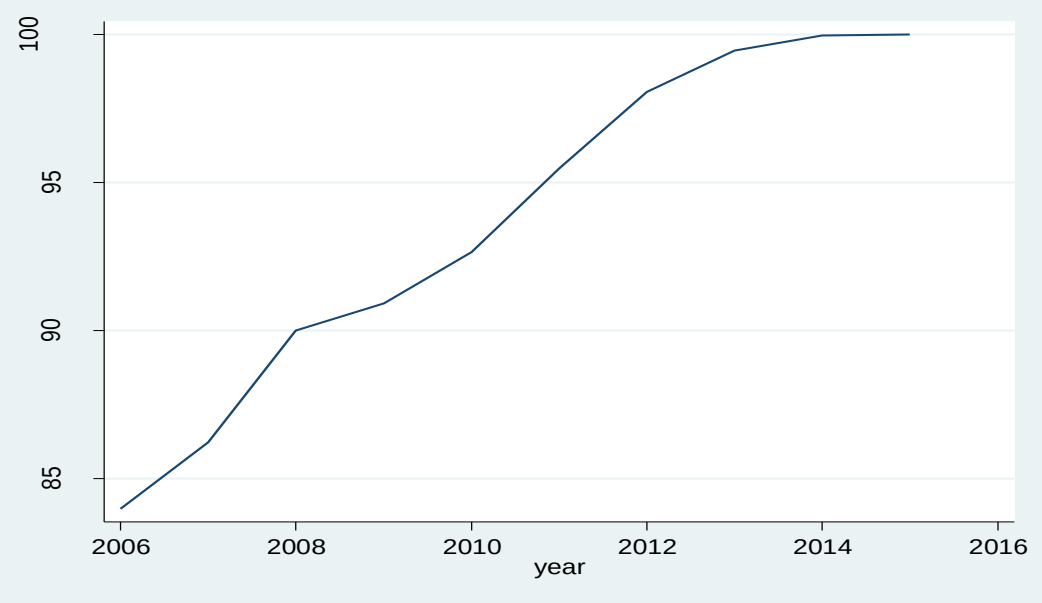
Highest concentration of Banks in EU28 is in Finland where Nordea Bank is dominating banking sector with 70% of market share, while lowest concentration is present in Luxemburg where largest bank has only 18% of market share.

In a market economy, the prices of products and services are constantly changing. Inflation represents a general increase in prices and services, not an individual increase for individual good. Consequently, for a price of one euro, we can buy more or less goods than before. (ECB, What is inflation? 2018) Inflation is an increase in the aggregate price level relative to the value of money. The term inflation can also be defined as a fall in money value, where value of money means its purchasing power. So if there is inflation in a particular economy, the purchasing power of that currency falls. Following authors such as (Athanasoglou, Delis and Staikouras, 2006; Pasiouras, 2008; Pasiouras, Tanna and Zopounidis, 2009; Shehzad and De Haan, 2009; Naceur and Omran, 2011; Barth *et al.*, 2013; Bouheni *et al.*, 2014; Ozkan, Balsari and Varan, 2014; Bucevska and Hadzi Misheva, 2017; Deli and Hasan, 2017), in this doctoral dissertation inflation is used as macroeconomic variable. In the euro area, inflation for consumer prices is measured by the

Harmonized Index of Consumer Prices, which measures the change over time in the prices of consumer goods and services acquired, used or paid for by euro area households. (ECB, Measuring inflation – the Harmonised Index of Consumer Prices (HICP), 2018)

Additional useful thing about this Index is that it ensures that the data of one country can be compared to the data of another EU country, considering they both follow the same methodology. The movement of Harmonized Index of Consumer Prices can be seen on the following graph.

Graph 16: Harmonized Index of Consumer Prices, EU28, 2006-2015



Source: Author, based on Eurostat database

Throughout the observed period, year 2015 being base year and equal to 100, it can be noticed almost linear increase in the inflation, with no significant jumps in trend. Moderate inflation is present in many world economies, and is considered stimulating both for aggregate supply and aggregate demand.

To calculate the impact of new EU regulation on banking performance a dummy variable is used (Chortareas, Girardone and Ventouri, 2012; Rezende and Wu, 2012; Barth *et al.*, 2013; Bouheni *et al.*, 2014; Ozkan, Balsari and Varan, 2014; Tanda, 2015; Roulet, 2017) for years 2006 and 2007 in order to control for the introduction of Basel 2 regulatory framework, and also for the 2013, 2014 and 2015 in order to control for the introduction of Basel 3 regulatory framework. Banks were

adapting to the Basel 2 regulatory framework between 2004 and 2007. (Košak *et al.*, 2015). For this reason, given the observed time period, the dummy variable had to be included for years 2006 and 2007 to capture the effect of Basel 2. Dummy variables for 2013 until 2015 represents introduction of Basel 3 regulatory framework which came into force in January 2014, but for which banks had to prepare earlier. Table 8 provides the overview of definition of variables used in the analysis.

Table 8: List, definition and source of variables used in the analysis

Variable	**Definition**	**Source**
Bank relative efficiency		
Funding (FUNDING = DSTFUNDING + LTFUNDING)	The sum of total deposits, short term funding and total long term funding (000 EUR)	BankScope
Personnel expenses (PEREXP)	Personnel expenses (000 EUR)	BankScope
Fixed assets (FA)	Fixed assets (000 EUR)	BankScope
Loan loss provision (LLPROVISION)	Loan loss provision (000 EUR)	BankScope
Loans (LOANS)	Total loans (000 EUR)	BankScope
Other earning assets (OEA)	Total other earning assets (000 EUR)	BankScope
Net fees (NETFEES)	Total net fees (000 EUR)	BankScope

Table 8 (continued)

Variable	Definition	Source
DEPENDANT VARIABLES		
Bank specific variables		
Return on assets (ROA)	Return on assets: pre-tax profit / total assets	Author's calculation
Efficiency (EFF)	Relative efficiency of the bank within the 0 – 1 range	Author's calculation
INDEPENDANT VARIABLES		
Bank specific variables		
Return on assets (ROA)	Return on assets: pre-tax profit / total assets	Author's calculation
Efficiency (EFF)	Relative efficiency of the bank within the 0 – 1 range	Author's calculation
Liquidity (LIQ)	Liquidity: loans / total assets	Author's calculation
Bank size (LBSIZE)	Bank size: logarithm of total assets	Author's calculation
Herfindahl–Hirschman Index (LHHI)	Herfindahl-Hirschman Index - sum of the squared fraction of bank's total assets to the total assets within a given country multiplied by 10.000. LHHI = logarithm of HHI	Author's calculation

Table 8 (continued)

Variable	Definition	Source
Macro (monetary) variables		
Long-term interest rate (LTR)	Long-term interest rates used as "a convergence criterion for the European Monetary Union, based on the Maastricht Treaty". (Eurostat, EMU convergence criterion series - annual data, 2018) Yearly interest rate is calculated based on the monthly averages.	Eurostat
Real gross domestic product growth (GDPG)	Percentage change from previous year.	Eurostat
Inflation (HICP)	Harmonised Index of Consumer Prices is "a measure of change over time in the prices of consumer goods and services." (ECB, Measuring inflation – the Harmonised Index of Consumer Prices, 2018) 2015 is the base year.	Eurostat
Regulatory variable (REG_DUMMY)	Dummy variable, years 2006, 2007, 2013, 2014, 2015 equal 1, while other years equal 0	Author's calculation

Source: Author

5.2. **Definition and description of used model**

This section will introduce the data analysis methodology, as well as the reason for selecting the particular methods and model for statistical analysis. In this doctoral thesis, Data Envelopment Analysis and Dynamic Panel Data methods were used. While Data Envelopment Analysis, due to higher speed of calculation, is calculated in R Programming language, for the panel data analysis is used statistical program STATA.

5.2.1. Measuring efficiency via Data Envelopment Analysis

Efficiency calculations can provide a good estimate of whether companies are reasonably using their inputs to generate outputs. Efficiency, as an efficiency in production, cost efficiency or intermediation efficiency, is used in many scientific researches for the numerous different industries. Company is efficient if the output is maximized with given inputs. Bank efficiency measures show how efficient banks are, relative to the best-practice frontier, in transforming their inputs (e.g. deposits) to outputs (e.g. loans). Frontier efficiency analysis is widely used in regulatory research and measurement of the effects of mergers and acquisitions, deregulation of interest rates, the removal of geographical constraints, regulatory capital, etc. on the operations of financial institutions. The main advantage of frontier efficiency is that it is an objectively determined quantitative measure that eliminates the effects of exogenous factors affecting observed performance, which allows the researcher to focus on the quantitative effects of regulatory regulations on inputs, outputs, costs, etc. (Bauer *et al.*, 1998). Different authors use different methodologies for calculating efficiency. One of the methodologies used is Stochastic Frontier Analysis which is parametric method of the relative efficiency calculation with econometrically assessed functional production frontier (Bucevska and Hadzi Misheva, 2017; Psillaki and Mamatzakis, 2017). More commonly used than parametric method is Data Envelopment Analysis (DEA) which is non-parametric method meaning that it does not require the knowledge of functional dependencies between inputs and outputs. Previous scientific researches has not answered the question which is the best method for calculating relative efficiency, and for this reason many researchers use different methodologies depending on the industry being observed. One of the main efficiency calculation methodologies used in the banking industry is Data Envelopment Analysis.

Data Envelopment Analysis (DEA) is a method of calculating relative efficiencies for production and non-production entities with multiple input and output variables. Such entities may have different values of the final product and the inputs used, but they must have a similar business model and the market in which they operate. DEA is data-oriented approach for evaluating a set of peer entities, called Decision Making Units (DMU), that converts multiple inputs into multiple outputs, and thus creating efficient frontier from the most efficient single DMUs. DEA methodology can also identify the sources and level of inefficiency for each of the inputs and outputs, for each inefficient DMU. Decision Making Unit is referred as any entity that is to be evaluated in terms of its abilities to convert inputs into outputs, and comparing it to the performance of other DMU entities in the observed dataset. Full efficiency is achieved for each DMU if and only if none of its inputs or outputs can be improved without adversely affecting its other inputs and outputs. A DMUs will be counted as the most efficient if and only if the performance of other DMUs is does not show that some of its inputs or outputs can be improved without adversely affecting its other inputs and outputs. The initial DEA model is originally presented by (Charnes, Cooper and Rhodes, 1978), and it is called CCR model by the first letters of their surnames. If there is to be evaluated *n*DMUs, then each entity consumes *i* different inputs to produce *r* different outputs, i.e. DMU consumes x_{ij} amounts of input *i* to produce y_{rj} amount of output *r*. (Řepková, 2015). As introduced by (Charnes, Cooper and Rhodes, 1978), "the ratio of outputs to inputs is used to measure the relative efficiency of the Decision Making Units". CCR specification is reducing multiple inputs and outputs to single input and output for each DMU. For a single DMU, the ratio of this single virtual output to single virtual input provides a measure of the efficiency that is function of the multipliers. To put it simply, calculation of efficiency can be put as: (Cooper, W., Seiford, L., Zhu, J., 2004).

$$\max h_0\,(u, v) = \sum_r u_r y_{ro} \,/\, \sum_r v_i x_{io} \qquad (2)$$

where u_r and v_i are variables, while y_{ro} and x_{io} are the observed input and output values of DMUs. Additional constraints must be taken into account, so $\sum_r u_r y_{ro} \,/\, \sum_r v_i x_{io} \leq 1$ for $j = 1,..,n$, and that $u_r, v_i \geq 0$ for all *i* and *r*.

Basic methodology for the calculation of efficiency using Data Envelopment Analysis is before mentioned CCR model, named after Charnes, Cooper and Rhodes. This model presents the constant return on scale. Under this model, with the constant scale of the changes in the input variables, it

is assumed that there will be proportional increase of the output variables. Such methodology was shown less efficient for some industries and therefore, (Banker, Charnes and Cooper, 1984) introduced BCC model. BCC model is the expansion of the CCR model, in which variable return of scale was assumed, meaning that an increase in inputs does not result in a proportional change in the outputs.

Data envelopment analysis in the calculation of the relative efficiency is using technique of mathematical programming, that enables using a lot of variables and limitations in the model. Taking this characteristic into account, Data Envelopment Analysis represents quality measure of the relative efficiency assessment, considering it is taking all of the necessary data that have the effect on the performance of the company, with no prior assumptions of different weights assigned to the particular variable. Data Envelopment analysis does not have the limitations in the types of variables used for the calculation, meaning that the inputs and outputs can be in different values, which makes it easier to choose significant variables that affect or can be affected in the model. (Šegota, 2003)

A brief historical development of this methodology will be presented in continuation. (Sealey and Lindley, 1977) developed a model for the behaviour of financial firms, within the context of a profit maximizing producer rather than as rational investor. The outputs of financial institutions, mainly the commercial banks, are earning assets such as loans and securities, while inputs, with different constraints, are deposits and input used to service those deposits, with other loanable funds. Production in financial firm is a process of transformation from inputs, where inputs lose their identity in original form, while new services, or outputs, are generated, through direction of employees. The premise of the intermediation approach is that banks' main objective is to generate output (i.e. loans and various other investments), while using inputs such as liabilities related to work, capital and other sources of bank funds. Their model has several implications, such as the conditions for the optimal behaviour of financial firms, the identification of the inputs and outputs of financial firms and the determinants of output mix, balance sheet management and scale in a financial firm. In their work they use deposit as input, and show that decisions regarding output and input are not independent, but linked through the production functions of financial firms. (Sherman and Gold, 1985) published the first analysis of the relative efficiency of bank branches using the DEA methodology. By analysing banking services and the resources used to provide such

services, they obtained useful information on inefficient branches and areas where they can improve their efficiency. Their results indicate that the *DEA is more advanced than other techniques and methods for improving bank branch efficiencies*. After this scientific paper, the use of the DEA methodology in calculating the relative efficiency of banks has increased, compared to other methodologies such as SFA. As mentioned by (Barth *et al.*, 2013), DEA has several advantages of non-parametric method in assessment of the efficiency relative to parametric methods such as stochastic frontier analysis mentioned before. The first one is that Data Envelopment Analysis calculates multiple inputs/outputs data of the sample banks, and such data do not suffer from the problem of functional form dependency. Functional form dependency is present with parametric methods, and it means that using such methodology, one should assume a particular functional form, and by doing so, impose specific structure on the shape of efficient frontier. True results will be dependent on how accurately this assumption where made. Second benefit is that DEA focus on the individual unit (bank, company etc.), rather than the population average, which make it more accurate in the prediction of the individual efficiency. Third benefit is that when using DEA, individual units are compared to the best-practice frontier, rather than on central-tendency properties. (Jemric and Vujcic, 2002) also state some of the advantages of the DEA method, namely that it does not require a priori assumptions of the analytic form of the lifetime function, and the probability of misspecification of the production technology is very low. This property makes it favourable to calculate the relative efficiency of an enterprise independently of the industry, as well as the amounts or units of the observed inputs and outputs. Such an advantage also has its drawbacks, which is that this methodology is exceptionally sensitive to mismeasurement problems. According to (Bauer *et al.*, 1998) Bauer, the Data Envelopment Analysis is a non-parametric approach to measuring relative efficiency that uses linear programming techniques. In its usual form, where the DEA is used to calculate technical relative efficiency, efficient entities are those for which no other entity or combination of entities produces the same or more outputs (with inputs given), or uses fewer inputs (with outputs given). The efficient frontier is made of these entities and the piecewise linear segments that join the set of output/input combinations of these entities, yielding a convex possibility set of their outputs or their production. One of the advantages of the DEA methodology is that it does not require explicit specification of the functional form, and imposes just a fraction of the structure on the appearance of the economic frontier. Each enterprise can be compared to an enterprise or a linear combination

of enterprises at the efficient frontier, with equal or greater outputs (given inputs), and equal or smaller inputs (given outputs). The problem can occur if there are too little observations with respect to the number of outputs, inputs, and other constraints. (BOĎA and Zimková, 2015) used three commonly applied approaches, with the assumption of variable return of scale, in analyses of technical efficiency, namely service-oriented approach, intermediation approach and profit oriented approach, on the commercial banks of the Slovak banking sector over the years 2000-2011. Their finding is that that *commercial banks that appear comparatively technically efficient under one approach were usually discovered technically efficient with respect to another approach*, owing it to a wide variety of banking goals that include goals of macroeconomic essence as well as those of micro- economic essence. They suggest that these three approaches should not be considered as conflicting but complementary in interpreting aspects of banking business. They presented main beneficiaries and perspective which is briefly given in following table.

Table 9: Conceptual treatment of the commercial bank under different technical efficiency approaches

	Intermediation approach	Profit-oriented approach	Service oriented approach
Perspective	The macroeconomic perspective	The microeconomic perspective	The microeconomic perspective
Main beneficiary	The regulator	The owner (shareholder)	The client
Interpretation of the bank	A production facility functioning as a financial intermediary	An entrepreneurial subject seeking a maximal profit	A service producer centered at minimizing cost of operations

Source: Author based on (BOĎA and Zimková, 2015)

As mentioned by authors, *main beneficiary of the intermediation approach is the regulator*, while for other two approaches main beneficiaries are the customer and the shareholder. Dominating perspective for the intermediation approach is the macroeconomic perspective. In this dissertation

main question is how does regulatory framework affect banking performance. Based on this question and conceptual treatment given by the authors, the calculation of relative efficiency will be made using intermediation approach, an approach that is most commonly used one in the literature. There should also be distinguished difference between input-oriented approach and output-oriented approach. As (Triki *et al.*, 2017) states, the DEA method can be applied using output orientation (maximizing outputs) or input orientation (minimizing inputs). The first approach captures the ability of banks to produce maximum level of outputs with current inputs, while the second approach captures the ability of banks to produce a given level of outputs using the minimum mixture of inputs. An efficiency score of 1 means that outputs cannot be increased without increasing inputs, while an efficiency score below 1 means that banking output can be achieved by using fewer inputs. In their work, the authors decided to use an input-oriented approach, since banks focus on cost control and have greater impact on inputs than outputs. In addition to these authors, other scientists in their scientific research opt for an input orientation with variable returns to scale, for example (Pasiouras, 2008; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013) to allow for the production technology of banks to exhibit decreasing, constant or increasing returns to scale.

Model specification

In the Data Envelopment Analysis framework, a "bank with an efficiency score of unity (100%) is located on the efficient frontier in the sense that its outputs cannot be further expanded without increasing its inputs". (Řepková, 2015). A bank with an efficiency score below 100% is relatively inefficient, suggesting that a bank can attain its current output level with fewer inputs. Every bank, or decision-making unit (DMU), has a certain number of inputs (i) and outputs (o), which means that every DMU "consumes" a certain amount of input to obtain a certain output.

