UNIVERSITY OF LJUBLJANA

FACULTY OF ECONOMICS

MASTER’S THESIS

THE EFFECTS OF IMPLEMENTING THE SINGLE SUPERVISORY MECHANISM IN THE EURO AREA WITH EMPHASIS ON BANKS' STABILITY

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LIST OF ABBREVIATIONS

CEBS - Committee of European Banking Supervisors

CET1 - Common Equity Tier 1 capital

DID - Coefficient of difference-in-difference estimator

EBA - European Banking Authority

ECB - European Central Bank

EIOPA - European Insurance and Occupational Pensions Authority

EU - European Union

ESAs - European Supervisory Authorities

ESMA - European Securities and Markets Authority

ESFS - European System of Financial Supervision

ESRB - European Systemic Risk Board

EFSF - European Financial Stability Facility

EUR - Euro

GDP - Gross domestic product

ICAAP - Internal Capital Adequacy Assessment Process

ILAAP - Internal Liquidity Adequacy Assessment Process

JSTs - Joint Supervisory Teams

LCR - Liquidity coverage ratio

Ln - Natural logarithm

Ln Z-score BS - Natural logarithm of Z-score bank stability

Ln Z-score FR - Natural logarithm of Z-score funding risk

RAS - Risk Assessment System

SSM - Single Supervisory Mechanism

SRM - Single Resolution Mechanism

SREP - Supervisory Review and Evaluation Process

NSAs - National Supervisory Authorities

NSFR - Net stable funding ratio

NPLs - Non-performing loans

NPLTL - Non-performing loans to total loans

ROA - Return on assets

RWA - Risk weighted assets

VIF - Variance inflation factor

INTRODUCTION

By definition, banking supervision is "The act of monitoring the financial performance and operations of banks in order to ensure that they are operating safely and soundly and following rules and regulations" (European court of auditors, 2014, p. 5).

The Single Supervisory Mechanism (hereinafter: SSM) as a system of banking supervision, is a recent phenomenon of high importance for the overall stability of the financial system in the Euro area. It was implemented in November 2014 as a stepping stone leading to more stable and resilient banks. Before the SSM, the supervision of the banks in the Euro area was performed inconsistently by national bodies in each country. This caused difficulties for implementing measures to respond to the crisis in 2007. With aim of achieving consistent supervision and consequently improving the safety and the resilience of the banks in the Euro area, the European Commission proposed the SSM (European court of auditors, 2014).

Under the SSM, the European Central Bank (hereinafter: ECB) is the main body responsible for supervision of the banks in the Euro area. As such, ECB developed the following significance criteria for classifying the banks as significant or less significant: banks' size, cross border activities, the economic importance of the bank and possible direct public financial assistance. Significant banks are the banks that fulfill the significance criteria and fall under direct supervision of the ECB. As additional rule of thumb, a bank is significant if it is one of the three largest banks in its domestic market. The less significant banks fall under supervision of their National Supervisory Authorities (hereinafter: NSAs). ECB and the NSAs work together and perform the supervision of the less significant banks in order ensure that they operate safely and follow bank regulations (European central bank, 2014).

Due to the recent implementation of the SSM in the Euro area, there are no published quantitative researches in the literature, which investigate whether the SSM contributes to the safety of the banking system, making banks more resilient and prone to less risk taking. Therefore, with this Master's thesis we contribute to the literature by opening a new, undiscovered field for research.

The main contribution of this Master's thesis is analyzing the effect of implementing the SSM in the Euro area from three perspectives: *bank safety* - in terms of probability of bankruptcy, *financial strength* and *liquidity*. We choose bank safety - in terms of probability of bankruptcy, since the top priority of the SSM is keeping the banking system stable. Our second perspective for analyzing the effect from implementing the SSM in the Euro area covers the financial strength of the banks measured in terms of banks' capital. A bank with strong capital base is less vulnerable to default in its loans and economic downturns since it can easily absorb incurred losses and maintain solvency (Federal reserve bank of Cleveland, 2012). Our third perspective for analyzing the effect from implementing the SSM covers banks' liquidity. Liquidity is an important aspect for assessing banks' health during the Supervisory Review and Evaluation Process (hereinafter: SREP). SREP is integral part of the supervision process for evaluating both significant and less significant banks. Moreover, supervisors perform focused liquidity stress tests on the Euro area banks in order to assess bank's resilience to liquidity shocks (European central bank, 2014).

Our main objective with this Master's thesis is to investigate if SSM fulfils its purpose of implementation. We want to examine the effect of implementing the SSM in the Euro area and to inspect whether the implementation of the SSM contributes to the safety of the banks in the Euro area. For this purpose, we develop three hypotheses. With the first hypothesis: Increased bank stability in the Euro area is related to the implementation of SSM, we observe the effect of implementing the SSM on the Euro area banks, from the perspective of *bank safety* - in terms of probability of bankruptcy. With the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, and the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, we examine the effects of implementing the SSM on the *financial strength* of the banks and the effect of implementing the SSM on *banks' liquidity*.

We build our research on a sample of panel data for 165 Euro area banks that fall under the scope of the SSM, for the period from 2011–2017. We retrieve the data from the Fitch Connect database and World Bank data set and apply it on constructed models. For testing the hypotheses, we use the statistical software Stata. We use difference-in-difference estimator in a two-stage approach for testing all models. The first stage covers estimating the models by using dummy variables to indicate the time when the treatment period (implementation of SSM) has started, and for identifying the group of banks, which fall under direct supervision from the ECB. The second stage includes controlling variables in addition to the dummy variables of the difference-in-difference estimator. The slope of the coefficient of difference-in-difference estimator (hereinafter: DID) shows the effect of implementing the SSM on the stability, financial strength and liquidity of the banks in the Euro area. In order to determine whether we should apply fixed effects or random effects model in all regression models for testing the three hypotheses, we run Hausman test. In addition, we perform a correlation matrix and Variance inflation factor (hereinafter: VIF) in order to investigate for potential collinearity and multicollinearity of the variables.

This Master's thesis has four chapters. In the first chapter, we emphasize the importance of implementing the SSM in the Euro area. We focus on detailed explanation of the process of conducting supervision, its implementation and goals. In the second chapter, we review the related literature and the hypotheses development in terms of bank stability, financial strength and liquidity. In the third chapter we focus on the data we use for the research, we construct the models for testing the hypotheses and explain all of the variables included in our models. In the fourth chapter, we cover the empirical results of running the regressions in the statistical software Stata. We focus on the parallel trend inspection, sample correlations, multicollinearity, as well as on the econometric estimation of all models for testing the hypotheses.

1 IMPORTANCE OF THE SSM FOR THE EURO AREA COUNTRIES

The European banking union has two pillars, the SSM, which was implemented in November 2014 and the Single Resolution Mechanism (hereinafter: SRM), which was implemented in March 2014. The first pillar of the European banking union, SSM comprises the ECB and the NSAs of the Euro area countries. SSM is not limited to Euro area countries, but all other countries of the European Union (hereinafter: EU) may choose to join. The main reason for implementing the SSM is performing consistent supervision of all banks in the Euro area (European central bank, 2014).

The need for a consistent supervision appeared after the crisis in 2007. Namely, the supervision of the banks in the Euro area was performed inconsistently by national bodies in each country. As a consequence, it was difficult to respond to the crisis and it became clear that banks need to be supervised in a consistent way. A consistent supervision is crucial not only to respond to a crisis in a more efficient manner, but also, for early intervention when identifying banks with financial difficulties (European court of auditors, 2014). Under the SSM, when supervisors identify banks with difficulties, demand implementation of supervisory measures such as: demanding additional funds, limiting the remuneration amounts, limiting dividends payouts to shareholders. Other supervisory measures include: submitting plans for achieving capital adequacy requirements, applying specific provisioning policies, demanding usage of profits for capital requirements, etc. The main purpose of the supervisory measures is to ensure that banks with financial difficulties will timely address all identified problems. The end goal or purpose of the banking supervision is to make banks less dependent on public funds and to improve the stability of the overall banking system (European central bank, 2014).

The second pillar of the European banking union, the SRM is responsible for resolution of failing banks and by default covers all Euro area countries. Its purpose is to ensure that banks in financial difficulties will be restructured with minimum impact on public funds and without negatively affecting the real economy. For most banks, liquidation can be done through normal insolvency process. However, the largest banks are interlinked and cannot be liquidated through normal liquidation process. Bailing them out by using public funds is very costly which is the main reason for establishing the single resolution fund (European court of auditors, 2014).

Until 2023 the single resolution fund should reach a target of 1 % of all deposits in the Euro area. However, the fund will not provide complete resolution of the failing banks but will contribute with up to 5 % of the total liabilities of the failing bank. In case the resolution fund does not have enough funds for resolution of a failing bank, a backstop will come in place. The backstop as a last-resort intervention, should become operational by 2019 with aim to strengthen the SRM and to enhance the confidence in the banking system (European Commission, n.d.).

1.1 Implementing the SSM in the Euro area

The crisis in 2007 appeared with the shortage of liquidity in the sub-prime mortgages. Many banks had less capital than required by the regulatory authorities. Because of the interlinked banking system, the bankruptcy of one big bank could affect many others, therefore, the whole financial system was at risk. Aware of the magnitude of a spillover effect of the bankruptcy of one bank, the central banks imposed measures to address the liquidity problems. In 2008, the fourth largest investment bank in America, Lehman Brothers went in bankruptcy and consequently intensified the crisis (Azadinamin, 2013).

Many people lost their jobs, which lead to increased unemployment rates. Public lost confidence in the banking system causing deposits withdraws. Banks lost confidence in each other's solvency. All of this lead to frozen credit markets and increased interest rates for borrowing loans. The economic growth, globally, decreased. The financial system in the EU was affected too. When banks lost confidence in each other's solvency, started to borrow public funds for recapitalization and liquidity. The banks with excess funds placed deposits in the ECB, and banks, which were short of funds borrowed additional funds from the ECB. Deposits were withdrawn from banks in the countries with poor banking systems (European court of auditors, 2014).

To help stabilize the banking system the European Commission proposed measures such as revision of the Capital Requirement Directive and increased the minimum protection of bank deposits up to 100.000 euro (hereinafter: EUR). Among the first package of proposals was changing the International accounting standards. Meanwhile, the EU countries started to use public funds for recapitalization of their banks. First was Hungary in 2008 when received financial support amounting to 6.5 billion EUR. Latvia followed one year later, with financial support in amount of 7.5 billion EUR. In 2010, Greece received 110 billion EUR. Other countries were requesting financial support as well, Ireland in 2010, Portugal in 2011 and Spain and Cyprus in 2012 (European court of auditors, 2014).

In 2010, the European Commission proposed additional measures in order to improve the resilience of the banks. One of the first implemented measures was improvement of the supervision of banks and establishing a resolution fund for banks. Other measures included implementation of stress tests and establishing the European Stability Mechanism (hereinafter: ESM) with capacity of 550 billion EUR. The first stress test was performed in 2010 and the second one, a year later (European court of auditors, 2014).

To help stabilize the banking system, the European Commission proposed improvements of the regulatory framework for banking supervision. A major improvement of the regulatory framework for banking supervision was the establishment of the European System of Financial Supervision (hereinafter: ESFS). ESFS covers both macro-prudential and micro-prudential supervision. By definition, macro-prudential supervision focuses on the stability of a financial system in EU, whereas the micro-prudential supervision focuses on the safety and the resilience of individual banks (European court of auditors, 2014).

ESFS covers the following authorities:

1) European Supervisory Authorities (hereinafter: ESAs). ESAs are mainly responsible for developing standards and assessing risks and vulnerabilities of the financial system (European court of auditors, 2014). The ESAs cover the following three authorities:

- *European Securities and Markets Authority* (hereinafter: ESMA) is providing data and is performing stress tests working together with the other ESAs (European court of auditors, 2014);
- *European Banking Authority* (hereinafter: EBA) is implementing rules for supervising the banking system (European court of auditors, 2014); and
- *The European Insurance and Occupational Pensions Authority* (hereinafter: EIOPA) provides advice to the European Commission, the European Parliament and the Council of the EU (European court of auditors, 2014).

2) The *Joint Committee of the ESAs* – is a forum which strengthens the cooperation between ESAs. Through the Joint Committee the ESAs coordinate their supervisory activities (European court of auditors, 2014);

3) The *European Systemic Risk Board* (hereinafter: ESRB) – is responsible for macro-prudential supervision including: identifying systemic risks, issuing warnings in case of high systemic risks, issuing recommendations for responding to the identified systemic risks and monitoring their implementation (European Central Bank, 2014); and

4) The *NSAs* of each member country of the EU are responsible for supervising individual banks (European Central Bank, 2014).

The key institution in the area of banking supervision is the EBA, established in order to replace the Committee of European Banking Supervisors (hereinafter: CEBS). The main objective of EBA is to assure consistent supervision and harmonized legislation in all Euro area countries. EBA has greater responsibilities than the former CEBS in both fields supervision and legislation. However, EBA's responsibilities extend the fields of supervision and legislation and include customer protection. The main tasks of EBA cover: developing the single rulebook, developing supervisory standards, ensuring consistent application of the legal acts. Although, EBA improved the cross-border supervision of banks, it had limited role because does not perform the direct supervision of the banks. Instead, NSAs perform the day-to-day supervision. Problems appear due to lack of cooperation and coordination between NSAs and the inconsistent application of the supervision legislation across all EU countries. A solution of the problem was introducing a centralized supervision. For that purpose, the governments of the EU countries proposed a *banking union* as final step for improving the supervision of the banks (European Commission, 2012).

The European banking union has four components:

- *SSM* – is a system for supervising the banks in the Euro area and was implemented in November 2014. Under the SSM, the ECB is responsible for supervision of the banks in Euro area together with the NSAs. In fact, ECB directly supervises the largest and significant banks, whereas the NSAs supervises the less significant banks. In addition to its role in banking supervision, NSAs performs tasks covering consumer protection as well as supervising branches of banks in third-countries (European central bank, 2014).
- *SRM* - is a framework for resolution and recovery of banks in EU implemented in March 2014. Its purpose is to help to banks in financial difficulties and to restructure them in efficient way (European central bank, 2014).
- *A common system for deposits guarantees* – a scheme for guaranteeing all deposits under 100.000 EUR (European central bank, 2014).
- *A single rulebook* - provides legal rules and standards for regulating and supervising the financial system in EU. It includes rules on capital requirements, recovery and resolution processes and a system of Deposit guarantee schemes (European central bank, 2014).

1.2 Conduct of supervision in the SSM

The SSM covers all banks in the Euro area. The participation of the banks in the SSM is automatic. However, the EU countries that use their own currencies can choose whether to participate in the SSM (European central bank, 2014).

Under the SSM, the ECB performs direct supervision of the significant banks, covering approximately 119 banks or 85 % of the banking assets in the Euro area. Approximately 3,500 banks are less significant and fall under supervision of their NSAs. In some cases, ECB can decide to perform direct supervision of a less significant bank as well (European central bank, 2014). There are few significance criteria for determining the significance of the banks, as follows:

- *Size* – Banks with total assets above 30 billion EUR are significant and fall under direct supervision of ECB (European central bank, 2014);
- *Cross-border activities* – Banks with total assets above 5 billion EUR and a ratio of cross-border assets/liabilities in more than one other country to its own total assets/liabilities of above 20 %, are significant and therefore, fall under direct supervision of ECB (European central bank, 2014);
- *Direct public financial assistance* - Banks which requested or received funding from the ESM or the European Financial Stability Facility (hereinafter: EFSF) are significant and fall under direct supervision of the ECB (European Central Bank, 2014);
- *The Economic importance of the bank* for the national country or the economy is another significance criterion (European central bank, 2014); and

- *If a bank is one of the three most significant banks in the national country,* then it falls under direct supervision of ECB (European central bank, 2014);

However, classifying the banks as significant or less significant is not a status given once for always, but it might change due to mergers and acquisitions, new group structures, license withdrawals, or even due to normal business activities. In case a less significant bank meets any of the significance criteria for the first time, it will be classified as significant and fall under direct supervision of the ECB (European central bank, 2014). That was the case with the Barclays Bank Ireland. Starting from January 2019 Barclays Bank Ireland falls under direct supervision of the ECB. The Central Bank of Ireland expects Barclays Bank Ireland to expand its banking activities after Brexit which is the main reason for the reclassification of the bank (European central bank, 2018b).

Reclassification of a significant bank which falls under direct supervision of the ECB is also possible. In case a significant bank fails to meet the significance criteria for three consecutive years, it will be reclassified as less significant (European central bank, 2014). That was the case with the Permanent tsb Group Holdings plc. The Group did not meet the significance criteria for three consecutive years and consequently, starting from January 2019, the bank falls under supervision of the Central Bank of Ireland with close cooperation with the ECB (European central bank, 2018b).

Other changes in the bank classification were made over the past years as well. For instance, five significant banks which fall under direct supervision of the ECB ceased to exist and were removed from the list of supervised banks. However, other five institutions were newly placed as significant banks: a subsidiary of Bank of America Merrill Lynch in Ireland, Luminor Bank AS in Estonia and Luminor Bank AS in Latvia, Banque Internationale à Luxemburg S.A. and Nordea Bank Abp in Finland (European central bank, 2018b).

In the supervisory process, ECB has many responsibilities, including making supervisory reviews, on-site inspections as well as granting and taking banking licenses and setting capital requirements in order to ensure that banks comply with the laws. In addition, ECB may issue its own regulations, guidelines and instructions for performing supervision. One of ECB’s responsibility is to assess the members of the management team of the significant and the less significant banks. As a rule of thumb, the members of management boards of the significant and less significant banks should have good reputation. In addition, they must be qualified for their position and have the required knowledge, skills and experience to perform their responsibilities. ECB also assesses the members of the management teams of the banks, in case of initial licensing of a bank (European central bank, 2014).

In some cases, NSAs, together with the Joint supervisory teams (hereinafter: JSTs) and the Authorization Division assess the members of the management team of the banks. After the assessment, they make a proposal for changing the members of the management team of the bank. However, the final decision regarding the composition of the members of the management team of the banks makes the Supervisory Board and the Governing Council (European central bank, 2014).

