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School of Slavonic and Eastern European Studies

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Evaluation of the Impact of Banking Regulation on the Stability of Banking Sector in CEE EU Members

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Author: Mengyao Wang
Supervisor: doc. RNDr. Petr Jeřábek, Ph.D.
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Abstract

The thesis studies the impact of European banking regulatory reforms on the stability of Central and Eastern European countries after the financial crisis with the annual data from Hungary, Poland, Slovakia, and Slovenia from 2009 to 2019. The thesis reaches several conclusions. Firstly, increasing minimum Tier 1 capital adequacy ratio through CRR/CRD IV did not significantly promote the bank stability in sample countries. However, total capital adequacy ratio is found to have positive and significant association with overall insolvency risk. Secondly, relaxing restrictions would have negative impact on bank stability measured by bank z-score. Thirdly, countries that are more open on the regulation may have more stable banks, while tighter entry restrictions boost bank fragility. Fourthly, when only taking deposit insurance variables as explanatory variables, increasing the level of deposit insurance coverage may dampen the bank stability. However, when controlling other regulation and supervision indexes, the results do not show any significant effect of deposit insurance scheme on bank z-score. Lastly, the supervisory variables are not significantly associated with bank stability in sample countries.

Abstrakt

Tato práce studuje dopad evropských bankovních regulačních reforem na stabilitu zemí střední a východní Evropy po finanční krizi s ročními údaji z Maďarska, Polska, Slovenska a Slovinska od roku 2009 do roku 2019. Práce dospívá k několika závěrům. Zaprvé, zvýšení minimálního poměru kapitálové přiměřenosti Tier 1 prostřednictvím CRR / CRD IV významně nepodpořilo stabilitu bank ve vybraných zemích. Ukazuje se

však, že poměr celkové kapitálové přiměřenosti je pozitivně a významně spojen s celkovým rizikem platební neschopnosti. Zadruhé, uvolnění omezení by mělo negativní dopad na stabilitu banky měřené z-skóre banky. Zatřetí, země s otevřenějšími přístupy k regulaci a dohledu mají tendenci mít stabilnější banky, zatímco přísnější omezení vstupu zvyšují křehkost bank. Začtvrté, vezmeme-li pouze proměnné pojištění vkladů jako vysvětlující proměnné, může zvýšení úrovně krytí pojištění vkladů ztlumit stabilitu banky. Při kontrole ostatních indexů regulace a dohledu však výsledky neukazují žádný významný vliv systému pojištění vkladů na z-skóre banky. A konečně, proměnné dohledu nejsou významně spojeny se stabilitou bank ve vybraných zemích.

Klíčová slova

Stabilita banky, požadavek kapitálové přiměřenosti, systém pojištění vkladů, bankovní unie, jednotný mechanismus dohledu

Keywords

Bank stability, Capital Adequacy Requirement, Deposit Insurance Scheme, Banking Union, Single Supervisory Mechanism

Range of thesis: 56 pages

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague 27.07.2021 **Mengyao Wang** 

Contents

Introduction

The impact of the financial crisis is often huge. In recent decades, the frequency of financial crises in different regions of the world has increased. As far as Europe is concerned, after the global financial crisis of 2007-2008, the European debt crisis occurred in just six years. Policymakers and economists pay attention to the financial crisis not only because it can exert a serious or even devastating impact on one area, but also because the crisis triggered in specific industry is very likely to spread to other fields, and thus affects the entire economy (Hellmann, Murdock, and Stiglitz, 2000). More importantly, in the context of such a deep integration and globalization today, if a crisis in a certain region is not controlled in time, it is highly possible that it will turn into a global crisis. A large number of empirical studies have found that the cost of financial instability is enormous. For instance, Hoggarth and Saporta (2001) find that the average fiscal costs of banking resolution across countries are 16% of GDP. More specifically, for developed economies the average cost is 12% and for emerging countries the figure could reach 17.5%. In terms of EU, the crisis was exacerbated within the euro area. Many of the eurozone member states had to run large current account and bore fiscal deficits, coupled with high debt ratios and anemic growth (Tarazi and Senel, 2011). Therefore, given the huge and manifest costs of financial crisis, it is natural for policymakers to make the avoidance of financial instability a high priority.

Bank instability is one of the sources of financial crisis. It is said that bank instability is caused by the mismatch between the level of bank regulation and supervision and the level of bank development (Chaikovska, 2019). Consequently, driven by the global financial crisis, a variety of improvements and revision on the bank regulation and supervision are taken in worldwide and EU to enhance the resilience of banking sector. One of the main regulatory innovations after the global financial crisis was the introduction of Basel III that finalised in 2011. Compared with Basel II, the Basel III reinforces risk management of banks, supervision, and the prudential regulation. What's more, the Basel III has increased the requirement on their capital. In order to guarantee that banks own adequate amount of capital that could cover losses, the

requirements for Common Equity Tier 1 were amplified in Basel III, which raised the minimum capital requirements for banks from 2% set in Basel II to 4.5% of common equity, as a percentage of the bank's risk-weighted assets. Also, it revoked capital that were deemed ineffective at absorbing losses when the crisis hit. Moreover, the new regulation introduces extra capital buffer requirements. With another capital buffer capital about 2.5%, the total capital requirement reaches 7%. When faced with financial constrains banks can use the buffer, although it is likely to result in even more financial stress when paying dividends. For large banks that are considered vital to the global financial system, or in order word Global Systemically Important Banks (G-SIBs), these banks are required to have more common equity, usually from 1% to 3.5% more than other banks. There are two types of capital buffers employed as extra layers of protection over the minimum capital ratios. One is the capital conservation buffer, which enhances the total common equity level and limits banks' discretionary payouts. The other is the countercyclical buffer, which could limit credit growth that is considered excessive.

Apart from Tier 1 capital adequacy ratio and capital buffer requirements, Basel III also implemented an upper limit on leverage. The leverage ratio requirement is a supplement to the capital adequacy ratio requirement. It is also another scrutiny of the bank's debt ratio. Capital adequacy ratio focuses on risk-weighted assets, while the leverage ratio compares bank capital with total assets without any adjustments. Therefore, the minimum leverage ratio helps to prevent banks from underestimating risks on purpose to whitewash their capital levels. However, due to the differences among banks, there may be conflicts between the leverage ratio requirement and the capital adequacy ratio requirement. Therefore, the minimum leverage ratio was not in effective immediately, but became mandatory 7 years later (Gambacorta and Karmakar, 2016).

Furthermore, a suitable level of high-quality liquid assets is essential for a healthy balance sheet. Banks are required to hold liquidity in case there are unanticipated withdrawals, or the borrowers cannot repay loans as planned. The 2008 financial crisis gave global banking regulators a warning to strengthen the supervision of liquidity risks of commercial banks. Therefore, Basel III was committed to establishing a globally consistent liquidity supervision index. It implements two liquidity requirements, the

Net Stable Funding Ratio (NSFR) aiming to promote long-term resilience and the Liquidity Coverage Ratio (LCR) with the effect of increasing banks' short stability.

Basel III was enforced in EU through Capital Requirements Regulation (CRR) and Directive (CRD IV), which are part of the Single Rulebook. While Basel III was implemented in phases and was completely in effect in 2019, European regulators applied higher standards before the schedule. On January 1, 2014, the new capital requirements regulation came into force in all EU Member States, with some provisions phased-in until 2019. On one hand, CRR lays the foundation for the prudent operation of credit institutions and investment companies with unified content in all EU Member States (Kisgergely and Szombati, 2014). Nevertheless, it only stipulates general principles on several issues. Defining specific rules and standards of operations is the responsibility of the European Banking authority (EBA). On the other hand, the Capital Requirements Directive enumerates the rules of the supervision of banks and the rules that are applicable for macroprudential purposes. The key points of supervision were defined by 28 national laws in practice, as the directive is enforced through the implementation of each country.

The single rulebook is the first pillar of Banking Union (BU), which is established in the purpose of eliminating interdependencies and detaching the stability of the banking sector from national fiscal capacity (Kisgergely and Szombati, 2014). The need for an integrated supervisory authority in EU as an element of the EU's Single Market arose much earlier. However, owing to sovereignty considerations as well as unresolved crisis management issues, the establishment of centralised supervisory framework was postponed. It was when a bunch of problems exacerbating the bank crisis into a sovereign debt crisis that were almost uncontrollable at the national level, that the construction for single, unbiased supervisory control was in schedule.

As the second pillar of BU, the Single Supervisory Mechanism (SSM) is another significant innovation on the bank supervision in EU triggered by the global financial crisis and sovereign debt crisis. Launched in 2013, the SSM is designed to supervise large banks. The supervisory authority of SSM is the European Central Bank (ECB).

Although the aim of single supervisory mechanism is to build up a centralised and unified supervision framework, the ECB will not perform its supervisory practices independently but in cooperation with national supervisory authorities. And the SSM is only compulsorily applicable to eurozone members. As of January 2016, ECB supervised about 130 out of approximately six thousand banks in the eurozone. The rest of the banks were still under the supervision of local authorities. Although the number of banks under the supervision of ECB may look quite small, they account for more than 80% of total assets of all banks in eurozone (Loipersberger, 2017). There are some criteria employed to determine which banks fall under ECB supervision. In this aspect, fulfilling a single standard is enough to be assigned to the SSM. Firstly, total assets of a bank must exceed 30 billion euro. Second, the bank ought to be considered systematically essential for the one country or the whole European economy. Moreover, total assets of a bank must be more than 5 billion euro and the international activities in more than 2 eurozone member state need to exceed twenty percent of total assets. Also, the bank must have received or requested funds from the European Stability Mechanism or the European Financial Stability Facility. Lastly, the ECB could also identify a bank as important out of its own consideration. Overall, the SSM supervises large and systemically important banks in the euro area.

Deposit Guarantee Scheme (DGS) becomes a common institution of countries' safety net to protect depositors. As an important complement to the prudential supervision of banks, DGSs are able to create solidarity among all the banks in the same banking market if one bank become insolvent. DGSs compensate a limited amount of money to depositors when bank they put money in fails. In the drastical reform of the bank regulation of EU that stabilises banking system and brings back market confidence, the Single Deposit Guarantee Scheme is an essential part, which is also one of pillars of BU. When the crisis exacerbateed in autumn 2008, the guaranteed amount in some EU member state was fairly low. Taking Poland as an example, the deposit insurance coverage was at the level of 22,500 euro. If the amount of deposit did not exceed 1,000 euro, the deposit was 100% guaranteed. Amounts of between 1,000 euro and 22,500 euro were 90% guaranteed. And the assets that exceed the upper limit of the deposit insurance would be claimed from bankruptcy assets. The Amendment of the Act on the BFG of 2008 came into force on 13 December 2008, which increased the limit of the

guarantee to the equivalent of 50,000 euro to underpin the confidence of depositor and to gain greater stability on the financial system. Protection for depositors has been enhanced once more after global financial crisis. In 2014, the revised Directive on DGS provides stronger protection and introduces “depositor preference”, which puts depositors in final order to bear any losses recorded in Bank Recovery and Resolution Directive. This will strengthen the protection provided to depositors and lower the requirements for DGS. In the new DGS Directive, the coverage of insurance increases to 100,000 euro, which applies to all aggregated accounts at the same bank. As deposits are covered per depositor per bank, for joint accounts, the upper limit is applicable to every depositor. Moreover, some special type of deposits, for example marriage, redundancy divorce, or retirement may be compensated over 100,000 euro. Overall, DGSs are able to cover all deposits possessed by both individuals and firms. Apart from increasing the level of deposit insurance, the operation of DGS also improved. For example, the repayment period is planned to be shortened moderately. Particularly, from 2014 to 2019, the repayment time was decreased from 20 working days 15 working days from 2019. And from 2021 to 2014, the deadline is planned to reduce from 10 working to 7 working days.