The productivity of DMU can be written as (Řepková, 2015):

$$max\ h_0(u,v) = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \qquad (3)$$

$$\text{subject to } \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1,\ j=1,2\ldots j_0, \ldots, n,$$

$$u_r \geq 0,\ r = 1,2, \ldots, s$$

$$v_i \geq 0,\ i = 1,2, \ldots, m$$

where *u* and *v* are weights assigned to each input and output.

By using the mathematical programming techniques, DEA assigns the weights in such a way that no other DMU has a higher efficiency. The objective function of DMU is the ratio of the total weighted output divided by the total weighted input. In the formula, h_0 is the technical efficiency of DMU_o to be estimated, $v_i$and u_r are weights to be optimized, x_{ij} represents the amount of input of the i^{th} type for the j^{th} DMU, y_{rj} is observed amount of output of the r^{th} type for the j^{th} DMU, *i* denotes the *m* different inputs, *r* indicates the *s* different outputs, and *j* indicates the *n* different DMUs. For the purposes of this doctoral thesis, the DEA methodology with variable return on scale and input orientation is used. (Pasiouras, 2008; Chortareas, Girardone and Ventouri, 2012; Barth *et al.*, 2013).

As already mentioned earlier, the inputs used for the calculation of relative efficiencies of the banks are funding (sum of deposits, short term funding and long-term funding), personnel expenses, fixed assets and loan loss provision as a measure of the risk, while the outputs are loans, other earning assets and net fees. Even though the Data Envelopment Analysis enables usage of inputs and outputs in different measuring units for the calculation of relative efficiency, all of the inputs and outputs are expressed in the same currency, i.e. euro.

Funding represents the sources of funds used by banks in their operations, fixed assets represent the value of the property of buildings and other types of assets, personnel expenditure represents the expenses that banks have towards employees, while loan loss provision represents the risk of banks which should be treated as an expense. As mentioned by (Laeven and Majnoni, 2003; Barth *et al.*, 2013), loan loss provision required to build up loan loss reserves should be treated as cost that will be faced with certainty over time, but is uncertain as to when it will materialize. Loans, net fees and other earning assets are used as output, and are they best describe both interest and non-interest incomes generated by banks.

Relative efficiency is calculated using 3.4.3. version of R software environment for statistical computing and graphics, due to high speed in calculation. Because it is free to use, R programming software has a large number of users making it available for big user support. For the purpose of this calculation, a package called “Benchmarking and Frontier Analysis using DEA and SFA” is used. Packages are collections of R functions, data and compiled code in a well-defined format, that makes them easy to use. This particular “Benchmarking” package has a variety of possibilities,

making it possible to calculate Data Envelopment Analysis under different technology assumptions (variable or constant return on scales, input/output orientation and many more).

5.2.2. Measuring regulatory impact via Panel data analysis

Panel data analysis became widely used econometrical and statistical method for data calculation. The reason for such popularity of this analysis lies in the fact that Panel Data uses both time and spatial dimension, which provides more accurate calculations of empirical research. The time series, on the other hand, only considers time or spatial dimension, and therefore, in order to obtain quality research and results, a long time series or big data should be considered. Due to its double dimension, panel data can result in quality conclusions with lesser amount of necessary data. Such characteristics have made it a popular methodology in evaluating the performance of banks and the banking industry in general.

(Baltagi, 2013, p. 6-8) highlights several benefits of using Panel Data in regards to cross-section and times series data:

1) Panel data analysis enables the control for individual heterogeneity. This analysis suggests that all of the firms, individuals, countries etc. are heterogeneous, that methodologies and studies such as cross-section or time-series can't imbed in their results, and therefore can have the risk of biased results.
2) Panels give additional variability, more informative data, less collinearity[14] amongst the variables, more degrees of freedom[15] and better efficiency
3) With panel data it is easier to examine the dynamics of adjustment
4) Panel data analysis is more suitable for recognizing and measuring effects that are simply not so obvious in times series or cross-section data
5) Panel data allows usage of construct and is enabling testing of more complicated behavioural models than do times series or cross-section data

[14] Collinearity is state at which independent variables are highly correlated, which means that if one variable is moving by certain percent, the other will also move by similar percent in either same or opposed direction (Newbold, William and Betty, 2013)

[15] Degrees of freedom indicate "the number of independent values that can vary in an analysis without breaking any constraints" (Newbold, William and Betty, 2013)

6) Micro panel data collected on the individuals, households and firms can be measured more precisely from similar variables that were measured at the macro level
7) Macro panel data have longer time series and panel unit root[16] test have standard asymptotic distributions and do not suffer from the problem of nonstandard distributions that occurs with unit root test in time-series analysis

In addition to the obvious benefits of using panel data analysis, (Baltagi, 2013, p. 8-11) lists some of the downsides and limitations of this methodology:

1) Misrepresentations of measurement errors
2) Problems with the design and collection of data
3) Short time dimension in regards to times series
4) Problems with the selectivity of data
5) Dependence on the cross-section analysis

Since the incompleteness of data is the biggest problem with any data analysis, the panel data analysis is no exception. The data in panel data analysis is divided into balanced data if all of the data are available and non-balanced data if there are some missing values. Balance data have the same amount of available observations (N) throughout entire observed period (T) for every observed unit (n), while unbalance data have some missing value, either in observations (N) or period (T) for specific observed unit (n).

Panel data analysis can be divided on static and dynamic panel data. Main characteristic of static panel data is independence of their dependent variable on the movements from previous periods. Most commonly used models in static panel data are Pooled OLS model, Fixed effects model and Random effects model. Pooled OLS model, or pooled ordinary-least-square model, represents the basic form of panel data calculation. It can be written as: (Cameron and Trivedi, 2005)

$$y_{it} = \alpha + \beta_K X_{itK} + \varepsilon_{it}, \text{ i=1…N; t=1…T; k=1…K} \qquad (4)$$

[16] Unit root represents stochastic trend in a time series. If there is unit root present, it shows a systematic pattern that is unpredictable. (Newbold, William and Betty, 2013)

where *i* is the observed subject, *t* time unit, *k* value of dependent variable and *y* is independent variable. Using the pooled OLS model, data or error terms can't be correlated, but independent variable can be correlated with the error term.

Fixed effect model represents simple linear model in which constant term is changing with every observed unit and is constant in time. This model can be used if in the analysis of the impact of variables that vary over time. With fixed effect model it is assumed that something within the observed individual may impact or bias the predictor or outcome variables. Such a property explains the assumption of correlation between predictor variables and entity's error term. The fixed effect model removes the impact of these time-invariant characteristics to estimate the net effect of the predictors on the outcome variable. Another important assumption of the fixed effect model is that time-invariant characteristics are unique to the individual observed units and are not correlated with other individual characteristics. Each unit is different so that the constant (which includes individual characteristics) and the error term of the entity are not correlated with the other units. Fixed effect model of panel data analysis can be separated on time and entity models.

Time fixed effect model is controlling unobserved effects that vary over time, but not over entities, and can be written as: (Brooks 2002)

$$y_{it} = \alpha + \beta_K X_{itK} + u_i + v_{it}, \text{ i=1…N; t=1…T; k=1… K} \quad (5)$$

while entity fixed effect model controls for the unobserved individual effects that vary among the entities, but not over time, and can be written as:

$$y_{it} = \alpha + \beta_K X_{itK} + z_t + v_{it}, \text{ i=1…N; t=1…T; k=1…K} \quad (6)$$

In both of the models, a random error ε_{it} is split into a part that includes all omitted variables affecting the dependent variable, and vary over time or entities. It is also possible to combine entity and time dimension within the same model.

Random effects model assumes that the observed units are chosen randomly, as well as that the difference between them are random. It is written as (Brooks, 2002).

$$y_{it} = \alpha + \beta_K X_{itK} + w_{it}, w_{it} = u_i + v_{it} \quad (7)$$

Random effect model is used depending on the assumption that differences between groups have an effect on the dependent variable. A random effect model can estimate the coefficients of time-invariant variables, which gives it an advantage over a fixed effects model.

Many economic relationships are essentially dynamic in nature, so the advantage of dynamic panel data is that it allows the researcher to better understand the dynamics of adjustment. Unlike static panel data, dependent variable in dynamic panel data has movement for one or more time periods backward (depending on the characteristics of dependent variables). Current values of variables are dependent on prior values, which means that they exhibit dynamic nature, i.e. the existence of autoregression of first order is present. It is because of this phenomenon that this dynamic panel data has become widely popular. The disadvantage of the static panel data is that it was not taken into account that the error in period *t* influence on errors in period *t+1*. Dynamic relationships are characterized by the presence of a lagged dependent variable among regressors: (Baltagi, 2013)

$$y_{it} = \delta y_{i,t-1} + x'_{it}\beta + u_{it} \quad (i = 1,\ldots,N;\ t = 1,\ldots,T) \qquad (8)$$

where δ is a scalar, x'_{it} is 1 × K, and β is K × 1

With the assumption that random error terms are independent of each other and among themselves, the dynamic panel data is characterized by two sources of persistence over time: individual effects that characterize the heterogeneity between individuals and autocorrelation because of the presence of a lagged dependent variable among independent variables.

Dynamic panel data is mostly conducted with the difference GMM (Generalized method of moments) estimator proposed by (Arellano and Bond, 1991), and system GMM estimator proposed by (Blundell and Bond, 1998). These estimators are used for the analysis of linear connection where dependent variable is dynamic, and independent variables are not strictly exogenous, as well as where is present shorter period of time in relation to the size of observed units, or in this case banks. GMM estimators are taking into account specific relations within the observed unit, where autocorrelation and heteroscedasticity is allowed within entities, but not between entities. System GMM is improved calculation of the estimators in relation to difference GMM in a sense that that difference GMM can have weak properties of the final sample in terms of bias and precision when the series are persistent, hence the inclusion of additional conditions on moments is suggested in system GMM estimator.

Two dependent variables are used in this doctoral thesis, namely profitability and relative efficiency of the banks. Relative efficiency and profitability values in the previous period certainly have an impact on relative efficiency and profitability in a later period, and for that reason it is used the dynamic panel data analysis which takes into account that characteristic. Moreover, observed time span is 10 years, while the number of banks is 433 which furthermore justify the usage of the dynamic panel data. Statistical software package STATA 14.0 for Windows is used for the dynamic panel data analysis.

Model specification

Given that most economic variables display dynamic behaviour, the second stage of the analysis is carried out by using dynamic panel models. The most commonly used estimators in empirical research are the difference GMM estimator proposed by (Arellano and Bond, 1991) and the system GMM proposed by (Arellano and Bover, 1995; Blundell and Bond, 1998).

Dynamic panels take into account the dynamic nature of the relationship among economic variables by including lags of the dependent as the independent variable. GMM estimators achieve consistent and unbiased estimation of parameters and they solve the problem of endogeneity that can arise due to the connections between the dependent and independent variables by using the lags of endogenous variables as instruments. (Dimitrić, Tomas Žiković and Arbula Blecich, 2019)

Linear dynamic panel data model, containing explanatory variables x_{it} as well as the lagged endogenous variable $y_{i,t-1}$ can be written as follows:

$$y_{it} = \mu + \gamma y_{it-1} + \beta_1 x_{it1} + \beta_2 x_{it2} + \ldots + \beta_K x_{itK} + \alpha_i + \varepsilon_{it}\,;\ \ i = 1, \ldots N, t = 1, \ldots, T \quad (9)$$

where *N* is the number of banks and *T* is the number of periods (years).

However, correlation does occur between and $y_{i,t-1}$. and the individual effects (part of the error term α_i) with the introduction of lagged dependent variable as one of the explanatory variables. To prevent such bias, (Arellano and Bond, 1991) suggested taking the first difference of the equation:

$$y_{it} - y_{i,t-1} = \gamma\left(y_{it-1} - y_{i,t-2}\right) + \beta_1\left(x_{it1} - x_{it1-1,1}\right) + \beta_2\left(x_{it2} - x_{it1-1,2}\right) + \ldots + \beta_K\left(x_{itK} - x_{it1-1,K}\right) + \left(\varepsilon_{it} - \varepsilon_{i,t-1}\right);\ \ i = 1, \ldots N, t = 1, \ldots, T \quad (10)$$

where *N* is the number of banks and *T* is the number of periods (years).

Although their form of the equation (10) eliminates the individual effects α_i, correlation is still present through the presence of $\varepsilon_{i,t-1}$ between the differenced error term $\varepsilon_{it} - \varepsilon_{i,t-1}$ and the differenced lagged dependent variable. Such problem has been solved with the usage of instrumental variables for which are expected to have high correlation with the differenced lagged dependent variable, and at the same time, instrumental variables are expected not to be correlated with the differenced error term. Therefore, valid instruments for the differenced lagged dependent variable $(y_{it-1} - y_{i,t-2})$ are lagged values of dependent variable in level $(y_{it-2}, \dots, y_{i2,}\ y_{i1})$. However, difference GMM exposes weaknesses in cases when dependent variable is highly persistent. For that reason, (Blundell and Bond, 1998) proposed a new system GMM estimator that uses equation in levels (9) and equation in first differences (10). Since this estimator displayed better properties than the previously mentioned estimator from (Arellano and Bond, 1991), the analysis will be carried out upon the system GMM estimator developed by (Blundell and Bond, 1998).

Bank performance is measured through two variables, that are profitability (calculated as Return on assets or ROA) and relative efficiency (calculated with the Data Envelopment Analysis method and ranging between 0 and 1). Due to endogeneity problem, variables used in the estimation of relative efficiency cannot be later used in the panel data analysis. To capture the effect of the regulatory measures on the efficiency and profitability of the banks depending on their size, we use a two tier approach. The same models are applied on the entire dataset involving all of the banks, and then separately for large/medium sized banks and small banks. As mentioned earlier, for each sample two models will be calculated - profitability (ROA) and relative efficiency (EFF). Calculation of the regulatory impact on the profitability and efficiency of the banks can be presented as follows:

All banks (model 1 and 2)

$$ROA_{it} = \mu + \gamma ROA_{it-1} + \beta_1 EFF_{it} + \beta_2 LIQ_{it} + \beta_3 LTR_{it} + \beta_4 GDPG_{it} + \beta_5 LHHI_{it} + \beta_6 HICP_{it} + \beta_7 LBSIZE_{it} + \beta_8 REG_DUMMY_{it} + \alpha_i + \varepsilon_{it};\ i = 1, \dots 433, t = 1, \dots, 10 \qquad (11)$$

$$EFF_{it} = \mu + \gamma EFF_{it-1} + \beta_1 ROA_{it} + \beta_2 LIQ_{it} + \beta_3 LTR_{it} + \beta_4 GDPG_{it} + \beta_5 LHHI_{it} + \beta_6 HICP_{it} + \beta_7 LBSIZE_{it} + \beta_8 REG_DUMMY_{it} + \alpha_i + \varepsilon_{it};\ i = 1, \dots 433, t = 1, \dots, 10 \quad (12)$$

Large and medium sized banks (model 3 and 4)

$$ROA_{it} = \mu + \gamma ROA_{it-1} + \beta_1 EFFsv_{it} + \beta_2 LIQ_{it} + \beta_3 LTR_{it} + \beta_4 GDPG_{it} + \beta_5 LHHI_{it} + \beta_6 HICP_{it} + \beta_7 LBSIZE_{it} + \beta_8 REG_DUMMY_{it} + \alpha_i + \varepsilon_{it};\ i = 1, \dots 281, t = 1, \dots, 10 \quad (13)$$

$$EFFsv_{it} = \mu + \gamma EFFsv_{it-1} + \beta_1 ROA_{it} + \beta_2 LIQ_{it} + \beta_3 LTR_{it} + \beta_4 GDPG_{it} + \beta_5 LHHI_{it} + \beta_6 HICP_{it} + \beta_7 LBSIZE_{it} + \beta_8 REG_DUMMY_{it} + \alpha_i + \varepsilon_{it};\ i = 1, \dots 281, t = 1, \dots, 10 \quad (14)$$

Small banks (model 5 and 6)

$$ROA_{it} = \mu + \gamma ROA_{it-1} + \beta_1 EFFm_{it} + \beta_2 LIQ_{it} + \beta_3 LTR_{it} + \beta_4 GDPG_{it} + \beta_5 LHHI_{it} + \beta_6 HICP_{it} + \beta_7 LBSIZE_{it} + \beta_8 REG_DUMMY_{it} + \alpha_i + \varepsilon_{it};\ i = 1, \dots 152, t = 1, \dots, 10 \quad (15)$$

$$EFFm_{it} = \mu + \gamma EFFm_{it-1} + \beta_1 ROA_{it} + \beta_2 LIQ_{it} + \beta_3 LTR_{it} + \beta_4 GDPG_{it} + \beta_5 LHHI_{it} + \beta_6 HICP_{it} + \beta_7 LBSIZE_{it} + \beta_8 REG_DUMMY_{it} + \alpha_i + \varepsilon_{it};\ i = 1, \dots 152, t = 1, \dots, 10 \quad (16)$$

In first model, dependent variable is banking profitability (measured by ROA), and the calculation, while in second model dependent variable is bank specific relative efficiency measured by using DEA. In the first two models were used all of the observed 433 commercial banks. In order to prove the main hypothesis and auxiliary hypothesis number 3, the same analysis has to be made for banks depending on their size. Therefore, a separate analysis was done for small sized banks and large/medium sized banks, with a separate calculation of relative efficiency. Third and fourth models are designed to measure the effect of regulation on the operations of large and medium sized banks, while the fifth and sixth model are just for the small banks. Depending on the model, value y_{it} is the value of dependent variable (return on asset – ROA of bank *i* in period *t*, or

efficiency score of bank *i* in period *t*). The parameter μ is a constant, $y_{i,t-1}$ is a lagged dependent variable, while $x_{it1,\ldots,}, x_{itk}$ are the independent variables:

- efficiency scores obtained through DEA (only in case where dependent variable is banking profitability – ROA)
- banking profitability measured by ROA (only in case where dependent variable is the bank's specific efficiency measured by DEA)
- bank specific variables (liquidity ratio, bank size, Herfindahl-Hirschman Index)
- macro variables (GDP growth, long term interest rate, Harmonised Index of Consumer Prices),
- regulation (dummy variable, introduction of Basel 2 in 2006 and 2007, and Basel 3 in 2013, 2014, 2015)

The parameters $\beta_1,\ldots, \beta_K$ are the exogenous variables, where K is the number of independent variables. Furthermore, α_i is the individual effects or specific error for each bank and the remaining part of the error term $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2)$ is normally distributed. It is assumed that the error term is orthogonal to the exogenous variables $E(x_{it}, \varepsilon_{it}) = 0$, and uncorrelated with the lagged dependent variable $E(y_{i,t-1}, \varepsilon_{it}) = 0$.

5.3. **Empirical results**

This section will present the results of the descriptive statistics and correlation matrices analysis, as well as the results and interpretations of the banking relative efficiencies and the regulatory impact.