The process of banking supervision includes few steps:

- *Developing regulations and supervisory policies* – ECB in close cooperation with ESAs, ESRB, Financial Stability Board (hereinafter: FSB) and the Basel Committee on Banking Supervision, develops regulations and supervisory policies for the banks, both significant and less significant, regarding risk management practices, liquidity and capital level requirements, as well as remuneration policies. The Supervisory Policies Division assists in setting requirements for all banks in terms of risk management practices, capital requirements as well as remuneration practices (European central bank, 2014).
- *Developing methodology for supervision and standards* – ECB issues regulations, policies and procedures regarding the supervision. The end goal is to achieve consistent and efficient supervision outcomes (European central bank, 2014).
- *Performing day-to-day supervision* - ECB performs strategic and operational planning for performing day-to-day supervision whereas the JSTs perform the actual day-to-day supervision. The strategic planning covers activities for the next 12 – 18 months' period regarding the risks and vulnerabilities of the financial system findings identified by the JSTs, priorities identified by the national supervisors. The operational planning covers the day-to-day supervision for a one-year period including: the type and the frequency of on-site and off-site activities, the approval procedures of internal models and on-going model supervision (European central bank, 2014).
- *Regular checks for improving the process* are important in order to improve the supervision process (European central bank, 2014).

The Supervisory Board is responsible for making decisions. The members of the Supervisory Board are a Chair and a Vice-Chair, four representatives from ECB and one representative from each NSAs. The Supervisory Board proposes decisions to the ECB Council. The Council cannot change the proposed decisions; it can only adopt or reject them (European central bank, 2014).

The ECB has four Directorates General for performing supervision:

- *Directorates General Micro-prudential supervision I and II* - covers direct day-to-day supervision of significant banks. The Directorates General Micro-prudential supervision I is responsible for supervision of the most significant banks, approximately 30, whereas the Directorates General Micro-prudential supervision II is responsible for supervision of the rest significant banks (European central bank, 2014);
- *Directorates General Micro-prudential supervision III* - covers supervision of less significant banks (European central bank, 2014);
- *Directorates General Micro-prudential supervision IV* - covers supervision for all significant and less significant banks (European central bank, 2014);

There are 10 horizontal divisions of the Directorates General Micro-prudential supervision IV, as follows: methodology and standards development, risk analysis, supervisory policies, planning and coordination of supervisory examination programs, on-site inspections, internal models, enforcements and sanctions, authorizations, crisis management and supervisory quality assurance. Those horizontal divisions cooperate with the JSTs for implementing supervisory methodologies aiming to achieve consistent supervision (European central bank, 2014).

The Methodology and Standards Development Division is responsible for developing supervisory methodologies and standards. Standards are needed for obtaining consistent supervision. Those standards may be developed by ECB or some international bodies with aim to achieve consistent supervision. The supervisory methodologies and standards are mainly used during SREP (European central bank, 2014).

SREP is annual supervisory process for evaluating banks' strategies, processes, risks, liquidity situation and capital adequacy. It evaluates banks' riskiness as a threat to the overall stability of the banking system and all risks identified with the stress tests. The SREP assessment covers both significant and less significant banks and has three elements: 1) Risk Assessment System (hereinafter: RAS) which evaluates the risks of the banks; 2) Review of the Internal Capital Adequacy Assessment Process (hereinafter: ICAAP) of the banks and Internal Liquidity Adequacy Assessment Process (hereinafter: ILAAP); and 3) a capital and liquidity qualification methodology which assess the liquidity and the capital needs of the banks after the risk assessment. RAS, ICAAP and ILAAP cover multi step approach based on different information as follows: stress test, loss given default, probability of default. The purpose of SREP is to ensure that banks have enough capital and liquidity to cover the risks to which are exposed (European central bank, 2014).

SREP existed long time before the implementation of the SSM. However, since the implementation of the SSM, SREP follows common methodologies. Previously it was performed by the NSAs and the methodologies differed on a country level. Although the methodology for SREP assessment is common for all banks in the Euro area, there are differences in the scope and the intensity of the assessment from bank to bank. In addition, each bank receives individual SREP decisions depending on their risk profile and business model (European central bank, 2014).

During the assessment of risks of the banks, the SSM follows the regulatory requirements. Additionally, the SSM takes into consideration the importance of the bank for the overall financial system, its intrinsic riskiness and whether the bank is a parent entity or subsidiary. During the SREP assessment, the supervisors identify the level of Common Equity Tier 1 (hereinafter: CET1) capital that banks must hold. For the period 2017 - 2018 the CET1 is set at level of around 10 % of the total risk weighted assets (hereinafter: RWA) of each individual bank. In addition to the capital requirements, during the SREP, the supervisors may impose additional measures to the banks, for instance, measures regarding liquidity and capital adequacy. From the latest assessments in 2017, SREP identified challenges for banks in terms of profitability and capital adequacy, as well as challenges in the risk management in the areas of risk infrastructure, data aggregation and reporting (European central bank, 2014). As major problems in the Euro area were identified the non-performing loans (hereinafter: NPLs) and the low interest rates which affect the interest margins, and consequently banks' profitability (European Parliament, 2017).

When assessing the risk profile of a bank, the supervisors identify short and long-term supervisory actions using information regarding the risk profile of the banks from various sources: regular reports from the banks, ICAAP, ILAAP, the risk appetite of the banks, the outcomes from the risk assessments, the outcome of the stress tests. The stress tests assess the risk exposure and the resilience of the banks to adverse scenarios. ECB performs variety of stress tests: solvency stress test, liquidity stress test, bottom-up stress test, top-down stress test, by using static or dynamic balance sheet assumptions and other methodologies, including variety of adverse scenarios (European Banking Authority, 2018).

Based on the outcomes from the stress tests and the other sources of information regarding the risk profile of the banks, the supervisors prepare SREP decisions and corrective measures for dealing with all identified risks. Banks may comment and object the proposed decisions and corrective measures (European central bank, 2014). The JSTs implement the short-term supervisory actions, whereas the SREP report and the annual planning cover the long-term supervisory actions (European central bank, 2014).

JSTs are composed from employees from both ECB and NSAs. Each bank which falls in the category of significant banks has its own JSTs whose members rotate based on a rotation principle. The size and the composition of the teams depends from the complexity and the business model of the bank in question. Each JSTs has coordinator at the ECB who is responsible for implementing the supervisory tasks. In addition, the JSTs have NSAs sub-coordinators responsible for specific areas of supervision. Complex banks have many JSTs responsible for specific areas of supervision and core JSTs. The members of the core JSTs include coordinator at the ECB and sub-coordinators of NSAs which are responsible for delegating tasks to the other members of the JSTs. The JSTs coordinators have a mandate of three to five years and rotate on a regular basis. Main responsibilities of the JSTs include: proposing and implementing supervision program, planning the on-site inspections as well as ensuring coordination with the on-site inspection teams and the national supervisors (European central bank, 2014).

Another division established by the ECB is the Risk Analysis Division. In addition to the daily supervision of risks of the banks which perform the JSTs, the Risk Analysis Division analyses the risks horizontally. This division considers the external risks which arise from international imbalances or excessive risk concentration. JTSs risk analyses the risks on a bank level, whereas the Risk Analysis Division analyses the risk across banks. Therefore, the risk analysis of the JSTs complement the risk analysis of this division (European central bank, 2014).

In addition, the ECB established the Centralized On-site Inspection Division. Within this division, the SSM performs on-site inspections of the banks and analyses the risks, the risk control, and the governance. The scope of the on-site inspections depends from the size of the bank, its risk appetite, as well as the overall supervisory strategy of the ECB. The inspection team usually plans the on-site inspections. However, in case of some events additional on-site inspections may take place if those events represent a threat for the stability of the banking system in the Euro area. While performing the on-site inspections, the inspection team assesses the level of risks, the established internal controls of risk, the quality of the corporate governance of the banks (European central bank, 2014).

Additionally, the inspection team assess the risk management processes in order to identify any potential flaws which may affect the capital and the liquidity adequacy of the banks. Also, regular checks of the balance sheet items, compliance with the laws and conducting of risk reviews are responsibilities of the inspection team (European central bank, 2014).

The on-site inspections may differ in scope. For instance, the inspection team performs full-scope inspections for analyzing broad area of risks and activities. While performing targeted on-site inspections, the inspection team focuses on specific parts of the business models of the banks. There are also thematic on-site inspections, where the inspection team focuses on one issue across a group of comparable banks. The inspection team may perform thematic on-site inspections as part of macroeconomic analyze in order to identify potential threats for the stability of the banking system. The composition of the inspection team is different for each inspection. After each inspection the inspection teams write a report with recommendations intended for the JSTs and the NSAs. The next step is a closing meeting with the bank (European central bank, 2014).

ECB has Crisis Management Directive too which is responsible for all recovery plans of the banks. The Crisis Management Directive performs benchmarking, quality controls and consistency checks. This directive enables ECB to react in case banks pose a threat for the stability of the banking system due to excessive risk taking or failing to keep their capital above the required level. ECB established this directive in order to prepare the banks for any potential crisis. The aim is to make banks more resilient and to make them more flexible in times of crisis. For that purpose, SSM sets up crisis management teams and cross-border stability teams for individual banks (European central bank, 2014).

When a bank does fulfill a requirement or performs risky activities that can damage the stability of the banking system, the ECB reacts. The first step for addressing such problems may be informal meeting with the board of directors. However, depending how serious the problems of the bank are, ECB may demand certain actions in order to solve the identified problems as soon as possible. In some cases, ECB may require from the banks to set goals and targets to be achieved in a specified timeline. Additionally, ECB may impose some limits or prohibitions, as well as actions regarding capital adequacy, risk management, liquidity risks, solvency risks and other (European central bank, 2014).

In addition to the supervisory measures, the ECB can punish the banks with penalties in case they do not fulfill the requirements. The penalties may amount up to twice the profit they have earned or the losses which incurred because the banks did not follow the requirements. Also, the penalties may amount up to 10 % of the bank's total annual turnover. The penalties can be periodic and can be calculated on a daily basis until the bank finally fulfills the requirements. For that purpose, ECB established the Enforcement and Sanctions Division. This division is responsible to identify banks which do not comply with the regulation of EU or the ECB's requirements and decisions. This division is in charge for writing reports regarding any violations of the laws and the regulations. Those reports are then sent to the ECB which further on arrange sanctions and penalties to those significant and less significant banks which violated the laws and regulations (European central bank, 2014).

In addition to all of the above-mentioned divisions of the Directorates General Micro-prudential supervision IV which covers tasks for all significant and less significant banks, the Directorates General Micro-prudential supervision III comprises three divisions and all of them refer to the supervision of less significant banks (European central bank, 2014).

The first division is the Supervisory Oversight and NSAs Relations Division, which cooperates with the NSAs and monitors how they perform the supervision of less significant banks. This division assures high quality and consistent supervision of the less significant banks. The second division is the Institutional and Sectoral Oversight Division, which monitors less significant banks in specific sectors of the banking system such as saving banks, cooperative banks or investment banks. This division is in charge for on-site inspections and crisis management activities. In addition, this division is responsible to assess the proper classification of the banks as less significant, or in other words, to assess whether they fulfill any of the significance criteria and should be reclassified as significant banks. The third division is the Analysis and Methodological Support Division, which is responsible for developing methodology for classifying the banks as significant and less significant. In addition, this division is responsible for writing reports regarding the supervision of the less significant banks as well as for monitoring the risks of the banking system (European central bank, 2014).

1.3 Goals and principles of the SSM

The SSM was implemented in the Euro area with intention of fulfilling the following goals:

1. *Ensuring safety and soundness of the European banking union* - The purpose of performing supervision is early intervention in case of identifying banks with a

probability of default. If the supervisors identify a bank with financial difficulties, as in case of not meeting the capital requirements, the ECB can demand supervisory measures. The purpose of the supervisory measures is to ensure that the supervised banks address the identified problems at early stages. In case banks do not comply with the measures and requirements, the ECB imposes sanctions and penalties. The end goal is to minimize the dependence of the banks on government funds and to improve the stability of the overall banking system (European central bank, 2014).

2. *Increased financial integration and stability;* and
3. *Ensuring consistent supervision* – With collaboration and exchange of information between the ECB and the NSAs, the supervision process gets more consistent and harmonized. With timely exchange of information, ECB can identify which banks pose a threat for the stability of the banking system and consequently to impose supervisory measures. SSM ensures a consistent supervisory practice for all banks, regardless of their significance. Even small banks may threaten the stability of the banking system, because banks are interlinked with each other with long-term and short-term lending. In addition to the exchange of information, an important determinant for consistent supervision is the quality control of the performed supervision (European central bank, 2014).

SSM achieves the above mention goals by defining supervisory priorities on a regular basis. The supervisory priorities are focus areas for supervision and are slightly differ from year to year depending on the latest developments in the economic, regulatory and supervisory environment. For instance, the focus areas for supervision in 2017 were: business models and profitability drivers, credit risk with focus on NPLs and concentrations and risk management (European central bank, 2016). In 2018, the supervisory priorities of the SSM were business models and profitability drivers, credit risk, risk management and activities comprising multiple risk dimensions (European central bank, 2017). The focus areas for supervision for 2019 are the credit risk, the risk management and activities comprising multiple risk dimensions (European central bank, 2018a).

For ensuring effective and consistent supervision, the SSM follows nine principles:

- The first principle of the SSM is *use of best practices.* When performing supervision, the SSM follows the best supervisory practices and methodologies in order to improve the safety and the resilience of banks. SSM continuously reviews the supervisory practices and methodologies in order to improve them (European central bank, 2014).
- The second principle of the SSM is *integrity and decentralization.* The SSM is decentralized meaning that ECB and the NSAs closely cooperate and exchange all needed information to achieve consistent supervisory practices and methodologies (European central bank, 2014).
- The third principle of the SSM is *homogeneity.* When performing supervision, the SSM applies harmonized supervisory practices and procedures to all banks in the Euro area in order to achieve consistent supervision outcomes (European central bank, 2014).

- The forth principle of the SSM is *consistency with the Single Market*. The SSM is consistent with the Single Market and contributes to the further convergence of the European banking union and to further development of the single rulebook (European central bank, 2014).
- The fifth principle of the SSM is *independence and accountability*. ECB and the NSAs perform the supervision of all banks independently (European central bank, 2014).
- The sixth principle of the SSM is *risk-based approach*. When performing supervision, the SSM takes into consideration the riskiness of the bank, in terms of probability of default and consequences in case a default happens. Those banks that pose threat to the stability of the overall financial system fall under more frequent supervision until total mitigation of the identified risks (European central bank, 2014).
- The seventh principle of the SSM is *proportionality*. When performing supervision, the SSM takes into consideration importance and the riskiness of the banks. Bigger, more complex or riskier banks fall under more frequent supervision (European central bank, 2014).
- The eighth principle of the SSM is *adequate levels of supervisory activity for all banks.* When performing supervision, the SSM assesses the riskiness of the banks to the overall stability of the financial system in Europe. However, regardless of the riskiness of the banks the SSM ensures adequate level of supervision for all banks (European central bank, 2014).
- The ninth principle of the SSM is *effective and timely corrective measures*. When performing supervision, the SSM assesses the riskiness of the banks to the overall stability of the financial system and intervenes as early as possible in order to prevent any adverse effects of a failing bank to the overall stability of the financial system (European central bank, 2014).

2 LITERATURE OVERVIEW AND HYPOTHESIS DEVELOPMENT

Due to the recent implementation of the SSM in Europe, there are no published quantitative researches in the literature that investigate whether the SSM contributes to the safety of the banking system, making banks more resilient and prone to less risk taking. Therefore, with this Master's thesis we contribute to the literature by opening a new, undiscovered field for research. However, in the literature there are small number of published quantitative researches regarding the SSM, which investigate different areas of the SSM.

Fiordelisi, Lopez and Saverio (2016) investigate bank's behavior during the launch period of the SSM in the period of 2013–2014. Authors provide empirical evidence that the Euro area banks that expected to fall under the direct supervision of the ECB, adjusted their lending activities in anticipation of the SSM launch. The authors collect data from 336 banks of the Euro area, out of which 103 banks are significant and directly supervised by the ECB and 233 are less significant and supervised by the ECB and NSAs, covering the period from 2011 to 2014. The study gives answer to the research question: Did the behavior of the significant banks differ from that of the less significant banks during the SSM launch? The authors conclude that significant banks in anticipation of the SSM launch, adjusted their lending behavior, more than the less significant banks, to shrink their balance sheets in an attempt to increase their capital ratios. The authors do not observe such differences between significant and less significant banks before the SSM launch, and do not find statistically significant differences between significant and less significant banks in their other earning assets.

Mansson (2014) in her Master's thesis is investigating the timing of the SSM launch. Her Master's thesis gives answer to the research question: whether the implementation of SSM is anachronistic, or in other words, whether the establishment of the SSM is taking place at the optimal time or should have been created at an earlier or a later stage? Based on qualitative data in the form of interviews, qualitative and quantitative data in the form of media content and quantitative data in the form of institutional indicators, the author found out that the SSM and the project of joint supervision is not anachronistic.

In the literature, there are researches that investigate the system of banking supervision of Amerika. For instance, Agarwal, Lucca, Seru and Trebbi (2014) empirically analyze the structure of the American dual banking supervision by examining the nature and consequences of supervisory decisions. The study finds differences between the federal and state regulators when implementing identical rules. Authors find out that federal regulators are less permissive, than state supervisors are. The study concludes that under federal regulators banks report higher NPLs, higher capital adequacy ratio and lower return on assets (hereinafter: ROA).

The main contribution of this Master's thesis is analyzing the effect from implementing the SSM in the Euro area from three perspectives: *bank safety* - in terms of probability of bankruptcy, *financial strength* and *liquidity*. We choose bank safety - in terms of probability of bankruptcy, since the top priority of the SSM is keeping the banking system stable. Our second perspective for analyzing the effect from implementing the SSM in the Euro area covers the financial strength of the banks measured in terms of bank's capital. A bank with strong capital base is less vulnerable to default in its loans and economic downturns since it can easily absorb incurred losses and maintain solvency (Federal reserve bank of Cleveland, 2012). The third perspective for analyzing the effect from implementing the SSM covers banks' liquidity. The liquidity is an important perspective for assessing banks' health during the SREP. SREP is integral part of the supervision process for evaluating both significant and less significant banks. Moreover, supervisors perform focused liquidity stress tests Euro area banks in order to assess bank's resilience to liquidity shocks (European central bank, 2014).