In addition to capital adequacy requirements, deposit insurance scheme and supervision, EU countries have also modified various levels of bank regulation and supervision in other aspects to enhance the stability of the banking industry, such as restrictions on banking activities, bank entry requirements, and ownership requirements. Although the improving banking regulation and supervision has become a common measure adopted by policymakers in many countries after the financial crisis, whether these measures can actually improve the stability of banks is controversial and to what extent the positive effects that new regulation and supervision could exert on the fragility of banking sector is not sure either. The transition countries of Central and Eastern Europe (CEE) are the research object of the thesis. CEE countries abolished the administrative interventions and regulations in their banking sector in the mid 1990s. Institutional improvements are the key elements in the development of the CEE banking sector (Agoraki et al., 2011). Although research that focus on transition countries’ banking system is massive, the issues of risk-taking are less studied (Haselmann and Wachtel, 2006). In the meantime, it is well-acknowledged that banks’ behaviour varies under

different institutions, which implies that the regulation and supervision suitable for banks in developed countries may not be applicable to that in CEE countries.

The thesis employs an empirical method to study the impact of European banking regulatory reforms on the stability of Central and Eastern European countries after the financial crisis with the annual data from Hungary, Poland, Slovakia, and Slovenia from 2009 to 2019. The thesis reaches several conclusions. Firstly, increasing minimum Tier 1 capital adequacy ratio through CRR/CRD IV did not significantly promote the bank stability in sample countries, which is probably because of inadequate of the new regulation and the increased complexity of the capital regulations that makes itself difficult to be effective; However, total capital adequacy ratio is found to have positive and significant association with overall insolvency risk. Secondly, relaxing restrictions would have negative impact on bank stability measured by bank z-score, because restricting bank activities would prevent bank from being too complex to be monitored by supervisors and loosening the restrictions on bank activities offers more chances to rise and shift risk. Thirdly, countries that are more open on the regulation may have more stable banks, while tighter entry restrictions boost bank fragility. Fourthly, when only taking deposit insurance variables as explanatory variables, the deposit insurer power does not significantly affect bank stability but increasing the level of deposit insurance coverage may dampen the bank stability. However, when controlling other regulation and supervision indexes, the results do not show any significant effect of DGS on bank z-score. Last but not least, the official supervisory power, the independency of supervision and the Single Supervisory Mechanism are not significantly associated with bank stability in sample countries.

The rest of the thesis is organized as follows. Section 2 reviews existing literature and Section 3 provides a theoretical discussion to back up the hypothesis of the thesis. Section 4 firstly discusses the data sources and sample choices, and then gives a preliminary analysis of the data. In addition, the empirical model is also presented in Section 4. Section 5 reports and discusses the empirical results. And finally, conclusion and policy implications are presented in Section 6.

Literature Review

1. Regulation and Bank Stability

Inadequacy in bank regulation and supervision are deemed as one of the major reasons of the occurrence of the global financial crisis (Chan-Lau, 2010; Nier and Merrouche, 2010; and Barth et al., 2012). As a result, many countries started to reform the elements of their bank regulatory and supervisory framework after global financial crisis. A major objective of bank regulation is to promote the stability of single banks and the banking system as a whole. While almost all countries accept and obey the Basel guidelines, existing literature does not provide consistent findings that this could improve the stability of banking system. The questions are put forward that whether strict regulation is suitable for banking markets in all countries, and which kind of regulation should be applied. The regulation on bank covers a wide range, including capital requirement, bank activities, entry of domestic and foreign banks, ownership, information disclosure and so on. The impacts of each type of regulation on bank stability are analysed in a considerable number of literature and the conclusions are in most cases inconsistent.

In terms of capital adequacy requirement, a lot of researchers claim that capital requirement regulation could have important impact on promoting bank stability. Barth, Caprio and Levine (2004) examine different aspects of regulatory and supervisory practices to see which of them are related to better performance, greater bank development, and increased stability. After examining the data from 107 countries, they claim that fewer nonperforming loans could be achieved by increasing the stringency of capital regulations, but they do not find a robust relation between banking crises and capital stringency when taking other supervisory and regulatory policies into account. Studying the Italian banks, Gambacorta and Mistrulli (2004) argue that higher capital requirements may discourage banks to engage in too much risky lending. Similar to Barth et al., Shaddady and Moore (2018) also investigate the comprehensive effect of regulation and supervision on bank stability with data for 2210 banks across 47 European countries over the period from 2000 to 2016. The research reveals that in general capital regulation has a positive influence on stability. On the contrary, there

are some mechanisms through which stricter capital regulation exerts negative impact on the financial system. Hakenes and Isabel Schnabel (2011) explore how the capital adequacy requirement impact on bank stability through competition. They stated that cumbersome supervision may impede the banks to offer financial assistant to other industry and that stricter capital requirements may also have negative impact on bank competition, which is likely to result in a higher possibility of loan defaults. In addition, it is found that although imposing a capital requirement can lower individual risk, it simultaneously enhances systemic linkage within the banking system; thus, capital requirements may fail to limit systemic risk and consequently create instability in the financial system (Zhou, 2013). Furthermore, some research point out that there is no significant positive effect of the compliance of capital requirement on financial stability (Demirgü.-Kunt and Detragiache, 2011). A possible explanation of the inconsistent conclusion is that the effect of the regulation may varies according to the development of countries and to the characteristics of banks. Shaddady and Moore (2018) find that commercial banks, smaller banks and banks in emerging countries tend to be more sensitive to changes in financial regulation and supervision; Using a sample of 6936 banks in 25 developed countries between 2007 and 2015, Danisman and Demirel (2018) argue that capital requirements are the strongest regulatory tool for decreasing bank risk, and they decrease bank risk more for banks with more market power.

With respect to the effect of restrictions in non-fee-based activities such as securities, real estate and insurance and non-financial firm ownership and control, the findings of literature are also distinct. Some theoretical studies point out to the benefits of activity restrictions which arise from the fact that interests may conflict when conducting diverse activities (Saunders, 1985). It is also argued that tighter restrictions may improve monitoring efficiency and reduce information asymmetry due to the lower complexity of banking activities (Boyd, Chang, and Smith, 1998). Besides, more restriction on bank activities may prevent banks from becoming too big to discipline. However, there are literature refuting that higher activity restrictions increases bank risk-taking or the probability of crisis (Barth et al., 2004; Barth et al., 2013; Shaddady and Moore, 2018). Danisman and Demirel (2018) also confirm the argument for developed markets, even though the increase in riskiness is mitigated for banks with higher market power. There are two prevalent theoretical rationales offered by

opponents of activities restrictions. Initially, with fewer restriction, banks are able to obtain more profits from diversifying their income through non-traditional activities, which may help banks to offer more efficient services and thus promote bank stability (Barth et al., 2004; Laeven and Levine, 2007; Shaddady and Moore, 2018). Secondly, more limitations on bank activities encourage bank risk-taking by preventing economies of scale and scope and efficiency advantages economies of scale and scope is achieved with diverse activities on both the production and the product side and services are offered more efficiently which leads to better risk management (Saunders and Walter, 1994; Danisman and Demirel, 2018).

It is commonly held that the with more foreign banks entering into domestic banking market, the competition would be intensified in the host country, which influences the behaviour and performance of local banks. To protect domestic banks, restrictions on foreign bank entry are usually implemented, which then are likely to exert effects on financial stability. However, Economic studies offer different opinions on the impact of the restriction on entry into banking. On one hand, there are some findings showing that effective control on bank entry is good for bank stability. Keeley (1990) claims that banks with large market share have greater franchise value, which promotes prudent risk-taking behaviour. The opponents stress the adverse impact of restricting entry. Barth et al. (2004) claim that limitations on foreign-bank entry and ownership result in higher probability of suffering a severe crisis; In emerging economies, foreign-owned banks not only are more risk-taking than their domestic counterparts, but also increases the risk of domestic banks (Chen et al., 2017); Looking at 129 countries from 1995 to 2013, Yin (2019) also find a higher level of bank risk in countries that allow the entry of foreign banks. Nevertheless, the results of studies may be influenced by the definition of financial stability and bank competition, the choice of data, estimation methodology, and control variables used by researchers and moderate publication bias probably exists (Zigraiova and Havranek, 2016). The meta-analysis by Zigraiova and Havranek (2016) of 598 estimates of the competition-stability nexus reported in 31 studies shows that there is little interplay between competition and stability.

2. Supervision and Bank Stability

With the strengthening of bank regulation in post-crisis period, the power of official supervision has been enhanced too. Some acknowledge that the role of supervision is crucial for the stability of the banking sector and emphasis on the positive effects of giving more powers to supervisors. Firstly, if there is no official supervision, bank would be likely to take too much risk, whereas official supervision is able to improve this market failure (Barth et al., 2004). According to Anginer & Demirguc-Kunt (2014), Official supervisory power has positive effect on bank stability because the regulators could have the right to prevent and correct banks' problems. In support of this view, some empirical studies show that supervisory power benefits bank stability through better loan quality and lower moral hazard (Agoraki et al., 2011; Shehzad and Haan, 2015). Secondly, deposit insurance schemes are adopted in a large number of countries, which could probably induce moral hazard problem. Under such context, official supervision can decrease the incentives of banks to take excessive risk and thus promote bank stability.

The positive effect of supervision assumes that regulatory officials will not act in the interest of their own but are on behalf of the public, but if they in fact aim to earn private gains, supervision destabilises banking sector (Barth et al., 2008). Beck, Demirguc-Kunt and Levine (2006) state that it is possible for a supervisor to abuse his authority and affect the allocation of bank credit to increase their own profits. As a result, the quality of loan would decrease, which will then lead to a reduction in bank stability (Beltratti & Stulz, 2012). Also, according to the self-interested assumption, the supervisor may keep some important information confidential in order to earn private benefits (Boyer and Ponce, 2012). Additionally, compared with supervisory authorities in a more sophisticated system, supervisory authorities in relatively poor environments are likely to deter prudential supervision, leading to a more vulnerable financial system (Chortareas et al., 2012; Melecky and Podpiera, 2013). Some empirical research reach conclusions consistent with these theories. Shaddady and Moore (2018) find that supervision is shown to adversely affect European banks' stability; Danisman and Demirel (2018) hold that powerful supervisory agencies, in general, lead to an increase

in bank risk and this increase is exacerbated for higher market-powered banks.

3. Deposit Insurance Schemes

It is common that countries implement deposit insurance schemes as a safety net to prevent a wide range of bank failure. A lot of countries significantly lifted the level of their financial safety nets in response to the global financial crisis, to underpin market confidence and to stop contagious effects on their banking system (Anginer, Demirguc-Kunt and Zhu, 2013). Nevertheless, deposit insurance schemes may be a double-edged sword. They may exacerbate moral hazard problems in bank lending as insuring government agency absorbs nearly all of the depositors' losses and is associated with higher likelihood of banking crisis (Demirguc-Kunt and Detragiache, 2002; Barth et al., 2004). The incentive problems are severe in lax regulatory environments, and they can lead to greater systemic instability (Cull, Senbet and Sorge, 2001). Comparing the risk-taking behaviour of banks before and after the introduction of this system in Bolivia, Ioannidou and Penas (2009) find that in the post-deposit insurance period, banks are more likely to initiate riskier loans. Besides, deposit insurance may destabilise banking sector by undermining trust on local currency. Prean and Stix (2011) point out that whether increasing the level of deposit insurance coverage adds uncertainty is even more important to transition countries, because they are more vulnerable to the financial crisis. Increasing in the coverage of deposit insurance could imply that the assessment of the safety of deposits increased, whereas can at the same time signal that the banking system is facing more stress. Given that people react very sensitively with respect to doubts about the stability of the banking system, the scheme could possibly have negative effects of stimulating uncertainty, resulting in withdrawals and decreasing the credibility of the local currency (Prean and Stix, 2011). As a result, many believe that the depositor scheme would produce deleterious effects on bank stability (Barth et al., 2004; Shaddady and Moore, 2018).