5.3.1. Interpretation of Data Envelopment analysis results

A total of 433 commercial banks from 28 European Union member states were used in this analysis to calculate their relative efficiencies, for the entire period from 2006 until 2015. From the initial 1.309 commercial banks, 433 commercial banks had the available input/output through the observed period. Obtained results can be used to analyse the relative efficiency trends of an individual bank, as well as the relative efficiency trend of the commercial bank on group level (country, region, European Union). All of the relative efficiencies for commercial banks are calculated separately for each year and for all of the banks, giving the total amount of 10 relative

efficiencies scores for each individual bank. Such separate results thus obtained were subsequently grouped together to give an insight in the changes and trend of relative efficiencies through time for each decision-making unit, i.e. bank. To the best of my knowledge, none of the authors have dealt with this issue of calculating banking relative efficiency individually for every year, with their subsequent grouping.

Descriptive statistics for variables used in the estimation of relative efficiency are presented in Table 10.

Table 10: Descriptive statistics on input/output variables

	No. of obs	Mean	Std.Dev.	Minimum	Maximum
FUNDING	4.330	43.900.000	138.000.000	300	1.340.000.000
PEREXP	4.330	428.172	1.544.161	460	16.100.000
FA	4.330	391.973	1.618.013	100	21.600.000
LLPROVISION	4.330	247.623	1.067.948	15	20.500.000
LOANS	4.330	28.600.000	89.100.000	50	759.000.000
OEA	4.330	29.400.000	125.000.000	35	1.760.000.000
NETFEES	4.330	347.376	1.236.808	10	12.800.000

Source: Author, based on STATA 14.0 calculation

The total dataset consists of 433 banks for the 10-year period, which is equal to 4.330 observations for every variable. All of the variables mentioned in Table 9 have positive average values making them suitable for data envelopment analysis (DEA). Highest arithmetic mean of all of the variables has the input variable funding in the amount of 43.900.000. Due to the nature of the commercial banks' business, a large correlation between funding and loans is expected, so the high amount of arithmetic mean for the loans is not surprising. Lowest arithmetic mean has the loan loss provisions, i.e. expense set aside for uncollected loans and loan payments that are associated with potential loan losses. The amount of loan loss provision equals approximately 1% of the amount of total

loans. Net fees also have a relatively low level of arithmetic mean, which is not surprising given that these are commercial banks.

The precondition for including variables in the calculation of relative efficiency using DEA is an existence of positive correlation between them. Correlation matrix of input and output variables can be seen in following table.

Table 11: Correlation matrix of input and output variables

	FUNDING	PEREXP	FA	LLPROVISION	LOANS	OEA	NETFEES
FUNDING	1						
PEREXP	0,9457*	1					
FA	0,8558*	0,8709*	1				
LLPROVISION	0,7028*	0,6448*	0,6713*	1			
LOANS	0,9725*	0,9011*	0,8563*	0,7352*	1		
OEA	0,8845*	0,9049*	0,7431*	0,5034*	0,7785*	1	
NETFEES	0,9120*	0,9645*	0,8188*	0,6449*	0,8653*	0,8722*	1

Source: Author, based on STATA 14.0 calculation

Correlation coefficients are positive and significant among the variables that are used in the analysis. Highest correlation amounts to 0,9725 and refers to the correlation between loans (output) and funding (input). This relationship is expected from the economics perspective since funding and loans are extremely dependable one of each other since higher amount of funding (as sources of funds) equals higher placements in the form of loans. The lowest, but still positive and significant correlation (0,5034), is between loan loss provision (input) and other earning assets (output).

As all the prerequisites were met, the calculation of relative efficiency continued. First, the relative efficiencies of all banks were calculated, then separate relative efficiencies for the medium and large banks, and separate relative efficiencies for the small banks. Relative efficiency is calculated using 3.4.3. version of R software environment for statistical computing and graphics. Such efficiency results are given in the following table.

Table 12: Bank efficiency, separate calculation according to the size of the bank

Relative efficiency variables	Obs	Mean	Std. Dev.	Min	Max
Relative efficiency of all banks (EFF)	4.330	0,751	0,175	0,176	1
Relative efficiency of large and medium sized banks (EFFsv)	2.810	0,822	0,147	0,281	1
Relative efficiency of small banks (EFFm)	1.520	0,803	0,171	0,206	1

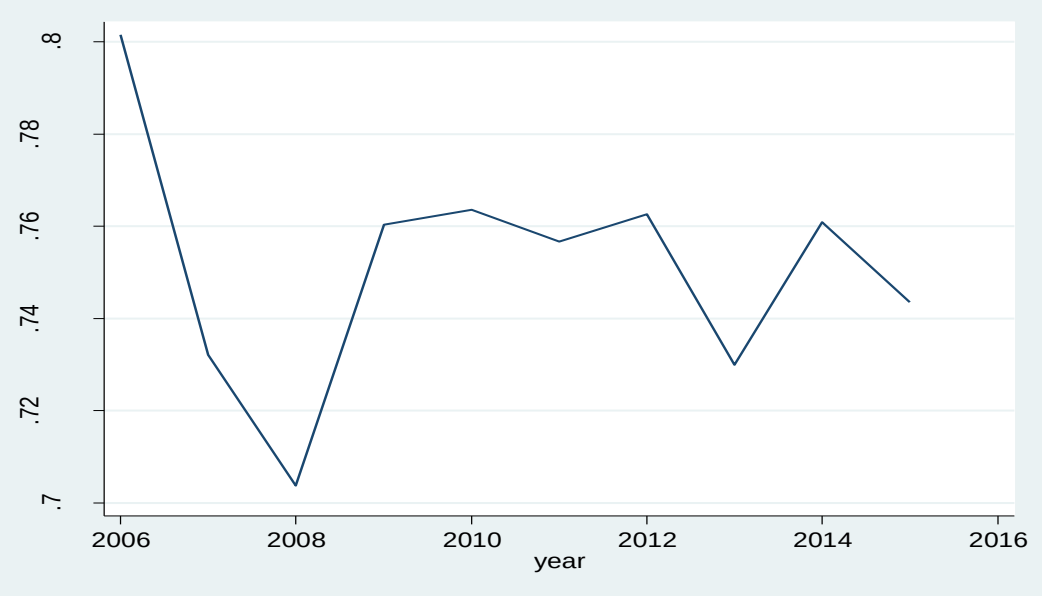
Source: Author, based on R software calculation

Average of relative efficiency for the entire dataset of commercial banks throughout observed period equals 0,751. After data separation on small and large/medium sized banks, having 152 of individual small banks and 281 of individual large/medium sized banks, another calculation for relative efficiency is performed. On average, through the observed period, small banks had lower mean with higher standard deviation than the large/medium-sized banks, which means that they are the main reason for the volatility of bank relative efficiency.

Table 11 shows the 10-year averages of banks' relative efficiencies. In the following graphs. the following graphs show the trend of relative efficiency movement over each observed year. The

graphs are divided into the relative efficiency of all banks (Graph 17), the relative efficiency of large and medium-sized banks (Graph 18), and the relative efficiency of small banks (Graph 19).

Graph 17: Bank relative efficiency, all EU28 banks, 2006-2015



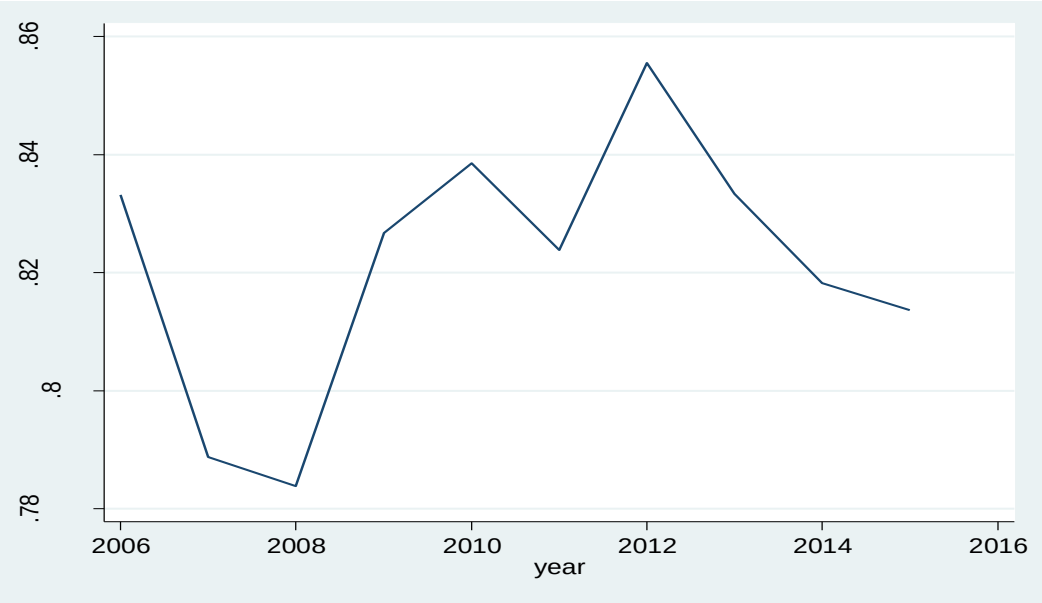
Source: Author, based on STATA 14.0 calculation

As can be seen from the above graph, yearly average efficiencies of banks (all Decision-Making Units), deteriorated due to financial crisis, and afterward it regained some of the losses. After 2009, relative efficiency had a stable trend, with minor declines in 2013 and 2015.

In order to see the trend of bank efficiency depending on size, two sets of data were created from the main dataset, and their relative efficiencies were calculated separately. In the observed 10-year period, there were 152 small banks and 281 large/medium sized banks that had all of the necessary inputs and outputs variables (in total 433 commercial banks). Looking at the groups of banks depending on their size separately, one can visually see how their relative efficiencies varied.

If we observe efficiency for the small banks and large/medium sized banks separately, we can see the difference in their movement, as shown in the following graphs. The trend of relative efficiencies of large and medium sized banks can be seen in the next graph.

Graph 18: Bank relative efficiency, large and medium sized banks in EU28, 2006-2015

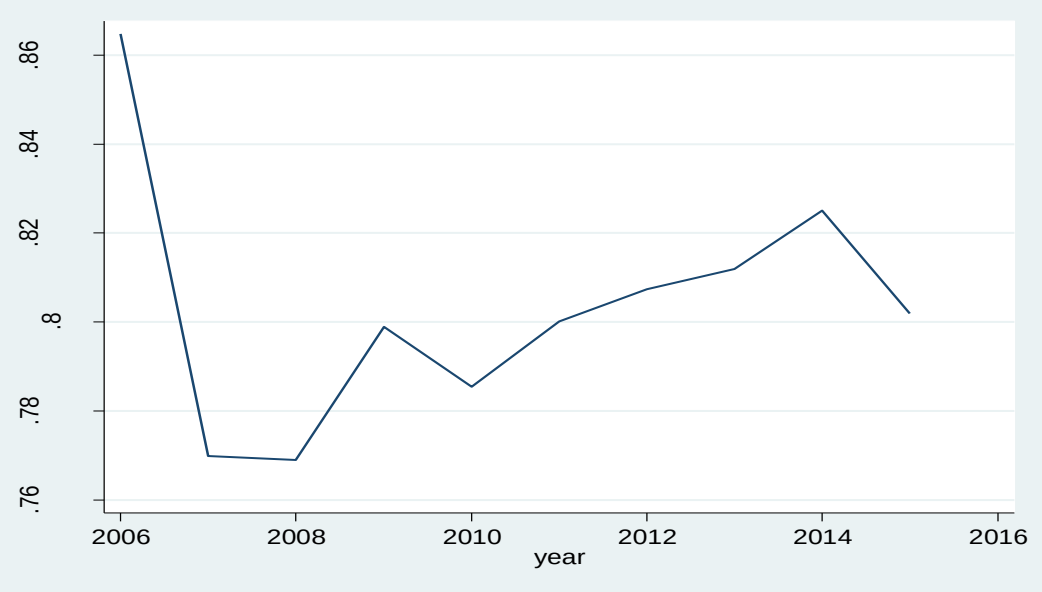


Source: Author, based on STATA 14.0 calculation

The average annual relative efficiency of large and medium-sized banks dropped significantly in the first two years, after which it experienced an upswing, and in 2012 relative efficiency even exceeded efficiency in the pre-crisis period. After 2012, large and medium-sized banks have been declining in relative efficiency.

The trend of relative efficiencies of small banks can be seen in the next graph.

Graph 19: Bank relative efficiency, small banks in EU28, 2006-2015



Source: Author, based on STATA 14.0 calculation

The average annual relative efficiencies of small banks dropped significantly in the first two years, after which they experienced mild annual upturns. Although the upward trend continued until 2014, the average annual relative efficiencies of small banks did not reach the level of efficiency before the crisis. A slight decrease in relative efficiency can be seen in 2015.

Small banks experienced a greater decline in relative efficiency due to the financial crisis, than large and medium sized banks. On top of that, their recovery was at lower pace up until 2014 when again it deteriorated. Although large and medium sized banks recovered easier and in larger percentage then small banks, they experienced significant drop of the relative efficiency in 2012.

When calculating group-level relative efficiencies for all banks, the results of average annual efficiency can be derived separately for large, then separately for medium-sized, and separately for small banks. Such results cannot be used in second stage calculation of regulatory impact on bank operations, but can serve to demonstrate that relative efficiency varies depending on the size of the bank and the country of origin. The following table shows the results of the relative efficiencies of banks when calculated at the group level and then extracted depending on the size of the bank.

With regards to the results on relative efficiency, it can be expected that the relative efficiency will differ depending on the size of the banks, as well as on the country of origin. Relative efficiency is calculated for each individual bank (433 banks in total) for the period of 10 years, which is equal to 4.330 observations of relative efficiency. Summary statistics of relative efficiency according to size and country of origin is given in Tables 13 and 14.

Table 13: Bank relative efficiency according to the size of the bank

Size of bank	Obs	Mean	Std. Dev.	Min	Max
LARGE	370	0,955	0,077	0,587	1
MEDIUM	2.440	0,763	0,157	0,186	1
SMALL	1.520	0,683	0,178	0,176	1

Source: Author, based on R software calculation

The table shows that the relative efficiency of banks varies significantly depending on their size. Large banks have highest average efficiency of 0,955 with the smallest standard deviation of 0,077. Medium sized banks are less efficient and have higher standard deviation compared to large banks, and the least efficient are the small banks, with the lowest mean and highest standard deviation. These results confirm the auxiliary hypothesis 1 which states that bank efficiency depends on the size of the bank.

In the following table the summarized bank efficiency according to the country of origin is presented.

Table 14: Bank relative efficiency according to the country of origin

Country	Obs	Mean	Std. Dev.	Min	Max
AUSTRIA	290	0,709	0,181	0,186	1
BELGIUM	90	0,811	0,132	0,475	1
BULGARIA	90	0,669	0,128	0,397	1

Table 14 (continued)

Country	Obs	Mean	Std. Dev.	Min	Max
CYPRUS	50	0,615	0,162	0,255	0,947
CZECH	100	0,751	0,138	0,362	1
GERMANY	650	0,7794	0,186	0,251	1
DENMARK	230	0,692	0,178	0,414	1
ESTONIA	40	0,697	0,209	0,359	1
SPAIN	140	0,857	0,137	0,453	1
FINLAND	30	0,871	0,163	0,571	1
FRANCE	530	0,796	0,165	0,377	1
GREECE	50	0,747	0,082	0,565	0,888
CROATIA	190	0,641	0,14	0,349	1
HUNGARY	90	0,725	0,123	0,485	1
IRELAND	40	0,917	0,096	0,638	1
ITALY	430	0,777	0,168	0,327	1
LITHUANIA	60	0,676	0,14	0,428	1
LUXEMBURG	140	0,744	0,185	0,291	1
LATVIA	110	0,609	0,157	0,176	1
MALTA	30	0,641	0,065	0,513	0,783
NETHERLANDS	60	0,771	0,186	0,369	1
POLAND	130	0,776	0,153	0,239	1
PORTUGAL	100	0,798	0,14	0,481	1
ROMANIA	100	0,561	0,09	0,37	0,763
SWEDEN	110	0,812	0,124	0,497	1

Table 14 (continued)

Country	Obs	Mean	Std. Dev.	Min	Max
SLOVENIA	70	0,688	0,102	0,444	1
SLOVAKIA	60	0,658	0,919	0,433	0,899
UNITED KINGDOM	320	0,817	0,187	0,254	1

Source: Author, based on R software calculation

The results point to a conclusion that banks from Ireland are the most efficient (average of 0,917), while banks from Romania are the least efficient (average of 0,562). These results confirm the auxiliary hypothesis 2 which says that bank efficiency depends on the country of origin.

(Košak, Zajc and Zorić, 2009) calculated bank cost efficiencies in the new EU member states that joined the EU in 2004: the Czech Republic, Poland, Hungary, Slovakia, Slovenia, Estonia, Latvia and Lithuania. Of these countries, banks from the Baltic countries were most efficient, while banks from the Czech Republic and Slovakia were the least efficient. Although they used a different method of calculation (cost vs technical intermediate relative efficiency), the results are somewhat similar, with the exception of the Czech Republic and Poland, which in this doctoral thesis have proven to be the country with the highest technical relative efficiency. Given that the authors used the period from 1996 until 2006, such difference in results can be attributed to the strong economic growth of Poland and the Czech Republic after the financial crisis. (Nurboja and Košak, 2017), observing selected banks from EU countries (Romania, Bulgaria and Slovenia) and outside of the EU (Albania, BiH, Croatia, Kosovo, Macedonia, Montenegro, and Serbia), in the period 1999-2013, concluded that banks from the EU have higher cost efficiency than banks from the non-EU countries. In the period the authors observed Croatia was not yet an EU member. Considering that it became a full member of the European Union in July 2013 and applied EU regulation even before joining the EU, the results can be compared with the results obtained in this dissertation, with the exception of a different approach used for the calculation of relative efficiencies. Results of the above mentioned authors suggest that the most efficient country is Slovenia, followed by Bulgaria and Croatia. Their conclusions are comparable to the results of this dissertation. The only difference was observed in Romania, for which the authors obtained satisfactory results of relative efficiency, while in this dissertation Romania proved to be the country from which banks with the lowest

relative efficiency come. Authors also concluded that banks 'relative cost effectiveness generally improved during the 2008, mostly due to managers' increasing desire to improve their cost efficiency during the crisis. These results are in line with the results of this dissertation, considering that in the period from 2006 to 2008 there was a significant decrease in the relative efficiencies of banks, while after 2008 there was a noticeable increase in the banks' relative efficiencies.

The following table shows the relative efficiencies of banks, depending on size, and for each country separately.