With this Master's thesis, we open a new undiscovered field for research. We want to examine the effect of implementing the SSM in the Euro area in terms of bank safety, financial strength of the banks and liquidity. Although, in the literature there are no research papers that analyze the effect of implementing the SSM in the Euro area, there are empirical researches, which analyze bank safety, capital and liquidity.

2.1 Bank safety

Our first perspective for analyzing the effect from implementing the SSM on the Euro area banks, covers *bank safety* - in terms of probability of bankruptcy. In a banking union, the economies are interlinked and consequently spill out effects arise. A default of one bank can affect the other banks and eventually can affect the overall economy. Supervisory activities help identify potential risks and vulnerabilities of the banks in a timely manner and consequently prevent bank failure and its spill out effects. Keeping the banking system stable is the top priority of the SSM (European Banking Authority, 2018). Therefore, we develop the following hypothesis in order to investigate the effect of implementing the SSM in the Euro area on bank's safety:

H1: Increased bank stability in the Euro area relates to the implementation of SSM

In the literature, there are number of studies, which investigate the safety of banks. Diaconu and Oanea (2015) investigate the main determinants of stability and profitability of CreditCoop covering the period from 2008 to 2013. The authors analyze the determinants of stability and profitability on a country level for all subsidiaries of CreditCoop. They conclude that internal factors have the highest impact on stability and profitability. The study finds high correlation between profitability and economic growth. The contribution of the study is in identifying the factors that influence the stability of the banks and in identifying the countries in which bank are most and least profitable.

Karima, AlHabshib and Abduhc (2016) investigate the effect of macroeconomic factors such as Gross domestic product (hereinafter: GDP), interest rates and consumer price index on bank stability. For investigating the long-term impact on bank stability, the authors use standard deviation shock, autoregressive distributive lag model and impulse response function. The study is performed on a sample of 58 commercials banks and 5 Islamic banks, covering the period from 1999 – 2013. The authors conclude that the stability of commercial banks in Indonesia is affected by the macroeconomic factors, whereas the stability of Islamic banks is not.

In the literature, many studies focus on bank stability and use the Z-score as a proxy for measuring the probability of bank default. For instance, Adusei (2015b) investigates the impact of bank size and funding risk on bank stability. The author uses Z-score as a measure of bank stability on a sample of 112 banks in Ghana for the period 2009 – 2013. The study finds that increasing bank size leads to increasing stability and concludes that both bank size and funding risk positively affect bank stability. As a control variable in the model, the author includes liquidity risk variable, credit risk variable, profitability variable, as well as macroeconomic variables such as inflation, GDP, etc.

2.2 Financial strength

Our second perspective for analyzing the effect from implementing the SSM in the Euro area covers the financial strength of the banks measured in terms of bank's capital. A bank with strong capital base indicates its financial strength towards depositors and investors. When bank has more capital for financing its assets, is less vulnerable to default in its loans and economic downturns. Bank with more equity can easily absorb incurred losses and maintain solvency, since the equity can be written down in case of drop of the value of the assets (Federal reserve bank of Cleveland, 2012).

The bank capital is the difference between bank's assets and bank's liabilities and represents the net worth of the bank. However, the global regulatory standards have their own definition of capital adequacy. The global regulatory standards need to ensure the stability of the banks and to prevent insolvency. Hence, they set the minimum capital adequacy requirements. According to the global regulatory standard Basel III, banks must meet minimum capital adequacy of 10.5 %, out of which 8 % should be Tier 1 and Tier 2 capital and 2.5 % should be capital conservation buffer (European Council, 2019). The formula for calculating the minimum capital adequacy is dividing the Tier 1 and Tier 2 capital with the RWA of the bank. The Tier 1 capital is the core capital of the banks that should absorb any potential losses. It includes the equity capital and the disclosed reserves. The Tier 2 capital is additional capital banks must hold and includes unaudited retained earnings, unaudited reserves and general loss reserves. The RWA refer to bank's assets and off-balance-sheet exposures weighted according to their riskiness (Federal reserve bank of Cleveland, 2012).

By recognizing the importance of bank's capital for the overall stability of the financial system, we develop the following hypothesis in order to investigate the effect of implementing the SSM in the Euro area on bank's financial strength:

H2: Increased financial strength of the Euro area banks relates to the implementation of the SSM

In the literature, many studies investigate the determinants of credit risk and its influence on banks profitability. Aktas, Bakin and Celik (2015) investigate the determinants of the credit risk on 71 commercial banks from 10 countries in South East Europe region for the period of 2007 – 2012. Authors develop two models in their study, one model with bank-specific determinants of capital adequacy and one model with macroeconomic determinants of capital adequacy. The first model identifies the following bank-specific determinants of capital adequacy: bank size, ROA, leverage, liquidity, net interest margin and risk. The second model in the study identifies the following macroeconomic determinants of capital adequacy: economic growth rate, stock market volatility index, deposit insurance coverage and governance.

Osama and Hassan (2015) in a study on 33 banks, which represent 83 % of the operating commercial banks in Egypt in the period from 2003 to 2013, investigate the variance of the capital adequacy of the banks. Authors aim to identify decisions that affect the quality of capital management. The study concludes that after the crisis, Egyptian banks paid more attention to credit risk, the quality of loan portfolio and building reserves.

Košak, Li, Lončarski and Marinč (2015) assessed the performance of banks during the financial crisis. On a worldwide bank sample covering the period from 2000 to 2010, the authors analyze the determinants of bank lending behavior during the global financial crisis. The study found that the high quality of funding strategy, Tier 1 bank capital and retail deposits as well as prevalent government backing were important for continuous bank lending during the financial crisis. The study concludes that high quality capital is a competitive strength for banks.

Nilsson, Nordströmb and Bredmar (2014) in their study examine the capital adequacy of the four largest Swedish banks before and after the financial crisis. Authors conclude that after the crisis, banks in Sweden manage to keep capital ratios above regulatory requirements. Before the crisis, banks tend to lower the capital ratios close to regulatory requirements and were prone to excessive risk taking.

2.3 Liquidity

Our third perspective for analyzing the effect from implementing the SSM covers banks' liquidity. The liquidity is an important perspective for assessing banks' health during the SREP. SREP is integral part of the supervision process for evaluating both significant and less significant banks. Moreover, supervisors perform focused liquidity stress tests on the Euro area banks in order to assess bank's resilience to liquidity shocks (European central bank, 2014).

The importance of the liquidity for the overall stability of the financial markets and the banking system appeared after the crisis in 2007. Gaps in liquidity risk management appeared, banks lost confidence in each other's solvency, deposits were withdrawn, making lending more expensive. It became clear that liquidity can vanish and can be absent for longer period of time (Allen and Moessner, 2013).

The Basel Committee issued new guidelines for liquidity risk management. In December 2010 the Basel Committee defined two minimum standards for funding and liquidity in the Basel III: Liquidity coverage ratio (hereinafter: LCR) and Net stable funding ratio (hereinafter: NSFR). The LCR was introduced as a measure for short-term liquidity risk, whereas the NSFR was introduced as a measure for long-term liquidity risk (Cucinelli, 2013). LCR ratio should increase the short-term resilience of the banks by ensuring that the bank has enough high quality liquid assets to survive any adverse scenarios in period of at least 30 days. The NSFR ratio should reduce the funding risk of the banks over a longer period by ensuring that banks use stable sources of funding (Bank for international settlements, 2014).

By dividing the high quality liquid assets with the total net cash outflows, which are expected over the next 30 days, we get the LCR ratio. The minimum requirement of the LCR ratio for banks was 60 % starting from October 2015. The minimum requirement of the LCR ratio is gradually increasing from October 2015 until January 2018, as follows: 70 % from January 2016, 80 % from January 2017 and 100 % from January 2018 (Eckhardt and Van Roosebeke, 2015). However, in December 2016 the average LCR ratio in the Euro area was 139 %, which is significantly above the minimum requirement of 100 % that should have been implemented starting from January 2018 (European Banking Authority, 2017).

By dividing the available amount of stable funding with the required amount of stable funding, we get the NSFR ratio. The minimum requirement of the NSFR ratio is 100 % on an on-going basis. It requires from banks to hold stable funding in relation to the composition of their balance sheets and off-balance sheet activities and eventually to reduce the probability of bank's default (Bank for international settlements, 2014).

There are two types of liquidity risk: market liquidity risk and funding risk. Market liquidity risk refers to the ability to convert assets into cash at a given price in a short period of time. Funding liquidity risk refers to the ability to raise money mainly through wholesale markets. Market liquidity risk occurs when a bank cannot obtain sufficient funds, either by increasing liabilities or by converting assets timely, at a reasonable cost. Funding liquidity risk occurs due to the maturity mismatch of the assets and liabilities of the banks, which lead to liquidity squeeze. A liquidity squeeze is a situation when banks hesitate to borrow money due to concerns about the short-term availability of money. Consequently, borrowing from other banks becomes expensive due to increase of the interbank market rates (Wójcik and Szajt, 2015).

By recognizing the importance of bank's liquidity for the overall stability of the financial system, we develop the following hypothesis in order to investigate the effect of implementing the SSM in the Euro area on bank's liquidity:

H3: Increased liquidity of the Euro area banks relates to the implementation of SSM

Liquidity risk gets the attention of the researchers in the literature right after the crisis. Chen, Shen, Kao and Yi (2009) investigate the causes of the liquidity risk and conclude that liquidity determines bank's performance. In their study, the authors reveal that although liquidity risk decreases the profitability of a bank due to higher funding costs, positively affects bank's net interest margin. The study highlights the dependence on external funding and regulatory and macroeconomic factors as determinants of the liquidity risk.

Rauch, Steffen, Hackethal and Tyrell (2010) investigate the determinants of liquidity risk. In their study, they conclude that the most important determinants of liquidity risks are macroeconomic variables and the monetary policy. The authors reveal less significant relationship between liquidity and bank specific variables such as size and performance.

Bonfim and Kim (2011) in a study on European and North American banks illustrate how banks manage liquidity risk. The authors identify the determinants of liquidity risk and highlight the dependence between liquidity risk and size, performance and the ratio between loans and deposits. In their study, bank size has positive impact on bank liquidity, while the performance measure shows an ambiguous relationship.

Allen and Moessner (2013) examine the liquidity effects of the Euro area sovereign debt crisis, including its effects on Euro area banks as a group, on intra-euro area financial flows, on the supply of and demand for collateral, and on international liquidity. The authors confirm that crisis has damaged the banking system of the Euro area and consequently, the flow of bank credit to the domestic private sector remains impaired until 2012.

Cucinelli (2013) analyses the relationship between liquidity risk and bank structure variables on a sample of 1080 Euro area banks. In the study, the liquidity risk is measured with the LCR and the NSFR. The study includes the following bank structure variables: size, capitalization, assets quality and specialization. The author concludes that bigger banks have a higher liquidity risk exposure and that assets quality impacts only on the short-term liquidity risk. The study highlights that banks more specialized on the lending activity have more vulnerable funding structure.

Wojcik and Szajt (2015) analyses the determinants of liquidity risk of commercial banks by comparing dependencies in two groups, banks operating in the *countries of the old EU* and banks operating in the *countries of the new EU*. The group *countries of the old EU* include the banks operating in: Austria, Belgium, Germany, Denmark, Spain, Finland, France, the UK, Greece, Ireland, Italy, Portugal; The group *countries of the new EU* include the banks operating in: Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovenia and Slovakia. The study shows that the determinants of liquidity risk characteristic for banks operating in the *countries of the old EU* are slightly different from those for banks operating in the *countries of the new EU*. Authors conclude that the interbank market interest rate in the *countries of the old EU* impact the level of liquidity, which is not the case with the banks operating in the *countries of the new EU* and the increase in the interbank market interest rate is not identical to the total increase in liquid assets.

Alyoubi (2017) in his study investigates the determinants of the liquidity risk on Islamic banks. Based on a sample of 42 Islamic banks from 15 countries, the author concludes that liquidity risk in Islamic banks is negatively related to cash held by the banks, investment in financial assets, and equity. The author highlights the importance of understanding the liquidity risk in Islamic banks since conventional banks are not limited in using tools to deal with the liquidity risk unlike Islamic banks.

3 DATA AND METHODOLOGY

In this chapter, we explain the data sample selection and the data sources. Moreover, we explain the difference-in-difference estimator and its appropriateness for testing our hypothesis. In addition, we explain our models and all variables included in each model for testing all hypotheses.

3.1 Data and sample selection

We build our empirical research on a sample of balanced panel data for 165 Euro area banks that fall under the scope of the SSM, for the period from 2011–2017. The SSM was officially implemented in November 2014. Therefore, this period covers the years before and after the implementation of the SSM. We retrieve bank-specific data from the Fitch Connect database and macroeconomic data from the World Bank data set and apply it on constructed models.

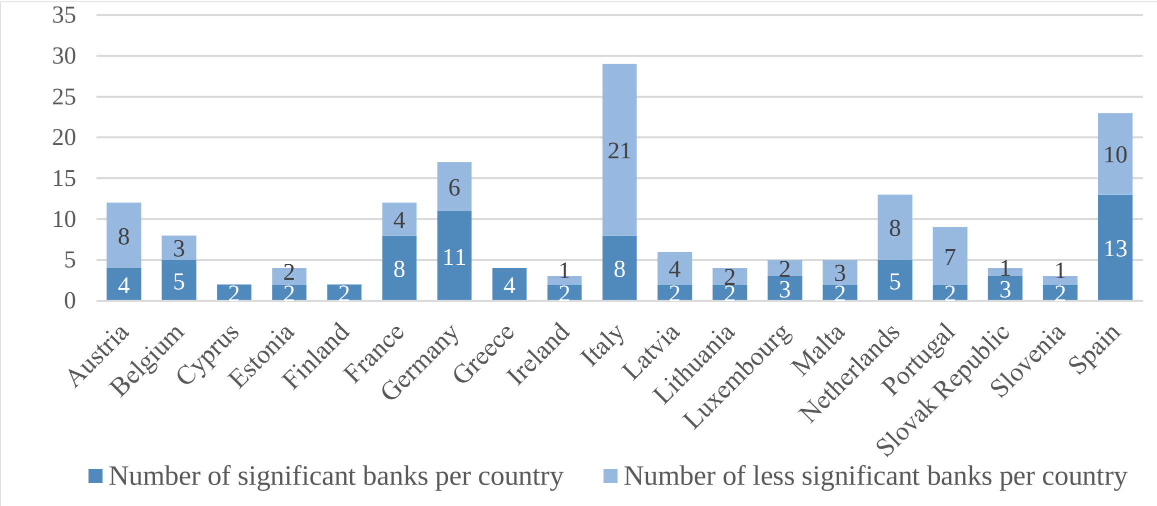
Our sample includes 82 significant banks which fall under direct supervision of ECB and 83 less significant banks. Significant banks fall under direct supervision of the ECB, whereas the less significant banks fall under supervision of their NSAs in close cooperation with the ECB. The ECB developed few significance criteria for classifying the banks as significant or less significant: banks' size, cross border activities, the economic importance of the bank and possible direct public financial assistance. There is one more significance criteria according to which significant banks are the three largest banks in a domestic market (European central bank, 2014).

Except for the banks' size, we cannot quantify most of the significance criteria for determining the significance of the banks and use them in a regression model. Therefore, in our regression models we use the total assets of the banks as a proxy for banks' size to differentiate between the significant and less significant banks. However, in order to avoid misclassification of the banks, we double-check the classification of the banks as significant and less significant according to the List of supervised entities (2018b). All banks classified as significant correspond to our *treatment group,* whereas all less significant banks correspond to our *control group*. We list all significant banks included in our sample in Table 1 (see Appendix B) and all less significant banks in Table 2 (see Appendix B).

In Figure 1 we show the distribution of our bank sample by countries. The vast majority of banks are Italian and Spanish, 18 % and 14 % of the total sample, retrospectively. Out of 29 Italian banks included in our sample, 8 are significant banks and 21 are less significant banks. Out of 23 banks located in Spain, 13 are significant banks and 10 are less significant.

Furthermore, we have 11 significant and 6 less significant banks located in Germany, and 4 significant and 8 less significant banks located in Austria. Our sample includes 8 significant banks and 4 less significant banks located in France.

Figure 1. Distribution of sample by countries



Source: own work.

Table 1. Source and abbreviation of all variables used in the empirical analysis

Variable	**Abbreviation**	**Source**
Dependent variables:		
Natural logarithm of Z-score bank stability	Ln Z-score BS	Fitch connect database
Equity to total assets ratio	ETA	Fitch connect database
Liquid assets to total assets	LATA	Fitch connect database
Independent variables:		
Bank-specific variables		
Return on average assets	ROAA	Fitch connect database
Net Interest Income to earning assets	NIIEA	Fitch connect database
Cost to income ratio	CI	Fitch connect database
Natural logarithm of Total Assets	Ln TA	Fitch connect database
Non-performing loans to total loans	NPLTL	Fitch connect database
Equity to total assets ratio	ETA	Fitch connect database
Liquid assets to total assets	LATA	Fitch connect database
Natural logarithm of Z-score funding risk	Ln Z-score FR	Fitch connect database
Growth of gross loan	GGL	Fitch connect database
Loans to consumers deposits	LD	Fitch connect database
Loan loss reserve to total loans	LLRL	Fitch connect database
Macroeconomic variables		
Growth of the gross domestic product	GGDP	World Bank data set
Unemployment	UE	World Bank data set
Inflation	INF	World Bank data set

Source: own work.

In Table 1 we show all bank-specific variables we use in our empirical analysis and their sources. The bank-specific variables included in our models refer to annual bank financials retrieved from the Fitch connect database for 165 Euro area banks for the period from 2011–2017. We filter the Fitch connect database by location, currency and consolidated financial statements. The macroeconomic variables refer to annual macroeconomic variables per country retrieved from the World Bank dataset for the period from 2011–2017.

In Table 3 (see Appendix C), Table 6 (see Appendix D) and Table 9 (see Appendix E), we show the descriptive statistics for the variables included in the models for testing the first, the second and the third hypothesis, retrospectively.