Why do an increasing number of countries adopt a deposit insurance scheme while prior studies have shown that it may encourage risky behaviour and increase the likelihood

of bank crisis? First of all, although full coverage of deposit insurance induces moral hazard by banks, deposit insurance is still an effective tool during the time of crisis (Anginer, Demirguc-Kunt and Zhu, 2013; Jumreornvong et al., 2018). Secondly, many contend that regulation and supervision can control the moral-hazard problem by designing an insurance scheme that encompasses appropriate coverage limits, scope of coverage, coinsurance, funding, premia structure, management, and membership requirements (Barth et al., 2004). Jumreornvong et al. (2018) state that implementing the safety nets of both deposit insurance and capital adequacy together is indispensable for banking system stability; Anginer, Demirguc-Kunt and Zhu (2013) find that good bank supervision can alleviate the unintended consequences of deposit insurance on bank systemic risk during good times. Moreover, if before the introduction of an explicit deposit insurance scheme, banking systems expect substantial implicit insurance as during times of distress there is government intervention, then the establishment of an explicit deposit guarantee scheme may imply decrease in the extent of the safety net. Therefore, the authorities are able to exclude some creditors of the bank out of the scheme (Cull, Senbet and Sorge, 2001). It is pointed out that the explicit deposit insurance scheme in some EU countries in 1990s significantly reduce the moral hazard problem and the risk taking of banks (Cull, Senbet and Sorge, 2001). Additionally, the relation between deposit insurance and bank performance is affected by the institutional environment; stronger institutions such as the rule of law, economic freedom and anti-corruption policies probably temper the risk-taking incentives of deposit insurance (Dewenter et al., 2017). Besides offering financial aids to banks during crisis, deposit insurance scheme may have positive spill over to non-banking sector stability. Using a dataset of 64 countries over the period 1970–2009, Ji et al. (2018) find that the adoption of deposit insurance scheme is associated with a 2.0–4.7 percentage points higher likelihood of banking crises, while it is associated with a 10.1–11.1 percentage points lower likelihood of non-banking financial crises; therefore, deposit insurance actually increases overall financial stability. Considering the first-aid role of the deposit insurance scheme in a crisis, its interplay with other regulation and supervision, as well as its positive effect on overall financial stability, an increasing number of countries adopt the scheme.

4. Banking Union and Bank Stability

The Banking Union (BU) was proposed in 2012 to treat some of the structural flaws of the Economic and Monetary Union which only became apparent during the global financial crisis. It is another step toward financial integration and signals the centralisation and harmonisation of bank supervision in EU. The ultimate goal of the banking union is to provide integrity, soundness and stability of the banking sector in the Eurozone and thus contribute for the economic growth (Kirova, 2017). The Banking Union was officially established in November 2014 and is based on five components: A Single Rulebook on bank capital and liquidity, the Single Supervisory Mechanism (SSM), the Single Resolution Mechanism (SRM) and European Deposit Insurance Scheme (EDIS) and the financial backstop (the ESM) (Constâncio, 2013). The Single Rulebook aims to provide a single set of harmonised prudential rules which institutions throughout the EU must respect; after the global financial crisis, Capital Requirements Directive IV package was implemented through the single rulebook. The SSM consists in the establishment of a new supervisory authority, which is directly led by the European Central Bank (ECB), whose main responsibility is banking supervision. SRM is the orderly restructuring of a bank by a resolution authority when the bank is failing or likely to fail. This procedure ensures that a bank failure does not harm the broader economy or cause financial instability. EDIS ensures that all deposits up to 100000 euro are protected through national.

Given that the SRM so far has come into force for a very short period and has been applied in a very limited number of cases, more time is needed for the empirical assessment on it effect. Also, as the Deposit Insurance Scheme was discussed in pervious part, in this part I will mainly discuss the literature regarding to the Single rulebook and SSM and studies related to CEE countries.

4.1 CRR/CRD IV

Learning a lesson from global financial crisis, the European Union adopted the CRD

IV package in 2014, the third set of amendments to the original capital requirements directive. The CRD IV package introduces in the EU law the bulk of the international standards agreed by Basel III framework. The package is comprised of a directive controlling the access to banking activities and a regulation establishing the prudential requirements that institutions need to respect. The package predominantly strengthens the capital requirement. Through this mechanism, banks have to meet Tier 1 capital requirements of at least 6% of risk-weighted assets (RWA); The highest form of Tier 1 capital is Common Equity Tier 1 capital, which must be at least 4.5%; Banks must have a total capital-to-RWAs ratio of at least 8% to meet the Basel Tier 2 standard and the CRD IV requirements. The CRD IV proposals also introduce a leverage ratio to ensure that banks don't circumvent requirements for secure and long-term forms of capital (CFA Institute, 2013). There are also new rules on supervision, corporate governance, remuneration, sanctions, counterparty credit risk for derivatives, and reliance on credit ratings under CRD IV.

There are pervasive literature studying the potential impact of CRR/CRD IV, but with a few shedding lights on EU bank stability. In terms of bank efficiency, it is proved in many studies that higher capital requirements under the CRD IV proposal would cause a decrease in banks' profitability and credit supply (Aiyar et al., 2014; Teplý and Šútorová, 2014). As for financial stability, ECB (2015) claims that CRR/CRD IV have positive impact on the resilience of the EU banking sector by reducing moral hazard problems thus improving the quality of lending decisions, protecting taxpayers and society from unexpected bank losses and so on; also, the harmonised application of prudential rules in all EU Member States is of great importance for ensuring financial stability. However, historical experience has shown that the effort to implement regulations, supervision and strong macroeconomic policy were not enough to protect the financial industry from periodic crises (Reinhart and Rogoff, 2009). Consequently, the new regulatory framework on bank capital requirements may generate a similar result. Klinger and Teplý (2014) state that the Basel III regulation is not sufficient and will not prevent financial markets from future crises due to its expected calibration, delayed implementation, and strong pressure from the banks' lobbyists. Teplý and Šútorová (2014) assess the potential impact of the new capital requirements defined in CRD IV 594 on European banks and find that higher level of capital ratios forces banks

lower risky assets compared with total assets, but they cannot recognize whether lowering risky assets simply mean that banks decrease their risk weighted assets, while keeping the same level of capital or more in line with regulators' expectations, the higher capital requirements make banks managers behave more prudentially when engaging in risky operation.

4.2 Single Supervisory Mechanism

The role played by the SSM is considered to produce fundamental changes in the realisation of supranational financial stability. Under the SSM, the European Central Bank (ECB) is responsible for the supervision of the significant banks in Eurozone as well as a few non-Eurozone member countries that voluntarily participate. In 2014, 130 systematically significant banks were directly supervised by the ECB (119 in 2019) and the assets of these important banks account for about 82% of the total assets of the Eurozone banks (Fiordelisi et al., 2017).

Some believe that the single supervisory mechanism could improve financial stability in several ways. To start, the SSM is supposed to break the vicious loop between sovereign and bank risk (Prisecaru, 2014; Cantero Sáiz et al., 2019). The interdependence between sovereign risk and bank credit risks was one of the important contributors for the rapid contagion of global and Eurozone crisis (Alter and Schüler, 2012). On one hand, after the bankruptcy of Lehman Brothers, the liquidity as well as the capital of the banking sector were weakened, forcing government to bailout the systemic banks. As a result, the national deficit increased to an unprecedented level (De Bruyckere et al., 2013). Conversely, sovereign risk could be transferred into bank credit risk (CGFS, 2011; Bolton and Jeanne 2011; Li and Zinna 2014; Correa et al. 2014). The SSM was designed to reduce the connection between sovereign risk and the risk of banks. European banks would be less affected by sovereign risk because the unified regulation and supervision will generate a more homogenous financial situation (Nowotny, 2014). Moreover, the Banking Union could offer financial help to banks when the situation worsens, which would stop bank risk transmitting to sovereign risk (Leblond, 2014). The impact of the SSM on the contagion between sovereign risk and

bank risk is also recognised in empirical research. Using quarterly data from 2009 to 2016 collected from ten countries in euro area and 25 banks, Cantero Sáiz et al. (2019) discover that after the launch of the single supervisory mechanism in 2013, the link between the sovereign CDS spread and bank was reduced; in addition, they also find that there was a rise in sovereign risk led to the reduction in contagion.

More importantly, SSM may contribute to financial stability because it brings better supervisory consistency and eliminate the conflict of supervision among eurozone member states. The EU possessed a fragmented financial supervisory structure before the financial crisis outbroke (Pisani-Ferry, Sapir and Tille, 2010), under which state supervisory authorities sometimes loosened the requirements to protect competitive advantage of their own banks, which leaded to mixed supervisory rules and practices (Agarwal et al., 2012; Belke et al.,2016). Thus, there is space of regulatory arbitrage in the single market. The capital is likely to concentrate in countries with high risk but loosen regulation and supervision, which increases systemic risk in the EU (Belke et al.,2016). Also, the interests of each member state are inconsistent and national policies are in favour of national welfare. As a result, in an integrated financial market, decentralised national financial supervision may adversely impact on financial stability as it is likely to have negative spillovers on other countries or may be affected by the externalities of national supervisory practices in other countries (Schoenmaker and Oosterloo, 2007; Constâncio, 2014). For instance, the home country supervisor is unlikely to take into account the impact of its multinational bank's operations on the financial stability of host country (Leblond, 2014; Ahmad et al., 2019). The Single Supervisory Mechanism replaced the previous cooperation and dispute settlement mechanism and harmonised banking supervision. It contributes to the financial stability as its decisions take into account the externalities on countries other than the bank's host country and be in the interest of the entire eurozone member states (Loipersberger, 2018). The conclusion is reinforced by empirical study by Avignone et al. (2020), who find that banks supervised directly by the SSM have reduced their credit risk exposures more than their nationally supervised peers after the establishment of the Banking Union and the introduction of the SSM. Additionally, the launch of SSM could probably improve the corporate governance in European banks, including risk management, compensation, and key function holders, and thus enhancing the

robustness of EU banks (Braendle, 2018); also, SSM could improve bank stability by promoting transparency (Florin, Anastasia and Fabian, 2018).

On the other hand, the effect of SSM on bank stability is questioned by many. The organisation of the SSM is still based on the cooperation in supervision in spite that the ECB has powers to direct and substitute national supervisors. The ECB becomes the main institution with broad powers to determine and monitor regulatory practices regarding supervision in the euro area, whereas in daily operations it still relies on the cooperation and commitment of national supervisory authorities (NSAs) in considerable aspects (Tröger, 2014; Fiordelisi et al., 2017). Although SSM is designed to harmonise the supervision in eurozone, the delegation to national supervisors and cooperation in banking supervision could still potentially produce inconsistency between the ECB and the NSAs (Fiordelisi et al., 2017). In particular, cooperation mechanism is likely to be risky in crisis, since supervisors would protect their national interest instead of the European interest (Ferrarini, 2015b). Furthermore, the risk exist that the local supervisors may not actively cooperate, which will impair the ECB's direction and substitution powers. In order to prevent the national supervisors from not cooperating, ECB is granted the power to push NSAs to comply by issuing instructions or posing permanent and pervasive threat of ousting NSAs as competent supervisor (Tröger, 2014). However, it will undermine the incentives of national supervisors (Ferrarini, 2015a). Overall, the friction between the ECB and NSAs is likely to hamper the positive effect of SSM on bank stability. Another issue that SSM may incur is that as significant banks will fall under direct supervision of ECB, they are likely to behave differently from less significant banks. Fiordelisi et al. (2017) find that during the launch of the SSM, banks under the ECB's direct supervision reduced the amount of loans provided in comparison of other banks, which led to a considerable growth in the banks' equity capital ratios without a corresponding rise in equity capital levels. Ristolainen (2018) also concludes that the direct supervision by the SSM possibly enlarges window dressing incentives in Euro areas significant banks, as they may be more interested in accumulating larger capital buffers due to the enhanced supervisions; in addition, incentive to under-report loan loss has been amplified due to the implementation of the SSM. From the perspective of a banking supervisor or a macroprudential policy maker, it is essential that loan loss reserves and loan losses are

reported accurately and timely to reflect bank's current financial condition. Therefore, the window dressing would also impede the effectiveness of SSM.

4.3 Banking Union and Non-euro EU CEE Countries

The economic and financial ties between countries in non-euro area and eurozone countries are close and cannot be ignored. Banking union is targeted at euro area countries, but the non-euro countries could voluntarily participate in the Banking Union as well. At present, among non-euro EU CEE countries, Poland, Hungary, Czech Republic, and Croatia choose to stay outside BU and take wait-and-see approach, while Romania and Bulgaria decided to join in (Mero and Piroska, 2016).

Opting-in to the BU would bring advantages to non-euro EU countries that are effective on all BU members regardless of local currency, including increased stability of and confidence in the banking system, potentially stronger and more effective supervision and uniform supervisory practices, better communication between national supervisors and improved “home-host” relations, some reduction of sovereign-bank nexus and so on (Darvas and Wolff, 2013; Belke, 2016; Huttle and Schoenmaker, 2016).