Table 15: Bank relative efficiency according to the size and country of origin

	Obs	Mean	Std. Dev.	Min	Max
LARGE					
FINLAND NETHERLANDS SWEDEN	10 10 20	1	0	1	1
BELGIUM	30	0,882	0,123	0,587	1
MEDIUM					
IRELAND	40	0,917	0,096	0,638	1
ROMANIA	60	0,595	0,086	0,400	0,763
SMALL					
POLAND	20	0,886	0,118	0,667	1
CYPRUS	20	0,504	0,127	0,255	0,724

Source: Author, based on R software calculation

For the large banks, highest relative efficiency (value of 1) have banks from 3 countries: Finland, Netherlands and Sweden, where large banks kept the highest possible efficiency throughout the entire observed 10-year period. The least efficient large banks, but with still significantly high values of 0,882, have large banks from Belgium. Medium sized banks are the most efficient from

Ireland, while least efficient from Romania. Interestingly, these results are in line with the average values for the entire banking system in European Union, regardless of their size. The highest relative efficiency for small banks can be seen in Poland (on average 0,886), while the least relative efficiency has the banks from Cyprus.

5.3.2. Interpretation of Panel data analysis results

It is common to start any analysis with the descriptive statistics. Descriptive statistics provide insights in number of observations, average values, standard deviation and minimum and maximum values. Descriptive statistics for variables used in the estimation of the impact of banking regulation on banking operations in the EU is given in Table 16.

Table 16: Descriptive statistics for variables used in the estimation of the impact of banking regulation on banking operations, all banks

Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
EFF	overall	4.321	0,7515	0,1753	0,1757	1
	between			0,1496	0,4059	1
	within			0,0921	0,2245	1,1985
ROA	overall	4.321	0,0059	0,0217	-0,3753	0,2146
	between			0,0139	-0,1637	0,0944
	within			0,0166	-0,2058	0,1942
LIQ	overall	4.321	0,564	0,2326	0	0,9934
	between			0,2183	0,0031	0,9702
	within			0,0815	0,1663	1,1999
LTR	overall	4.321	3,6946	2,0263	0	22,5
GDPG	overall	4.321	1,2289	3,2679	-14,8	25,6
LHHI	overall	4.321	7,6616	0,4371	6,5228	8,8839
HICP	overall	4.321	93,6779	6,1193	69,19	103,42

Table 16 (continued)

Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
LBSIZE	overall	4.321	15,2296	2,267	9,7014	21,5128
	between			2,25	10,1732	21,3601
	within			0,2823	13,2503	17,2807
REG_DUMMY	overall	4.321	0,5006	0,5001	0	1

Source: Author, based on STATA 14.0 calculation

Sample consists of 4.333 observations, i.e. 433 banks spanning over a period of 10 years (from 2006 to 2015). However, due to missing data, total number of observations used in panel data analysis is equal to 4.321.

Descriptive statistics in the previous table are both for dependent and independent variables. Mean relative efficiency of entire banking population, through observed period is 0,7515, ranging between minimum of 0,1757 and maximum of 1, with standard deviation of 0,1753 on the level of entire population. Between credit institutions the relative efficiency varies between 0,4059 and 1 with standard deviation of 0,1496, while within banks it varies between 0,2245 and 1,1985 (statistical measure) with standard deviation of 0,0921. Such results indicate that the individual commercial bank retains its relative efficiency throughout years, because the relative efficiency has lower volatility within groups that in between. Although no value of relative efficiency in the data exceeds value of 1, STATA calculates the within number as the deviation from each individual's average, and for this reason, such calculation results in within number higher than 1. The mean value of profitability (ROA) is 0,0059, ranging between -0,3753 and 0,2146 with standard deviation of 0,0217 for the entire sample. Between credit institution, the profitability ranges between -0,1637 and 0,0944 with standard deviation of 0,0139, while within credit institution profitability ranges between -0,2058 and 0,1942 with standard deviation of 0,0166. As for the independent variables, liquidity (LIQ) has the mean of 0,5640, ranging from 0 to 0,993, with standard deviation of 0,233. Standard deviation of liquidity is lower when within is observed, rather between, meaning that banks tend to keep their liquidity stable. Logarithm of the bank size

(LBSIZE) has the mean value of 15,2296, ranging between 9,7014 and 21,5128 with standard deviation of 2,2670. It can also be noticed, based on standard deviation, that bank size doesn't vary that much within banks as it does between banks. Macro variables have more or less similar values regardless of size of the bank, because their difference is more pronounced for the country than for the bank, therefore only the average was observed for them.

Descriptive statistics for variables used in the estimation of the impact of banking regulation on large and medium sized banks is given in Table 17.

Table 17: Descriptive statistics for variables used in the estimation of the impact of banking regulation on banking operations, large and medium-sized banks

Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
EFFsv	overall	2.806	0,8215	0,1472	0,2806	1
	between			0,1227	0,5274	1
	within			0,0816	0,3303	1,1912
ROA	overall	2.806	0,0061	0,0151	-0,1647	0,0887
	between			0,0087	-0,0319	0,0288
	within			0,0123	-0,1285	0,0879
LIQ	overall	2.806	0,5774	0,2207	0,0028	0,9918
	between			0,2091	0,0221	0,9702
	within			0,0732	0,2136	1,1677
LTR	overall	2.806	3,7868	2,0781	0	22,5
GDPG	overall	2.806	1,1878	3,2583	-14,8	25,6
LHHI	overall	2.806	7,6305	0,4384	6,5228	8,8838
HICP	overall	2.806	93,6539	6,1533	69,19	103,42
LBSIZE	overall	2.806	16,4263	1,8329	12,8984	21,5128
	between			1,8169	13,6375	21,3601
	within			0,2583	14,9680	18,1239
REG_DUMMY	overall	2.806	0,5003	0,5001	0	1

Source: Author, based on STATA 14.0 calculation

Sample consists of 2.810 observations, i.e. 281 commercial banks spanning over a period of 10 years (from 2006 to 2015). However, due to missing data, total number of observations used in panel data analysis for large and medium sized banks is equal to 2.806.

Descriptive statistics in the previous table are both for dependent and independent variables. Mean relative efficiency of large and medium sized banks, through observed period is 0,8215, ranging between minimum of 0,2806 and maximum of 1, with standard deviation of 0,1472. Between credit institutions the relative efficiency varies between 0,5274 and 1 with standard deviation of 0,1227, while within banks it varies between 0,3303 and 1,1912 (statistical measure) with standard deviation of 0,0816. Although no value of relative efficiency in the data exceeds value of 1, STATA calculates the within number as the deviation from each individual's average, and for this reason, such calculation results in within number higher than 1. The mean value of profitability (ROA) is 0,0061, ranging between -0,1647 and 0,0887 with standard deviation of 0,0151. Between credit institution, the profitability ranges between -0,0319 and 0,0288 with standard deviation of 0,0087, while within credit institution profitability ranges between -0,1285 and 0,0879 with standard deviation of 0,0123. As for the independent variables, liquidity (LIQ) has the mean of 0,5774, ranging from 0,0028 to 0,9918, with standard deviation of 0,2207. Logarithm of the bank size (LBSIZE) has the mean value of 16,4263, ranging between 12,8984 and 21,5128 with standard deviation of 1,8329.

Descriptive statistics for variables used in the estimation of the impact of banking regulation on small banks is given in Table 18.

Table 18: Descriptive statistics for variables used in the estimation of the impact of banking regulation on banking operations, small banks

Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
EFFm	overall	1.515	0,8034	0,1709	0,2058	1
	between			0,1387	0,5132	1
	within			0,1005	0,263	1,212
ROA	overall	1.515	0,0056	0,0302	-0,3753	0,2145
	between			0,0203	-0,1636	0,0944
	within			0,0224	-0,206	0,1939

Table 18 (continued)

Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
LIQ	overall	1.515	0,5393	0,2514	0	0,9933
	between			0,2329	0,0031	0,9381
	within			0,0962	0,1416	1,1753
LTR	overall	1.515	3,5238	1,9157	0	14
GDPG	overall	1.515	1,3052	3,2852	-14,8	11,9
LHHI	overall	1.515	7,7192	0,4286	6,5228	8,831
HICP	overall	1.515	93,7221	6,0575	69,19	102,72
LBSIZE	overall	1.515	13,0133	0,9332	9,7013	15,5744
	between			0,8792	10,1731	14,7802
	within			0,3222	11,034	15,0643
REG_DUMMY	overall	1.515	0,5009	0,5001	0	1

Source: Author, based on STATA 14.0 calculation

Sample consists of 1.520 observations, i.e. 152 small commercial banks spanning over a period of 10 years (from 2006 to 2015). However, due to missing data, total number of observations used in panel data analysis for small banks is equal to 1.515.

Descriptive statistics in the previous table are both for dependent and independent variables. Mean relative efficiency of small banks, through observed period is 0,8034, ranging between minimum of 0,2058 and maximum of 1, with standard deviation of 0,1709. Between credit institutions the relative efficiency varies between 0,5132 and 1 with standard deviation of 0,1387, while within banks it varies between 0,2630 and 1,2120 (statistical measure) with standard deviation of 0,1005. Although no value of relative efficiency in the data exceeds value of 1, STATA calculates the within number as the deviation from each individual's average, and for this reason, such calculation results in within number higher than 1. The mean value of profitability (ROA) is 0,0056, ranging between -0,3753 and 0,2145 with standard deviation of 0,0302. Between credit institution, the profitability ranges between -0,1636 and 0,0944 with standard deviation of 0,0203, while within credit institution profitability ranges between -0,2060 and 0,1939 with standard deviation of 0,0224. As for the independent variables, liquidity (LIQ) has the mean of 0,5393, ranging from 0 to 0,9933, with standard deviation of 0,2514. Logarithm of the bank size (LBSIZE) has the mean value of 13,0133, ranging between 9,7013 and 15,5744 with standard deviation of 0,9332.

Observing the results of descriptive statistics of variables for small and large/medium sized banks, several interesting conclusions can be drawn. First, the relative efficiency, as well as profitability, is higher for large and medium sized banks, than it is for small banks, meaning that large and medium sized banks better manage their efficiency. Interestingly, if one looks at the range of bank profitability, it can be seen that small banks have higher profitability than large banks in absolute terms. Such results lead to conclusion that some small banks specialize in particular business segments, which allowed them to be more profitable than large and medium sized banks. Furthermore, volatility of observed variables, expressed as standard deviation, is higher for the small banks for almost every observed variable, except for the size of the bank. The bank size variable is more volatile with large banks when looking at the whole sample and when looking at the volatility between banks in the sample. However, when the size of the banks within the sample is observed, it can be seen that the volatility is higher for small banks. From this can be concluded that there are significant variations in the size of large banks in the sample, that is some individual banks are extremely large. Yet, large banks still had lower volatility in their size if the individual bank was observed during the 10-year period.

Since profitability varies considerably depending on the size of the banks, a separate table is presented below, showing the profitability of the banks depending on the size for each year.

Table 19: Descriptive statistics of bank profitability, depending on the size of the bank, 2006-2015

Year	Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
2006	ROA	All banks	433	0,0139	0,0151	-0,0333	0,148
		Large and medium sized banks	281	0,0129	0,0104	-0,0137	0,0887
		Small banks	152	0,0157	0,0211	-0,0333	0,148
2007	ROA	All banks	432	0,0131	0,0151	-0,0262	0,2145
		Large and medium sized banks	281	0,0121	0,0087	-0,0126	0,061
		Small banks	151	0,0146	0,0226	-0,0262	0,2145

Table 19 (continued)

Year	Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
2008	ROA	All banks	432	0,0072	0,0166	-0,0686	0,1694
		Large and medium sized banks	281	0,0069	0,0096	-0,0349	0,0355
		Small banks	151	0,0079	0,0249	-0,0686	0,1694
2009	ROA	All banks	429	0,0036	0,0189	-0,1022	0,1303
		Large and medium sized banks	278	0,0035	0,014	-0,0767	0,0336
		Small banks	151	0,0039	0,0256	-0,1022	0,1303
2010	ROA	All banks	433	0,0045	0,0183	-0,188	0,0624
		Large and medium sized banks	281	0,00585	0,0127	-0,083	0,0409
		Small banks	152	0,002	0,0254	-0,188	0,0624
2011	ROA	All banks	432	0,003	0,0234	-0,1515	0,1532
		Large and medium sized banks	281	0,0028	0,0204	-0,1515	0,0461
		Small banks	151	0,0034	0,0281	-0,1302	0,1532
2012	ROA	All banks	432	0,0034	0,0212	-0,2668	0,1608
		Large and medium sized banks	281	0,0039	0,0136	-0,0658	0,0447
		Small banks	151	0,0025	0,0308	-0,2668	0,1608
2013	ROA	All banks	432	0,0029	0,0288	-0,3584	0,1852
		Large and medium sized banks	280	0,003	0,0199	-0,1368	0,0382
		Small banks	152	0,0026	0,0404	-0,3584	0,1852

Table 19 (continued)

Year	Variable		Number of obs.	Arithmetic mean	Standard deviation	Minimum	Maximum
2014	ROA	All banks	433	0,0033	0,0228	-0,2618	0,1416
		Large and medium sized banks	281	0,004	0,0155	-0,0927	0,0599
		Small banks	152	0,0019	0,0321	-0,2618	0,1416
2015	ROA	All banks	433	0,0038	0,0276	-0,3753	0,1393
		Large and medium sized banks	281	0,0051	0,0168	-0,1647	0,0483
		Small banks	152	0,0014	0,0405	-0,3753	0,1393

Source: Author, based on STATA 14.0 calculation

The table above shows how extreme maximum and minimum values are present in small banks. Moreover, by 2010, small banks on average had higher profitability than large banks, after which they had lower profitability on average. Large banks had lower volatility of profitability in all observed years, which means that their business is more stable and predictable, and therefore easier for both management and investors.

After the descriptive statistics, it is necessary to determine the correlation between the variables using correlation matrix.

High correlation between analysed variables can result in multicollinearity problem that can deteriorate the significance of parameters. Most commonly used indicator of correlation is Pearson coefficient of correlation that ranges between -1 and 1 and shows the direction and intensity of linear statistical dependencies of variables.

Correlation value of 0 shows that there are no statistical dependencies between variables, meaning that they vary independently of each other.

Correlation value of 1 shows a strong positive dependency among the variables, while correlation value of -1 shows a strong negative dependence among the variables. When there is a strong

positive correlation among the variables, then one variable increase or decrease in the same amount as the other variable. A strong negative correlation means that if one variable increases, then the other variable will change in the same amount but in the opposite direction, or in this case it will decrease. Multicollinearity in the model can occur if the correlation between variables varies between 0,8 and 1, as well as between -0,8 and -1. Correlation matrices for the three proposed models are presented in the Table 20, Table 21 and Table 22.

Table 20: Correlation matrix of variables used in the panel data analysis, all banks

	ROA	EFF	LIQ	LTR	GDPG	LHHI	HICP	LBSIZE	REG_DUMMY
ROA	1								
EFF	0,1534*	1							
LIQ	0,0253	0,1427*	1						
LTR	-0,1227*	-0,1001*	0,104*	1					
GDPG	0,1651*	-0,0045	-0,0562*	-0,2706*	1				
LHHI	0,0588*	0,0253	0,0842*	-0,0901*	-0,0527*	1			
HICP	-0,1721*	0,0208	0,017	-0,3466*	-0,2214*	-0,0592*	1		
LBSIZE	-0,0397*	0,4644*	-0,0182	-0,0069	-0,0394*	-0,082*	0,0441*	1	
REG_DUMMY	0,0696*	0,012	-0,0229	-0,3039*	0,3998*	-0,0268	0,0413*	-0,0079	1

Source: Author, based on STATA 14.0 calculation

Table 21: Correlation matrix of variables used in the panel data analysis, large and medium sized banks

	ROA	EFFsv	LIQ	LTR	GDPG	LHHI	HICP	LBSIZE	REG_DUMMY
ROA	1								
EFFsv	0,0828*	1							
LIQ	-0,0035	0,0896*	1						
LTR	-0,2263*	-0,1716*	0,1084*	1					
GDPG	0,2645*	-0,0317	-0,0709*	-0,2796*	1				
LHHI	-0,0280	0,0336	0,1243*	-0,0213	-0,0813*	1			
HICP	-0,2083*	0,0811*	0,0204	-0,3139*	-0,2073*	-0,0683*	1		
LBSIZE	-0,1343*	0,3927*	-0,1729*	-0,0809*	-0,0540*	0,0151	0,0603*	1	
REG_DUMMY	0,0950*	-0,0282	-0,0241	-0,3017*	0,4023*	-0,0261	0,0468*	-0,0122	1

Source: Author, based on STATA 14.0 calculation

Table 22: Correlation matrix of variables used in the panel data analysis, small banks

	ROA	EFFm	LIQ	LTR	GDPG	LHHI	HICP	LBSIZE	REG_DUMMY
ROA	1								
EFFm	0,2403*	1							
LIQ	0,0492	-0,0048	1						
LTR	-0,0392	-0,1460*	0,0858*	1					
GDPG	0,0932*	0,0355	-0,0296	-0,2519*	1				
LHHI	0,1510*	0,0071	0,0400	-0,2149*	-0,0045	1			
HICP	-0,1593*	0,0508*	0,0127	-0,4151*	-0,2482*	-0,0440	1		
LBSIZE	0,0120	0,2372*	0,0763*	-0,0575*	0,0082	-0,1441*	0,1129*	1	
REG_DUMMY	0,0542*	0,0661*	-0,0211	-0,3106*	0,3954*	-0,0286	0,0310	-0,0073	1

Source: Author, based on STATA 14.0 calculation

From all three correlation matrices can be seen that there are no variables in the model that can cause multicollinearity, since all of them have correlation bellow 0,8 or above -0,8. Looking at the variables for entire sample, highest positive correlation is recorded between the size of the bank and relative efficiency (0,464), meaning that the larger the bank, the more relatively efficient it is. Correlation among these two variables is still below the threshold considered significant for the possible presence of multicollinearity. For large and medium sized banks, the highest positive correlation is between the variables GDP growth and regulation (0,4023), and between variables bank size and efficiency in the amount of 0,393, which means that larger the bank, the higher its relative efficiency. For small sized banks, the highest negative correlation is between inflation and long-term interest rates (-0,4151). As is the case with the correlation matrix of the variables used for all banks, in the correlation matrices of large and small banks the variables with highest correlation are still below the threshold considered significant for the possible presence of multicollinearity.

Presence of multicollinearity among independent variables is also tested using variance inflation factors (VIF), where overall model variance is put in proportion to the variance of model which includes only that single independent variable. Values of VIF between 1 and 5 indicate moderate correlation, while values greater than 10 indicate multicollinearity. For all three models, VIF test scores average around 1,28, with highest number of 1,69 for LTR variable in the third model where only small banks are observed. Such low values further corroborate Pearson coefficient that there is no presence of multicollinearity and that selected variables are suitable for proposed models.