3.2 Difference-in-difference estimator and model specification

In this Master's thesis, we develop three hypotheses in order to examine the effect of implementing the SSM in the Euro area and to inspect whether the implementation of the SSM contributes to increased safety of the overall banking system. With the first hypothesis: Increased bank stability in the Euro area is related to the implementation of SSM, we observe the effect of implementing the SSM on the Euro area banks, from the perspective of *bank safety* - in terms of probability of bankruptcy. With the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, and the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, we examine the effects of implementing the SSM on the *financial strength* of the banks and the effect of implementing the SSM on the *liquidity*.

The difference-in-difference estimator is appropriate for testing our hypotheses and evaluating the effect of implementing the SSM on the Euro area banks. The difference-in-difference estimator evaluates the impact of a treatment on outcome Y over a population. It requires a *control group* of population - the population that did not received the treatment and *treatment group* - the population that received the treatment. The difference-in-difference estimator is based on three assumptions: 1) correctly specified model; 2) the error term is on average zero; and 3) parallel trend assumption (Albouy, n.d.). The most important assumption of the difference-in-difference estimator is the third one, the parallel trend assumption. This assumption requires, in absence of the treatment, the unobserved difference between the treatment and control group to be constant over time. If this assumption is not fulfilled the regression results might be biased. Therefore, it is very important to inspect the parallel trend of the control and the treatment group before running the regressions in a statistical software. There is no statistical test for the parallel trend assumption. The visual inspection is the best way for inspecting this assumption (Hill, Griffiths and Lim, 2018).

For testing all of the hypotheses in the first stage, we use the equation (1) in general form:

$$Y_{it} = \alpha + \gamma t_{it} + \beta T_{it} + \delta(T_{it} * t_{it}) + \varepsilon_{it} \tag{1}$$

Where the coefficients α, β, γ, δ are the estimated parameters and ε_{it} is the error term (Albouy, n.d.).

α is the constant term;

γ is the dummy variable Time;

β is the dummy variable Treated; and

δ is the coefficient of interest or the true effect of treatment.

The coefficient of the dummy variable Treated, β, is the estimated mean difference in Y_{it} between the treatment and control groups prior the treatment. It shows the differences that existed between the groups before implementing the treatment. The dummy variable Time, γ, is the expected mean change in Y_{it} after the treatment period among the control group. The coefficient of our interest, δ, is the difference in differences estimator and shows whether the expected mean change in Y_{it} from before to after the treatment was different in the two groups (Albouy, n.d.).

We test our hypotheses with the difference-in-difference estimator in a two-stage approach. The first stage covers estimation of the models by using two dummy variables of the difference-in-difference estimator, a dummy variable that indicates the time when the treatment period started and a dummy variable that indicates the treatment group. The coefficient of interest is a composite variable of the two dummy variables. This coefficient is defined as: "The difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment" (Albouy, n.d.).

In the second stage, in addition to the dummy variables of the difference-in-difference estimator γ and β and the coefficient of interest δ, we include a vector of control variables. The control variables cover bank-specific and macroeconomic variables that differ for each hypothesis.

3.2.1 First hypothesis: Model construction

For testing the first hypothesis: Increased bank stability in the Euro area relates to the implementation of SSM, we use the following models:

First stage:

$$Ln\,Z-score\,BS_{it} = \alpha_0 + \alpha_1 Time_{it} + \alpha_2 Treated_{it} + \alpha_3 DID_{it} + \varepsilon_{it} \quad (2)$$

Second stage:

$$Ln\ Z - score\ BS_{it} = \alpha_0 + \alpha_1 Time_{it} + \alpha_2 Treated_{it} + \alpha_3 DID_{it} + \alpha_4 ROAA_{it} + \alpha_5 NIIEA_{it} + \alpha_6 CI_{it} + \alpha_7 LnTA_{it} + \alpha_8 TA_{it} + \alpha_9 NPLTL_{it} + \alpha_{10} ETA_{it} + \alpha_{11} LATA_{it} + \alpha_{12} Ln\ Z - Score\ FR_{it} + \alpha_{13} GGDP_{jt} + \alpha_{14} UE_{jt} + \alpha_{15} INF_{jt} + \varepsilon_{it} \quad (3)$$

As a proxy for bank stability, we use Z-score as dependent variable in both equations, equation (2) and equation (3). Diaconu and Oanea (2015), Adusei (2015a), Fiordelisi, Lopez and Saverio (2016) and many others in the literature use the Z-score as a measure for bank safety in their empirical researches. An increase in Z-score indicates decrease of bank's probability of bankruptcy. In this Master's thesis, we use natural logarithm of Z-score BS[1] to avoid the effect of extreme values.

For calculating Z-score BS we use the equation (4):

$$Z - score\ BS = \frac{\left(Return\ on\ assets + \frac{Equity}{Total\ assets}\right)}{sd.\ (Return\ on\ assets)} \quad (4)$$

We estimate the models with including two dummy variables of the difference-in-difference estimator, $Time_{it}$ and $Treated_{it}$ and a composite variable named DID_{it} coefficient. The $Time_{it}$ variable is a dummy variable that indicates the time when the treatment period started, or in other words, it differentiates the years before and after implementing the SSM. It equals zero for the period from 2011 to 2014 and one from year 2015 to 2017. The $Treated_{it}$ variable is a dummy variable that indicates the banks that fall under direct supervision of ECB and the banks that fall under supervision of the NSAs. It equals zero for the banks that fall under supervision of the NSAs and one for the banks that fall under direct supervision of ECB. In both equations, equation (2) and equation (3), the slope of the DID_{it} is of our interest as it shows the effect of implementing the SSM on the *bank safety* in the Euro area. This variable is a composite variable of the two dummy variables $Time_{it}$ and $Treated_{it}$.

In the second stage, in addition to the dummy variables of the difference-in-difference estimator and the coefficient of interest, we include in the model bank-specific variables and macroeconomic variables as control variables.

We include the following bank-specific variables in equation (3):

$ROAA_{it}$ – return on average assets is a common measure of profitability of banks in the literature. It is calculated as ratio of net income and the average of total assets. The more profitable the bank is, the safer it is, therefore, we expect positive sign of this coefficient on bank safety.

[1]In this Master's thesis, we use Z-score for measuring bank stability and Z-score for measuring funding risk. For differentiating between them, we use the acronyms *Z-score BS* - where BS stands for Bank Stability and *Z-score FR* - where FR stands for Funding Risk.

$NIIEA_{it}$ – The ratio of net interest income to earning assets or a net interest margin is the second profitability ratio we use as a control variable in equation (3). The net interest margin measures the difference between generated interest income and the interest paid to the lenders, relative to the interest earning assets. The more profitable the bank is, the safer it is, and therefore, we expect positive sign of this coefficient.

CI_{it} – As a proxy for operational efficiency, we use cost to income ratio measured via the ratio of total non-interest expense to net income. An increase of the cost to income ratio means increase of the non-interest expenses, which adversely affects the profitability of the bank and hence its stability. We expect negative sign of the coefficient of operational efficiency.

$LnTA_{it}$ – We use natural logarithm of total assets of banks as a proxy variable for the size of the bank. Bank size is an important indicator of bank's riskiness; however, its relationship with bank's safety is ambiguous. Bigger banks are more efficient due to economies of scale and scope, which positively affects bank stability. However, according to the "Too big to fail" theory, large banks are systematically important and their failure would impose serious damage to the broader financial system. Consequently, the governments must assist them in times of difficulties to prevent their failure. This practice encourages the banks to operate with greater leverage and to undertake risky activities[2].

TA_{it} – We use total assets of the banks in our model only to incorporate a dummy variable to differentiate between banks that fall under direct supervision of the ECB and banks that fall under supervision of the NSAs. One of the ECB's criteria for selecting the banks for direct supervision is the bank size measured by the total assets. All Euro area banks with total assets more than 30 billion EUR fall under direct supervision of the ECB (European central bank, 2014). Therefore, our dummy variable indicates one for all banks with total assets more than 30 billion EUR and zero for total assets less than 30 billion EUR. Due to the fact, ECB has few significance criteria for classifying the banks as significant or less significant, we double-check the classification of the banks as significant and less significant according to the List of supervised entities (2018b) in order to avoid misclassification of the banks.

Another independent variable we use in equation (3) is the funding risk measured via Z-score FR[3] of bank i in time t. We calculate the Z – score FR with the following equation developed by Adusei (2015),

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[2]The practice when insurance encourages risk-taking is moral hazard.

[3] In this Master's thesis, we use Z-score for measuring bank stability and Z-score for measuring funding risk. For differentiating between them we use the acronyms *Z-score BS* - where BS stands for Bank Stability and *Z-score FR* - where FR stands for Funding Risk

$$Z - score\ FR\ = \frac{\left(\frac{Deposits}{Total\ Assets} + \frac{Equity}{Total\ Assets}\right)}{sd.\left(\frac{Deposits}{Total\ Assets}\right)} \tag{5}$$

which measures the number of deviations customer deposits would have to fall to compel the bank to wipe out equity finance (Adusei, 2015). We use natural logarithm of $Z - Score\ FR_{it}$ to avoid the effect of extreme values. We expect positive correlation of the coefficient on bank stability.

$NPLTL_{it}$ − We use non-performing loans to total loans (hereinafter: NPLTL) ratio as proxy for the credit risk. The banks classify loans as non-performing when borrowers are being late with paying their liabilities more than 90 days (European Commission, 2018b). An increase in NPLTL ratio indicates an increase in the NPLs or in other words worsened quality portfolio. Here, we expect negative correlation between the coefficient of quality of loan portfolio and bank safety.

ETA_{it} refers to the ratio of equity to total assets. Bank's equity serves as a reserve for absorbing potential losses and maintaining solvency. When bank has more capital for financing its assets, is less vulnerable to default in its loans and economic downturns and can easily absorb incurred losses and can maintain solvency (Federal reserve bank of Cleveland, 2012). We expect positive correlation between this coefficient and the dependent variable.

$LATA_{it}$ we use the ratio of liquid assets to total assets as a proxy for banks' liquidity. Bank's liquidity is important indicator of bank's safety. Any unanticipated money withdrawal may affect bank's stability in case the bank does not hold enough liquid assets that can be converted to cash with low cost (Hoerova, Mendicino, Nikolov, Schepens, Van den Heuvel, 2018). We expect positive correlation of the coefficient of liquidity and bank safety.

Table 2. First hypothesis: Expected signs of the coefficients

ROAA	+
NIIEA	+
CI	-
Ln TA	?
NPLTL	-
ETA	+
LATA	+
Ln Z-score FR	+
Macroeconomic variables	
GGDP	+
UE	+
INF	?

Source: own work.

To evaluate the effect of country's economy on banks stability in equation (3) we include the following macroeconomic variables:

$GDPG_{jt}$ refers to growth of the GDP of country j at time t. The growth of GDP affects the demand for loans and consequently bank's profitability. In times of increasing growth of GDP, the demand for loans increases, which positively affects the bank's profitability, therefore, we expect positive sign of this coefficient.

UE_{jt} refers to coefficient of unemployment of country j at time t measured as % of the total labor force. In times of crisis, the unemployment is high and consequently the demand for new loans decreases. Consequently, the default rate of NPLs increases. We expect positive correlation of this coefficient with our dependent variable.

INF_{jt} is our coefficient of inflation as a measure of the inflation of country j at time t. We use it as proxy for the macroeconomic general situation. Inflation is "general increase of prices and fall of the purchasing value of the money" (Singh and Sharma, 2016). In times of inflation, the loan interest rates are increasing which positively affects banks' income. However, at the same time, the supply of deposits decreases due to low purchasing power of the customers (Karima, AlHabshib and Abduhc, 2016). The relationship of the coefficient of inflation with the coefficient of the dependent variable in our model is ambiguous.

3.2.2 Second hypothesis: Model construction

For testing the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, we use the following models:

First stage:

$$ETA_{it} = \alpha_0 + \alpha_1 Time_{it} + \alpha_2 Treated_{it} + \alpha_3 DID_{it} + \varepsilon_{it} \tag{6}$$

Second stage:

$$ETA_{it} = \alpha_0 + \alpha_1 Time_{it} + \alpha_2 Treated_{it} + \alpha_3 DID_{it} + \alpha_4 GGL_{it} + \alpha_5 LnTA_{it} + \alpha_6 TA_{it} + \alpha_7 CI_{it} + \alpha_8 ROAA_{it} + \alpha_9 GGDP_{it} + \alpha_{10} UE_{it} + \alpha_{11} INF_{it} + \varepsilon_{it} \tag{7}$$

In both equations, equation (6) and equation (7) our dependent variable is ETA_{it}, or equity to total assets ratio. We use this ratio as a measure of banks' financial strength. Bank's equity serves as a reserve for absorbing potential losses and maintaining solvency. When bank has more capital for financing its assets, is less vulnerable to default in its loans and economic downturns and can easily absorb incurred losses and can maintain solvency (Federal reserve bank of Cleveland, 2012).

We estimate both equation (6) and equation (7) with including two dummy variables of the difference-in-difference estimator, $Time_{it}$ and $Treated_{it}$ and a composite variable named DID_{it} coefficient. The $Time_{it}$ variable is a dummy variable that indicates the time when the treatment period started, or in other words, it differentiates the years before and after implementing the SSM. It equals zero for the period from 2011 to 2014 and one from year 2015 to 2017. The $Treated_{it}$ variable is a dummy variable that indicates the banks, which fall under direct supervision of ECB, and the banks that fall under supervision of the NSAs. It equals zero for the banks that fall under supervision of the NSAs and one for the banks that fall under direct supervision of ECB. In both equations, equation (6) and equation (7), the slope of the DID_{it} coefficient is of our interest as it shows the effect of implementing the SSM on the *financial strength* of the banks in the Euro area. This variable is a composite variable of the two dummy variables $Time_{it}$ and $Treated_{it}$.

In the second stage, in addition to the dummy variables of the difference-in-difference estimator and the coefficient of interest, we include in the model both bank-specific and macroeconomic variables as control variables.

We include the following bank-specific variables in equation (7):

The variable GGL_{it} refers to growth of gross loan. An increase in loans should increase the banks' capital in order to secure the bank against unexpected losses. However, higher capital reduces the lending supply of banks (The clearing house, 2016). We expect positive correlation of the coefficient of this variable with the dependent variable in the model.

We use $LnTA_{it}$ of bank i at time t as a proxy for bank's size. Bank size is a strong determinant of bank capital. Bigger banks have higher capital requirements in absolute numbers. We expect positive sign of this coefficient with the dependent variable in the model.

TA_{it} – We use total assets of the banks in our model only to incorporate a dummy variable to differentiate between banks that fall under direct supervision of the ECB and banks that fall under supervision of the NSAs. One of the ECB's criteria for selecting the banks for direct supervision is the bank size measured by the total assets. All Euro area banks with total assets more than 30 billion EUR fall under direct supervision of the ECB (European central bank, 2014). Therefore, our dummy variable indicates one for all banks with total assets more than 30 billion EUR and zero for total assets less than 30 billion EUR. Due to the fact, ECB has few significance criteria for classifying the banks as significant or less significant, we double-check the classification of the banks as significant and less significant according to the List of supervised entities (2018b) in order to avoid misclassification of the banks.

CI_{it} refers to the ratio of total non-interest expense to net income used as a proxy for operational efficiency. An increase of the cost to income ratio means increase of the non-interest expenses, which negatively affects banks profitability, and hence bank's capital.

Therefore, we expect negative correlation of the coefficient of operational efficiency with the dependent variable in the model.

We use $ROAA_{it}$, calculated as ratio of net income and the average of total assets, as a proxy for bank's profitability. Banks with riskier asset structure need to hold additional funds for covering potential risks and in turn, riskier assets have higher returns. Therefore, we expect positive correlation of profitability with the coefficient of the dependent variable.

We present the expected signs of the coefficients of the variables that comprise the models of the second hypothesis in Table 3.

Table 3. Second hypothesis: Expected signs of the coefficients

Independent variables	**Expected sign**
Bank-specific variables	
GGL	+
Ln TA	+
CI	-
ROAA	+
Macroeconomic variables	
GGDP	-
UE	+
INF	-

Source: own work.

In addition to the bank-specific variables, in the second stage model we include the following macroeconomic variables as control variables in equation (7):

UE_{it} refers to unemployment of country j at time t is measured as % of the total labor force. In times of crisis, the unemployment is high and consequently the demand for new loans shrinks and the default rate of NPLs increases. Consequently, banks tend to work with higher capital in order to decrease their risk levels. We expect positive correlation of the UE with the dependent variable in the model.

$GDPG_{it}$ - In times of economic expansion, the banks may tend to work with lower capital to take advantage of growth opportunities. Whereas, in times of crisis, banks tend to work with higher capital in order to decrease their risk levels (Aktas, Bakin and Celik, 2015). We expect negative correlation of the coefficient of GGDP with the capital requirements.

INF_{it} − refers to inflation of country j at time t. High inflation erodes bank's capitals (Aktas, Bakin and Celik, 2015). We expect negative correlation of the coefficient of inflation with the

3.2.3 Third hypothesis: Model construction

For testing the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, we use the following models:

First stage:

$$LATA_{it} = \alpha_0 + \alpha_1 Time_{it} + \alpha_2 Treated_{it} + \alpha_3 DID_{it} + \varepsilon_{it} \quad (8)$$

Second stage:

$$LATA_{it} = \alpha_0 + \alpha_1 Time_{it} + \alpha_2 Treated_{it} + \alpha_3 DID_{it} + \alpha_4 LD_{it} + \alpha_5 ETA_{it} + \alpha_6 ROAA_{it} + \\ + \alpha_7 LnTA_{it} + \alpha_8 TA_{it} + \alpha_9 LLRL_{it} + \alpha_{10} GGDP_{it} + \alpha_{11} UE_{it} + \alpha_{12} INF_{it} + \varepsilon_{it} \quad (9)$$

In both equations, equation (8) and equation (9), we use $LATA_{it}$ as a dependent variable which refers to liquid assets to total assets ratio. The liquid assets to total assets ratio measures the maturity structure of the asset portfolio. The higher the ratio, more liquid the bank (Poghosyan and Čihák, 2009).