However, joining the BU also brings several risks. First of all, BU will weaken the supervisory power of the state, which is mostly concerned by CEE policymakers (IMF, 2015). Secondly, there is limited decision-making rights of the countries who choose to join the BU compared with euro area members of the banking union (Belke, 2016). This unbalanced and unfair competitive environment has clearly deviated from the uniformity and stability that the BU aims to achieve and has formed a two-tier system. Also, opting-out is risky, as it would decrease the attractiveness of country who choose to leave the Banking Union for investors, possibly leading to the loss of foreign capital. In addition, the country has to reorganise the national supervisory framework if leaving the BU. These generate adverse impact on the bank stability of country who opts out (Belke, 2016). Moreover, Darvas and Wolff (2013) point out that the opt-out is likely

to result in significant uncertainty and may exert adverse impact on the consistency of the whole system.

5. Comparison of methodology

In this part, I would like to analyse the data and methodology adopted in the discussed paper. As this dissertation aims to examine the impact of post-crisis EU bank regulation and supervision on bank stability, it is essential to find the proper proxies for bank stability, regulation and supervision.

5.1 Bank Stability

The definition of financial stability is studied in several research. According to the ECB (2005), financial stability has the ability to offer assistant continuously for an economy. While in the opinion of Issing (2003), the investment chances could be enhanced by the financial stability because it could allocate resources more efficiently. The difficulty of defining the stability of bank results in various measures of proxying bank stability in empirical research. The bank z-score is one of widely employed indicator at the micro-level (Demirgü-Kunt and Detragiache, 2011; Anginer et al., 2013; Tabak et al., 2016; Bermpei, 2018), which indicates the likelihood of default of a bank. Its widespread use is because it is relatively simple to compute, and it could be calculated with publicly available accounting data (Li, Tripe and Malone, 2017). The basic principle of the z-score measure is to relate a bank's capital level to variability in its returns, so that one can know how much variability in returns can be absorbed by capital without the bank becoming insolvent. The variability in returns is typically measured by the standard deviation of return on assets (ROA) as the denominator of z-score, while the numerator of the ratio is defined as the ratio of equity capital to assets plus ROA.

Barth, Caprio and Levine (2004) proxy bank stability by the percentage of non-performing loans with respect to total assets. Shaddady and Moore (2019) employ a

CAMELS-DEA model to indicate bank stability. The model could examine various dimensions of bank development, including capital adequacy, the quality of asset, management, profit, and so on. Moreover, Anginer et al. (2013) use bank stock return volatility to measure bank risk. In country-level, bank stability is quantified by the possibility of bank crisis (Barth, Caprio and Levine, 2004).

Stress tests in banking becomes an important tool for supervisory authorities to examine the resilience of banking system. The main purposes of a stress test are to examine the risk drivers that are most likely to undermine the financial stability and to measure whether the banks could keep resilient when they are hit by adverse shocks (Darne, Levy-Rueff and Pop, 2013). Bohl, Siklos, Borio, Drehmann, and Tsatsaronis (2014) defined four elements of a financial stress test: the set of risk exposures subjected to stress, the scenario that defined the shocks that stress those exposures, the model that maps those shocks and a measure of the result. They conclude that stress tests can be early warning devices and aid in crisis management and resolution, but regulators must ensure that stress tests are administered correctly. It is obvious that the credibility of the results of stress test to a large extent depends on the assumptions. There are considerable research focusing on how to build robust and effective stress tests. Darne, Levy-Rueff and Pop (2013) propose a methodological framework to choose the proper initial shocks in terms of both magnitude and persistence. Gersl et al. (2013) discuss the stress-testing framework used by Czech National Bank (CNB), which consists of the model of DSGE type (g3), a number of satellite models, the dynamic linkages of the models and a number of ad-hoc shocks determined by expert judgment. From the practice of CNB the authors provide some views on constructing robust and well-functioning stress tests. Initially, the framework should be calibrated conservatively, which ensures that the impact of shocks will not be underestimated in downturn. Secondly, the assumed shocks ought to be severe enough to represent extreme but plausible events. Also, the framework must be continuously updated and improved, and a back testing exercise should be conducted regularly. Last but not least, the stress tests should be actively used in policy and the results regularly published and discussed by professional analysts. Basel Committee on Bank Supervision (BCBS) (2013) particularly discusses the assessment methodology of the systemic importance of global systematically important banks who would create cross-border negative spillover. The

committee develops an indicator-based measurement approach, which could capture the impact that a bank's failure can have on the global financial system and wider economy. Based on the cut-off score and bucket thresholds, the magnitude of the higher loss absorbency requirement is determined and required to be met with Common Equity Tier 1 capital only. In terms of quantifying systematic risk, Dijkman (2010) designs a systemic risk assessment framework for supervisors to assess the extent to which that particular crisis situation poses systemic risk. The framework is divided into two stages: preparatory stage and application during crisis. In the preparatory stage, the supervisors need to define critical elements of the financial system, map interconnections, identify information needs and define scaling criteria. During the crisis, the authorities should assess the initial impact of triggering event and then estimate adverse second-round effects by assessing the expected direction and intensity of contagion effects. Meantime, it's essential to assess the how the transmission of the shock through the financial system impacts the real economy. Schwaab, Koopman and Lucas (2011) also proposed a framework for financial systemic risk assessment. They use the mixed-measurement dynamic factor model approach and combine the risk factor and parameter estimates into coincident measures and forward-looking indicators of financial system risk. Using credit data for more than 12,000 firms, they find that a decoupling of credit risk from macro-financial fundamentals may serve as an early warning signal for a macro-prudential policy maker.

5.2 Bank regulation and supervision

In terms of the comprehensive research that study both regulation and supervision, most of the paper (Barth, Caprio and Levine, 2004; Tabak et al., 2016; Shaddady and Moore, 2019) collect data from the comprehensive dataset created by the Barth et al. (2004, 2006, 2008, 2011, 2017), which contain extensive information on bank regulation, supervision and monitoring and is compiled from the answers provided by official regulatory and supervisory authorities. In the paper by Barth, Caprio and Levine (2004), 7 indexes of regulations and supervision are constructed, covering regulations of on bank activities, regulations on domestic and foreign bank entry, regulations on capital

adequacy, deposit insurance, regulations on information disclosure and private-sector monitoring of banks, government ownership of banks supervisory power and independence, and supervisory experience and structure. In the research of the effect of one aspect of regulation or supervision, the variable is more specific. For example, in literature of Deposit Insurance Scheme, the coverage of the scheme is adopted in Prean and Stix (2011); deposit insurance dummy is set equal to 1 if a country has explicit deposit insurance and depositors were fully compensated the last time a bank failed and 0 otherwise (Barth et al., 2008; Anginer et al., 2013); Demirguc-Kunt et al. (2008) create full coverage dummy which is set equal to 1 if a country offers full coverage and 0 otherwise.

Hypothesis

The thesis aims to examine the impact of new bank regulation and supervision after global financial crisis in EU on CEE countries bank stability. The thesis plans to analyse the bank regulation and supervision from five aspects, which are capital adequacy regulation, restrictions on bank activities, the limitation on bank entry, deposit insurance scheme and supervision with regards to Single Supervisory Mechanism. In this section, hypothesis of each aspect is generated based on the literature review and theoretical discussion.

There is common agreement that the global financial crisis was resulted from too much risk-taking by financial institutions and inadequate capital cushions to absorb unexpected financial losses (Anginer et al., 2019). And thus, from Basel II to Basel III several fundamental improvements including the orientation to both micro and macro risks were made (Avandanei, 2013). However, the question arises that how effective these new measures are expected to be? In general, there are two ways to enhance the adequacy of capital to cover unexpected losses. One is enhancing the quality or the amount of regulatory capital, and the other is decreasing total risk exposure (Jones, 2000). Economic theories explain the effect of capital on bank risk from various dimensions. One of important purposes of increasing the stringency of capital

requirement is to make sure that banks are able to endure unanticipated losses in the values of the assets they own and at the same time banks could still carry out deposit withdrawals and other obligations (Anginer and Demirgüç-Kunt, 2014). Holding the similar idea, considerable theories point out the positive effect of capital as a buffer to sustain earning shocks to maintain market confidence (Repullo, 2004; Von Thadden, 2004; Shaddady and Moore, 2018). Therefore, higher capital ratio helps reduce bank risk. Moreover, capital requirements are deemed to stabilise banks because they also motivate bank managers and shareholders to upgrade the risk management as well as to restrain inappropriate risk-taking. Coval and Thakor (2005) and Mehran and Thakor (2011) emphasize that higher capitalization forces the bank to strengthen the screening of the borrower and to improve risk monitoring, and thus reducing bank fragility. In addition, capital requirements can influence bank stability by decreasing competition. High initial capital adequacy requirements not only impose entry barriers for newcomers, but also lifts the fixed costs of running a bank, which would restrict competition and allow existing banks to accumulate power, leading to a more prudent behaviour (Agoraki, Delis and Pasiouras, 2011). Lastly, some theories explain from the angle of the moral hazard. As risk-shifting incentives are likely to be limited, stricter capital regulation may result in the choice of less risky portfolios (Keeley and Furlong, 1990; Rochet, 1992; Acharya, Mehran, and Thakor, 2011). ECB (2015) claims that CRR/CRD IV have positive impact on the resilience of the EU banking sector by reducing moral hazard problems thus improving the quality of lending decisions, protecting taxpayers and society from unexpected bank losses. Overall, based on the literature and theoretical discussion, the thesis formulates the first empirically testable hypothesis.

Hypothesis 1. H_0: Capital adequacy regulation has positive effect on bank stability.

The nature of financial services provision has been changing rapidly in the last decade, and this is affecting the desire and need of banks to widen their scope of activities. In terms of regulation of bank activities, Anginer et al. (2019) study the changes of bank regulation and supervision after the global financial crisis from 2009 to 2019. They find that there are more banks in high-income countries being able to own up to 100% of voting shares equity in non-financial firms. In contrast, more developing countries

impose restrictions on this aspect. Moreover, more developing countries increased the stringency of regulation of engaging in non-traditional activities and ask banks to obtain the approval from the supervisory authority. In accord with splitting practices in different countries, the economic theories also divided. One of the reasons to relaxing restrictions on bank activities is that by permitting banks to conduct non-fee-based activities, banks could diversify income and thus diversify risks. Restrictions on activities could probably impede the ability of banks to diversify income flows which may affect financial services and impede banks to provide more efficient services and thus decrease bank stability (Barth et al., 2004; Laeven and Levine, 2007). Also, higher restrictions on bank activities may destabilise the banks as bank managers and shareholder tend to increase risk to compensate for the loss. For example, since the engagement in financial services is limited, banks may have to focus more on the loan market. However, the regulation on bank activities is a controversial theme, in particular for emerging markets (Claessens, 2003). Although in theory, loosening the limitations on bank activities may have positive effect on risk diversification, at the same time it also offers more chances to stimulate and shift risk. What's more, as banks could engage in various activities, banks will become more complex, which means the difficulty for supervisors to monitor will be escalated. In emerging countries of which supervision may be weak, this problem is possible to become more severe (Claessens, 2003). While tighter restrictions may improve monitoring efficiency and reduce information asymmetry due to the lower complexity of banking activities (Boyd, Chang, and Smith, 1998). According to the theoretical discussion and considering the characteristics of countries examined in the thesis, the second hypothesis is:

Hypothesis 2. H_0: restrictions on bank activities are effective in increasing bank stability.