Based on the previously shown correlation matrices, results of the panel data analysis will be shown in the following section. Given the fact that the lagged values of dependent variables, namely profitability and efficiency, are significant in explaining the future values of dependent variables, using dynamic panel data is advisable. Auxiliary hypothesis H3, will be proven by testing the previously mentioned models which use the relative efficiency and ROA as dependent variables.

Any financial crisis or major market disruption increases interest in finding solutions to reduce banks' riskiness through various regulatory reforms. Each new regulatory framework seeks to find the solution that works best and promotes the existence of a banking system, that is, a system that will increase the efficiency of banks. (Barth *et al.*, 2013). Table 23 shows the results of the panel data analysis where relative efficiency is used as the dependent variable.

Table 23: GMM system results of relative efficiency model

	All banks	Large and medium sized	Small
	EFF	EFFsv	EFFm
L.EFF	0.457***		
	(0.0345)		
ROA	0.670***	0.866***	0.646***
	(0.136)	(0.264)	(0.235)
LIQ	0.0935***	0.0787***	0.0503
	(0.0247)	(0.0292)	(0.0462)
LTR	-0.00597***	-0.00543***	-0.00778*
	(0.00145)	(0.00172)	(0.00417)
GDPG	0.000574	0.00111	-0.000268
	(0.000928)	(0.00110)	(0.00264)
LHHI	0.0122	0.00278	0.0187
	(0.00815)	(0.0108)	(0.0206)
HICP	0.00414***	0.00542***	0.00350
	(0.00100)	(0.00157)	(0.00255)
LBSIZE	0.0289***	0.0256***	0.0566***
	(0.00334)	(0.00445)	(0.0149)
REG_DUMMY	-0.106***	-0.0624***	-0.844**
	(0.0118)	(0.00745)	(0.349)
L.EFFsv		0.446***	
		(0.0407)	
L.EFFm			0.479***
			(0.0830)
_cons	-0.495***	-0.516**	0.003
	(0.120)	(0.203)	(0.037)
N	3879	2521	1358

Tabe 23 (continued)

	All banks	Large and medium sized	Small
Hansen test (p-value)	0.057	0.051	0.100
AR (1) test (p-value)	0.000	0.000	0.000
AR (2) test (p-value)	0.052	0.129	0.155
Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01			

Source: Author, based on STATA 14.0 calculation

Autocorrelation test and validity test (Hansen) for instruments are presented at the bottom of the table. Arellano-Bond test for serial autocorrelation in first residual differences rejects the hypothesis of nonexistence of serial correlation in the first order for all of the model specifications. The same hypothesis cannot be rejected for higher levels, which is desirable (AR2). The obtained results allow us to exclude the presence of residual serial correlation in the errors. Null hypothesis of Hansen test is that the instruments are valid, i.e., that the instruments are not correlated with stochastic errors of the model, which can be proven with the p-value higher then 0,05 (5%).

Introduction of new regulation has negative effects on the efficiency for all of the banks, regardless of their size, indicating that the new regulation imposes stiffer conditions on efficiently transforming inputs (funding, personnel expenses, fixed assets and loan loss provision) into outputs (loans, other earning assets and net fees). Profitability, measured by return on assets, has a positive and significant impact on the efficiency, regardless the size of bank. However, increase of profitability has a stronger effect on the efficiency of the large and medium sized banks, compared to small banks. Bank size measured by the logarithm of total assets is positively related with bank efficiency in all model specification indicating that efficiency increases with the size. This is not only valid for the entire banking system, which is in line with the results obtained by (Pasiouras, 2008), but also for the subsamples of small and large/medium banks. Inflation and liquidity have a

positive impact on bank's relative efficiency in model specification that considers all banks, as well as in model specification that takes into account only large and medium sized banks. These variables did not prove significant in model specification that includes only small banks. This can be explained by the fact that small banks operate locally and are thus to a lower extent are affected by inflation and liquidity. Long term interest rates (LTR) have a negative and significant impact on the relative efficiency of the banks, regardless of their size. If there is an increase in the market interest rate, there will be a reduction of relative efficiency for all of the banks. Variables that have no significant impact on the relative efficiency of the banks, regardless of their size, are gross domestic product growth and logarithm of Herfindahl–Hirschman Index.

The following table shows the results of the panel data analysis where profitability is used as the dependent variable.

Table 24: GMM system results of profitability (ROA) model

	All banks	Large/medium sized	Small
	ROA	ROA	ROA
L.ROA	0.522***	0.274***	0.447**
	(0.108)	(0.0534)	(0.176)
EFF	0.0304***		
	(0.00857)		
LIQ	0.00645	0.00542**	0.00586
	(0.00440)	(0.00243)	(0.00788)
LTR	-0.000514	-0.00181***	0.00130
	(0.000423)	(0.000325)	(0.000848)
GDPG	0.000656***	0.000731***	0.00172**
	(0.000240)	(0.000167)	(0.000744)
LHHI	-0.00192	-0.00323***	0.0125**
	(0.00185)	(0.00124)	(0.00517)

Table 24 (continued)

	All banks	Large/medium sized	Small
HICP	-0.000421**	-0.000296	0.0000592
	(0.000193)	(0.000189)	(0.000577)
LBSIZE	-0.000672	-0.00310***	0.00196
	(0.000499)	(0.000523)	(0.00260)
REG_DUMMY	-0.000243	0.000126	-0.168*
	(0.00181)	(0.00162)	(0.0960)
EFFsv		0.0138***	
		(0.00403)	
EFFm			0.0407**
			(0.0161)
_cons	0.0414	0.0976***	0.0386
	(0.0286)	(0.0223)	(0.0513)
N	3879	2521	1358
Hansen test (p-value)	0.206	0.594	0.286
AR (1) test (p-value)	0.000	0.000	0.000
AR (2) test (p-value)	0.156	0.897	0.268
Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01			

Source: Author, based on STATA 14.0 calculation

Autocorrelation test and validity test (Hansen) for instruments are presented at the bottom of the table. Arellano-Bond test for serial autocorrelation in first residual differences rejects the hypothesis of nonexistence of serial correlation in the first order for all of the model specifications. The same hypothesis cannot be rejected for higher levels, which is desirable (AR2). The obtained

results allow us to exclude the presence of residual serial correlation in the errors. Null hypothesis of Hansen test is that the instruments are valid, i.e., that the instruments are not correlated with stochastic errors of the model, which can be proven with the p-value higher then 0,05 (5%).

Results of the panel data analysis show that the new regulatory framework (REG_DUMMY) has no significant impact on bank profitability (measured by ROA) in case when all banks are taken into account, as well as for only large and medium sized banks. Interestingly, new regulatory framework has a significant negative impact on the profitability of small banks. One of the significant reasons for this result is that the new regulation means higher administrative burden that equals new costs such as new employments and IT services. Due to their smaller size and lower margins, it affects small banks' costs much higher than it does large and medium sized banks. Efficiency, in case of all banks (EFF), as well as for large/medium sized (EFFsv) and small banks (EFFm) has a positive and significant effect on bank profitability. The impact of relative efficiency on profitability is positive, since it is expected that the banks are more profitable if they are better in turning inputs (funding, personnel expenses, fixed assets and loan loss provision) into outputs (loans, other earning assets and net fees). Increase of relative efficiency is having a higher impact on the profitability of small banks compared to large and medium sized banks. Gross domestic product growth has a positive and significant impact in all three model specifications, implying that the increase of gross domestic product growth will result in the increase of the bank's profitability. Increase of gross domestic product growth has a higher impact on the profitability of small bank compared to the effect on the large and medium sized banks. Concentration of banks, measured by Herfindahl–Hirschman Index, shows some interesting results. It can be expected that higher concentration in the banking sector is positively related with bank profitability. However, increase of the logarithm of Herfindahl–Hirschman Index has no effect on the profitability of banks when observing the entire sample. On the other hand, increase of the logarithm of Herfindahl–Hirschman Index leads to an increase of profitability for small banks, while it leads to a decrease of profitability for the large and medium sized banks. Significant, but negative effect on the profitability of large and medium sized banks, is recorded for long term interest rate (LTR) and the logarithm of bank size (LBSIZE). These variables have no effect on the profitability of small banks and the entire analysed banking sample. It is interesting to note that bank size had a positive effect on the relative efficiency of large and medium sized banks (measured by DEA) but negatively affects their profitability. One of the reasons for this paradox could be that, regardless of their

ability to adapt their business operations in sense of efficiency, they tend to be less flexible to the needs of their clients, leading to lower profitability. This can only be possible in case when the increase of other factors influencing relative efficiency scoring outweigh the relative fall in the profitability. Liquidity (LIQ) and inflation, measured by the Harmonized Index of Consumer Prices (HICP), provided interesting results. Liquidity has a positive and significant impact on large and medium-sized banks, while inflation has a significant and negative impact on the profitability of all banks. Large banks are more capable of controlling their liquidity than small banks. One reason may be that large banks can rely on market liquidity in the event that they run out of liquidity, unlike small banks, which primarily rely on self-generated and maintained liquidity within the bank itself. Inflation has a negative impact on banks' profitability since rising inflation, in the case of slower adaptation of banks to market conditions, reduces their profit margin.

Results obtained from the analysed model specifications, which are meant to determine the impact of new regulation on banking operations, confirm that banking regulation has different effect on the commercial banks, depending on their size. With regards to the relative efficiency, regulation has a negative effect on the efficiency score regardless of the bank's size. Effect of the regulation on the profitability (measured by ROA) differs depending on the size of the bank. For large and medium sized banks, regulation has no significant effect on the profitability, while for the small banks it has a significant negative impact. Large and medium sized banks do not face significant problems in adapting their businesses to new regulatory requirements. Even though their relative efficiency is decreasing as a result of introducing new regulation, it has no significant impact on their profitability. Small sized banks have a much harder time coping with the new regulatory framework. It decreases both their relative efficiency, as well as their profitability. Based on the obtained results, we can confirm the auxiliary hypothesis 3, that size of the bank is one of the key features influencing the effect of regulation on banking efficiency and profitability.

Results of this research show that relative efficiencies differ according to the size of the banks and their country of origin. Furthermore, the obtained results show how regulation affects the relative efficiencies of banking operations as well as their profitability. The new regulation has a negative effect on the efficiency of all of the observed banks, while it only has a negative effect on the profitability of small banks. Interestingly, new regulatory burden has no significant effect on large and medium sized banks, indicating that even though their relative efficiency has deteriorated, their

profitability did not suffer. Therefore, the main hypothesis stating that global banking regulatory framework (Basel 2 and Basel 3) have considerable negative effects on banking operation within European Union can be partially accepted, in the sense that it negatively effects the efficiency of all the banks but has a negative impact only on the profitability of small banks. This result is actually even more worrisome than initially assumed since it may lead to even higher concentration in the banking sector in the long run.

5.4. **Discussion on the results, contributions, implications and future research possibilities**

This section will present the conclusion of the results of the scientific research and highlight the contributions and implications of the research. At the end of the chapter will be presented opportunities for future research that will continue the topic started by writing this doctoral dissertation.

A bank efficiency analysis was conducted for all of the EU countries in period from 2006 to 2015, and it was determined in which European countries are the most efficient large, medium-sized and small banks. Efficiency analysis was not conducted for only one year, as is the case in other scientific papers, but it was conducted for all 10 observed years, which gave a better insight into the dynamics of the relative efficiencies of banks over a ten-year period. To the best of my knowledge, none of the authors have dealt with this issue of calculating banking relative efficiency individually for every year, with their subsequent grouping to obtain efficiency trends over the years. Relative efficiency showed that on average, large and medium sized banks are more efficient in turning inputs to outputs, compared to the small sized banks. with higher mean values as well as lower standard deviation. In addition to higher efficiency, large and medium sized banks also have a smaller standard deviation or volatility compared to small banks. The results also indicate that the European market is not unique and that the banks from certain countries stand out in terms of relative efficiency. The results point to a conclusion that banks from Ireland are the most efficient, while banks from Romania are the least efficient. On average, large banks tend to have highest relative efficiency in Finland, Netherlands and Sweden, while lowest efficiency in Belgium. Medium sized banks have highest efficiency in Ireland and lowest in Romania, while small bank have highest efficiency in Poland and lowest in Cyprus.

Size of the bank showed to be key feature when calculating the effect of regulation on their operations. Even though regulation affected negatively on the relative efficiencies in all of the models, the impact on the profitability differs. Global banking regulatory framework had negative effect on the profitability only for the small banks, while there is no significant effect on the profitability of large and medium sized banks.

Banking regulation has a significant negative impact on the relative efficiencies of all banks. Such an effect should not be too surprising given that the new regulation is designed to increase the resilience of banks to the crisis situations, in a way that increases its liquidity, improves the quality of capital, and forces the bank to keep its assets in highly liquid assets. Consequently, the process of converting the sources of funds into placements automatically reduces, since according to the new regulation, most of the funds of the bank must be kept in cash and in cash equivalents. This process is much more difficult for smaller banks, and they see a greater decline in relative efficiency in relation to large and medium-sized banks. As mentioned, the new regulation, if one looks at the entire banking system or only large and medium-sized banks, does not have a significant impact on their profitability measured by the return on assets. However, if we look only at small banks, there is a negative and significant impact on their profitability. Such an effect can be explained by the fact that small banks, although more flexible in their work, have difficulties in adapting to the new regulation that requires higher amounts of liquid assets and higher quality of capital. If a small bank is prevented from placing funds in larger amounts, due to the specific nature of their business, it may have significant impact on their profitability. Small banks have more difficulties in adapting to new market conditions and are reluctant to opt for complex financial instruments since they do not have human capacity to deal with them. Most small banks instantly have liquidity ratios and other indicators higher than the legally prescribed minimum, so that they do not get in the situation of problems in front of the regulator. Small banks do not rely on market funding, since the financial institutions are not willing to finance a bank in problems. In spite of these facts, banks prefer to keep their assets above the statutory requirements so as to reduce the possible regulatory costs, or even the penalties that may arise from the failure to comply with the regulatory prescribed minimum.

The new regulation, just like the one before it, benefits large banks that can afford advanced risk calculations, thereby reducing regulatory costs. In addition to having easier access to capital, large

banks may want to raise interest rates on taken deposits in order to attract additional sources of funds. Such increased interest rates on deposits drives small banks to raise their interest rates in order to retain clients or to eventually attract new clients. As they are more difficult to adapt to the new regulatory environment and have a significant regulatory cost, such an increase in interest rates has a negative impact on their business and profitability.

This doctoral thesis contributes to the existing literature on several levels. First, data from the BankScope database of all commercial banks that had published financial statements for each observed year were used. Second, small banks were not excluded, but were used as an important sample for later relative efficiency calculations and the impact of regulation. Third, all of the banks with available data in European countries (EU 28) were used, not just selected banks. Fourthly, using the DEA methodology for all commercial banks it is gained adequate insight into the relative efficiency of banks across the EU and their trend of moving through the years. Despite extensive literature and research on bank relative efficiency and profitability, a comprehensive study on whether bank efficiency varies by country of origin and size, and whether banking regulation affects banks' relative efficiency and profitability by size has not been made. There is a scarce amount of research on the relative efficiency of banks in all 28 EU Member States, as is the scarce number of studies on the impact of banking regulation on profitability and relative efficiency in European countries. Most of the research focuses on selected countries and selected banks, and no one, to the best of my knowledge, has done any research on this topic for all banks in the European Union. While previous research focused mainly on the impact of regulation on the largest countries and only selected, in most cases, the largest banks, in this dissertation all commercial banks with available data over the observed time period were used, and further divided into groups of large banks and small banks to calculated and estimated the impact of regulation on banks' operations depending on their size. It can be concluded that the choice of a research sample is one of the contributions of this scientific research. This doctoral thesis contributes to the existing literature in a way that empirically demonstrates the impact of introducing new regulation on the relative efficiency and profitability of banks, depending on their size. The results add to the existing literature on the relationship between banking regulation and commercial bank operations, i.e. that the regulation should not be based on “one size fits all” approach.

Therefore, it can be stated that the contributions in theory are reflected in the following:

- comprehensive critical analysis of existing theoretical framework on bank regulation
- identification of determinants of bank profitability and their relative efficiency
- developed appropriate econometric methodology for empirical model
- developed scientific knowledge on the dependence of banks' size and their relative efficiency
- developed scientific knowledge on the dependence of country of origin and their relative efficiency
- developed scientific knowledge about disproportional (harming) effects that current regulation has on small banks, compared to large and medium sized banks
- developed scientific knowledge as a basis for future scientific researches

In application terms, the following contributions of the doctoral dissertation are highlighted:

- developed a framework for better understanding and identifying the determinants of profitability and efficiency of commercial banks
- a detailed analysis of the regulation and regulatory framework in the European Union countries
- a detailed analysis of the supervision characteristics of European Union banks
- developed framework for better understanding the relative efficiency variation between commercial banks, depending on their size and country of origin
- developed framework for better understanding the role and importance of bank regulation on banking operations depending on the size of the bank
- insight that bank regulation is disproportional to commercial banks
- insight that banking regulation should be size dependent

Regulators and supervisory bodies need to have sufficient knowledge based on relevant researches on topic whether regulation has a positive or negative effect on bank operations. As noted, stricter regulation certainly contributes to a more stable banking system, but the question is how such regulation affects the business of the banks themselves. If regulators do not have quality information based on quantitative research on the impact of regulation on banks' operations, their decisions can have negative consequences on banks operations and on the provision of financial services to clients. Method of calculation used in this dissertation is extremely important, as

regulators need to know and take into account the introduction of new regulatory rules and frameworks depending on the size of the banks. To the best of my knowledge, this dissertation paper is the first to empirically quantify the relative effectiveness of EU28 commercial banks, and the comparative impact of regulation on banks' operations, depending on their size.

Contribution of this dissertation is an empirical proof that current banking regulation is size dependent and as such disproportional to market participants. Since the hypotheses are proven, it means that differences in sizes between commercial banks should be taken into account. Such a conclusion has important implications for the regulation of banks, given that current regulation has negative effects on the operations of small banks only, and therefore the specificities of small banks should be taken into account when creating the regulatory framework.

As (Nakamura, 1994) points out, small banks process information on loans to small businesses better and faster than large banks, because of their simpler organizational structure and the ability to resolve disputes within the bank more easily and more quickly. Furthermore, as (Mercieca, Schaeck and Wolfe, 2007) states, by concentrating on specific market segment, small banks gain a comparative advantage over large banks. They manage to differentiate their products and services through long-term customer relationships, and therefore are in a better position than large banks. The dissemination of soft information through large banks is significantly more difficult than in small banks. On top of that in a complex organizational structure and channels, some customer-relevant information may even be lost. (Berger, Hasan and Klapper, 2004) investigated the relationship between small community banks and economic trends in a cross-country analysis, and conclude that healthy small banks are related with faster GDP growth It is for this reasons that it would be a pity to disable such flexible business operations of small banks that benefit not only end-clients, but also the entire economy.