We estimate the models with including two dummy variables of the difference-in-difference estimator, $Time_{it}$ and $Treated_{it}$ and a composite variable named DID_{it} coefficient. The $Time_{it}$ variable is a dummy variable that indicates the time when the treatment period started, or in other words, it differentiates the years before and after implementing the SSM. It equals zero for the period from 2011 to 2014 and one from year 2015 to 2017. The $Treated_{it}$ variable is a dummy variable that indicates the banks that fall under direct supervision of ECB and the banks that fall under supervision of the NSAs. It equals zero for the banks that fall under supervision of the NSAs and one for the banks that fall under direct supervision of ECB. In both equations, equation (8) and equation (9), the slope of the DID_{it} coefficient is of our interest as it shows the effect of implementing the SSM on the *liquidity* in the Euro area. This variable is a composite variable of the two dummy variables $Time_{it}$ and $Treated_{it}$.

In the second stage, in addition to the dummy variables of the difference-in-difference estimator and the coefficient of interest, we include in the model bank-specific variables and macroeconomic variables as control variables.

We include the following bank-specific variables in equation (9):

LD_{it} refers to loans to consumers' deposits ratio. The percentage of the loans to consumers' deposits ratio may increase in case of sudden deposit withdrawals. In such situations, banks face liquidity problems. They must hold adequate level of liquid assets to cover the unanticipated fund requirements. If not, they must borrow from the inter-bank markets or the central banks (Singh and Sharma, 2016). We expect negative correlation of this coefficient with the dependent variable of the model.

ETA_{it} refers to the ratio of equity to total assets. Bank's equity serves as a reserve for absorbing potential losses and maintaining solvency. When bank has more capital can remain solvent when the value of the assets drops (Federal reserve bank of Cleveland, 2012). We expect positive relationship of this coefficient with the dependent variable of the model.

We use $ROAA_{it}$ as proxy for bank's profitability. We calculated as ratio of net income and the average of total assets. According to the finance theory, there is a non-linear relationship between bank's profitability and holding liquid assets. More specifically, more liquid banks are more profitable, but after a certain point, the benefits from holding liquid assets outweigh the opportunity costs of holding liquid assets (Bordeleau and Graham, 2010). The relationship of the coefficient of return on average assets with the coefficient of the dependent variable in our model is ambiguous.

We use the variable $LnTA_{it}$ of bank i at time t as a proxy for the bank's size. Bank size is one of the determinants of liquidity risk. The relationship of bank size with bank's liquidity is ambiguous. Generally, is expected that the bigger banks hold less liquid assets due to the "too big to fail" theory which indicates that banks are big enough to be supported by the central banks. However, a positive relationship might appear due to banks' strategy for managing liquidity risk (Singh and Sharma, 2016).

We use TA_{it} in our model, which refers to total assets of the bank, only to incorporate a dummy variable to differentiate between banks that fall under direct supervision of the ECB and banks that fall under supervision of the NSAs. One of the ECB's criteria for selecting the banks for direct supervision is the bank size measured by the total assets. All Euro area banks with total assets more than 30 billion EUR fall under direct supervision of the ECB (European central bank, 2014). Therefore, our dummy variable indicates one for all banks with total assets more than 30 billion EUR and zero for total assets less than 30 billion EUR. Due to the fact, ECB has few significance criteria for classifying the banks as significant or less significant, we double-check the classification of the banks as significant and less significant according to the List of supervised entities (2018b) in order to avoid misclassification of the banks.

The variable $LLRL_{it}$ refers to loan loss reserve to total loans ratio. We use this ratio as a proxy for the quality of the bank's assets. Therefore, the higher the ratio, the worse the quality of assets. Bank holds more reserves as it expects potential losses (Singh and Sharma, 2016). We expect negative correlation of this coefficient with the dependent variable of the model.

In addition to the bank-specific variables, in equation (9) we include the following macroeconomic variables as control variables.

We use the variable $GGDP_{it}$, which refers to the growth of GDP of country j at time t, as a proxy for the business cycle of the economy. We expect positive correlation of the coefficient of GGDP with the liquidity. At times of crisis banks, tend to hold more liquid assets since there is increased probability that creditors will default on their debts to banks. If creditors default on their debts to banks, then banks without liquid assets that can be easily converted to cash, will default to back the principal and the interest to the depositors. This might lead to bankruptcy (Singh and Sharma, 2016).

UE_{it} - refers to unemployment of country j at time t is measured as percentage of the total labor force. In times of crisis, the unemployment is high and consequently banks suffer from reduced both solvency and liquidity (Singh and Sharma, 2016). We expect negative correlation of UE with the dependent variable of the model.

INF_{it} - refers to inflation of country j at time t. In times of deflation, banks tend to keep high liquidity and in times of inflation, they tend to decrease their liquidity. This helps maintaining economic stability (Singh and Sharma, 2016). We expect negative correlation of the coefficient of inflation with the dependent variable of the model.

We show the expected signs of the coefficients of the variables, which comprise the models of the third hypothesis in Table 4.

Table 4. Third hypothesis: Expected signs of the coefficients

Independent variables	**Expected sign**
Bank-specific variables	
LD	-
ETA	+
ROAA	?
Ln TA	?
LLRL	-
Macroeconomic variables	
GGDP	+
UE	-
INF	-

Source: own work.

4 EMPIRICAL RESULTS

In this chapter, we focus on the empirical results of testing our hypotheses in the statistical software Stata. Here we explain the outcomes of the difference-in-difference estimator and the Hausman test and give conclusions based on the empirical results. In addition, we visually inspect the parallel trend assumption of the difference-in-difference estimator and cover the outcomes from the correlation matrix and VIF.

We use the difference-in-difference estimator in a two-stage approach for testing our hypotheses. The first stage covers estimating the models by using dummy variables to indicate the time when the treatment period (implementation of SSM) has started, and for identifying the group of banks, which fall under direct supervision from the ECB. The second stage includes controlling variables in addition to the dummy variables of the difference-in-difference estimator. The slope of the coefficient DID shows the effect of implementing the SSM on the stability, financial strength and liquidity of the banks in the Euro area.

Generally, under the null hypothesis we test whether the change in our dependent variable after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. If our coefficient of interest DID is statistically significant at the 0.05 significance level, we reject the null hypothesis (Hill, Griffiths and Lim, 2018).

Before testing the hypotheses with the difference-in-difference estimator, we check the parallel trend assumption for all three hypotheses. In addition, we inspect the correlation of the variables in each of the models with correlation matrix and we run VIF in order to check for multicollinearity issues in our models. Next, we use Durbin – Wu – Hausman test to determine which model corresponds to the panel data for testing each hypothesis. In statistics, there are two models for testing panel data sets: fixed effect model and random effect model. The fixed effect model is a model in which the group means are fixed, whereas in a random effect model the group means are a random sample from a population. Generally, under the null hypothesis we choose random effects model since obtains more efficient estimates, whereas under the alternative hypothesis we chose the fixed effect model, at significance level of 0.05 (Hill, Griffiths and Lim, 2018).

Follows detailed explanation of the visual inspection of the parallel trend assumption of the difference-in-difference estimator, explanation of the outcomes from the correlation matrix and VIF as well as of the econometric results from Stata regarding the difference-in-difference estimator and the Hausman test.

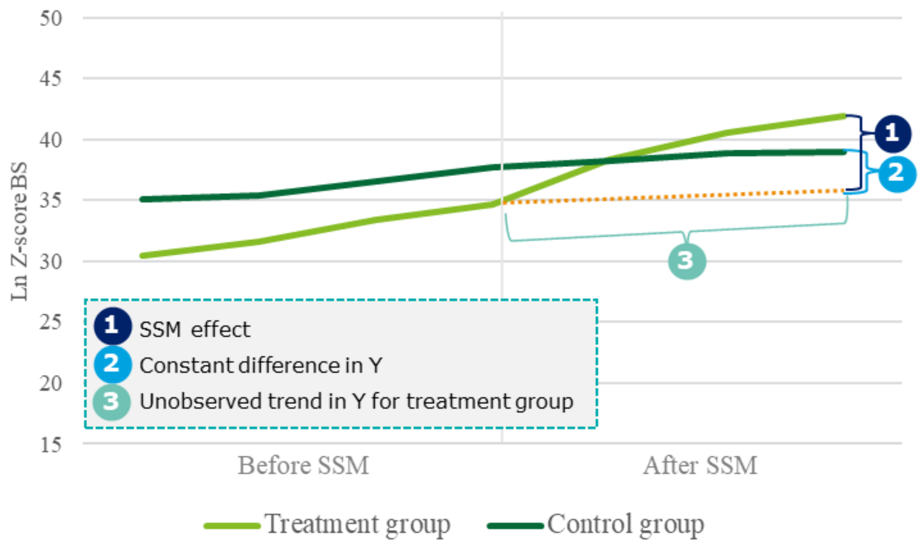
4.1 Parallel trend assumption of difference-in-difference estimator

Before running the regressions in the statistical software Stata to test all of the hypotheses, we inspect the parallel trend assumption of the difference-in-difference estimator. The parallel trend assumption requires, in absence of the treatment, the unobserved differences between the treatment group and control group to be constant over time (Hill, Griffiths and Lim, 2018).

We inspect the parallel trends of the dependent variables before and after implementation of the SSM in the Euro area. For that purpose, we split the dependent variables in two groups, treatment group and control group. The *treatment group* refers to the banks that fall under direct supervision of the ECB whereas the *control group* refers to the banks that fall under supervision of the NSAs with close cooperation with the ECB. We analyze the trend of the dependent variable of all three hypotheses in two points of time, before and after implementation of the SSM. The period before implementation of the SSM refers to years 2011–2014 and the period after implementation of the SSM refers to years 2015–2017.

In Figure 2 we inspect the parallel trend of the dependent variable Ln Z-score BS of our models for testing the first hypothesis, for both, the treatment group and the control group of banks before and after implementation of the SSM in the Euro area. As we already explain, the treatment group refers to the banks that fall under direct supervision of the ECB whereas the control group refers to the banks that fall under supervision of the NSAs. In Figure 2 both lines, the line of Ln Z-score BS of the treatment group and the line of Ln Z-score BS of the control group, seem to be almost parallel in the period before the official implementation of the SSM in the Euro area. In the period after the implementation of the SSM, we see the line of the Ln Z-score BS of the treatment group crosses the line of the Ln Z-score BS of the control group and continues with upward trend above the line of the control group.

Figure 2. First hypothesis: Parallel trend assumption



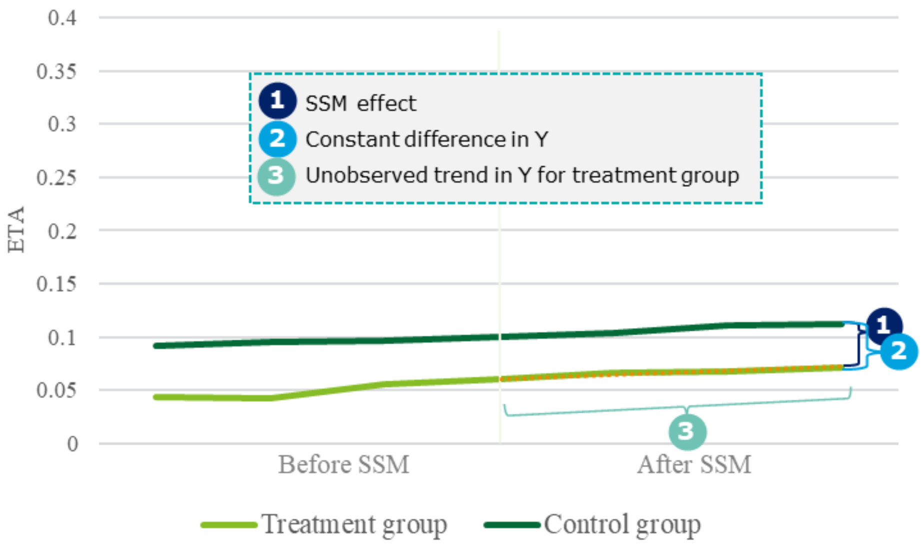
Source: own work.

The difference-in-difference estimator relies on assumption that in absence of the implementation of the SSM, the unobserved differences between the treatment and the control group are constant over time. Therefore, in Figure 2 we mark the "Unobserved trend in Y for treatment group", which refers to the trend of the Ln Z-score BS of the significant banks under assumption the SSM was never implemented in the Euro area. The "Constant difference in Y" measures the difference in Ln Z-score BS between the treatment and the control group of banks under assumption the SSM was never implemented. The "SSM effect" measures the change in the Ln Z-score BS of the treatment group of banks that appears due to implementation of the SSM. We do see a change in the trend of the Ln Z-score BS treatment group of banks before and after implementing the SSM in the Euro area. After implementing the SSM in the Euro area, the Ln Z-score BS as a measure of bank's safety increased for the banks that fall under direct supervision of the ECB.

In Figure 3 we inspect the parallel trend of the dependent variable ETA of our models for testing the second hypothesis, for both, the treatment group and the control group of banks before and after implementation of the SSM in the Euro area. As we already explain, the *treatment group* refers to the banks that fall under direct supervision of the ECB whereas the *control group* refers to the banks that fall under supervision of the NSAs. Both lines, the line of the equity to total assets ratio of the treatment group and the line of the equity to total assets ratio of the control group, have smooth upward trend during the analyzed period - before and after implementing the SSM in the Euro area.

The difference-in-difference estimator relies on assumption that in absence of the implementation of the SSM, the unobserved differences between the treatment and the control group are constant over time. Therefore, in Figure 3 the "Unobserved trend in Y for treatment group" refers to the trend of the equity to total assets ratio of the significant banks under assumption the SSM was never implemented in the Euro area. The "Constant difference in Y" measures the difference in the equity to total assets, between the treatment and the control group under assumption the SSM was never implemented. The "SSM effect" measures the change in the equity to total assets ratio of the treatment group of banks which happens due to implementation of the SSM. In Figure 3 the "SSM effect" and the "Constant difference in Y" seem to be equal. This implies there is no change in the trend of the equity to total assets ratio of the treatment group of banks before and after implementing the SSM in the Euro area.

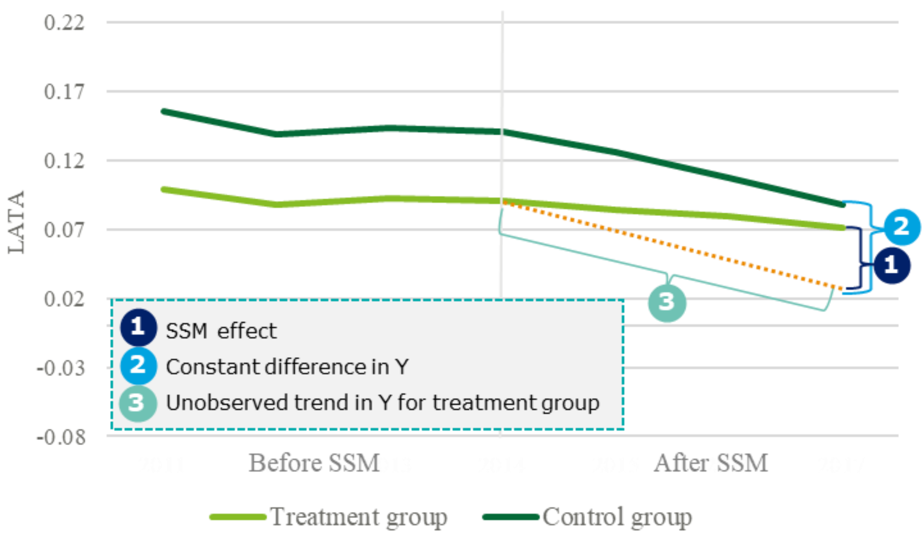
Figure 3. Second hypothesis: Parallel trend assumption



Source: own work.

In Figure 4 we inspect the parallel trend of the dependent variable LATA of our models for testing the third hypothesis, for both, the treatment group and the control group of banks before and after implementation of the SSM in the Euro area. As we already explain, the *treatment group* refers to the banks that fall under direct supervision of the ECB whereas the *control group* refers to the banks that fall under supervision of the NSAs. The change in liquidity, measured via the liquid assets to total assets ratio, after the implementation of the SSM in the Euro area is not the same in both treatment and control group of banks. Namely, both lines, the line of the liquid assets to total assets ratio of the treatment group and the line of the liquid assets to total assets ratio of the control group, follow parallel trend before the implementation of the SSM. After the implementation of the SSM, we see the line of the liquid assets to total assets ratio of the treatment group is coming closer to the line of the control group. This implies that the implementation of the SSM in the Euro area affects the liquidity of banks. Liquid assets of the less significant banks, measured via the ratio of liquid assets to total assets, follow sharper decreasing trend than the liquid assets of the significant banks.

Figure 4. Third hypothesis: Parallel trend assumption



Source: own work.

The difference-in-difference estimator relies on assumption that in absence of the implementation of the SSM, the unobserved differences between the treatment and the control group are constant over time. Therefore, in Figure 4 the "Unobserved trend in Y for treatment group" refers to the trend of the liquid assets to total assets ratio of the significant banks. The "Constant difference in Y" measures the difference in the liquid assets to total assets ratio between the treatment and the control group under assumption the SSM was never implemented. The "SSM effect" measures the change in the liquid assets to total assets ratio of the treatment group of banks which happens due to implementation of the SSM. We do see a change in the trend of the liquid assets to total assets ratio of the treatment group of banks before and after implementing the SSM in the Euro area. After the implementation of the SSM, the significant banks that fall under direct supervision of the ECB, decreased their liquid assets less than the less significant banks.

4.2 Sample correlation

We inspected the correlation of the variables in each of the models with correlation matrix. As a rule of a thumb, the closer the correlation coefficient is to one, the stronger collinearity exists between the variables (Hill, Griffiths and Lim, 2018).

In Table 4 (see Appendix C) we show the correlation matrix of the variables of the second stage model we develop for testing our first hypothesis: Increased bank stability in the Euro area relates to the implementation of SSM. We see strong negative correlation between the variables Ln Z-score BS and Ln TA. The correlation coefficient of -0.9111 implies that bigger banks have lower Z-scores BS and hence higher probability of bankruptcy. The variables TA and Ln TA show high correlation coefficient as well. However, we ignore this correlation coefficient because we include the TA variable in the model only to incorporate a dummy variable to differentiate between banks that fall under direct supervision of the ECB and banks that fall under supervision of the NSAs.