According to Anginer et al. (2019), there are also several changes on the limitations of bank entry after the global financial crisis in worldwide. Between 2011 and 2016, high-income OECD countries accepted 87 percent of the applications from domestic entities that want to enter banking market, higher than the portions in other regions; Also, the percentage of application received from foreign banks that were denied in OECD countries is relatively low; there are more foreign banks prohibited to enter the local

banking market in developing countries than in developed countries. During the past decades foreign banks have entered several CEE transition countries. Some countries regarded foreign banks as a tool to improve both the quantity and quality of financial intermediation. In contrast, there are also critics pointing to the risks for the domestic bank stability, emphasising the risk of a more volatile credit supply. There are conflicting theories on the penetration of foreign banks into less-developed banking systems. Although there is no comprehensive theory of foreign bank entry, especially in emerging market, there are some important ways through which foreign banks may affect the stability of the banking system of host country. A fundamental fact is that foreign bank subsidiaries belong to their parent banks who possess internationally diversified asset portfolio. Consequently, the parent banks' policies will to a certain extent influence the decisions of their subsidiaries. The theory supporting lowering the foreign bank entry limitations claims that the parent bank may save their cross-border subsidiaries or act as a lender of last resort during crisis periods (De Haas and Lelyveld, 2006). It may also allocate capital and liquidity to its subsidiaries by managing an internal capital market and centralised treasury operations (Stein, 1997). Furthermore, when there is a bank capital shock in the host country, foreign banks may be less affected since they have a supportive parent bank. As a result, compared to domestic banks, foreign banks may be able to recover faster from the shock. On the other hand, there are also theories holding the opposite position. One possible mechanism through which the foreign bank entry imposes negative impact on domestic banks' stability is that it intensifies competition among banks. Competition among banks has been argued to be a contributor to the instabilities of banking market in many countries (Smith, 1984; Keeley 1990). With more banks enter the banking market, the market share of existing bank will diminish, leading to the contraction of franchise value or charter value. Since lower franchise value results in fewer opportunity costs during bankruptcy, bank owners may become more reluctant to take prudential actions (Marcus, 1984; Keeley, 1990). Therefore, more competition drives banks to take risk. However, Yin (2020) claims that stringent capital requirements and more effective information sharing can all mitigate the impact of foreign bank entry on competition in the host countries. With the reformation of regulation and supervision in various aspects in EU, the third hypothesis is generated.

Hypothesis 3. H_0: Higher restrictions on bank entry have negative impact on bank stability.

Deposit insurance coverage has become more generous after the global financial crisis. Under EU rules, deposit guarantee schemes could guarantee deposits up to 100,000 euro per depositor per bank. The rationale of deposit guarantee schemes protecting the banking sector is that it helps to prevent the massive withdrawal of deposits if bank failure happens, and thus decreases bank instability (Prean et al., 2011). Also, it may be beneficial for market confidence on global banking system to expand the level of deposit insurance coverage. Although DGS is designed to minimise systemic risk, it can actually have negative effects. If the design and the management of deposit insurance schemes are not sufficient, banks are likely to take excessive risk (Anginer and Demirgüç-Kunt, 2018). An explicit deposit insurance could possibly motivate bank owners and depositors take risky strategies. If the depositors can be bailed out when systemic problems occur, how does explicit deposit insurance increase bank fragility? Numerous literatures provide answers to this question. In general, there are several possible interpretations. Firstly, if there is no explicit deposit insurance scheme, the part of depositors would be unsure about whether their deposits could be compensated and how quickly it would be covered when the bank becomes insolvent, which will probably make depositors more prudent and have more incentives to monitor bank. However, with the explicit deposit insurance scheme, depositors may be reluctant to check the solvency of the banks where they place their money. This are possibly to result in misuse and misallocation of resources and might dampen the market discipline in the banking system (Demirgüç-Kunt et al., 2008; Anginer and Demirgüç-Kunt, 2018). An alternative explanation is that the safety net provided by deposit insurance schemes may encourage banks to take excessive risks by lending to borrowers who are not creditworthy. The above reasons are known as the 'moral hazard' problem. In addition, "too big to fail" problem may also explain why the DGS may trigger bank instability. In the financial crisis, several banks were bailed out because they were deemed systematically important, and their failure had the hidden danger to transform to an attack to the whole financial market and even to the entire economy. In the event of a crisis, the owners and creditors of larger banks may be in a better position to force policymakers to extend protection to their own claims (Demirgüç-Kunt and

Detragiache, 2002). Overall, a large number of literatures points out the adverse effects of the deposit insurance scheme on the bank stability. Therefore, the hypothesis of DGS is that

Hypothesis 4. H_0: The more generous deposit insurance scheme has negative effect on the bank stability.

Turning to the bank supervision, there are some dimensions of supervision that could have split effects on bank stability. To begin with, the effect of bank supervision may partly depend on supervisory power. However, only a few papers focus on this issue theoretically. In general, the theories demonstrate that broader supervisory power could be beneficial for the banking industry. Kupiec and O'Brien (1995) argue that supervisors' powers to impose fines and penalties on banks may reduce moral hazard problems in banking. It is well-known that banks' activities are complex and costly to understand and monitor. Moreover, the government's bailout during crises can encourage financial institutions to take excessive risk taking. As a result, it is necessary to have effective supervision with strong supervisory power, otherwise bank runs will be socially costly (Diamond and Dybvig, 1983). According to He et al. (2021), a powerful supervisor is able to limit bank lenders' excessive risk taking, because they tend to take more prompt and effective intervention in case there is any potential issue in banks' lending activities. In addition, if the regulators have broad power such as suspending banks' distribution of shareholder dividends and management bonus, ordering banks to constitute loss-covering provisions, or imposing legal sanctions on the banks' directors and managers, banks are more likely to behave prudently in their lending practices when facing powerful regulators.

After the global financial crisis, supervision in EU has been substantially strengthened with consistent regulation for the banking industry and more uniform enforcement in the EU, which is considered beneficial for decreasing risks by some researchers (Nowotny, 2014; Leblond, 2014). However, the effect of Single Supervisory Mechanism on bank stability is questioned by many. On one hand, banks become larger and more complex, which may result in insufficient supervision. There is a growing need for supervisory resources to monitor the risks of financial institutions. On the other

hand, new supervisory mechanism that requires stress testing and disclosure imposes additional pressure on supervisory authorities to generate, process and publish information. More importantly, although the SSM concentrates the supervision in euro area, the organisation of the SSM is still based on the cooperation in supervision. Therefore, the agency problem still exists that the ECB and national supervisory authorities act on behalf their own interests (Fiordelisi).

With respect to CEE countries, as many CEE countries are not member state of eurozone, they are facing the choices whether to opt-in the Banking Union or not. Some CEE countries take a wait and see approach after weighting the costs and benefits of joining the Banking Union, such as Czech Republic, Hungary, and Poland. Méró and Piroska (2016) explains these countries' choice from the theory of banking nationalism and claim that affected by banking nationalism, the banking policies in countries that opt out contradict with Bank Union's rules. Banking nationalism is a policy that enhances national benefits in bank ownership, regulation, and supervision. Since the introduction of the single rule book, the scope for banking nationalism with regards to bank regulation has been significantly reduced within EU. However, there are still several important regulatory powers delegated to the ECB and the national supervisory authorities. It encourages CEE countries to maintain their existing regulatory framework instead of joining the BU. By claiming on behalf of national interest, banking nationalism can strengthen national control and increase governments' room for adjustments within the banking sector. Taking Hungary as an example, OTP Bank one of the largest banks in Hungary with over 20% market share in Hungary. However, under European standards, it becomes a small bank. If Hungary opts in the BU, OTP would be supervised by the ECB and become a small individually supervised bank with less specific supervisory attention (Kisgergely and Szombati, 2014). Moreover, the national supervisory authority could also benefit from regulating and supervising the systematically significant banks. Through the Supervisory Review Process (SREP), the banks and the supervisors could determine the Pillar II capital requirement through negotiation. For banks that have good relationship with supervisors, the Supervisory Review Process can be relatively lighter. However, as a BU member, ECB makes the decision on the capital requirement. As for bank regulation, a bunch of important tools of bank regulation were implemented in Hungary in 2010. Within the BU, the

macroprudential tools of MNB, the central bank of Hungary, would become weaker. Keeping the right to make independent macroprudential rules is a key contributor of MNB's opt-out decision (Kisgergely and Szombati, 2014). After analysing the theories of bank supervision, especially the Single Supervisory Mechanism, hypothesis of supervision is formulated.

Hypothesis 5. H_0: Boarder supervisory power has positive effect on bank stability, while the SSM is not significantly associated with bank stability before 2019.

Data and methodology

1. Database

The thesis investigates the relationship between bank stability and bank regulation and supervision, which are explored from five aspects: capital stringency, restrictions on bank activities, foreign bank entry and ownership, deposit insurance scheme and supervision. The data are collected from Bank Regulation and Supervision Survey (World Bank, 2011, 2019), BankFocus, the database of national banks and European Banking Authority. The Bank Regulation and Supervision Survey is funded by World Bank and conducted by Barth, Caprio, and Levine to obtain details on bank regulations and supervisory practices. So far there has been 5 surveys published. Survey I was completed in 1999, covering 118 countries and included over 300 questions. In terms of the second survey, the questionnaire was expanded and adjusted according to the input from country officials, scholars, and World Bank staff. The second survey was released by World Bank in 2003, which includes answers from 151 counties. Survey III was published in 2007, and it offers information on banking policies for 142 countries. Survey IV provides information on banking policies in 125 countries from 2008 to 2011. And the most recent one was released in 2019, which is organised in 15 sections. The survey raised questions about a large range of bank regulation and supervisory rules, including entry into banking, capital, ownership, activities, bank governance, depositor protection schemes, supervision and so on. The dataset also

provides information on the organization of regulatory agencies and the size and structure of the overall banking system. Overall, the surveys cover 180 countries and show the changes of bank regulation and supervision over 20 years. The dataset facilitates analyses of the content and feature of bank regulation and supervision, the organisation of national banking authorities, and the organisation and size of the banking sector. As the Survey V documents the information till 2016, the paper updates the data in 2017, 2018 and 2019 from the database of national banks and supervisory authorities. Moreover, the European Banking Authority provides valuable information on bank regulation and supervision in its member state.

Bank-level data are collected from BankFocus, which combines core data from Bureau van Dijk and Moody's Investor Services to create a comprehensive bank database that can be used to identify and analyse banks and other financial institutions. BankFocus provides detailed and standardized reports and ratios for more than 44,000 banks worldwide. In addition, the database offers multiple financial templates: global standard format, expanded global detailed format, national format templates, IFRS/GAAP and Islamic banking templates, etc. In addition, BankFocus can query market indicators and credit ratings, including credit default swap (CDS) information, market data, and bank ratings of Moody's Investor Service, Standard & Poor's, Fitch Ratings and Morningstar. The information for each bank consists of detailed balance sheet, ownership data and income statement data. The thesis matches the bank-level information with the bank regulation index to explore the link between bank regulation and supervision.

2. Sample Selection

The thesis focuses on the post-crisis bank regulation and supervision and thus examine time period from 2009 to 2019. In the CEE countries, four banking systems are chosen as the sample, Poland, Hungary, Slovakia, and Slovenia. Selection of the research sample is based on a comparable level of economic development as well as the scale and structure of banking sectors of the analysed countries. Initially, all four countries are the member state of EU and thus their legal system reflects the legal solutions in

force across the EU. EU regulations, including the Capital Requirements Regulation and Directives and the Deposit Guarantee Schemes Directive, are directly applicable in sample countries. Also, Poland, Hungary and Slovakia are the member of Visegrad Group. The members share some commons in economy, politics, culture, and military. In addition, there are similarities in the characteristics of banking sectors in all four countries. For instance, a significant fraction of banks in four countries are foreign owned. Apart from similarities, selection of the research sample is also based on the differences among four countries. The predominant difference is that Slovakia and Slovenia are the part of eurozone, while Hungary and Poland have not adopted the euro as its currency and is not a member of the Euro system or the Banking Union.

In CEE, the largest economy is Poland. The Polish banking sector is considered high stability and safety. Although a number of financial crises hit other countries in EU, the credit institution in Poland were able to keep resilient and avoided serious problems. In the global financial crisis, the Polish economy were the only one in CEE countries that remained growth. At the end of 2019, there were 538 cooperative banks, 30 commercial banks, and 32 branches of credit institutions in Poland. In terms of ownership, the Polish banking sector is characterised by the large share of state and foreign capital. About 25 percent of commercial banks in Poland have predominantly state capital and 50 percent are with a large extent foreign capital. The two largest Polish banks in terms of assets – PKO Bank Polski and Bank Pekao – are subsidiaries of the Polish State Treasury. In 2019, over half of commercial banks were controlled by foreign capital. In 2019, assets of the banking sector reached 467 billion euro. In terms of the value of assets, the 5 largest commercial banks in Poland represent almost 50 percent of the Polish banking sector. These banks have been identified by the Polish Financial Supervision Authority (PFSA) as other systemically important institutions (O-SIIs).