Small banks are mainly focused on local economy. In the case of their bankruptcy or liquidation, negative externalities for the businesses may arise due to the costs associated with getting new funds. These businesses, that were mainly performing their operations through local bank, may find it difficult to get financing somewhere else, and their customers could be similarly disadvantaged. As a result, failure of local banks could have negative or contagious effect on the economic prospects of the whole local community, resulting in lower sales, production and employment.

There are several ideas for future direction of research based on this doctoral dissertation. Firstly, the results of this doctoral dissertation can be deepened in such a way as to increase the time period and, in addition to dividing banks by size, banks can be divided by country. The impact of regulation can be then calculated for such separated bank samples. It would also be interesting to compare the relative efficiencies of banks in all 28 European countries using alternative methods to calculate relative efficiencies, namely parametric and non-parametric methods. In addition to defining different types of inputs and outputs, different measurement approaches could also be applied, such as profit or cost efficiency. This would produce more robust results to the existing research. Secondly, the importance of small banks to the local economy could be analysed, and then to compare the countries where small banks are most represented with their impact on the economy. Thirdly, the impact and composition of small bank placements relative to large banks should be investigated, and thus can be seen what type of economy would be particularly affected by the closure of small banks. And for the last possible future research, it is important to find out if small banks can threaten the financial system in a way that they are overly connected through holding companies or other structures within individual countries. Namely, if there is a strong interconnection of small banks through certain interconnected structures, then another problem may arise called “Too many too fail”, where the collapse of a large number of small banks due to a lighter regulatory framework could put the financial system in trouble. As more detailed data becomes available, it can be analysed what particular regulatory factors affect banks' operations (i.e. profitability and relative efficiency) and to what extent, for both large and small banks.

One of the main goals of the new regulatory framework is to strengthen the security and stability of the banking system by realistically evaluating the riskiness of each individual bank. Despite the good idea of the regulatory framework put in place, it has been criticized for being overly complex, which may also affect banks' operations. This dissertation showed that the regulatory framework has a significant but different impact on the size of commercial banks depending on the size of the EU in 28 countries. Since the analysis was conducted on bank-level data, this impact of the regulation is further emphasized and shows that it has a conflicting impact on the efficiency and profitability of banks depending on their size and economic context. In this context, this research may be an initiative and motivation for regulators to further address the specific regulatory framework for small banks that will not have such a negative impact on their business.

Results of this dissertation thesis suggest several important policy implications. First, policy actions and regulatory frameworks are universally established for all banks within the European Union. However, the regulatory framework thus set up has different effects on banks depending on their size, and the regulator should take such specificities into account when further creating or changing the regulation. Large and medium sized banks behave differently from small banks. This difference should be taken into account and the regulator should implement bank-based policy actions and regulations. Second, for commercial banks is suggested to better monitor risk factors associated with liquidity, as the main emphasis is set on this topic, and also to significantly diversify their sources of funds given that special emphasis is placed on capital that serves as non-deposit source of funds. Third, to enable small banks to borrow in the time of distress so as not to hold liquidity reserves above the statutory limits during quiet times, and in the fear that they will not be able to quickly and cheaply obtain quality sources of funds when needed. Such behaviour of small banks greatly affects their profitability and efficiency. Fourth, the regulator should define and classify more clearly the liquid assets and sources of funds depending on the specific nature of each bank's operations, especially regarding their size.

A key conclusion of the dissertation is that the regulator must take into account the diversity of commercial banks in European Union, especially in the context of their size. Such results may prompt the regulator to create loosened regulatory framework for small banks since they are not relevant to the overall financial system, that will prevent them from risky business on one hand, and make it easier for them to do business and thus improving their relative efficiency and profitability.

The last part of the doctoral dissertation is a conclusion in which the synthesis of all relevant insights is presented, as well as the most important results of the empirical research.

6. CONCLUSION

New regulatory framework and guidelines provide better resilience for banks during the crisis, as confirmed by many authors. However, the question is whether the banks perform better in such regulatory environment. Despite the positive desire of supervisory bodies to make the banking system more stable and to reduce the devastating impact of future global financial crises, there is a growing number of theoretical and empirical researches pointing to the negative effects that the regulatory system may have on bank operations. Big challenges are posed to regulators, since the effects of the regulatory framework on banks' operations depend on the specifics of the banks' operations.

With the development of the financial sector and society, and due to the significant negative effect that the banking industry has on the world economy, the need for sound regulatory framework and for more supervisory institutions has developed. While there is a general consensus that strict regulation is required in the banking industry, the question is whether such overcomplicated regulatory framework and supervision is truly needed. Many financial institutions have expressed dissatisfaction with this way of controlling banks, as it greatly affects their business by overburdening their staff who must deal with strict standards rather than looking at how to improve their business and client operations. It is for this reason that there is a problem in the creation of regulation, which must be neither too simple nor too complicated. It must be simple enough not to interfere with the normal business of the bank, but it must also be sufficiently complicated to completely avoid future potential adverse effects not only on the bank's operations but also on the overall banking system. Standardization of bank operations will certainly lead to an equal pattern of business that all banks must respect and follow, but the problem may arise from the fact that such regulation limits the freedom of banks to create innovative products that can lead to the common good. In this case, there are two opposing parties - on the one hand we have policy makers and authorities aimed at strong standardization and regulation to avoid future negative effects on the economy, while on the other side we have banks and financial institutions to which these rules apply and which aim to have as much free decision-making in their business as possible. Banks and other financial institutions will be happy to embrace the regulation that benefits them and their business policies, while fiercely fighting the regulation that disrupts their business. One of the banks that oppose the new regulation are also small banks, not because of the complexity of their

business (such as some other bank whose main business is securities and derivatives), but because of the burden placed on them to monitor business and compliance with legal norms. Strong regulation leads to an increase in the number of employees engaged in a narrow segment of compliance with regulatory provisions, in which case there is a danger of losing a broad view of the bank's business and purpose, namely its own profit and an increase in the economy and economic standard of its clients.

Such a complex system of regulation and organization of regulatory bodies can lead to an increase in systemic risk. Specifically, banks have a large incentive to avoid strict regulatory constraints, since they directly affect their profitability and operations. Strict regulation can give the illusion that everything is stable and functioning in the banking system, but as history has shown, not every new regulatory framework can capture a problematic glitch that has not yet been introduced and does not actually exist. Any new regulation is actually a correction of the business of something that has already happened and that has caused market problems. The new and tougher regulatory environment will make it much easier for large banks to adapt, since they can move part of their business beyond regulatory boundaries and thus increase their profitability. This kind of business cannot be afforded by small banks, mainly because of limitations in the number of employees. In essence, this should not be the goal of stricter regulation because it does not solve the general problem, which is a maintenance of more secure financial and banking system for all market participants. On the other hand, a looser regulatory framework may treat equally, in terms of risk, items that are seemingly similar but actually very different in terms of risk. Future developments in regulation go in the direction of more complex business operations, which means an immediate negative impact on small banks, and questionable stability of the banking system, given that they have the potential to transfer risks outside the regulatory framework. In this way, the profitability of small banks is affected, while for medium and large banks the new regulation will not affect their profitability.

The specificity of commercial banks' operations is most evident in their size. Large banks are generally slower systems, while small banks process information on loans to small businesses better and faster than large banks and they manage to differentiate their products and services through long-term customer relationships. However, problem arises with the regulation of banks. A stricter regulatory framework imposes on banks to hold more funds in liquid placements, while

on the other hand they must have a secure base of their own sources of funds in form of capital. A strict regulatory framework impose small banks with a significant regulatory cost, which they cannot meet from other channels, and for this reason their efficiency and profitability fall. In most cases, large banks can easily reach liquidity by borrowing in the capital market, while small banks rely solely on their own liquidity. Due to the fear of regulatory penalties on the one hand and the lack of funds on the other, small banks maintain a high level of liquidity in their operations, which consequently affects their profitability since liquid assets are not profitable assets.

The focus of the research interest of this doctoral dissertation was to evaluate the relative efficiencies of commercial banks in all 28 EU Member States, and the impact of regulation on their profitability and efficiency. Due to differences between commercial banks from investment and other types of banks, it is impossible to calculate relative efficiency using same methodology, i.e. input and output variables, that would satisfy such different approaches to banking business.

Relative efficiency and the regulatory impact on banking operations are estimated for the 10-year period. Banks' financial statements are obtained from the BankScope database, published by Bureau van Dijk (BvD). The data is collected on the individual level i.e. for each bank in the EU 28 states, for the period of 10 years (yearly data from 2006 to 2015). The final sample is composed of 433 commercial banks that have all of the necessary data for the calculation of relative efficiency and the impact of regulation on banking operations.

The entire quantitative analysis performed in the dissertation is separated into two groups. First the econometric evaluation of the relative efficiency of banks' operations is performed using the data envelopment analysis. In the second step, due to the dynamic nature of economic relations, the impact of regulation on the banking operations is analysed by using dynamic panel data approach, which implies that the value of an individual variable is influenced by values from previous periods.

With the analysis is confirmed that the relative efficiencies of banks vary significantly depending on their size. Large banks have highest average efficiency with the smallest standard deviation. Medium sized banks are less efficient and have higher standard deviation compared to large banks, and the least efficient are the small banks, with the lowest average efficiency mean and highest standard deviation. Not only that, the results of relative efficiency calculation confirm that the relative efficiency depends also on the country of origin of bank. While banks from Ireland have the highest efficiency, banks from Romania have the lowest efficiency. For the large banks, highest

relative efficiency has banks from 3 countries: Finland, Netherlands and Sweden, where large banks kept the highest possible efficiency throughout the entire observed 10-year period. The least efficient large banks are situated in Belgium. Banks from Ireland are the most efficient from medium sized banks, while least efficient are medium sized banks from Romania. The highest relative efficiency for small banks can be seen in Poland, while the least relative efficiency has the banks from Cyprus.

Introduction of new regulation has negative effects on the efficiency for all of the banks, regardless of their size, indicating that the new regulation imposes stiffer conditions on efficiently transforming inputs (funding, personnel expenses, fixed assets and loan loss provision) into outputs (loans, other earning assets and net fees). Profitability, measured by return on assets, has a positive and significant impact on the efficiency, regardless the size of bank. However, increase of profitability has a stronger effect on the efficiency of the large and medium sized banks, compared to small banks. Bank size measured by the logarithm of total assets is positively related with bank efficiency in all model specification indicating that efficiency increases with the size. Inflation and liquidity have a positive impact on bank's relative efficiency in model specification that considers all banks, as well as in model specification that takes into account only large and medium sized banks. These variables did not prove significant in model specification that includes only small banks. This can be explained by the fact that small banks operate locally and are thus to a lower extent are affected by inflation and liquidity. Long term interest rates (LTR) have a negative and significant impact on the relative efficiency of the banks, regardless of their size. If there is an increase in the market interest rate, there will be a reduction of relative efficiency for all of the banks. Variables that have no significant impact on the relative efficiency of the banks, regardless of their size, are gross domestic product growth and logarithm of Herfindahl–Hirschman Index.

Results of the panel data analysis show that the new regulatory framework (REG_DUMMY) has no significant impact on bank profitability (measured by ROA) in case when all banks are taken into account, as well as for only large and medium sized banks. Interestingly, new regulatory framework has a significant negative impact on the profitability of small banks. One of the significant reasons for this result is that the new regulation means higher administrative burden that equals new costs such as new employments and IT services. Due to their smaller size and lower margins, it affects small banks' costs much higher than it does large and medium sized banks.

Efficiency, in case of all banks (EFF), as well as for large/medium sized (EFFsv) and small banks (EFFm) has a positive and significant effect on bank profitability. The impact of relative efficiency on profitability is positive, since it is expected that the banks are more profitable if they are better in turning inputs (funding, personnel expenses, fixed assets and loan loss provision) into outputs (loans, other earning assets and net fees). Increase of relative efficiency is having a higher impact on the profitability of small banks compared to large and medium sized banks. Gross domestic product growth has a positive and significant impact in all three model specifications, implying that the increase of gross domestic product growth will result in the increase of the bank's profitability. Increase of gross domestic product growth has a higher impact on the profitability of small bank compared to the effect on the large and medium sized banks. Concentration of banks, measured by Herfindahl–Hirschman Index, shows some interesting results. It can be expected that higher concentration in the banking sector is positively related with bank profitability. However, increase of the logarithm of Herfindahl–Hirschman Index has no effect on the profitability of banks when observing the entire sample. On the other hand, increase of the logarithm of Herfindahl–Hirschman Index leads to an increase of profitability for small banks, while it leads to a decrease of profitability for the large and medium sized banks. Significant, but negative effect on the profitability of large and medium sized banks, is recorded for long term interest rate (LTR) and the logarithm of bank size (LBSIZE). These variables have no effect on the profitability of small banks and the entire analysed banking sample. It is interesting to note that bank size had a positive effect on the relative efficiency of large and medium sized banks (measured by DEA) but negatively affects their profitability. One of the reasons for this paradox could be that, regardless of their ability to adapt their business operations in sense of efficiency, they tend to be less flexible to the needs of their clients, leading to lower profitability. This can only be possible in case when the increase of other factors influencing relative efficiency scoring outweigh the relative fall in the profitability. Liquidity (LIQ) and inflation, measured by the Harmonized Index of Consumer Prices (HICP), provided interesting results. Liquidity has a positive and significant impact on large and medium-sized banks, while inflation has a significant and negative impact on the profitability of all banks. Large banks are more capable of controlling their liquidity than small banks. One reason may be that large banks can rely on market liquidity in the event that they run out of liquidity, unlike small banks, which primarily rely on self-generated and maintained liquidity within the bank

itself. Inflation has a negative impact on banks' profitability since rising inflation, in the case of slower adaptation of banks to market conditions, reduces their profit margin.

Large and medium sized banks do not face significant problems in adapting their businesses to new regulatory requirements. Even though their relative efficiency is decreasing as a result of introducing new regulation, it has no significant impact on their profitability. Interestingly, new regulatory burden has no significant effect on large and medium sized banks, indicating that even though their relative efficiency has deteriorated, their profitability did not suffer. Small sized banks have a much harder time coping with the new regulatory framework. It decreases both their relative efficiency, as well as their profitability. Regulation negatively effects the efficiency of all the banks but has a negative impact only on the profitability of small banks. This result is actually even more worrisome than initially assumed since it may lead to even higher concentration in the banking sector in the long run.

No one disproves the need for stringent regulation, because entire economies depend on that, however, it should be clearly distinguishing between the regulation for small banks and medium and large banks.

In banking regulation and supervision, it is necessary to apply a different set of rules depending on their size. Since small banks are not systemically important, they should be subject to a lighter set of rules than larger banks. This regulatory framework significantly affects the efficiency of all banks, but only adversely affects the profitability of small banks, which means that they have failed to adapt adequately to the new regulatory environment.

This regulation certainly drives small banks into closing down or merging with larger banks, which affects the diversification of financial services provided by banks. In order to ensure diversity, the application of different sets of rules is only imposed as a logical sequence in the further creation of laws related to the regulation and supervision of banks. In the European Union single rulebook there is already a milder treatment of banks in some fields, such as the obligation to report, but more can be done.

One of the many questions may be where is the border between small and large banks. One of the contributions of this dissertation is that it is proven that the size of banks according to the methodology of the European Central Bank is adequate for future decisions on possible special

regulations for banks depending on their size, since there can be clearly seen the effect on small banks and large and medium sized banks. Some of the measures could be to further reduce the administrative burden, rationalize the obligation of public disclosures for unlisted banks, and reduce capital requirements for market as well as counterparty credit risk for banks that have small trading books and do not deal with derivatives or similar products.

In addition to applying less stringent rules for small banks, consideration should also be given to reducing the amount of capital and liquidity they should hold in their portfolios. This does not mean far less amounts, but rather an amount that provides most small banks with an adequate cost-benefit ratio that would not significantly affect their efficiency and profitability.

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Figure 6: Average HHI index for EU28, from 2006-2015 100

PROŠIRENI SAŽETAK

Regulacijom bankarskog sektora se prvenstveno namjerava zaštiti nepovoljan utjecaj kojeg lančana reakcija propasti banaka može imati na globalnu ekonomiju. Kroz povijest su oduvijek postojali različiti pogledi između poslovnih banaka i regulatora o tome što predstavlja sigurno poslovanje banaka. Dok su banke željele poslovati što je moguće više slobodno, uvijek je postojao regulator čije su odredbe i zakoni služili kao smjernice njihovog poslovanja. Poslovne banke i nadzorna tijela imaju različiti pogled na obujam i strukturu regulatornog okvira. Cilj poslovnih banaka je maksimizacija profita, te se one žele aktivno uključiti u sve poslove financijskog poslovanja. Negativne efekte takvih odluka mogu se vidjeti još i u prvoj polovici 20. stoljeća, kada je nesmotreno poslovanje banaka dovelo do Velike industrijske krize 1929. godine i pada burze. Nakon toga je 1933. godine usvojen prijedlog zakona poznat pod nazivom "Glass-Steagall Act". Ovaj je zakon razdvojio investicijsko bankarstvo od komercijalnih banaka, a razlog razdvajanja je taj što su komercijalne banke s neadekvatnom količinom znanja bile previše uključene u aktivnosti investicijskog bankarstva koje se smatralo rizičnim. Takav je zakon trajao sve do 1999. godine, kada ga je zamijenio zakon pod nazivom "Gramm-Leach-Bliley Act" koji je uklonio dotadašnja ograničenja između komercijalnih i investicijskih banaka. Unatoč želji regulatora da učini bankarski sustav sigurnijim i stabilnijim, česte promjene i nadopune regulatornih zahtjeva imaju implikacije i na poslovanje individualnih banaka. Nadzorna tijela zadužena za regulaciju trebaju imati stabilnu kontrolu nad bankama s obzirom na to da njihova slobodna volja može naštetiti čitavoj ekonomiji. Međutim, trebaju uzeti u obzir da banke imaju različite karakteristike, te da jednaki zahtjevi mogu dovesti do loših rezultata poslovanja i propasti određenog broja banaka. Bankarski sustav koji dobro funkcionira smatra se generatorom gospodarskog rasta i razvoja, te je upravo iz tog razloga nastala ideja za pisanje ove doktorske disertacije. Predmet doktorske disertacije jest analiza utjecaja novog regulatornog okvira na profitabilnost i efikasnost komercijalnih banaka, ovisno o njihovoj veličini. Cilj istraživanja je analiza utjecaja najnovijeg europskog regulatornog bankarskog okvira na relativnu efikasnost i profitabilnost komercijalnih banaka u Europskoj uniji (EU28), uzimajući pritom u obzir njihovu veličinu, te isto tako i pokazati kako se relativne efikasnosti razlikuju ovisno o veličini komercijalnih banaka u ovisno u kojoj državi članici Europske Unije posluju. Sve su europske banke dužne poštivati zajednički europski regulatorni bankarski okvir, bez obzira na njihovu veličinu ili zemlju odakle dolaze. Fokus