Table 7 (see Appendix D) displays the correlation matrix of the variables of the second stage model we develop for testing our second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM. As we can see from Table 13, the strongest correlation exists between the variables ETA and Ln TA with correlation coefficient of -0.4392; and ETA and ROAA with correlation coefficient of 0.4162. The variables TA and Ln TA show high correlation coefficient, however, we ignore this correlation coefficient because we include the TA variable in the model only to incorporate a dummy variable to differentiate between banks that fall under direct supervision of the ECB and banks that fall under supervision of the NSAs.

In Table 10 (see Appendix E) we show the correlation matrix of the variables of the second stage model we develop for testing our third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM. The strongest correlation exists between the ETA and Ln TA with correlation coefficient of -0.4434. The variables TA and Ln TA show high correlation coefficient as well. However, we ignore this correlation coefficient because we include the TA variable in the model only to incorporate a dummy variable to differentiate between banks that fall under direct supervision of the ECB and banks that fall under supervision of the NSAs.

4.3 Multicollinearity

In addition to the correlation matrix, we run VIF in order to check for multicollinearity issues in our models. Multicollinearity occurs when there is high correlation between two or more independent variables, or in other words, it occurs when one variable can predict the other. Multicollinearity is a problem since it affects the signs of the coefficients and results in unstable coefficient estimates. VIF is a measure for detecting multicollinearity and measures how much the variance of the estimated coefficients is inflated. A variance factor higher than four shows high correlation of the coefficient with at least one variable in the model (Baum, 2006).

Table 5. First hypothesis: Variance Inflation Factor

Variables	**VIF**	**1/VIF**
Ln TA	103.86	0.0096
Ln Z-score FR	93.00	0.0108
Treated	5.25	0.1904
UE	5.04	0.1986
ETA	4.48	0.2232
Time	3.75	0.2670
DID	2.93	0.3417
NIIEA	2.81	0.3554
INF	2.59	0.3864
NPLTL	2.38	0.4199
LATA	1.91	0.5239
GGDP	1.70	0.5877
ROAA	1.56	0.6414
CI	1.02	0.9843
Mean VIF	16.59	

Source: own work.

Table 6. Second hypothesis: Variance Inflation Factor

Variables	**VIF**	**1/VIF**
Ln TA	12.61	0.0793
Treated	4.55	0.2198
UE	4.15	0.2408
Time	3.53	0.2835
DID	2.90	0.3446
INF	2.54	0.3938
GGDP	1.63	0.6139
ROAA	1.22	0.8220
GGL	1.07	0.9326
CI	1.01	0.9942
Mean VIF	3.52	

Source: own work.

In Table 5 we show the VIF of the variables of the second stage model we develop for testing our first hypothesis: Increased bank stability in the Euro area relates to the implementation of SSM. As we can see from Table 5 the mean, VIF of all variables is 16.59. To deal with the multicollinearity issue, we remove from the model all variables with VIF above four: Ln Ta with factor of 103.86, Ln Z-score FR with factor of 93, UE with factor of 5.04 and ETA with factor 4.48.

In Table 6 we show the VIF of the variables of the second stage model we develop for testing our second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM. The mean VIF of all variables included in our second model is 3.52. To deal with the multicollinearity issue, we remove from the model only two variables with VIF above four: Ln TA with factor of 12.61 and UE with factor of 4.15.

In Table 7 we show the VIF of the second stage model we develop for testing our third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM. As we can see from Table 15 the mean VIF of all variables is 3.99. To deal with the multicollinearity issue, we remove from the model the following three variables: Ln TA with factor of 13.89, UE with factor of 4.97 and ETA with factor 4.72

Table 7. Third hypothesis: Variance Inflation Factor

Variables	**VIF**	**1/VIF**
Ln TA	13.89	0.0720
UE	4.97	0.2011
Treated	4.80	0.2082
ETA	4.72	0.2119
Time	3.55	0.2815
DID	2.84	0.3520
INF	2.65	0.3774
LLRL	2.07	0.4828
GGDP	1.62	0.6181
ROAA	1.47	0.6786
LD	1.32	0.7572
Mean VIF	3.99	

Source: own work.

4.4 Econometric estimation

We test the three hypothesis with difference-in-difference estimator in a two-stage approach. In the first stage, we inspect the effect of implementing of SSM on: 1) the bank safety - in terms of probability of bankruptcy, 2) financial strength and 3) liquidity. In the second stage, we control the results by adding bank-specific and macroeconomic variables in the models. In all models, the coefficient DID_{it} is the difference-in-difference estimator that we observe at significance level of 0.05. Generally, under the null hypothesis we test whether the change in our dependent variable after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. If our coefficient of interest DID is statistically significant at the 0.05 significance level, we reject the null hypothesis (Hill, Griffiths and Lim, 2018).

Before running the regressions, we conduct Hausman test to all models to decide whether fixed effects or random effects estimator is appropriate for estimating our equations in first and second stage models and obtain reliable conclusions. Generally, under the null hypothesis we choose random effects model since obtains more efficient estimates, whereas under the alternative hypothesis we chose the fixed effect model, at significance level of 0.05 (Hill, Griffiths and Lim, 2018).

4.4.1 First hypothesis: Econometric estimations

When testing the first hypothesis: Increased bank stability in the Euro area relates to the implementation of SSM, for the first and second stage models, at the level of significance of 0.05 we reject the null hypothesis of the Hausman test that we should use random effects estimator (Baum, 2006). Therefore, we run the equation (2) and equation (3) with the fixed effect estimator.

When testing the first hypothesis with the difference-in-difference estimator in the first stage model or equation (2), we get statistically significant coefficient of interest DID, at the 0.05 significance level. Hence, we reject the null hypothesis that the change in Ln Z-score BS after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. In the control group, or group of banks that fall under supervision of the NSAs with close cooperation with the ECB, the expected mean change in Ln Z-score BS is 0.1515075 after the implementing the SSM in the Euro area. This number corresponds to the coefficient of our variable Time.

In the treatment group, or group of banks that fall under direct supervision of ECB, the expected mean change in Ln Z-score BS is 0.3012267 after the implementation of the SSM. We get the expected mean change in Ln Z-score BS of the treatment group as sum of the coefficients of Time and DID. The effect of implementing the SSM between our control and treatment group is the difference of those changes 0.1497192, which is our coefficient of interest, DID. DID shows that the expected mean change in Ln Z-score BS from before to after the implementation of the SSM is different in the control and treatment groups. The coefficient of the variable Treated, -0.9810835, is the estimated mean difference in Ln Z-score between the treatment and control groups prior the treatment. It shows the differences that existed between the groups before implementing the treatment.

We test the first hypothesis with the difference-in-difference estimator in the second stage model or equation (3) by adding additional bank-specific and macroeconomic variables as control variables. Our coefficient of interest DID is statistically significant at the 0.05 significance level. Hence, we reject the null hypothesis that the change in Ln Z-score BS after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. In the control group, or group of banks that fall under supervision of the NSAs, the expected mean change in Ln Z-score BS is 0.0758946 after the implementing the SSM in the Euro area. This number corresponds to the coefficient of our variable Time.

Table 8 displays the results from the difference-in-difference estimator, the respective standard errors and p-values, in both models, first and second stage, as well as the results from the Hausman test.

Table 8. First hypothesis: Difference-in-difference estimator, respective standard errors and p-values

Variables	**First stage (1)**	**Second stage (2)**
Constant	3.3046*** (0.0438)	3.2388*** (0.0689)
Time	0.1515*** (.0255)	0.0759*** (0.0997)
Treated	-0.9811*** (0.1014)	-0.9265*** (0.0997)
DID	0.1497*** (0.0404)	0.1403*** (0.0349)
ROAA		19.942*** (0.9179)
NIIEA		3.7810* (2.1297)
CI		0.00007 (0.0002)
NPLTL		-0.0838 (0.1754)
LATA		-0.2334 (0.1702)
GGDP		-0.2056 (0.5139)
INF		-2.7854*** (0.8133)
N observations N groups	1,132 165	1,022 165
R^2	Within = 0.1949 Between = 0.0052 Overall = 0.0068	Within = 0.4950 Between = 0.0393 Overall = 0.0506
F-statistics	F(3, 964) = 77.78***	F(10, 850) = 83.30***
sigma_u sigma_e rho	1.2544 .3257 .9369	1.2290 .2604 .9570
Hausman test	chi2 = (b-B)’[(V_b-V_B)^(-1)](b-B) = 103.46 ***	

*Note: Standard errors in parentheses; *, **, *** Indicates significant at the 0.1 level, 0.05 level and 0.01 level; We remove variables Ln Z-score FR, UE, ETA and Ln TA due to multicollinearity (see Table 5); For the sake of clarity we rounded numbers in table on four decimals.*
Source: own work.

In the treatment group, or group of banks that fall under direct supervision of ECB, the expected mean change in Ln Z-score BS is 0.2161503 after the implementation of the SSM. We get the expected mean change in Ln Z-score BS of the treatment group as sum of the coefficients of Time and DID. The effect of implementing the SSM between our control and treatment group is the difference of those changes 0.1402557, which is our coefficient of interest, DID. DID shows that the expected mean change in Ln Z-score BS from before to after the implementation of the SSM is different in the control and the treatment groups. The coefficient of the variable Treated, -0.9264841, is the estimated mean difference in Ln Z-score between the treatment and control groups prior the treatment. It shows the differences that existed between the groups before implementing the treatment.

Due to multicollinearity we remove the following variables from equation (3): Ln TA, Ln Z-score FR, ETA and UE.

The ROAA variable in the second stage model has positive sign and is statistically significant, at the significance level of 0.05. We use ROAA as a proxy for profitability. The sign is consistent with the theory. Generally, profitable banks are safer. The following variables are statistically insignificant: NIIEA, CI, NPLTL, LATA and GGDP, at the significance level of 0.05. The coefficient of the INF variable is negative and statistically significant, at the significance level of 0.05. We use the INF variable as a proxy for the macroeconomic situation. In times of inflation, the value of the savings erodes and consequently the supply of deposits is decreased.

To sum up, when testing the first hypothesis: Increased bank stability in the Euro area is related to the implementation of SSM, in both first and second stage, we reject the null hypothesis that the change in Ln Z-score BS after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. The effect of implementing the SSM in terms of increased bank stability measured via the Ln Z-score BS is the difference of the changes between the control group of banks and the treatment group of banks in our empirical research and is 0.1497192 in the first stage and 0.1402557 in the second stage model.

We can conclude that the implementation of the SSM has positive effect towards bank safety in the banking system of the Euro area. We confirm the same result with the parallel trend inspection of the dependent variable Ln Z-score BS for both, the treatment group and the control group of banks in Figure 2. In the Figure 2, in the period after the implementation of the SSM we see the line of the Ln Z-score BS of the treatment group crosses the line of the Ln Z-score BS of the control group and continues with upward trend above the line of the control group. This lead to conclusion that after the implementation of the SSM in the Euro area the Ln Z-score BS as a measure of bank's safety increased for the banks that fall under direct supervision of the ECB.

The SSM is a recent phenomenon and undergoes frequent changes since ECB constantly improves the supervisory practices striving for more consistent and high quality supervisory practices. This leaves space for further empirical analysis of the effect from implementing the SSM in the medium and long run.

4.4.2 Second hypothesis: Econometric estimations

When testing the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, for the first and second stage models, at the level of significance of 0.05 we reject the null hypothesis of the Hausman test that we should use random effects estimator (Baum, 2006). Therefore, we run the equation (6) and equation (7) with the fixed effect estimator.

When testing the second hypothesis with the difference-in-difference estimator in the first stage model or equation (6), we got we got statistically insignificant coefficient of interest DID, at the 0.05 significance level. Hence, we cannot reject the null hypothesis that the change in financial strength, after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. The coefficient of the variable Treated -0.0445365 is the estimated mean difference in the dependent variable between the treatment and control groups, prior the treatment. It shows the differences that existed between the groups before implementing the treatment. The coefficient of the variable Time is 0.0136928 and shows the expected mean change in the dependent variable of the control group, after implementing the SSM.

We test the second hypothesis with the difference-in-difference estimator in the second stage model or equation (7) by adding additional bank-specific and macroeconomic variables as control variables. Our coefficient of interest DID is statistically insignificant, at the 0.05 significance level. Hence, we cannot reject the null hypothesis that the change in financial strength, after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. The coefficient of the variable Treated -0.0427789 is the estimated mean difference in dependent variable between the treatment and control groups prior the treatment. It shows the differences that existed between the groups before implementing the treatment. The coefficient of the variable Time is 0.0081985 and shows the expected mean change in the dependent variable of the control group, after implementing the SSM.

Due to multicollinearity we remove the following variables from equation (7): Ln TA and ETA and UE.

The ROAA variable in the second stage model has positive sign and is statistically significant, at the significance level of 0.05. We use ROAA, calculated as ratio of net income and the average of total assets, as a proxy for bank's profitability. Banks with riskier asset structure need to hold additional funds for covering potential risks and in turn, riskier assets have higher returns. The following variables are statistically insignificant: GGL, CI, GGDP, and INF, at the significance level of 0.05.

To sum up, when testing the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, for the first and second stage models, at the level of significance of 0.05 we cannot reject the null hypothesis that the change in financial strength, after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group.

Table 9 displays the results from the difference-in-difference estimator, the respective standard errors and p-values, in both models, first and second stage, as well as the results from the Hausman test.

Table 9. Second hypothesis: Difference-in-difference estimator, respective standard errors and p-values

Variables	**First stage (1)**	**Second stage (2)**
Constant	0.0956*** (0.0042)	0.0963*** (0.0042)
Time	0.0137*** (0.0025)	0.0082*** (0.0026)
Treated	-0.0445*** (0.0096)	-0.0428*** (0.0089)
DID	0.0037 (0.0040)	0.0025 (0.0037)
GGL		-0.0161 (0.0049)
CI		-0.0000 (0.0000)
ROAA		0.9476*** (0.0783)
GGDP		0.0356 (0.0508)
INF		-0.1228 (0.0859)
N observations N groups	1,154 165	1,149 165
R^2	Within = 0.0846 Between = 0.1887 Overall = 0.1571	Within = 0.2211 Between = 0.2990 Overall = 0.2745
F-statistics	F(3,986) = 30.39***	F(8,976) =34.63***
sigma_u sigma_e rho	0.0434 0.0325 0.6407	0.0405 0.0301 0.6447
Hausman test	chi2 = (b-B)'[(V_b-V_B)^(-1)](b-B) = 398.03***	

*Note: Standard errors in parentheses; *, **, *** Indicates significant at the 0.1 level, 0.05 level and 0.01 level; We remove variables Ln TA, UE, and ETA due to multicollinearity (see Table 6); For the sake of clarity we rounded numbers in table on four decimals.*
Source: own work.

We can conclude that the implementation of the SSM has no effect towards banks' financial strength, measured via the equity to total assets ratio, of the banks in the Euro area. We confirm the same result with the parallel trend inspection of the dependent variable ETA for both, the treatment group and the control group of banks in Figure 3. In Figure 3, both lines, the line of the equity to total assets ratio of the treatment group and the line of the equity to total assets ratio of the control group, have smooth upward trend during the analyzed period.

We notice no change in the trend of the equity to total assets ratio of the treatment group of banks before and after implementing the SSM in the Euro area.

A possible reason for not identifying any effect of the SSM implementation on banks' financial strength, measured via the equity to total assets ratio, might be found in the regulation for capital adequacy and leverage. According to the global regulatory standard Basel III, banks must meet minimum capital adequacy of 10.5 %, out of which 8 % should be Tier 1 and Tier 2 capital and 2.5 % should be capital conservation buffer. The minimum CET1 ratio that must be maintained by banks starting from 2015 is 4.5%, whereas the leverage ratio must be above 3% (European Council, 2019). Many banks as part of their internal policies tend to hold capital in excess of the capital and leverage requirements.

4.4.3 Third hypothesis: Econometric estimations

We test the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, for both the first and second stage models, with the Hausman test. Under the null hypothesis of the Hausman test we choose random effects model since obtains more efficient estimates, whereas under the alternative hypothesis we chose the fixed effect model (Baum, 2006). When testing the third hypothesis, at the level of significance of 0.05, we cannot reject the null hypothesis of the Hausman test. Therefore, we run the equation (8) and equation (9) with the random effect estimator.

When testing the third hypothesis with the difference-in-difference estimator in the first stage model or equation (8), we get statistically significant coefficient of interest DID, at the 0.05 significance level. Hence, we reject the null hypothesis that the change in liquidity after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. In the control group, or group of banks that fall under supervision of the NSAs, the expected mean change in the liquidity ratio is -0.0372524 after the implementing the SSM in the Euro area. This number corresponds to the coefficient of our variable Time. In the treatment group, or group of banks that fall under direct supervision of ECB, the expected mean change in the liquidity ratio is -0.017414 after the implementing the SSM. We get the expected mean change in LATA of the treatment group as sum of the coefficients of Time and DID. The effect of implementing the SSM between our control and treatment group is the difference of those changes 0.0198384 which is our coefficient of interest DID. DID shows that the expected mean change in the liquidity ratio from before to after the implementation of the SSM is different in the control and treatment groups. The coefficient of the variable Treated, -0.0374089, is the estimated mean difference in LATA between the treatment and control groups prior the treatment. It shows the differences that existed between the groups before implementing the treatment.

We test the third hypothesis with the difference-in-difference estimator in the second stage model or equation (9) by adding additional bank-specific and macroeconomic variables as control variables. Our coefficient of interest DID is statistically significant at the 0.05 significance level. Hence, we reject the null hypothesis that the change in liquidity after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. In the control group, or group of banks that fall under supervision of the NSAs, the expected mean change in liquidity ratio is -0.0410627 after the implementing the SSM in the Euro area. This number corresponds to the coefficient of our variable Time.

In the treatment group, or group of banks that fall under direct supervision of ECB, the expected mean change in liquidity ratio is -0.0252761 after the implementing the SSM. We get the expected mean change in LATA of the treatment group as sum of the coefficients of Time and DID. The effect of implementing the SSM between our control and treatment group is the difference of those changes 0.0157866 which is our coefficient of interest DID. DID shows that the expected mean change in the liquidity ratio from before to after the implementation of the SSM is different in the control and treatment groups. The coefficient of the variable Treated, -0.0332746, is the estimated mean difference in LATA between the treatment and control groups prior the treatment. It shows the differences that existed between the groups before implementing the treatment.