The Hungarian banking market is quite diversified. It consists of 41 institutions, 30 of which are commercial banks. 17 banks are foreign-owned commercial banks with a strong market share and an ownership structure greatly subject to the Banking Union (Kisgergely and Szombati, 2014). In 2019, assets in the Hungary banking sector stood at 38255 million HUF (about 106 million euro). The Hungarian banking sector is concentrated within four largest banks who control more than 50% of the banking assets

and the largest bank itself- OTP Bank-represented 26.5%. In 2013, the supervisory authority was integrated into the central bank by Hungarian government, the Hungarian National Bank (MNB), and thus the financial markets are exclusively supervised by MNB. MNB is responsible for mitigating and managing risks potentially arising in the financial sector at system level and for overseeing the safety and stability of individual financial institutions.

The Slovak banking system was developed on the basis of the European model. According to Slovak law, commercial banks can engage in investment banking and brokerage activities to a certain extent, as well as traditional commercial transactions and loans. However, these activities are licensed and regulated by the National Bank of Slovakia (NBS). In addition to supervising bank activities, the bank is also responsible for controlling minimum capital, reserve requirements and bank supervision. There are 27 financial institutions with banking licenses in the Slovak banking industry. Most of them are universal banks, focusing on retail and corporate banking. As with other countries in the sample, most banks in Slovakia are controlled by foreign capital. Only four banks are totally owned by the government and domestic capital. The Slovak banking industry is highly concentrated, with the three largest banks controlling more than 50% of the assets of the Slovak banking industry. Nevertheless, it could be seen that the market power of small and medium banks has increased in a small magnitude in recent years. On the 1st of January 2009, the Slovak Republic joined the eurozone and NBS participates in the Single Supervisory Mechanism.

On 1 January 2007 Slovenia adopted the euro as its currency. At the end of 2019 there were 12 commercial banks operating in the banking market of Slovenia. Total assets of the banking sector reached €41.2 billion in 2019, which enlarged by 6.3% compared with 2018. The banking industry in essential in Slovenia as the total asset of the banking sector equals to 85.8% of the GDP. As an eurozone member, Slovenian banking sector automatically takes part in the Banking Union. The national supervisory authority, the Bank of Slovenia, participates in all the supervisory activities, while the supervisory decisions regarding significant banks are made by the ECB. The supervision of banks that do not meet the criteria for being classed as significant institutions is conducted by

national supervisor in accordance with the rules and methodology of the ECB and the SSM.

3. Variables' Definition

Based on BRSS, the thesis examines bank regulation and supervision from five aspects and constructs indexes for each aspect as independent variables. The first category is capital regulatory variables. After the global financial crisis, four countries in the sample all moved from Basel II to Basel III. Under Basel III, the overall minimum capital requirements (8%) remained unchanged, while the Tier 1 capital requirements increase from 4% in Basel II to 6% in Basel III and Tier 3 capital is completely abolished. The 6% includes 4.5% of Common Equity Tier 1 and an extra 1.5% of additional Tier 1 capital. In the thesis, two measures of capital regulatory stringency are employed: 1) Tier 1 Capital indicates the stringency of regulatory requirements measured by the level of Tier 1 capital banks required to hold. 2) Total capital ratio measures the amount of capital that banks hold. 3) Other Systematically Important institution (OSII) variable shows whether the banks are obliged to hold OSII buffer on an individual and sub consolidated basis of 2%. OSII are institutions that are more likely to create risks to financial stability because of their systemic importance. The objective of the O-SII buffer is to reduce the probability of failure of a systemically important institution. It enhances the resilience of these institutions, which due to the scale or nature of their business are of systemic importance, by providing an additional layer of loss absorbing capital. A higher capital requirement for these institutions acknowledges the greater impact that their failure would have. If the bank is identified as OSII, the variable equals to 1, otherwise equals to 0.

In terms of restrictions on bank activities, Bank Activities Variables measure the degree to which banks are allowed to engage in the fee-based activities. The variable includes three activities: Securities Activities captures the ability of banks to engage in the business of securities underwriting, dealing, brokering, and all aspects of the mutual fund industry; Insurance Activities is the ability of banks to undertake insurance underwriting and selling; Real Estate Activities measures the ability of banks to conduct

real estate investment, development, and management. If a full range of these activities can be conducted directly in banks, the variable is assigned value of 3; if all these activities are allowed but a part of these activities have to be conducted in subsidiaries, or in another part of a common holding company or parent, the variable is assigned value of 2; if less than the full range of activities can be conducted in institutions mentioned above, the variable is assigned value of 1; and if none of these activities can be done in either banks or subsidiaries, or in another part of a common holding company or parent, the variable is assigned value of 0. And an overall activity regulatory stringency is constructed by combining above variables together. Therefore, overall activity regulatory stringency variable ranges from 0 to 7. The larger number represents less restrictions on bank activities and higher level of freedom for banks on fee-based activities.

Foreign Bank Entry Restriction captures whether there are any limitations placed on the ability of foreign banks to enter the domestic banking industry and the level of requirements. It is shown in the Survey IV and V that foreign banks are not prohibited from entering through acquisition, subsidiary, branch, or joint venture in four countries during the examined period, and there is no limitation on the percentage of foreign ownership of domestic bank. Thus, the variable is mainly proxied by the specific legal requirements for obtaining a license to operate as a bank. The variable is assigned the number of licenses required to carry out banking business. The more licenses required, the more difficult it is for foreign bank to entre.

In terms of Deposit Insurance Scheme, all countries have an explicit deposit insurance protection system for banks. The thesis employs two variables to outline deposit insurance regime in each country. One is Deposit Insurer Power, which assesses if the deposit insurance authority has the right to conduct bank examination, to make the decision to intervene in a bank, to access to information collected by banking supervisors, to determine method of failure resolution and to use the deposit insurance fund as a paybox. The sum of the values has a range from 0 to 5. The higher values indicates more power of deposit insurer. Another is Deposit Insurance Fund, which is collected from national deposit insurance authority. It measures the maximum amount of deposit that is guaranteed by the scheme.

Lastly, there are three variables capturing bank supervision. 1) Official Supervisory Power measures the extent to which the bank supervisory agency in one country has the power to take specific actions. It combines the answers from following survey questions: Are auditors required to contact directly with the supervisory agency about fraud, elicit activities, or insider abuse? Could the supervisory agency meet and communicate with external auditors about banks? Are supervisors able to take legal action against external auditors if where the supervisor identifies that the bank has received an inadequate audit? Are off-balance sheet items disclosed to supervisors? Is the supervisory authority able to order a bank to adjust its internal organizational structure? Can the supervisory agency suspend the directors' decision to distribute dividends, bonuses, and management fees? Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? Can the supervisory agency supersede the rights of bank shareholders, declare a bank insolvent, and remove and replace directors? The value of Official Supervisory Power ranges from 0 to 12, where larger numbers indicate greater power. 2) Independence of Supervisory Authority proxies the level of supervisory authority's independency. Based on the question that whether the banking supervisory agency has to gain approval or objection from the government in order to issue binding secondary regulations for the banking sector, to determine its budget, to obtain funding, to hire and fire senior staff, to define salaries and benefits structure of staff, and to define its organizational structure, the variable is assigned value from 0 to 6, with higher value indicating less independency. 3) Significant supervised institution variable captures whether the banks are directly supervised by ECB to explore the effect of SSM. The variable is assigned value of 1 if the bank is classified as significant supervised institution; otherwise, the variable is assigned value of 0.

For dependent variable, bank stability is proxied by the Z-score of each bank in the thesis, which equals the return on assets plus the equity-asset ratio divided by the standard deviation of return on assets. Specifically,

$$Z - score = \frac{ROA+ETA}{s(ROA)} \quad (1)$$

where ROA is the rate of return on assets, ETA is the ratio of equity to assets, and

s(ROA) is the standard deviation of the ROA. Z-score can be understood as a measurement of the distance to bank default. A high value of z-score represents a low-risk bank, showing that a great number of standard deviations of a bank's return of asset needed to fall to become insolvent. The lower the value of z-score, the more unstable the bank.

The data of bank return, assets and capital-asset ratio are obtained from BankFocus. However, it is worth discussing that how to estimate the elements of z-score, which is now often used as a variable that changes with time in empirical research. Previous research adopts several approaches to calculate time-varying z-score. One way is to calculate standard deviation of return on asset of the whole period and combine it with the average of annual ROA and capital-asset ratio over the same period (Laeven and Levine, 2009; Houston et al., 2010). The 3-years rolling z-score is one of the most widely employed methods in studies. Boyd and Graham (1986) and Hannan and Hanweck (1988) calculate z-score with the sum of equity to total assets and return on assets divided by the three-year standard deviation of ROA. Boyd et al. (2006) use the sum of current return on assets and three-years moving average of equity-to-assets ratio, divided by standard deviation of ROA over the same time window. Beck and Laeven (2006) employ standard deviation of ROA calculated with the whole sample, together with current time values of return asset ratio and CAR.

It is apparent that the consensus has not been reached on what the correct way is to compute time-varying z-score. Choosing which method to calculate the elements of z-score and how to the combine these elements would largely change the results of z-score. Using the whole sample period to compute elements is able to generate more stable z-score (Lepetit and Strobel, 2013). However, if the sample time is longer, the risk feature and the management may change. In this case, it is better to use the rolling time window in the computation. Theoretically, computing the elements of z-score with rolling windows would be more reasonable since a bank's risk profile and lending pattern may change in a relatively long period. Therefore, the thesis follows Boyd and Graham (1986) and Hannan and Hanweck (1988), implementing the annual value of ROA, the current value of equity to asset ratio and three-year rolling standard deviation of ROA. Moreover, the natural logarithm of the z-score is employed, which is normally

distributed. For brevity, the natural logarithm of z-score is labelled as lnz.

Furthermore, the thesis also includes several country-level variables to control for differences in economic development and institutions across countries. First, the natural logarithm of GDP is employed to capture the size of the economy. Second, GDP per capita captures the economic development of the country. In addition, the estimation also controls for the inflation of the economy.

4. Descriptive data

The thesis only considers the population of banks that behaviour as a commercial bank. Limited by the data availability, 37 banks are selected from 4 countries: 9 from Hungary, 14 from Poland, 7 from Slovak Republic and 7 from Slovenia. To ensure accounting uniformity among different countries, all data are converted to euro. The descriptive statistics for whole sample are reported in Table 1. In average, the logarithm of z-score is 3.25, ranging from -2.487 to 6.636. In average, the z-score shows that profits must fall by 26 times the standard deviation to eliminate bank equity. The profits of least stable bank only need to fall by 0.14 standard deviations to eliminate bank equity, while the profits of most stable bank have to fall by 762 standard deviations. It is apparent that the bank fragility varied greatly among banks over the period from 2009 to 2019. The estimates of total capital adequacy ratio of banks display a similar variation. Total capital adequacy ratio varies from a low of about 7.5% to a high of 34.7%. The average capital adequacy ratio is 15.18%. The minimum Tier 1 capital ratio ranged from 0%, in country who didn't set requirement for Tier 1 capital but for the sum of Tier 1 and Tier 2, to 6%. The means of Securities, Insurance and RE are 2.67, 1.29 and 1.20, respectively, from which it could be inferred that in general banks in four countries can engage in securities activities most freely than in insurance and real estate activities. The maximum of both insurance and real estate activities are 2, showing that none of four countries allowed a full range of these activities to be conducted directly in banks. In terms of the bank entry, in average banks need to provide 4.98 licenses to get approval from authority. Among four countries, Slovenia required the highest number of licenses from bank, with 21 licenses after 2011. Deposit Insurer Power (DIP) also varies greatly. In 2009 and 2011, the deposit insurer in Poland only had bank

examination authority, while from 2009 the deposit insurance agency in Slovenia were authorised to conduct bank examination, to make the decision to intervene in a bank, to access to information collected by banking supervisors, to determine method of failure resolution and to use the deposit insurance fund as a paybox. The average of the logarithm of deposit insurance coverage is 11.285. From 2011, the deposit insurance coverage in EU countries were required to increase to 100 thousand euro. The differences in the extent of supervisory power and independence of supervisory authority among countries are also considerably large. The average of official supervisory power was 8.9, with the minimum at 7 and the maximum at 11. In terms of control variables, the mean of the logarithm of GDP is 25.93, while the average of log GDP per capita equals 9.72, with relatively small variation. The minimum inflation rate is -1.16%, which took place in Slovakia in 2009. And Hungary had the highest inflation rate in 2018, which was at 4.83%.