doktorske disertacije jest na učinku regulacije na europsko bankarsko poslovanje, posebno na njihovu profitabilnost i relativnu efikasnost. Potpisivanjem Haškog sporazuma 20. siječnja 1930. vlade sedam zemalja (Švicarska, Sjedinjene Američke Države, Ujedinjeno Kraljevstvo, Japan, Italija, Njemačka, Francuska i Belgija) donijele su odluku o potrebi osnivanja međunarodne organizacije koja bi promovirala suradnju između centralnih banaka. Banka za međunarodna poravnanja (eng. Bank for International Settlement), najstarija je međunarodna financijska organizacija na svijetu sa sjedištem u Baselu (Švicarska), u kojoj sudjeluje 60 članica središnjih banaka, a koje predstavljaju zemlje širom svijeta s oko 95% svjetskog bruto domaćeg proizvoda. Misija ove banke, koja djeluje kao banka nacionalnim središnjim bankama, jest pružiti središnjim bankama financijsku i monetarnu stabilnost koju traže, što je preduvjet održivog gospodarskog rasta i prosperiteta. Baselski odbor za bankarsku superviziju i nadzor je prvi globalni pokretač makroprudencijalnih politika i propisa za banke širom svijeta. Odbor regulira standarde nadzora nad bankama, mjerenja adekvatnosti kapitala i upravljanja rizicima, te pomaže zemljama nečlanicama da usvoje i implementiraju te standarde u svoje bankarske sustave. Prvi dokument kojeg je izdao Baselski odbor bio je onaj iz 1975. godine, poznat pod nazivom "Concordat". Glavni cilj ovog dokumenta je bio postavljanje smjernica za suradnju između državnih tijela u nadzoru nad inozemnim bankama i povećanje njihove učinkovitosti. Naglasak je stavljen na područja izravnog prijenosa informacija između nadzornih tijela države u kojem se nalazi sjedište institucije i države u kojoj institucija posluje. U narednim godinama su se regulatorni zahtjevi dopunjavali i unaprjeđivali. Kao rezultat konzultacija na temu međunarodne regulacije i supervizije, glavni naglasak je stavljen na adekvatnost kapitala, odnosno mjere kapitala. Kako bi se banka smatrala stabilnom, mora imati dovoljno vlastitog kapitala za pokriće očekivanih i neočekivanih gubitaka, te je iz tog zaključka 1988.godine nastao prvi regulatorni okvir poznat pod nazivom Basel 1, koji je kasnije nadopunjen zahtjevima vezanim uz tržišne rizike. Nakon dugog perioda konzultacija, 2004.godine se izdaje novi regulatorni okvir poznat pod nazivom Basel 2. U novom regulatornom okviru se uvodi pojam takozvana tri stupa, odnosno tri temeljna problema na koje se treba obratiti posebna pozornost prilikom upravljanja i nadzora nad bankama. Tako prvi stup obuhvaća minimalne kapitalne zahtjeve u kojima se u detalje propisuje izračun i nadzor nad adekvatnošću kapitala, te izračun operativnih, tržišnih i kreditnih rizika temeljem standardiziranog ili naprednog pristupa internog mjerenja. Drugi stup predstavlja nadzor na adekvatnošću kapitala banaka u kojem je popisan set pravila supervizijskog nadzora nad poslovanjem bankama. Ključna načela nadzora

nad adekvatnošću kapitala su ta da banke moraju imati postupak procjene ukupne adekvatnosti kapitala prema profilu rizika, kao i strategiji za očuvanje razine kapitala, zatim da supervizori moraju pregledati i procijeniti postupak procjene interne adekvatnosti kapitala i osigurati njegovu usklađenost s različitim omjerima kapitala, zatim da supervizori trebaju osigurati da banke posluju iznad minimalnih propisanih razina kapitala, kao i poticati ih da imaju kapital veći od propisanog minimuma, te da nadzorna tijela moraju imati metode procjene rane faze problema banaka kao i mogućnost intervencije u bankarsko poslovanje kako bi se spriječilo smanjenje kapitala banke ispod potrebnog minimuma. Treći stup predstavlja tržišnu disciplinu u kojem su propisani načini javne objave poslovanja banaka, s naglaskom na javnu objavu rizika kojima su banke izložene ili bi mogle biti izložene. Informacije koje bi mogle biti od značaja za širu publiku su kvalitativne i kvantitativne prirode i odnose se na izloženost i procjeni adekvatnosti kapitala i rizika banaka (kreditni rizik, tržišni rizik, operativni rizik, vlasnički udjeli, rizik kamatne stope, rizik izloženosti itd.) Nedostatak likvidnosti i niska razina adekvatnosti kapitala bili su jedan od većih problema tijekom posljednje financijske krize. Posljednji regulatorni okvir, poznat pod nazivom Basel 3, uveden je 2010. godine kao odgovor na globalnu financijsku krizu uslijed propasti investicijske banke Lehman Brothers 2008. godine. Propast Lehman Brothers-a doveo je do trenutnog i snažnog zaokreta na tržištu, uzrokujući nagli pad realne ekonomije, propast niza banaka, likvidnosne krize i kreditnog sloma. Pogrešna procjena kreditnog i likvidnosnog rizika, u kombinaciji s padom kapitalnih zahtjeva i korištenjem financijskih poluga, rezultiralo je snažnim rastom broja loših kredita i posljedično financijskom krizom. Čak je i prije propasti investicijske banke Lehman Brothers postalo jasno da se određene promjene moraju napraviti na području regulacije nad bankama, najviše u pogledu likvidnosnih i kapitalnih zahtjeva koje nisu bile adekvatno definirane u prijašnjem regulatornom okviru. Basel 3 je uveo strože definicije kapitala u pogledu kvantitete i kvalitete, te unaprijeđenu metodologiju za izračun kapitalnih omjera. Novi Basel uvodi niz mjera upravljanja likvidnosnim rizikom, nameće više kapitalne zahtjeve za sistemski važne financijske institucije, uvodi bolju kontrolu nad rastom banaka, te uvodi protucikličke mehanizme osiguranja kapitaliziranosti banaka zbog kojih su banke dužne držati dodatni iznos kapitala u slučaju nepovoljnih kretanja na tržištu. Reforme unutar Basel 3 regulatornog okvira imaju dva cilja: osnažiti kapital i likvidnost kako bi banke učinili otpornijima na tržišna kretanja, te ojačati sposobnost bankarskog sektora da prevlada tržišne šokove koji se mogu preliti na realnu ekonomiju. Baselski odbor je vođen trima načelima prilikom zaključivanja ovih reformi: daljnje

jačanje regulacije i supervizije banaka širom svijeta, uključivanje širokog kruga dionika tijekom savjetovanja, te realnom utjecaju na bankarski sustav i ekonomiju. Bankarski sustav Europske Unije je prošao kroz brojne promjene tijekom posljednjih godina. Europska integracija i zadnja financijska kriza su imale značajne utjecaje na strukturu i poslovanje banaka širom svijeta, pa tako i u Europskoj uniji. Pravilnici Europske unije o prudencijalnoj regulaciji su većinom izvedeni iz smjernica Baselskog odbora, te se bave količinom i kvalitetom likvidnosti i kapitala koje banke drže u svojem poslovanju. Cilj tih pravilnika je sličan onima Baselskog odbora, a to je održavanje stabilnosti bankarskog sektora za vrijeme gospodarskog pada, osiguravajući pritom da banke nastave financirati realnu ekonomiju. Europska je komisija 2011. godine objavila prijedlog legislative pod naslovom „Capital Requirements Directive IV" koji se u osnovi bavi sadržajem Basela 3. Prijedlog legislature sadržava dva odvojena pravna akta: jedne EU Direktive ("Capital Requirements Directive") i jedne EU Uredbe ("Capital Requirements Regulation"). Kod implementacije ovih dvaju zahtjeva u zakonodavni okvir država članica Europske unije postoje određene razlike. Dok se Direktiva implementira kroz nacionalne pravno-zakonske okvire, Uredba se, prema europskom zajedničkom zakonu, neposredno i jednako primjenjuje u svim zemljama članicama Europske unije. Odnosno, kod uvođenja Direktive zemlje članice mogu prilagoditi pojedine zahtjeve potrebama svojeg tržišta, dok kod primjene Uredbe ne postoji „prostor za prilagodbu" kroz nacionalne zakonske okvire. Direktiva Europskog parlamenta i Vijeća o kapitalnom zahtjevu 2013/36 / EU zamjenjuje prethodne direktive i odnosi se na aktivnosti kreditnih institucija, kao i prudencijalnom nadzoru kreditnih institucija i investicijskih poduzeća. Bavi se temama kao što su pristup poslovanju banaka, osnivanje banaka i sloboda pružanja različitih financijskih usluga. Službeni datum stupanja na snagu je 17. srpnja 2013., a pravila su se počela primjenjivati od 31. prosinca 2013. godine. Uredba Europskog parlamenta br. 575/2013 o kapitalnim zahtjevima odnosi se na prudencijalne zahtjeve za kreditne institucije i investicijska poduzeća. Službeni datum stupanja na snagu je 28. lipnja 2013., dok su se zahtjevi počeli primjenjivati od 1. siječnja 2014. godine. U ovoj je legislativi glavni naglasak stavljen na kapital i likvidnost banaka, budući da su tijekom posljednje financijske krize banke bile posebno osjetljive na negativna tržišna kretanja uslijed nedovoljne količine i kvalitete vlastitog kapitala, te nedostatka kratkoročne i dugoročne likvidnosti. Najnoviji zakonodavni paket Europske unije postavlja snažnije bonitetne zahtjeve za banke u smislu kapitalnih rezervi i likvidnosti. Efikasnost i njeno mjerenje oduvijek je bilo u središtu zanimanja svakog uspješnog poslovnog subjekta, jer od

poslovne učinkovitosti ovisi i krajnji poslovni rezultat. Poznavanje i provedba različitih metoda mjerenja efikasnosti ključna je za razumijevanje prednosti i nedostataka koje pojedini poslovni subjekti imaju. Posebno je važna procjena efikasnost bankarskog sektora, obzirom na veliku ulogu koji taj sektor ima u gospodarstvu i društvu. Uzimajući u obzir specifičnosti bankarskog sektora mogu se primijeniti različite metode mjerenja efikasnosti. Međutim, jedna od najčešće korištenih metoda za ocjenu efikasnosti u bankarskom sektoru je Analiza omeđivanja podataka (eng."Data Envelopment Analysis"). Temeljni cilj bilo kojeg ekonomskog sustava je postizanje ekonomske relativne efikasnosti, te u tom smislu nije moguće poboljšati ekonomski položaj jednog subjekta bez istodobnog smanjenja ekonomskog položaja drugog subjekta. Subjekt je u potpunosti efikasan ako i samo ako nije u mogućnosti poboljšati bilo koji od svojih inputa ili outputa bez smanjenja svojih drugih inputa ili outputa. Drugim riječima, subjekt je efikasan ako je output maksimalan s obzirom na postojeće inpute. Na tu temu napravljeno je mnogo istraživačkih radova s različitim načinima mjerenja relativne efikasnosti u raznim industrijama. U ovom znanstvenom istraživanju promatrao se utjecaj bankarske regulacije na poslovanje banaka u svim državama članicama Europske unije (EU28), kroz vremenski period od 10 godina, odnosno od 2006. do 2015. godine. Glavni izvor podataka koji se koristi u disertaciji su bankarski podaci iz BankScope baze podataka, a koja ima sveobuhvatnu pokrivenost banaka u Europskoj uniji (EU28) i sadrži njihove osnovne podatke, financijske omjere i financijske izvještaje. Svi podaci iz ove baze imaju godišnju učestalost i izraženi su u eurima. Ostali potrebni podaci prikupljeni su iz statističkog ureda Europske unije – EUROSTAT, te iz javno objavljenih financijskih izvještaja banaka. Utjecaj novog regulatornog okvira na bankarski sektor (implementacija Basela u zakonodavstvo Europske Unije) je analiziran u 2 faze. U prvoj fazi se proveo izračun relativne efikasnosti temeljem često korištene neparametarske metode analize omeđivanja podataka (eng. Data Envelopment Analysis), te su se dobiveni rezultati u drugoj fazi koristili kao zavisna i nezavisna varijabla. S obzirom na to da većina ekonomskih varijabli pokazuje dinamično ponašanje, u drugoj fazi se analizirao utjecaj regulacije na poslovanje banaka korištenjem dinamičke panel analize (eng. dynamic panel data) koja ima i vremensku i prostornu dimenziju. Prvi korak u ovom istraživanju je bio definirati najprikladnije determinante poslovanja banaka za analizu efikasnosti, a kasnije i ispitati koje banke u državama EU28 imaju najvišu relativnu efikasnost uzevši u obzir njihove veličine. Dalje je bilo potrebno istražiti utjecaj regulatornog okvira na poslovanje banaka, odnosno na njihovu profitabilnost i relativnu efikasnost. U skladu s postojećom literaturom o mjerenju efikasnosti banaka, ova se

doktorska disertacija fokusira isključivo na komercijalne banke. Komercijalna banka je vrsta financijske institucije koja uzima depozite, što im zajedno uz uzete kredite i vlastiti kapital čini izvor sredstava za daljnje poslovanje. Iz tako kreiranih izvora sredstava komercijalne banke nude široki spektar proizvoda poput osobnih i hipotekarnih kredita, ulaganja u vrijednosne papire, otvaranje različitih vrsta računa klijentima itd., čime im najveći postotak prihoda i rashoda ovisi o kretanju kamatnih stopa na tržištu. S druge strane, investicijske banke pomažu korporacijama u velikim i složenim financijskim transakcijama, izdavanju vrijednosnih papira na tržištu, pomažu im u procesu spajanja i akvizicija itd., što znači da se većina njihovih prihoda temelji na osnovi raznih vrsta naknada. Upravo zbog ovih razlika između komercijalnih banaka i investicijskih i drugih vrsta banaka, nemoguće je izračunati relativnu efikasnost primjenom iste metodologije koja bi zadovoljila takve različite pristupe poslovanju. Konačni uzorak čine 433 komercijalne banke koje imaju sve potrebne podatke za izračun relativne efikasnosti i utjecaja regulacije na poslovanje banaka. Da bi se konstruirao analitički okvir, potrebno je odrediti veličinu banaka, odnosno razdvojiti komercijalne banke na male, srednje i velike banke. Europska središnja banka definira veličinu banaka temeljem ukupnog iznosa konsolidirane imovine svih banaka u Europskoj uniji. Prema toj metodologiji, banka se definira kao velika ako je omjer aktive pojedine banke u ukupnoj konsolidiranoj aktivi banaka EU veći od 0,5%, zatim kao srednja banka ako je omjer aktive pojedinih banaka u ukupnoj konsolidiranoj aktivi banaka EU između 0,5% i 0,005%, te kao mala banka ako je omjer aktive pojedine banke u ukupnoj konsolidiranoj aktivi banaka EU ispod 0,005%. Primjenom metodologije Europske središnje banke, u 2015. godini prag za male banke iznosi 1.550.000 eura, za srednje banke između 1.550.000 eura i 155.000.000 eura, dok se velike banke smatraju onim bankama koje imaju vrijednost svoje aktive iznad 155.000.000 eura. Konačni uzorak ovog istraživanja čini 37 velikih banaka, 244 srednjih banaka i 152 male banke. Najveći broj banaka u uzorku čine banke iz Njemačke (65 banaka), dok najmanji broj banaka čine banke iz Finske i Malte (po 3 banke iz svake zemlje). Najveći broj velikih i srednjih banaka se nalazi u Francuskoj (7 velikih i 35 srednjih banaka), dok se najveći broj malih banaka nalazi u Njemačkoj (njih 26). Kao zavisne varijable koriste se profitabilnost banke i njihove relativne efikasnosti. Značajan broj znanstvenika za profitabilnost banaka koristi povrat na imovinu, te se iz tog razloga ona koristi i u ovom doktorskom radu. Zanimljivo je napomenuti da su do 2010. godine male banke u prosjeku imale veću profitabilnost od velikih banaka, nakon čega su u prosjeku imale nižu profitabilnost, dok su srednje i velike banke imale nižu volatilnost profitabilnosti u svim

promatranim godinama, što znači da je njihovo poslovanje kroz cijeli promatrani period bilo stabilnije. Relativna efikasnost je dobivena izračunom, gdje su se prilikom izračuna uzela 4 inputa i 3 outputa. Kao inputi su se koristili financiranje, odnosno zbroj depozita, kratkoročnog i dugoročnog financiranja (FUNDING), dugotrajna imovina (FA), troškovi osoblja (PEREXP) i rezerviranja za gubitke (LLPROVISION) koji predstavlja kategoriju rizika. Za outpute su se koristili krediti (LOANS), naknade (NETFEES) i ostala imovina koja nosi zaradu (OEA). Zbog problema s endogenošću, varijable koje se koriste u procjeni relativne efikasnosti ne mogu se koristiti u dinamičkoj panel analizi. Povrat na imovinu i relativna efikasnost se koriste i kao zavisna i kao nezavisna varijabla. Povrat na imovnu (ROA) je izračunata kao omjer profita prije poreza pojedine banke s njenom ukupnom imovinom, dok se relativna efikasnost (EFF) kreće između 0 i 1. Nezavisne varijable koje se koriste u ovoj doktorskoj disertaciji na razini individualne banku su likvidnost koja je mjerena kao omjer između kredita i ukupne imovine pojedine banke (LIQ), veličina banke koja je mjerena kao logaritam od ukupne imovine pojedine banke (LBSIZE), te Herfindahl-Hirschman Indeks koji je mjeren kao logaritam sume kvadriranih udjela imovine banke u ukupnoj imovini banaka za pojedinu zemlju, pomnoženo s 10.000 (LHHI). Nezavisne makro (monetarne) varijable su dugoročna kamatna stopa koja se koristi kao kriterij konvergencije za Europsku monetarnu uniju temeljen na Maastrichtskom ugovoru (LTR), realni rast bruto domaćeg proizvoda (GDPG), te harmonizirani indeks potrošačkih cijena koji predstavlja mjeru promjene cijena potrošačkih dobara i usluge kroz određeni vremenski period (HICP). Kao mjera uvođenja regulacije se koristi dummy varijabla, gdje su godine 2006., 2007., 2013., 2014., 2015. jednake 1, a ostale godine su jednake 0. Rezultati procjene relativne efikasnost su pokazali sljedeće rezultate. Prosječna relativna efikasnost komercijalnih banaka tijekom promatranog razdoblja iznosi 0,751. Nakon razdvajanja podataka posebno na male i posebno na velike i srednje banke, provodi se poseban izračun za relativnu efikasnost. U prosjeku su kroz promatrano razdoblje male banke imale nižu srednju vrijednost relativne efikasnosti s višim standardnim devijacijama od velikih i srednjih banaka. Relativna efikasnost banaka značajno varira ovisno o njihovoj veličini. Velike banke imaju najveću prosječnu relativnu efikasnost u iznosu od 0,955 s najmanjom standardnom devijacijom od 0,077. Srednje banke su manje efikasne i imaju veću standardnu devijaciju u odnosu na velike banke, a najmanje efikasne su male banke, s najnižom prosječnom relativnom efikasnošću i najvećom standardnom devijacijom. Relativna efikasnost banaka značajno varira i o zemlji podrijetla, odnosno zemlji gdje te banke posluju. Rezultati pokazuju da su banke iz Irske