The LD variable in the second stage model has positive sign and is statistically significant, at the significance level of 0.05. In theory, if the percentage of the loans to consumers' deposits ratio increases, the bank may not have enough liquidity to cover any unanticipated fund requirements. However, banks can alter their liquid assets, by borrowing on the inter-bank market or from the central bank. This might explain the positive correlation of this variable with the dependent variable in the model.

The following variables are statistically insignificant: ROAA, LLRL and INF, at the significance level of 0.05. The coefficient of the GGDP variable in the second stage model has positive sign and is statistically significant, at the significance level of 0.05. The positive sign of the GGDP variable is consistent with the theory. Namely, at times of crisis banks tend to hold more liquid assets since there is increased probability that creditors will default on their debts to banks. If creditors default on their debts to banks, then banks without liquid assets which can be easily converted to cash, will default to back the principal and the interest to the depositors which consequently might lead to bankruptcy.

To sum up, when testing the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, for both the first and second stage models, we reject the null hypothesis that the change in LATA after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. The effect of implementing the SSM in terms of liquidity is the difference of the changes between the control group of banks and the treatment group of banks in our empirical research and is 0.0157866 in the first stage and 0.0157866 in the second stage model.

Table 10 displays the results from the difference-in-difference estimator, the respective standard errors and p-values, in both models, first and second stage, as well as the results from the Hausman test. Due to multicollinearity we remove the following variables from equation (9): Ln TA, ETA and UE.

Table 10. Third hypothesis: Difference-in-difference estimator, respective standard errors and p-values

Variables	**First stage (1)**	**Second stage (2)**
Constant	0.1375*** (0.0110)	0.1339*** (0.0117)
Time	-0.0373*** (0.0047)	-0.0411*** (0.0053)
Treated	-0.0374*** (0.0136)	-0.0333** (0.0135)
DID	0.01984*** (0.0075)	0.01579** (0.0075)
LD		0.0014** (0.0006)
ROAA		-0.1289 (0.1496)
LLRL		-0.0273 (0.0480)
GGDP		0.3820*** (0.0999)
INF		-0.0699 (1734)
N observations N groups	1,092 162	1,064 162
R^2	Within = 0.0703 Between = 0.0279 Overall = 0.0358	Within = 0.0837 Between = 0.0629 Overall = 0.0596
Wald chi2	(3) = 74.30***	(8) = 89.27***
sigma_u sigma_e rho	0.1152 0.0587 0.7937	0.1122 0.0570 0.7947
Hausman test	chi2 = (b-B)’[(V_b-V_B)^(-1)](b-B) = 19.97*	

*Note: Standard errors in parentheses; *, **, *** Indicates significant at the 0.1 level, 0.05 level and 0.01 level; We remove variables Ln TA, UE, and ETA due to multicollinearity (see Table 7); For the sake of clarity we rounded numbers in table on four decimals.*
Source: own work.

We can conclude that the implementation of the SSM affects bank liquidity, measured via the liquid assets to total assets, of the banks in the Euro area. We confirm the same result with the parallel trend inspection of the dependent variable LATA for both, the treatment group and the control group of banks in Figure 4. We see in Figure 4, the line of the liquid assets to total assets ratio of the treatment group is coming closer to the line of the control group in the period after the SSM implementation. This confirms our finding that the implementation of the SSM in the Euro area affects the liquidity of banks. However, the liquid assets of the less significant banks follow sharper decreasing trend than the liquid assets of the significant banks. In other words, after the implementation of the SSM, the significant banks, which fall under direct supervision of the ECB, decreased their liquid assets less than the less significant banks.

A possible reason for the decreasing trend of the liquid assets of banks might be the cost efficiency. Namely, on individual bank level, by holding liquid assets such as: cash, central bank assets and central government assets, the resilience of the banks is positively affected and the liquidity risk is reduced. Liquid and capitalized banks can borrow by lower cost of funding, which positively affects bank profitability. However, after an optimum level of liquid assets, any additional liquid assets diminish bank's returns (European Banking Authority, 2017). In other words, maintaining excess liquidity – holdings of reserves above the reserve requirements, is costly and reduces bank's profitability via lower net interest spreads.

The excess liquidity was an interesting phenomenon in the Euro area after the crisis in 2007. It was identified on country level – in Germany, France, Netherlands, Finland and Luxembourg, and on institution level – the top 50 banks hold 70-80 % of the excess liquidity. However, according to a research performed by the ECB, rising trend of excessive liquidity appeared again in 2015. However, this time the excess liquidity did not appeared because of the crisis as in the period between 2008 and 2012, but it was driven by the asset-purchasing program of the ECB. According to ECB, the asset purchasing was the dominant factor for the excess liquidity in the Euro area in 2015. On individual, or bank level, there are different factors that might affect the excess liquidity: the business model, the internal liquidity management strategy of the bank as well as the regulatory requirements. For instance, investment banks tend to hold more excess liquidity than commercial banks (Baldo et al., 2017).

Another factor that might affect the excess liquidity in 2015 was the introduction of the minimum standards for funding and liquidity risk in the Basel III: LCR ratio and NSFR ratio. Although, both standards were set to minimum required level of 100 %, the minimum required level was not intended to be achieved by the banks immediately, but was set to increase gradually in the period from 2015–2018. However, one year after the implementation of the LCR ratio, the average LCR ratio in the Euro area was 139 % significantly above the minimum requirement of 100 % that should have been implemented starting from January 2018 (European Banking Authority, 2017).

Another reason for the decreasing trend of the liquidity might be the overall health of the economy. Namely, in times of crisis banks tend to hold more liquid assets since there is increased probability that creditors will default on their debts to banks. The economy in the

Euro area recovered from the latest crisis, which might be a reason for the decreasing trend of the liquid assets of banks we identified.

CONCLUSION

In this Master's thesis, we analyze the effect of the implementation of the SSM in the Euro area from three perspectives: *bank safety* - in terms of probability of bankruptcy, *financial strength* and *liquidity*. We choose bank safety - in terms of probability of bankruptcy, since the top priority of the SSM is keeping the banking system stable. Our second perspective for analyzing the effect from implementing the SSM in the Euro area covers the financial strength of the banks measured in terms of banks' capital. A bank with strong capital base is less vulnerable to default in its loans and economic downturns since it can easily absorb incurred losses and maintain solvency (Federal reserve bank of Cleveland, 2012). Our third perspective for analyzing the effect from implementing the SSM covers banks' liquidity. The liquidity is an important perspective for assessing banks' health during the SREP. SREP is integral part of the supervision process for evaluating both significant and less significant banks. Moreover, supervisors perform focused liquidity stress tests Euro area banks in order to assess bank's resilience to liquidity shocks (European central bank, 2014).

The main purpose of this Master's thesis is to investigate if the SSM fulfils its purpose of implementation. We examine the effect of implementing the SSM in the Euro area and to inspect whether the implementation of the SSM contributes to the safety of the banks in the Euro area. For this purpose, we develop three hypotheses. With the first hypothesis: Increased bank stability in the Euro area is related to the implementation of SSM, we observe the effect of implementing the SSM on the Euro area banks, from the perspective of *bank safety* - in terms of probability of bankruptcy. With the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, and the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, we examine the effects of implementing the SSM on the *financial strength* of the banks and the effect of implementing the SSM on *banks' liquidity*.

We build our empirical research on a sample of balanced panel data for 165 Euro area banks that fall under the scope of the SSM, for the period from 2011–2017. We retrieve the data from the Fitch Connect database and the World Bank data set and apply it on constructed models. We test our hypotheses in the statistical software Stata with the difference-in-difference estimator in a two-stage approach and the Hausman test. Additionally, we inspect the parallel trend assumption of the difference-in-difference estimator and we inspect our models for collinearity and multicollinearity.

When testing the first hypothesis: Increased bank stability in the Euro area is related to the implementation of SSM, in both first and second stage, we reject the null hypothesis that the change in Ln Z-score BS after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. The effect of implementing the SSM in terms of increased bank stability measured via the Ln Z-score BS in our empirical study is the coefficient of interest DID which is 0.1497192 in the first stage and 0.1402557 in the second stage model. When testing the second hypothesis: Increased financial strength of the Euro area banks relates to the implementation of SSM, for the first and second stage models, at the level of significance of 0.05 we cannot reject the null hypothesis that the change in financial strength, after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. When testing the third hypothesis: Increased liquidity of the Euro area banks relates to the implementation of SSM, for both the first and second stage models, we reject the null hypothesis that the change in LATA after implementing the SSM in the Euro area is the same in both groups of banks, the treatment group and the control group. The effect of implementing the SSM in terms of liquidity is our coefficient of interest DID which is 0.0157866 in the first stage and 0.0157866 in the second stage model.

Based on the results of our empirical research we can derive the following conclusions regarding the implementation of the SSM in the Euro area:

- The implementation of the SSM contributes to the safety of the banking system measured in terms of probability of bankruptcy. After the implementation of the SSM in the Euro area, the Ln Z-score BS as a measure of bank's safety increased for the banks that fall under direct supervision of the ECB. We confirm this conclusion in Figure 2.
- The implementation of the SSM has no effect towards banks' financial strength, measured via the equity to total assets ratio. There is no change in the trend of the equity to total assets ratio of the treatment group of banks before and after implementing the SSM in the Euro area. We confirm this conclusion in the Figure 3. A possible reason for identifying no effect of the SSM implementation on banks' financial strength, measured via the equity to total assets ratio, might be found in the regulation for capital adequacy and leverage.
- The implementation of the SSM affects bank liquidity, measured via the liquid assets to total assets. After the implementation of the SSM, the significant banks, which fall under direct supervision of the ECB, decreased their liquid assets less than the less significant banks. We confirm this conclusion in the Figure 4. Possible reasons for the decreasing trend of the liquid assets of banks might be the cost efficiency and the overall health of the economy.

Due to the recent implementation of the SSM in the banking system in the Euro area, there are no published quantitative researches in the literature, which investigate whether the SSM contributes to the safety of the banking system, making banks more resilient and prone to less risk taking. Therefore, with this Master's thesis, we contribute to the literature by opening a new, undiscovered field for research.

The SSM is a recent phenomenon and undergoes frequent changes since ECB constantly improves the supervisory practices striving for more consistent and high quality supervisory practices. This leaves space for further empirical analysis of the effect from implementing the SSM.

REFFERENCE LIST

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APPENDICES

APPENDIX A: Summary of the thesis in Slovenian language

Enotni nadzorni mehanizem (angl. Single Supervisory Mechanism) je nedavni fenomen, ki je zelo pomemben za splošno stabilnost finančnega sistema v Evropi. Enotni nadzorni mehanizem, implementiran v novembru 2014, deluje v smeri zagotavljanja varnosti bank in finančnega sistema v Evropi. Banke razdeli na pomembne in na manj pomembne. Sredstva pomembnih bank obsegajo približno 85 % bančnih sredstev v evro območju in spadajo pod neposredni nadzor Evropske centralne banke. Manj pomembne banke so nadzorovane s strani njihovih nacionalnih nadzornih organov. Evropska centralna banka in nacionalni nadzorni organi tesno sodelujejo in preverjajo ali manj pomembne banke sledijo bančnim pravilom in pravočasno rešujejo vse težave, ki se pojavijo. Glavni cilj te magistrske naloge je raziskati ali Enotni nadzorni mehanizem izpolnjuje svoj namen implementacije.

V tej magistrski nalogi empirično preučujemo učinek implementacije Enotnega nadzornega mehanizma v evro območju in preverjamo ali implementacija Enotnega nadzornega mehanizma prispeva k večji varnosti finančnega sistema v Evropi kot celoti. V ta namen testiramo prvo hipotezo z modelom razlike v razlikah (angl. difference-in-difference estimator): Povečana stabilnost bank v evro območju je povezana z izvajanjem Enotnega nadzornega mehanizma. Poleg opazovanja stabilnosti bank v evro območju z vidika *bančne varnosti* - v smislu verjetnosti stečaja, opazujemo stabilnost bank še z drugih dveh perspektiv: *finančne moči* in *likvidnosti*. S tem namenom testiramo še dve hipotezi, ki preučujeta učinke implementacije Enotnega nadzornega mehanizma na finančno moč in likvidnosti z uporabo modela razlike v razlikah. Druga hipoteza: Povečana finančna moč v evro območju je povezana z implementacijo Enotnega nadzornega mehanizma in tretja hipoteza: Povečana likvidnost v evro območju je povezana z implementacijo Enotnega nadzornega mehanizma.

Empirično raziskavo gradimo na vzorcu uravnoteženih panelnih podatkov za 165 bank evro območja, ki spadajo pod okrilje Enotnega nadzornega mehanizma, za obdobje od leta 2011 do 2017. Podatke pridobimo iz podatkovne baze Fitch Connect in podatkovne zbirke Svetovne banke ter jih uporabimo na izdelanih modelih. Hipoteze testiramo v statistični programski opremi Stata z uporabo modela razlike v razlikah, v dvostopenjskem pristopu in Hausmanovem testu. Poleg tega preverjamo predpostavko vzporednega trenda (angl. parallel trend) modela razlike v razlikah in pregledujemo naše modele za kolinearnost in multikolinearnost.

Na podlagi rezultatov našega empiričnega raziskovanja lahko izpeljemo naslednje sklepe o uvedbi Enotnega nadzornega mehanizma v evro območju:

- Uvedba Enotnega nadzornega mehanizma prispeva k varnosti bančnega sistema, merjeno z vidika verjetnosti stečaja. Po uvedbi Enotnega nadzornega mehanizma v evro območju se je Ln Z-score BS kot merilo varnosti bank, povečalo za pomembne banke, ki so pod neposrednim nadzorom Evropske centralne banke. To ugotovitev potrjujemo na Sliki 2.

- Uvedba Enotnega nadzornega mehanizma ne vpliva na finančno moč bank, merjeno s pomočjo razmerja med lastniškim kapitalom in skupnimi sredstvi. Trend gibanja deleža lastniškega kapitala v bilančni vsoti tretiranih skupin bank, pred in po uvedbi Enotnega nadzornega mehanizma v evro območju, ni spremenjen. To ugotovitev potrjujemo na Sliki 3.
- Uvedba Enotnega nadzornega mehanizma vpliva na likvidnost bank, merjeno prek razmerja med likvidnimi sredstvi in celotnimi sredstvi. Po uvedbi Enotnega nadzornega mehanizma so pomembne banke, ki so pod neposrednim nadzorom Evropske centralne banke, zmanjšale likvidna sredstva v manjšem obsegu kot manj pomembne banke. To ugotovitev potrjujemo na sliki 4.

Zaradi nedavne implementacije Enotnega nadzornega mehanizma v bančni sistem v Evropi še ni objavljenih kvantitativnih raziskav, ki bi proučevale ali Enotni nadzorni mehanizem prispeva k varnosti bančnega sistema preko zagotavljanja odpornosti in zniževanja tveganja. S to magistrsko nalogo prispevamo k obstoječi literaturi z odprtjem novega, neodkritega področja za raziskave.

Enotni nadzorni mehanizem je nedavni pojav in se pogosto spreminja, saj Evropska centralna banka nenehno izboljšuje nadzorne prakse in si prizadeva za bolj dosledne in kakovostne nadzorne prakse. To pušča prostor za nadaljnjo empirično analizo učinka izvajanja Enotnega nadzornega mehanizma v srednjeročnem in dolgoročnem obdobju.

APPENDIX B: List of supervised banks included in the sample

Table 1. List of significant banks included in the sample

Significant banks	**Country**
Erste Group Bank AG	Austria
Raiffeisen Bank International AG	Austria
Raiffeisenlandesbank Oberoesterreich Aktiengesellschaft	Austria
Salzburger Landes-Hypothekenbank	Austria
Argenta Spaarbank N.V.	Belgium
AXA Bank Belgium	Belgium
Belfius Bank SA/NV	Belgium
Dexia	Belgium
KBC Group NV	Belgium
Bank of Cyprus Public Company Limited	Cyprus
Hellenic Bank Public Company Limited	Cyprus
AS SEB Pank	Estonia
Swedbank AS	Estonia
Nordea Bank Finland Plc	Finland
OP Financial Group	Finland
BNP Paribas S.A.	France
BPCE S.A.	France
Credit Agricole S.A.	France
Groupe BPCE	France
HSBC France	France
La Banque Postale	France
RCI Banque	France
Societe Generale S.A.	France
Aareal Bank AG	Germany
Bayerische Landesbank	Germany
Commerzbank AG	Germany
DZ Bank AG Deutsche Zentral-Genossenschaftsbank	Germany
Landesbank Baden-Wuerttemberg	Germany
Landesbank Hessen-Thueringen Girozentrale	Germany
Landwirtschaftliche Rentenbank	Germany
Norddeutsche Landesbank Girozentrale	Germany
Volkswagen Bank GmbH	Germany
Deutsche Bank AG	Germany
Deutsche Pfandbriefbank AG	Germany
Alpha Bank AE	Greece
Eurobank Ergasias S.A.	Greece
National Bank of Greece S.A.	Greece
Piraeus Bank S.A.	Greece
Bank of Ireland	Ireland

Table continues

Table 1. List of significant banks included in the sample (continued)

Significant banks	**Country**
Ulster Bank Ireland DAC	Ireland
Banca Carige S.p.A. - Cassa di Risparmio di Genova e Imperia	Italy
Banca Monte dei Paschi di Siena SpA	Italy
Banca Popolare di Sondrio-Societa' Cooperativa per Azioni	Italy
BPER Banca S.p.A.	Italy
Intesa Sanpaolo S.p.A.	Italy
Mediobanca Spa	Italy
UniCredit S.p.A.	Italy
Unione di Banche Italiane S.p.A.	Italy
AS SEB Banka	Latvia
Swedbank AS (Latvia)	Latvia
AB SEB Bankas	Lithuania
Swedbank AB	Lithuania
Banque et Caisse d'Epargne de l'Etat	Luxembourg
Banque Internationale a Luxembourg	Luxembourg
KBL European Private Bankers SA	Luxembourg
Bank of Valletta	Malta
HSBC Bank Malta plc	Malta
ABN AMRO Group N.V.	Netherlands
Bank Nederlandse Gemeenten (BNG)	Netherlands
Cooperatieve Rabobank U.A.	Netherlands
de Volksbank N.V.	Netherlands
ING Group	Netherlands
Banco Comercial Portugues, S.A.	Portugal
Caixa Geral de Depositos, S.A.	Portugal
Slovenska Sporitelna	Slovak Republic
Tatra Banka	Slovak Republic
Vseobecna Uverova Banka	Slovak Republic
Abanka d.d.	Slovenia
Nova Ljubljanska banka d.d.	Slovenia
Banco Bilbao Vizcaya Argentaria, S.A.	Spain
Banco de Sabadell	Spain
Banco Mare Nostrum S.A.	Spain
Banco Santander, S.A.	Spain
Bankia S.A.	Spain
Bankinter	Spain
BFA, Tenedora de Acciones, S.A.U.	Spain
Ibercaja Banco, S.A.	Spain
Kutxabank, S.A.	Spain
Liberbank S.A.	Spain
Unicaja Banco S.A.	Spain
ABANCA Corporacion Bancaria, S.A.	Spain
CaixaBank, S.A.	Spain

Source: own work.