Table 1. Descriptive Statistics for Whole Sample

Variable	Obs	Mean	Std. Dev.	Minimum	Maximum
lnz	401	3.247	1.418	-2.487	6.636
Tier1	407	0.05	0.013	0	0.06
CR	407	15.18	3.586	7.5	34.7
OSII	407	0.27	0.445	0	1
Securities	407	2.666	0.747	1	3
Insurance	407	1.287	0.959	0	2
RE	407	1.204	0.936	0	2
Activity	407	5.157	2.397	1	7
License	407	4.975	7.391	1	21
DIP	407	3.295	1.23	1	5
lnFund	407	11.285	0.519	9.826	11.513
OSP	407	8.902	1.554	7	11
Independency	407	1.204	1.563	0	4
SII	407	0.064	0.245	0	1
lngdp	407	25.927	0.928	24.57	27.217
lngdppc	407	9.721	0.226	9.403	10.22

Inflation	407	1.825	1.442	-1.161	4.833

Note: This table reports summary statistics of all variables. Sample consists of 37 banks from 4 countries. Statistics based on annual data from 2009 to 2019. lnz is the natural logarithm of the bank's return on assets plus the equity asset ratio divided by the three-year rolling standard deviation of ROA. Tier1 is the amount of Tier 1 capital banks must hold over the period 2009–2019. CR is the total capital ratio of individual banks. OSII is the dummy variable that indicates whether the banks are identified as other systematically important institution. Securities measures the ability of banks to engage in the business of securities underwriting, dealing, brokering, and all aspects of the mutual fund industry. Insurance measures the ability of banks to undertake insurance underwriting and selling; RE measures the ability of banks to conduct real estate investment, development, and management. Activity is an index of overall activity restrictions. License is the number of licenses required to entry into banking sector. DIP measures the power of deposit insurance authority, ranging from 0 to 5, with higher values indicating more power. lnFund is the natual logarithm of the coverage level of the deposit insurance scheme over the period from 2009 to 2019. OSP measures the degree to which the country's bank supervisory agency has the authority to take specific actions. It combines the answers from 8 survey questions. It ranges from 0 to 12, where larger numbers indicate greater power. Independence proxies the level of supervisory authority's independency. It is assigned value from 0 to 6, with higher value indicating less independency. SSI takes a value of one if the bank is classified as systematically important institution, and zero otherwise. lngdppc is the log of gross domestic product (GDP) per capita of the country. lngdp is the logarithm of GDP (constant at 2010 US dollar) over the period 2009–2019. Inflation is the inflation rate of the country during 2009-2019.

Table 2 to Table 5 display the summary statistics by countries. It could be concluded from the tables that the banking sector of Poland has highest z-score and thus is most stable among four countries after the global financial crisis. In contrast, the average log z-score of Hungary is the lowest, meaning profits of Hungarian banking sector need to fall by 11.3 standard deviations to eliminate bank equity. The Tier1 shows the capital regulatory difference among countries. In 2009 and 2010, the Hungarian central bank did not impose minimum requirement regarding Tier 1 capital ratio, instead it required the Tier 1 and Tier 2 capital adequacy ratio to be no less than 8%. It was until 2011 that the Hungarian banks were asked to hold no less 4% of tier 1 equity of assets and the requirement increased to 6% in 2015 according to Basel III. While in the other three countries, before 2014 the minimum Tier 1 capital adequacy ratio was 4% and from 2014 the minimum raised to 6% gradually. The O-SIIs identification process started in 2015 and takes place on a yearly basis. 7 out of 9 banks from Hungary, 10 out of 11 banks from Poland, 4 out of 7 banks in Slovak Republic and 5 out of 7 banks in Slovenia had been identified at least once as other systematically important institution from 2015 to 2019. From the value of Activities, it could be seen that the banks in Hungary were the least restricted, while the Slovakian banks were not allowed to engage in insurance activities and real estate activities over the whole period. The restrictions on bank

activities loosened considerably after global financial crisis in Poland. Among four countries, the deposit insurer in Slovenia owned largest power but in Slovakia, the deposit insurance agency could only access to information collected by banking supervisors and manage paybox system. Regarding deposit guarantee coverage, before the unified requirement in 2011, Poland had the highest coverage level with 50000 euro and Slovenia had the lowest coverage with 18500 euro. As all four countries are EU member state, the variation of deposit insurance fund is small. The averages of the logarithm of insurance coverage in sample countries are very closed. In terms of supervision, the Hungarian supervisory authority had the highest level of power among four countries over the whole period. Apart from Hungary, the supervisory authorities in other countries experienced a shrank in terms of supervisory power after 2011. Especially in Poland, the value of OSP decreased to 7 from 9 since 2012. Moreover, the banking supervisory agency of Poland did not need to obtain approval or no objection from the government to hire and fire senior staff. Last but not least, as both Slovakia and Slovenia were eurozone member during the examined period, the banks that were classified as systematically important institution were under the direct supervision by ECB after the implementation of single supervisory mechanism. 3 banks in Slovak Republic and 3 banks Slovenia had been identified at least once as systematically important institution from 2014 to 2019.

Table 2: Summary statistics by Country (Hungary)

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
lnz	96	2.427	1.275	-1.048	5.336
Tier1	99	.046	0.019	0	0.06
CR	99	16.383	4.691	8.235	34.7
OSII	99	.384	0.489	0	1
Securities	99	3	0	3	3
Insurance	99	2	0	2	2
RE	99	2	0	2	2
Activity	99	7	0	7	7
License	99	2	0	2	2
DIP	99	2.727	0.448	2	3

lnFund	99	11.239	0.584	10.007	11.513
OSP	99	11	0	11	11
Independency	99	0	0	0	0
SSI	99	0	0	0	0
lngdp	99	25.694	.091	25.594	25.869
lngdppc	99	9.588	.099	9.474	9.775
Inflation	99	3.253	1.086	1.352	4.833

Note: This table reports summary statistics of all variables of Hungary. There are 9 banks selected from Hungary. Statistics based on annual data from 2009 to 2019.

Table 3: Summary statistics by Country (Poland)

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
lnz	153	3.767	1.241	-2.487	6.636
Tier1	154	.051	0.01	0.04	0.06
CR	154	14.761	3.117	7.5	25.97
OSII	154	0.201	0.402	0	1
Securities	154	2.117	0.996	1	3
Insurance	154	1.117	0.996	0	2
RE	154	1.117	0.996	0	2
Activity	154	4.351	2.989	1	7
License	154	1.273	0.447	1	2
DIP	154	3.455	1.161	1	4
lnFund	154	11.387	0.268	10.820	11.513
OSP	154	1.545	7.55	7	9
Independency	154	3.182	0.387	3	4
SSI	154	0	0	0	0
lngdp	154	27.023	0.109	26.86	27.217
lngdppc	154	9.569	0.11	9.403	9.765
Inflation	154	1.763	1.186	.305	3.786

Note: This table reports summary statistics of all variables of Poland. There are 14 banks selected from Poland. Statistics based on annual data from 2009 to 2019.

Table 4: Summary statistics by Country (Slovenia)

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
lnz	75	2.782	1.401	-2.246	5.028
Tier1	77	.051	0.01	0.04	0.06
CR	77	15.077	3.561	9.17	27.03
OSII	77	0.273	0.448	0	1
Securities	77	3	0	3	3
Insurance	77	2	0	2	2
RE	77	1.558	0.5	1	2
Activity	77	6.558	0.5	6	7
License	77	20.182	1.345	18	21
DIP	77	5	0	5	5
lnFund	77	11.206	0.655	9.836	11.513
OSP	77	9.545	0.897	9	11
Independency	77	0	0	0	0
SSI	77	0.182	0.388	0	1
lngdp	77	24.638	.066	24.57	24.772
lngdppc	77	10.099	.061	10.032	10.22
Inflation	77	1.247	1.107	-1.029	3.4

Note: This table reports summary statistics of all variables of Slovenia. There are 7 banks selected from Slovenia. Statistics based on annual data from 2009 to 2019.

Table 5: Summary statistics by Country (Slovakia)

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
lnz	77	3.691	1.323	-1.11	6.313
Tier1	77	.053	.01	0.04	0.06
CR	77	14.574	2.336	9.13	19.72
OSII	77	.26	.441	0	1
Securities	77	3	0	3	3
Insurance	77	0	0	0	0
RE	77	0	0	0	0
Activity	77	3	0	3	3
License	77	1	0	1	1

DIP	77	2	0	2	2
lnFund	77	11.22	0.625	9.903	11.513
OSP	77	8.273	0.448	8	9
Independency	77	0	0	0	0
SSI	77	0.156	0.365	0	1
lngdp	77	25.323	.089	25.17	25.465
lngdppc	77	9.818	.085	9.671	9.953
Inflation	77	.693	1.105	-1.161	2.51

Note: This table reports summary statistics of all variables of Slovakia. There are 7 banks selected from Slovakia. Statistics based on annual data from 2009 to 2019.

Figure 1 to Figure 4 report the changes of lnz of banks in Hungary, Poland, Slovakia, and Slovenia, respectively. It could be seen that the lnz of Poland banks were most stable and kept in relatively high level than other countries. Similarly, the z-score of Slovakian banks kept an upward trend in general. In contrast, the lnz of Hungary and Slovenia fluctuated rigidly. The bank stability of Hungary and Slovenia showed similar pattern. From 2009 to 2010, the logarithm of z-score decreased to varying degrees, which is probably due to the negative effects of global financial crisis. Then, there was an increase in the bank stability from 2010 to 2013. However, the majority of banks in Hungary and Slovenia experienced a sharp decline in the z-score during 2014 and 2015. And from 2016 the bank stability grew gradually and peaked in 2018 or 2019.

The correlation matrix of regression variables is reported in Table 6. It shows that more stable banks (as measured by higher z-score) have higher total capital adequacy ratio and are more likely to be the OSII. Also, minimum Tier 1 capital ratio is positively correlated with bank z-score. The securities activities variable, insurance activities variable and real estate activities variable all have negative correlation with lnz, but the correlation between securities activities and bank stability is not statistically significant. In general, more stable banks were located in countries with fewer activity restrictions. As for deposit guarantee scheme variables, more power of deposit insurer was correlated with lower bank z-score. However, the correlation is not significant. In contrast, the correlation between the logarithm of deposit insurance fund and bank stability is positive and significant at 10% level. Furthermore, risk is higher in banks