najefikasnije (prosjek 0,917), dok su banke iz Rumunjske najmanje efikasne (prosjek 0,562). Za velike banke najveću relativnu efikasnost (vrijednost 1) imaju banke iz 3 države: Finske, Nizozemske i Švedske, gdje su zadržale najvišu relativnu efikasnost za svaku godinu tijekom cijelog promatranog desetogodišnjeg razdoblja. Najmanje efikasne velike banke, ali s još uvijek značajno visokim vrijednostima od 0,882 imaju velike banke iz Belgije. Srednje banke su najefikasnije u Irskoj, dok su najmanje efikasne srednje banke u Rumunjskoj. Najveću relativnu efikasnost za male banke možemo vidjeti u Poljskoj (u prosjeku 0,886), dok najmanju relativnu efikasnost imaju banke u Cipru (0,504). Utjecaj regulacije na poslovanje banaka se analizirao kroz utjecaj na efikasnost i profitabilnost banaka. Uvođenje nove regulacije negativno utječe na efikasnost svih banaka, bez obzira na njihovu veličinu, što ukazuje da nova regulacija predstavlja poteškoće bankama u efikasnom pretvaranju inputa (financiranje, troškovi osoblja, materijalna imovina i rezerviranja za gubitka) u outpute (krediti, naknade i ostala imovina koja nosi zaradu). Profitabilnost, mjerena prinosom na imovinu, ima pozitivan i značajan utjecaj na efikasnost banaka, bez obzira na veličinu banke. Međutim, povećanje profitabilnosti ima snažniji učinak na efikasnost velikih i srednjih banaka u usporedbi s malim bankama. Veličina banke mjerena logaritmom ukupne imovine pozitivno je povezana s efikasnošću banke u svim specifikacijama modela što ukazuje da se učinkovitost povećava s veličinom. Inflacija i likvidnost pozitivno utječu na relativnu efikasnost banke u specifikaciji modela koja uzima u obzir sve banke, kao i kod specifikacije modela koja uzima u obzir samo velike i srednje banke. Te se varijable nisu pokazale značajnima u specifikaciji modela koji uključuje samo male banke. To se može objasniti činjenicom da male banke posluju lokalno, pa su u manjoj mjeri pod utjecajem inflacije i likvidnosti. Dugoročne kamatne stope (LTR) negativno i značajno utječu na relativnu učinkovitost svih banaka, bez obzira na njihovu veličinu. Ako se poveća tržišna kamatna stopa, doći će do smanjenja relativne efikasnosti svih banaka. Varijable koje nemaju značajan utjecaj na relativnu efikasnost banaka, bez obzira na njihovu veličinu, su rast bruto domaćeg proizvoda i logaritam od Herfindahl – Hirschman indeksa. Kod utjecaja regulacije na profitabilnost dobiveni su sljedeći rezultati. Rezultati dinamičke panel analize pokazuju da novi regulatorni okvir (REG_DUMMY) nema značajan utjecaj na profitabilnost banaka (mjereno ROA) u slučaju kada se sve banke uzimaju u obzir, kao i u specifikaciji modela gdje se uzimaju samo velike i srednje banke. Zanimljivo je da novi regulatorni okvir ima značajan negativan utjecaj na profitabilnost malih banaka. Jedan od značajnih razloga za taj rezultat je što nova regulativa implicira veće administrativno opterećenje

što posljedično nameće nove troškove poput novih zapošljavanja ili troškova vezanih uz informatičke usluge. Novi troškovi utječu značajno više na male banke koje imaju niže marže, nego li što utječu na velike i srednje banke. Efikasnost ima pozitivan i značajan utjecaj na profitabilnost banaka u svim specifikacijama modela, neovisno o njihovim veličinama. Utjecaj relativne efikasnosti na profitabilnost banaka je pozitivna, jer se očekuje da će banke biti profitabilnije ako su bolje u pretvaranju inputa (financiranja, troškova osoblja, materijalne imovine i rezerviranja za gubitke) u outpute (kredite, naknade i ostalu imovinu koja nosi zaradu). Povećanje relativne efikasnosti ima veći utjecaj na profitabilnost malih banaka u usporedbi s velikim i srednjim bankama. Rast bruto domaćeg proizvoda ima pozitivan i značajan utjecaj u sva tri modela, što znači da će rast bruto domaćeg proizvoda rezultirati povećanjem profitabilnosti banke. Porast rasta bruto domaćeg proizvoda ima veći utjecaj na profitabilnost malih banke u usporedbi s učinkom na velike i srednje banke. Koncentracija banaka, mjerena Herfindahl – Hirschman indeksom, pokazuje zanimljive rezultate. Može se očekivati da je veća koncentracija u bankarskom sektoru pozitivno povezana s profitabilnošću banke. Međutim, povećanje logaritma Herfindahl-Hirschman indeksa ne utječe na profitabilnost banaka kad se promatra cijeli uzorak. S druge strane, povećanje logaritma Herfindahl-Hirschman indeksa dovodi do povećanja profitabilnosti kod malih banaka, dok dovodi do smanjenja profitabilnosti kod velikih i srednjih banaka. Značajan, ali negativan utjecaj na profitabilnost velikih i srednjih banaka bilježe rast dugoročnih kamatnih stopa (LTR) i porast veličine banke (LBSIZE). Te varijable ne utječu na profitabilnost malih banaka i na cijeli analizirani uzorak. Zanimljivo je napomenuti da je veličina banaka pozitivno utjecala na relativnu efikasnost velikih i srednjih banaka, ali negativno utječe na njihovu profitabilnost. Jedan od razloga ovog paradoksa mogao bi biti taj što su, bez obzira na sposobnost prilagodbe svog poslovanja u pogledu efikasnost, velike banke manje fleksibilne prema potrebama svojih klijenata, što dovodi do manje profitabilnosti. Takav odnos je moguć samo u slučaju kada porast drugih čimbenika koji utječu na relativnu ocjenu efikasnosti nadmašuje relativni pad profitabilnosti. Likvidnost (LIQ) i inflacija, mjereni Harmoniziranim indeksom potrošačkih cijena (HICP), dali su zanimljive rezultate. Likvidnost ima pozitivan i značajan utjecaj na profitabilnost velikih i srednjih banaka, dok inflacija ima značajan i negativan utjecaj na profitabilnost svih banaka. Velike banke sposobnije su kontrolirati vlastitu likvidnost u odnosu na male banke, a jedan od razloga može biti taj što se velike banke mogu pouzdati u tržišno zaduživanje u slučaju da im ponestane vlastite likvidnosti, za razliku od malih banaka, koje se prvenstveno oslanjaju na vlastite izvore sredstava

i zadržavanje likvidnosti unutar svojeg poslovanja. Inflacija negativno utječe na profitabilnost banaka jer porast inflacije, u slučaju sporijeg prilagođavanja banaka tržišnim uvjetima, smanjuje njihovu profitnu maržu. Veličina banke jedna je od ključnih obilježja koje utječe na učinak regulacije na relativnu efikasnost i profitabilnost banaka. Rezultati dobiveni iz analiziranih specifikacija modela kojima se želi odrediti utjecaj nove regulative na bankarsko poslovanje potvrđuju da bankarska regulativa ima različit utjecaj na komercijalne banke ovisno o njihovoj veličini. S obzirom na relativnu efikasnost, regulacija negativno utječe na rezultate efikasnosti bez obzira na veličinu banke, dok se učinak regulacije na profitabilnost razlikuje ovisno o veličini banke. Za velike i srednje banke regulacija nema značajan utjecaj na profitabilnost, dok za male banke ima značajan negativan utjecaj, što znači da se velike i srednje banke ne suočavaju sa značajnim problemima u prilagođavanju svog poslovanja novim regulatornim zahtjevima. Iako se njihova relativna efikasnost smanjuje kao rezultat uvođenja nove regulacije, ona nema značajnog utjecaja na njihovu profitabilnost. Male banke se znatno teže nose s novim regulatornim okvirom, obzirom da umanjuje njihovu relativnu efikasnost, kao i profitabilnost. Time se zaključuje da globalni bankarski regulatorni okvir (Basel 2 i Basel 3) ima značajne negativne učinke na bankarsko poslovanje unutar Europske unije u smislu da negativno utječe na relativnu efikasnost svih banaka, ali ima negativan utjecaj samo na profitabilnost malih banaka. Taj rezultat zapravo više zabrinjava nego što se prvotno pretpostavljalo jer dugoročno može dovesti do još veće koncentracije u bankarskom sektoru. Nova regulacija, baš poput i one prije nje, koristi velikim bankama koje si mogu priuštiti uvođenje naprednih sustava upravljanja rizicima, smanjujući si tako regulatorne troškove. Osim što imaju lakši pristup kapitalu i likvidnosti na tržištu, velike banke mogu povećati kamatne stope na uzete depozite kako bi privukle dodatne klijente i time si povećale bazu izvora sredstava. Takav postupak povećanja kamatnih stopa na depozite tjera male banke da također povisuju svoje kamatne stope kako bi zadržale klijente ili eventualno privukle nove klijente. Budući da se teže prilagođavaju novom regulatornom okruženju i imaju značajne regulatorne troškove, takvo povećanje kamatnih stopa negativno utječe na njihovo poslovanje i profitabilnost. Unatoč opsežnoj literaturi i istraživanjima na temu relativne efikasnosti i profitabilnosti banaka, nije napravljeno sveobuhvatno istraživanje o tome razlikuju li se relativne efikasnosti banaka ovisno o državi podrijetla i veličini te utječe li bankarska regulacija na relativnu efikasnost i profitabilnost banaka ovisno o veličini. Postoji malo istraživanja o relativnoj efikasnosti banaka u svih 28 država članica EU, kao i oskudan broj studija o utjecaju bankarske

regulacije na profitabilnost i relativnu efikasnost u europskim zemljama. Većina se istraživanja fokusira na odabrane zemlje i odabrane banke, ali niti u jednoj, koliko znam, nije napravljena analiza na ovu temu za sve banke u Europskoj Uniji. Dok su se prethodna istraživanja uglavnom fokusirala na utjecaj regulative u najvećim zemljama, te u većini slučajeva na najveće banke, u ovoj disertaciji korištene su sve komercijalne banke s dostupnim podacima u promatranom vremenskom razdoblju, koje su dalje podijeljene u skupine velikih i malih banaka, čime se omogućila procjena utjecaja regulative na poslovanje banaka ovisno o njihovoj veličini. Rezultati nadopunjuju postojeću literaturu vezano za utjecaj bankarske regulative na poslovanje komercijalnih banaka, odnosno pridonosi zaključku kako se regulativa ne bi trebala primjenjivati jednako na sve banke. Ovaj doktorski rad pridonosi postojećoj literaturi na više razina. Prvo, korišteni su podaci svih komercijalnih banaka u Europskoj uniji koje su imale dostupne financijske izvještaje za svaku promatranu godinu. Drugo, male banke nisu isključene, već su korištene kao važan uzorak za izračune relativne efikasnosti i utjecaja regulacije. Treće, korištene su sve banke s dostupnim podacima u europskim zemljama (EU 28), a ne samo odabrane banke iz odabranih zemalja. Četvrto, koristeći metodologiju omeđivanja podataka za sve komercijalne banke, stječe se kvalitetniji uvid u relativnu efikasnost bankarskog sustava u EU-u i njihov trend kretanja kroz godine. Jedno od pitanja može biti gdje je granica između malih i velikih banaka. Jedan od doprinosa ove disertacije jest to što je dokazano da je veličina banaka prema metodologiji Europske središnje banke odgovarajuća za buduće odluke o mogućim posebnim propisima za banke ovisno o njihovoj veličini, jer se jasno vidi učinak na male banke, te učinak na velike i srednje banke. Doprinos ove disertacije jest empirijski dokaz da trenutna bankarska regulativa ovisi o veličini i kao takva je nerazmjerna sudionicima na tržištu. Budući da su hipoteze dokazane, to znači da se trebaju uzeti u obzir razlike u veličinama između poslovnih banaka. Takav zaključak ima važne implikacije na regulaciju banaka, obzirom na to da trenutna regulacija ima negativne učinke na poslovanje malih banaka, pa bi se posebnosti malih banaka trebale uzeti u obzir prilikom stvaranja novog regulatornog okvira. Regulatori i nadzorna tijela moraju imati dovoljno znanja temeljenih na relevantnim istraživanjima o temi ima li regulacija pozitivan ili negativan učinak na poslovanje banaka. Kao što je napomenuto, stroža regulacija sigurno doprinosi stabilnijem bankarskom sustavu, no pitanje je kako takva regulacija utječe na poslovanje individualnih banaka. Ako regulatori nemaju kvalitetne informacije temeljene na kvantitativnom istraživanju utjecaja regulative na poslovanje banaka, njihove odluke mogu imati negativne posljedice na poslovanje

banaka i pružanje financijskih usluga klijentima. Metoda izračuna korištena u ovoj disertaciji izuzetno je važna jer nadzorna tijela moraju znati i uzeti u obzir uvođenje novih regulatornih pravila i okvira ovisno o veličini banaka. Koliko znam, ovo je istraživanje prvo koje je empirijski kvantificiralo relativnu efikasnost komercijalnih banaka u svih 28 zemalja članica Europske Unije, te u kojoj je proveden komparativni utjecaj regulacije na poslovanje banaka, ovisno o njihovoj veličini. Ključni zaključak disertacije jest da tijela koja donose regulatorne propise moraju uzeti u obzir raznolikost komercijalnih banaka u Europskoj uniji, posebno u kontekstu njihove veličine. Rezultati ovog istraživanja mogu potaknuti regulatora da stvori blaži regulatorni okvir za male banke, obzirom da one nisu značajne za cjelokupni financijski sustav. Novi regulatorni okvir bi trebao pružiti malim bankama lakše poslovanje čime bi im se popravila relativna efikasnost i profitabilnost, dok bi im istovremeno trebao onemogućiti rizično poslovanje. U bankarskoj regulaciji i superviziji potrebno je primijeniti različiti skup pravila prema različitim tipovima banaka. Kako male banke nisu sistemski važne, one bi trebale podlijegati lakšim pravilima u odnosu na velike banke. Ovako postavljen regulatorni okvir značajno utječe na efikasnost svih banaka, ali samo nepovoljno utječe na profitabilnost malih banaka, što znači da se one nisu uspjele adekvatno prilagoditi novom regulatornom okruženju. Tako se male banke potiču na zatvaranje ili spajanje s većim bankama, što utječe na diverzifikaciju financijskih usluga koje pružaju banke. Kako bi se osigurala raznolikost, primjena različitih regulatornih pravila nameće se kao logičan slijed u daljnjem stvaranju zakona koji se odnose na regulaciju i superviziju banaka. U jedinstvenom pravilniku Europske unije već je prisutan blaži tretman banaka na nekim poljima, poput obveze izvještavanja, ali može se učiniti više. Neke od mjera bi mogle biti dodatno smanjenje administrativnog opterećenja, racionalizacija obveza javnih objava za banke koje ne kotiraju na tržištu, te smanjenje kapitalnih zahtjeva za tržišne rizike, kreditne rizike, kao i za rizike druge ugovorne strane kod banaka koje se ne bave derivativnim instrumentima ili sličnim proizvodima. Uz primjenu manje strogih pravila, trebalo bi razmotriti i smanjenje kapitalnih i likvidnosnih zahtjeva kapitala kod malih banaka. To naravno ne znači daleko manje zahtjeve u odnosu na velike banke, već smanjenje zahtjeva na razinu koji bi većini malih banaka pružao odgovarajući omjer troškova i koristi, što ne bi značajno utjecalo na njihovu efikasnost i profitabilnost. Nekoliko je ideja za budući smjer istraživanja temeljeno na ovoj doktorskoj disertaciji. Prvo, rezultati ove doktorske disertacije mogu se produbiti tako da se poveća promatrano vremensko razdoblje, te da se banke, osim podijele prema veličini, podjele i po zemljama, te da se na tako kreiran skup

primjeni dinamička panel analiza podataka temeljem koje će se vidjeti utjecaj regulatornog okvira. Također bi bilo zanimljivo usporediti relativnu efikasnost banaka u svih 28 europskih zemalja koristeći alternativne metode za izračunavanje relativne efikasnost, odnosno parametarske i neparametarske metode. Pored definiranja različitih vrsta inputa i outputa, mogu se primijeniti i različiti pristupi mjerenju, poput profitne ili troškovne efikasnosti, što bi rezultiralo doprinosu postojećoj literaturi o relativnoj efikasnosti banaka na području Europske unije. Drugo, može se analizirati važnost malih banaka za lokalno gospodarstvo, te usporediti razvijenost zemalja u kojima su male banke najzastupljenije u gospodarskim i ostalim vrstama kreditiranja. Treće, trebala bi se usporediti struktura plasmana malih banaka u odnosu na velike banke, te bi se tako moglo vidjeti koji segment ekonomije će biti pod značajnim utjecajem ako dođe do zatvaranja malih banaka. I za kraj, važno je otkriti mogu li male banke prijetiti financijskom sustavu tako da su pretjerano povezane preko holding kompanija ili drugih povezanih struktura unutar pojedinih zemalja. Naime, ako postoji snažna povezanost malih banaka, može se pojaviti tzv. “too big to fail” problem, gdje bi kolaps velikog broja malih banaka uslijed olakšanog regulatornog okvira mogao stvoriti probleme na tržištu.

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Ivan Gržeta, PhD, is born in Rijeka, on December 14th 1989. He finished his Master degree and Postgraduate specialist studies (MBA) on Faculty of Economics in Rijeka, where he also started his Postgraduate doctoral study in Economics and Business Economics in 2016. He finished Postgraduate doctoral study in 2019, when he successfully defended his doctoral dissertation with the title: Efficiency Determinants and Regulatory Impact on Banking Operations in the EU. He works as a Teaching and research assistant since 2014 on Faculty of Economics Rijeka at the courses: Banking, Bank Policy and Risk Management. Prior this job, he was Risk Controller in Primorska Banka Rijeka. His field of interest is Banking and Energy Economics, and he is a member-researcher at several domestic and international scientific projects.

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IZJAVA

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