Table 2. List of less significant banks included in the sample

Less significant banks	**Country**
Bank fuer Tirol und Vorarlberg Aktiengesellschaft	Austria
Bankholding Winter & Co AG	Austria
HYPO NOE Landesbank fur Niederosterreich und Wien AG	Austria
Hypo Tirol Bank AG	Austria
Hypo Vorarlberg Bank AG	Austria
Oberbank AG	Austria
Oberosterreichische Landesbank	Austria
Raiffeisen-Landesbank Steiermark AG	Austria
Crelan SA	Belgium
Delen Private Bank nv	Belgium
Banque CPH	Belgium
BIGBANK AS	Estonia
LHV Group AS	Estonia
Banque PSA Finance	France
Edmond de Rothschild (France)	France
Rothschild & Co S.C.A.	France
UBS Holding (France) SA	France
Bremer Kreditbank AG	Germany
Investitionsbank Berlin	Germany
KfW	Germany
ODDO BHF Aktiengesellschaft	Germany
ProCredit Holding AG & Co. KGaA	Germany
HSBC Trinkaus & Burkhardt AG	Germany
DEPFA BANK plc	Ireland
Allianz Bank Financial Advisors SpA	Italy
Banca Agricola Popolare di Ragusa SCaRL	Italy
Banca di Credito Cooperativo di Alba Societa Cooperativa	Italy
Banca di Bologna Credito Cooperativo Societa Cooperativa	Italy
Banca Finnat Euramerica S.p.A.	Italy
Banca Generali SpA	Italy
Banca IFIS S.p.A.	Italy
Banca Leonardo SpA	Italy
Banca Popolare di Bari SCARL	Italy
Banca Popolare Etica SCRL	Italy
Banca Profilo S.p.A.	Italy
Banca Sella Holding S.p.A.	Italy
Banco di Desio e della Brianza	Italy
Banca Intermobiliare di Investimenti e Gestioni S.p.A.	Italy
Cassa di Risparmio di Bolzano S.p.A.	Italy
Cassa di Risparmio di Ravenna S.p.A.	Italy
Credito Valtellinese	Italy
Banca Popolare Pugliese	Italy
Nexi S.p.A.	Italy

Table continues

Table 2. List of less significant banks included in the sample (continued)

Less significant banks	**Country**
Unipol Banca S.p.A.	Italy
Banca Popolare del Lazio - Società Cooperativa	Italy
AS Citadele banka	Latvia
AS Meridian Trade Bank	Latvia
Baltic International Bank	Latvia
PrivatBank	Latvia
Siauliu Bankas	Lithuania
AB Citadele Bankas	Lithuania
BGL BNP Paribas	Luxembourg
Nordea Bank SA	Luxembourg
APS Bank Limited	Malta
Fimbank Plc	Malta
Lombard Bank (Malta)	Malta
AEGON Bank N.V.	Netherlands
Credit Europe Bank N.V.	Netherlands
F. Van Lanschot Bankiers N.V.	Netherlands
MUFG Bank (Europe) NV	Netherlands
NIBC Bank N.V.	Netherlands
NIBC Holding N.V.	Netherlands
RBS Holdings NV	Netherlands
Credit Europe Group NV	Netherlands
Banco Finantia S.A.	Portugal
Banco L.J. Carregosa S.A.	Portugal
Caixa Central Credito Agricola	Portugal
Caixa Económica Montepio Geral	Portugal
Finantipar SGPS S.A.	Portugal
Haitong Bank S.A.	Portugal
Banco Invest, S.A.	Portugal
Poštová banka, a.s.	Slovak Republic
Deželna Banka Slovenije d.d.	Slovenia
Banca Pueyo, S.A.	Spain
Banco Caminos S.A.	Spain
Banco Inversis S.A.	Spain
Banco Mediolanum, S.A.	Spain
Caja de Ahorros Y M.P. De Ontinyent	Spain
Caja Laboral Popular Coop. De Credito	Spain
Colonya - Caixa Destalvis de Pollensa	Spain
EBN Banco de Negocios, S.A.	Spain
Banca March, S.A.	Spain
Banco Cooperativo Español, S.A.	Spain

Source: own work.

APPENDIX C: First hypothesis: Results from Stata

Table 3. First hypothesis: Descriptive statistics

Variables		Mean	Std. Dev.	Min	Max	Observations
Ln Z-score BS	Overall Between Within	2.9987	1.2260 1.2060 0.3351	-3.5679 0.3586 -1.3294	5.5822 5.4168 4.2929	N=1132 n = 165 T-bar = 6.861
ROAA	Overall Between Within	0.0029	0.0155 0.0099 0.0119	-0.1192 -0.0309 -0.1037	0.1160 0.0487 0.0910	N=1153 n = 165 T-bar = 6.988
NIIEA	Overall Between Within	0.0184	0.0167 0.0163 0.0041	-0.0069 0.00002 -0.0083	0.2125 0.1786 0.0523	N=1150 n = 165 T-bar = 6.969
CI	Overall Between Within	2.9611	53.62 24.24 47.86	-1091 -260.49 -974.93	233.57 56.11 300.41	N=1154 n = 165 T-bar = 6.994
Ln TA	Overall Between Within	9.8951	2.111 2.111 0.189	5.176 5.374 8.405	14.59 14.49 11.58	N=1154 n = 165 T-bar = 6.994
TA	Overall Between Within	136,002	318,384 321,467 28,977	177 217 -61,145	2,164,103 1,970,310 512,412	N=1154 n = 165 T-bar = 6.994
NPLTL	Overall Between Within	0.0935	0.1090 0.0946 0.0539	0.0000 0.0003 -0.3103	0.9512 0.5151 0.5297	N=1088 n = 163 T-bar = 6.674
ETA	Overall Between Within	0.0837	0.0574 0.0482 0.0314	-0.0545 .01573 -0.1239	0.8025 0.3330 0.5532	N=1154 n = 165 T-bar = 6.994
LATA	Overall Between Within	0.1096	0.1312 0.1192 0.0558	0.000 0.000 -0.2326	0.8125 0.7044 0.6050	N=1107 n = 164 T-bar = 6.75
Ln Z-score FR	Overall Between Within	-8.3628	2.3400 2.3450 0.2080	-14.646 -14.375 -9.7020	-3.3307 -3.4382 -5.5131	N=1151 n = 165 T-bar = 6.976
GGDP	Overall Between Within	0.0132	0.0258 0.0157 0.0205	-0.0910 -0.0257 -0.0559	0.2560 0.0691 0.2001	N=1155 n = 165 T-bar = 7
UE	Overall Between Within	0.1101	0.0596 0.0571 0.0176	0.0374 0.0484 0.0515	0.2747 0.2373 0.1565	N=1155 n = 165 T-bar = 7
INF	Overall Between Within	0.0131	0.0125 0.0036 0.0119	-0.0210 0.0017 -0.0127	0.0498 0.0210 0.0448	N=1155 n = 165 T-bar = 7

Source: own work.

Table 4. First hypothesis: Correlation matrix

	Ln Z-score BS	ROAA	NIIEA	CI	Ln TA	TA	NPLTL	ETA
Ln Z-score BS	1							
ROAA	0.3818	1						
NIIEA	0.0716	0.2327	1					
CI	-0.0054	0.0135	-0.0322	1				
Ln TA	0.0308	-0.1641	-0.3012	0.0552	1			
TA	0.1168	-0.0653	-0.1346	0.0383	0.6820	1		
NPLTL	-0.3588	-0.2103	0.2238	-0.0634	-0.1426	-0.1222	1	
ETA	0.1530	0.4158	0.2991	-0.0468	-0.4371	-0.2627	0.1572	1
LATA	0.1033	0.0547	-0.0543	0.0386	-0.1105	0.0514	-0.0599	0.0320
Ln Z-score FR	0.0491	0.1735	0.3668	-0.0774	-0.9111	-0.6160	0.1469	0.3974
GGDP	0.0782	0.2147	0.0611	-0.0180	-0.1063	-0.0406	-0.0363	0.1469
UE	-0.2442	-0.0803	0.0216	-0.0093	-0.0049	-0.0341	0.2973	0.0132
INF	0.0471	-0.0139	0.0114	0.0121	-0.0695	-0.0321	-0.2302	-0.0897

Table continues

Table 4. First hypothesis: Correlation matrix (continued)

	LATA	Ln Z-score FR	GGDP	UE	INF
Ln Z-score FR	0.0887	1			
GGDP	0.1639	0.1144	1		
UE	-0.2690	-0.0421	-0.2497	1	
INF	0.0355	0.0527	-0.1631	-0.1916	1

Source: own work.

Table 5. First hypothesis: Hausman test

Variables	**Coefficients**		**(b-B) difference**	**Sqrt (diag(V_b-V-B)) S.E.**
	(b) fe	**(B) re**		
Time	0.0439	0.0372	0.0067	.
Treated	-0.5813	-0.5255	-0.0558	.
DID	0.1146	0.1366	-0.0220	.
ROAA	16.785	16.088	0.6973	.
NIIEA	6.0844	4.5925	1.4920	0.2587
CI	0.0001	0.0001	0.0000	.
LnTA	-0.2786	-0.0327	-0.2459	0.0282
NPLTL	-0.3054	-0.3443	0.0388	.
ETA	2.6642	3.9689	-1.3047	0.1631
LATA	0.0451	0.0092	0.0359	.
Ln Zscore FR	0.1375	-0.0268	0.1643	0.0337
GGDP	-0.3945	-0.2395	-0.1550	.
UE	0.0440	-0.3069	0.3509	0.0401
INF	-3.2340	-3.0245	-0.2095	.
chi2(14)	(b-B)’[(V_b-V_B)^(-1)](b-B) = 103.46***			

Source: own work.

APPENDIX D: Second hypothesis: Results from Stata

Table 6. Second hypothesis: Descriptive statistics

Variables		Mean	Std. Dev.	Min	Max	Observations
ETA	Overall Between Within	0.0837	0.0574 0.0482 -0.0314	-0.0545 0.0157 -0.1239	0.8025 0.3330 0.5532	N = 1154 n = 165 T-bar = 6.994
GGL	Overall Between Within	0.0251	0.2207 0.1215 0.1850	-1 -0.5309 -0.8336	1.8259 0.5223 1.4013	N = 1151 n = 165 T-bar =6.976
Ln Ta	Overall Between Within	9.8951	2.1107 2.1109 0.1897	5.176 5.374 8.405	14.59 14.49 11.58	N = 1154 n = 165 T-bar = 6.994
CI	Overall Between Within	2.9611	53.62 24.24 47.86	-1091 -260.49 -974.93	233.57 56.11 300.41	N=1154 n = 165 T-bar = 6.994
ROAA	Overall Between Within	0.0029	0.0155 0.0099 0.0120	-0.1192 -0.0309 -0.1037	0.1160 0.0487 0.0910	N=1153 n = 165 T-bar = 6.988
GGDP	Overall Between Within	0.0132	0.0258 0.0157 0.0205	-0.091 -0.0257 -0.0559	0.2560 0.0691 0.2001	N=1155 n = 165 T-bar = 7
UE	Overall Between Within	0.1101	0.0596 0.0570 0.0176	0.0374 0.0484 0.0515	0.2747 0.2373 0.1565	N = 1155 n = 165 T-bar = 7
INF	Overall Between Within	0.0131	0.0125 0.0036 0.0119	-0.0210 0.0017 -0.0127	0.0498 0.0210 0.0448	N = 1155 n = 165 T-bar = 7
TA	Overall Between Within	136001.7	318,384 321,467 28,977	176.9 216.9 -61,145	2,164,103 1,970,310 512,412	N = 1154 n = 165 T-bar = 6.994

Source: own work.

Table 7. Second hypothesis: Correlation matrix

	ETA	GGL	Ln TA	CI	ROAA	GGDP	UE	INF	TA
ETA	1								
GGL	-0.0297	1							
Ln TA	-0.4392	-0.1390	1						
CI	-0.0444	-0.0180	0.0417	1					
ROAA	0.4162	0.2035	-0.1755	0.0129	1				
GGDP	0.1713	-0.0114	-0.1138	-0.0108	0.2828	1			
UE	-0.0126	0.0129	-0.0078	-0.0046	-0.1469	-0.2844	1		
INF	-0.0827	0.0283	-0.0708	0.0100	-0.0560	-0.1679	-0.1650	1	
TA	-0.2491	-0.0437	0.6693	0.0334	-0.0453	-0.0367	-0.0311	-0.0372	1

Source: Own work.

Table 8. Second hypothesis: Hausman test

Variables	**Coefficients**		**(b-B) difference**	**Sqrt (diag(V_b-V-B)) S.E.**
	(b) fe	**(B)re**		
Time	0.0118	0.0101	0.0017	.
Treated	0.0129	0.0087	0.0042	0.0022
DID	-0.0061	0.0007	-0.0067	.
GGL	-0.0035	-0.0168	0.0132	.
LnTA	-0.0919	-0.0203	-0.0716	0.0036
CI	0.0000	0.0000	0.0000	.
ROAA	0.8795	0.9603	-0.0808	.
GGDP	-0.0048	0.0247	-0.0210	.
UE	0.0109	0.0322	-0.0212	0.0248
INF	-0.2752	-0.1582	-0.1170	.
chi2(11)	(b-B)’[(V_b-V_B)^(-1)](b-B) = 398.03***			

Source: own work.

APPENDIX E: Third hypothesis: Results from Stata

Table 9. Third hypothesis: Descriptive statistics

Variables		Mean	Std. Dev.	Min	Max	Observations
LATA	Overall	0.1112	0.1314	0.0000	0.8125	N = 1092
	Between		0.1193	0.0000	0.7044	n = 162
	Within		0.0562	-0.2311	0.6065	T-bar = 6.741
LD	Overall	1.7902	4.7891	0.0969	91	N = 1151
	Between		3.8408	0.1434	42.439	n = 165
	Within		2.8899	-39.627	50.352	T-bar = 6.976
ETA	Overall	0.0837	0.0574	-0.0545	0.8025	N= 1154
	Between		0.0482	0.0157	0.3330	n = 165
	Within		0.0314	-0.1239	0.5532	T-bar = 6.994
ROAA	Overall	0.0029	0.0155	-0.1192	0.1160	N = 1153
	Between		0.0099	-0.0309	0.0487	n = 165
	Within		0.0120	-0.1037	0.0910	T-bar = 6.988
Ln TA	Overall	9.8951	2.1107	5.1760	14.588	N = 1154
	Between		2.1109	5.3736	14.493	n = 165
	Within		0.1897	8.4051	11.583	T-bar = 6.994
LLRL	Overall	0.0511	0.0661	0.0000	0.8369	N = 1121
	Between		0.0542	0.0005	0.4183	n = 165
	Within		0.0380	-0.3451	0.4696	T-bar = 6.794
GGDP	Overall	0.0133	0.0258	-0.091	0.2560	N = 1155
	Between		0.0157	-0.0257	0.0691	n = 165
	Within		0.0205	-0.0559	0.2001	T-bar = 7
UE	Overall	0.1102	0.0596	0.0374	0.2747	N = 1155
	Between		0.0570	0.0484	0.2373	n = 165
	Within		0.0176	0.0515	0.1565	T-bar = 7
INF	Overall	0.0131	0.0125	-0.0210	0.0498	N = 1155
	Between		0.0036	0.0017	0.0210	n = 165
	Within		0.0119	-0.0127	0.0448	T-bar = 7
TA	Overall	136,002	318,384	176.96	2,164,103	N = 1154
	Between		321,467	216.87	1,970,310	n = 165
	Within		28,977	-61,145	512,412	T-bar = 6.994

Source: own work.

Table 10. Third hypothesis: Correlation matrix

	LATA	LD	ETA	ROAA	Ln TA	LLRL	GGDP	UE	INF	TA
LATA	1									
LD	-0.0067	1								
ETA	0.0318	0.2498	1							
ROAA	0.0767	0.0602	0.4270	1						
Ln TA	-0.1495	0.0859	-0.4434	-0.1626	1					
LLRL	-0.0775	-0.0611	0.1998	-0.1804	-0.1455	1				
GGDP	0.1677	-0.0145	0.1762	0.2960	-0.1224	-0.0512	1			
UE	-0.2449	-0.0662	-0.239	-0.1554	0.0350	0.2831	-0.2914	1		
INF	0.0463	0.0002	-0.1053	-0.0694	-0.0671	-0.2174	-0.1752	-0.1614	1	
TA	0.0364	0.0028	-0.2511	-0.0416	0.6759	-0.1089	-0.0351	-0.0209	-0.037	1

Source: own work.

Table 11. Third hypothesis: Hausman test

Variables	**Coefficients**		**(b-B) difference**	**Sqrt (diag(V_b-V-B)) S.E.**
	(b) fe	**(B)re**		
Time	-0.0336	-0.0388	0.0052	0.0010
Treated	-0.3358	-0.0372	0.0036	0.0094
DID	0.0176	0.0160	0.0016	.
LD	0.0024	0.0022	0.0002	0.0001
ETA	-0.1590	-0.2271	0.0681	0.0430
ROAA	-0.0224	0.0736	-0.0960	0.0326
LnTA	0.0218	-0.0025	0.0243	0.0110
LLRL	-0.0061	-0.0048	-0.0012	0.0121
GGDP	0.3842	0.3928	-0.0086	0.0076
UE	0.3066	0.0014	0.3052	0.0660
INF	0.1037	-0.0914	0.1951	0.0239
chi2(11)	(b-B)’[(V_b-V_B)^(-1)](b-B) = 19.97*			

Source: own work.