Figure 1: The Line Plots of lnz of Banks in Hungary

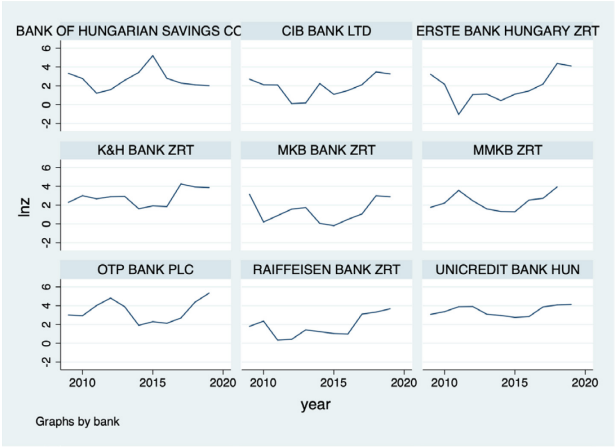


Figure 2: The Line Plots of lnz of Banks in Poland

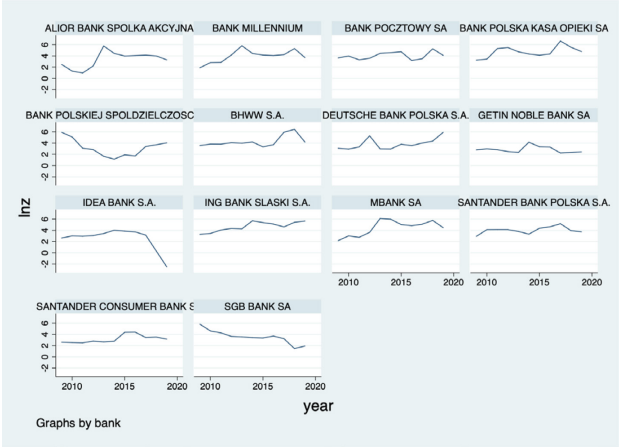


Figure 3: The Line Plots of lnz of Banks in Slovakia

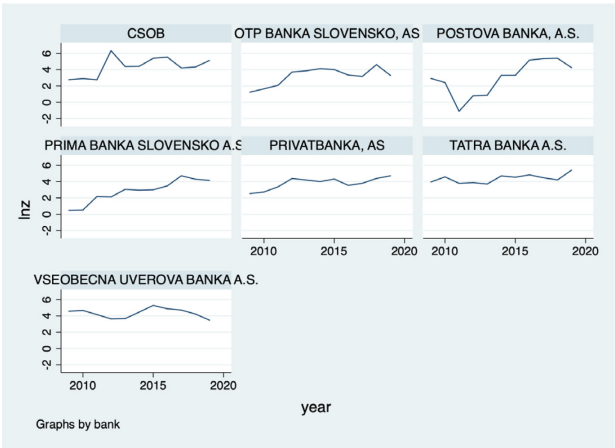
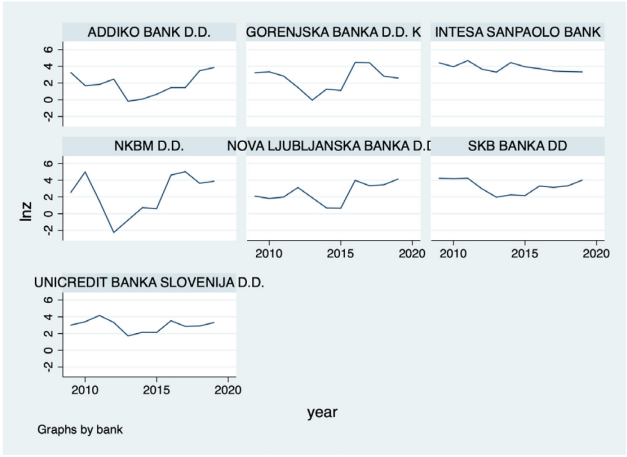


Figure 4: The Line Plots of lnz of Banks in Slovenia



where the authority required more license on bank entry. In countries where the supervisory authority had more supervisory power, the bank stability was lower. However, the relation between these supervisor independency and bank z-score are positive and statistically significant. In addition, the z-score is positively correlated with SSI, but not statistically significant.

Table 6: Correlation matrix of regression variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) lnz	1.000																
(2) Tier1	0.196*	1.000															
(3) CR	0.222*	0.378*	1.000														
(4) OSII	0.143*	0.476*	0.377*	1.000													
(5) Securities	-0.074	0.353*	0.219*	0.273*	1.000												
(6) Insurance	-0.183*	0.192*	0.238*	0.222*	0.602*	1.000											
(7) RE	-0.156*	0.262*	0.309*	0.281*	0.576*	0.958*	1.000										
(8) Activity	-0.157*	0.289*	0.284*	0.284*	0.778*	0.962*	0.954*	1.000									
(9) DIP	-0.012	0.251*	0.107*	0.093	0.193*	0.567*	0.456*	0.465*	1.000								
(10) lnFund	0.098*	0.593*	0.318*	0.264*	0.050	0.088	0.171*	0.118*	0.264*	1.000							
(11) License	-0.185*	0.025	0.007	0.016	0.204*	0.3715*	0.209	0.294*	0.652*	-0.051*	1.000						
(12) OSP	-0.409*	-0.342*	-0.017	0.0172	0.192*	0.310*	0.241	0.278*	-0.167*	-0.338*	0.230*	1.000					
(13) Independency	0.271*	0.015	-0.111*	-0.140*	-0.633*	-0.189*	-0.124*	-0.322*	0.012	0.103	-0.383*	-0.633*	1.000				
(14) SSI	0.070	0.197*	0.280*	0.316*	0.117*	-0.057	-0.036	-0.0004	0.068	0.115*	0.240*	-0.061*	-0.201*	1.000			
(15) lngdp	0.273*	0.079	-0.002	-0.025	-0.482*	-0.118*	0.008	-0.194*	-0.118*	0.196*	-0.676*	-0.557*	0.905*	-0.261*	1.000		
(16) lngdppc	0.017	0.363*	0.137*	0.249*	0.502*	0.221*	0.094	0.282*	0.520*	0.100*	0.791*	0.030*	-0.549*	0.340*	-0.718*	1.000	
(17) Inflation	-0.121*	-0.176*	0.163*	0.129*	-0.148*	0.195*	0.246*	0.128*	-0.160*	0.016	-0.153*	0.461*	-0.004	-0.139*	0.136*	-0.266*	1.000

*** *p<0.01,* ** *p<0.05,* * *p<0.1*

Note: This table reports the correlations between the main regression variables. Sample consists of 37 banks from 4 countries. Statistics based on annual data for the year 2009 to 2019.

5. Methodology

According to the mixed results of the impact of banking regulation and supervision on bank stability from literature, this paper estimates whether there is casual relationship between the two. As Activities is the sum of the Securities, Insurance and RE, there will be multicollinearity problems between these four variables if all of them are chosen as independent variables. And the Pearson correlation analysis displayed in Table 6 also shows the multicollinearity. Therefore, the thesis chooses Activities as the independent variable to capture the overall bank activities regulatory stringency. Furthermore, because the difference between the range of dependent variable and the range of deposit insurance fund is huge, the logarithm of deposit insurance fund is employed in the estimation. After running both fixed-effect model and random effect model and comparing them by Hausman test, the paper employs fixed-effect model to estimate the effect of the banking regulation and supervision on bank stability. In total, there are 5 regressions estimated in the analysis. In the first four regressions, the thesis regresses the outcome variable on each type of regulatory and supervisory indicator. And in the last regression, the thesis regresses the outcome variable on all regulatory and supervisory indicator. More formally, the last equation that contain various indicators is:

$$lnz_{it} = \beta_0 + \beta_1 Tier1_{it} + \beta_2 CR_{it} + \beta_3 OSII_{it} + \beta_4 Activities_{it} + \beta_5 DIP_{it} + \beta_6 lnFund_{it} + \beta_7 OSP_{it} + \beta_8 Independency_{it} + \beta_9 SSI_{it} + \beta_{10} lngpd_{it} + \beta_{11} lngdppc_{it} + \beta_{12} Inflation_{it} + u_i + \varepsilon_{it}$$

where lnz_{it} is the logarithm of bank z-score of bank i in year t and bank fixed effects $u_i$captures unobserved bank attributes that are constant over time.

Estimation Results and Discussion

Table 7 presents regression results when regressing lnz on each bank regulation and supervision indicator separately. When the variables related to capital adequacy requirements are used as explanatory variables alone, the coefficient of Tier1 is negative and statistically significant at 10% level. However, the total capital adequacy

ratio is positively and significantly associated with logarithm of bank z-score at 5% level. 1% increase in the total capital adequacy ratio could enhance bank z-score by 1.07. Although being identified as other systematically important institutions is related with higher bank stability. The association is not statistically significant. When the index of restrictions on bank activities are used as independent variable, the results show that the coefficient of Activity is negative but insignificant. In terms of entry into banking, the results suggest that increasing in the number of licenses required to entry into banking sector would have negative impact on bank stability. If one more license required, the bank z-score will decrease by 1.37. From the estimation of lnz on deposit insurance scheme variables, it could be seen that the coefficient of deposit insurer power is negative and insignificant. But the logarithm of deposit insurance fund is negatively and significantly associated with bank z-score. Moreover, when applying the variables related to bank supervision as explanatory variables, stronger supervisory power is not significantly associated with higher bank stability. And the coefficient of Independency and SSI are both positive but insignificant.

Table 7. Regression Results of Individual Variable

	(1)	(2)	(3)	(4)	(5)
	lnz	lnz	lnz	lnz	lnz
Tier1	-16.33*				
	(-2.24)				
CR	0.0658**				
	(2.96)				
OSII	0.0353				
	(0.19)				
Activity		-0.0781			
		(-1.84)			
License			-0.318***		
			(-3.41)		
DIP				-0.044	
				(-0.45)	
lnFund				-0.252**	
				(-1.98)	
OSP					0.200
					(1.57)
Independency					0.0144
					(-0.05)
SSI					0.0373

					(0.11)
lngdp	11.29	19.51	30.51**	17.65	26.08*
	(1.03)	(1.82)	(2.71)	(1.62)	(2.11)
lngdppc	-6.819	-14.38	-26.58*	-12.69	-21.02
	(-0.62)	(-1.36)	(-2.39)	(-1.17)	(-1.75)
Inflation	-0.0232	-0.0358	0.0449	-0.0054	-0.0358
	(-0.45)	(-0.64)	(0.89)	(-0.10)	(-0.62)
Constant	-223.4	-362.4*	-528.1**	-328.17	-470.4*
	(-1.26)	(-2.06)	(-2.88)	(-1.84)	(-2.30)
N	401	401	401	401	401

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

This table presents the fixed-effects regression of bank stability (the natural log of the Z-score) against a set of bank regulation and supervision variables, explained in Section 3.

The results of Tier 1 capital ratio and total capital ratio are contradicted which is probably because other aspects of regulation and supervision are not taken into consideration. So, the thesis then explores whether these results change when examining various regulations and supervisory practices at the same time and the results are reported in the Table 8. When including all indicators, the coefficient of Tier 1 becomes positive but insignificant. However, the total capital adequacy ratio is still positively and significantly associated with lnz. When the total capital adequacy ratio increases by 1%, the profits of banks have to be reduced by 1.09 standard deviation more than before to eliminate bank equity. The coefficient of OSII remain insignificant, indicating that when a bundle of bank regulations and supervisory practices are implemented, holding more capital buffer as required does not significantly promote bank stability. The results for the whole sample using fixed effects estimators suggest that increasing the bank activities restrictions significantly promote the stability of banks. On average, if, the restrictions on bank activities are increased by 1 level, the bank z-score will increase 0.89. Moreover, it is also proved by the results that there is negative relation between the requirement of bank entry and bank stability. The coefficient is statistically significant in 1% level. The bank z-score will drop 0.63 when one more license is required by central bank. In terms of deposit guarantee scheme, the coefficients of both deposit insurer power and the logarithm of deposit insurance fund become insignificant. Similarly, when taking all bank regulations into account, the bank supervision indicators do not have significant effects on bank stability. As for control

variables, the logarithm of GDP is positively associated with bank z-score and is statistically significant at 5% level. While the coefficient of log of GDP per capita is negative and significant.

Table 8. Regression results of Various Indicators

lnz	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Tier1	1.837	9.265	0.20	0.843	-16.385	20.059	
CR	0.086	0.023	3.69	0	0.04	0.132	***
OSII	0.082	0.195	0.42	0.674	-0.302	0.466	
Activity	-0.107	0.048	-2.24	0.026	-0.201	-0.013	**
License	-0.458	0.122	-3.74	0	-0.698	-0.217	***
DIP	-0.129	0.443	-0.29	0.771	-1.001	0.743	
lnFund	-0.174	0.172	-1.02	0.31	-0.512	0.163	
OSP	-0.08	0.149	-0.53	0.595	-0.373	0.214	
Independency	-0.056	1.342	-0.04	0.967	-2.695	2.582	
SII	-0.234	0.37	-0.63	0.526	-0.961	0.492	
lngdp	37.784	17.333	2.18	0.03	3.695	71.873	**
lngdppc	-33.636	17.375	-1.94	0.054	-67.809	0.536	*
Inflation	-0.008	0.065	-0.12	0.901	-0.137	0.12	
Constant	-645.029	283.136	-2.28	.023	-1201.886	-88.172	**
Mean dependent var		3.247	SD dependent var			1.418	
R-squared		0.195	Number of obs			401.000	
F-test		6.550	Prob > F			0.000	
Akaike crit. (AIC)		1169.123	Bayesian crit. (BIC)			1225.038	

*** *p<.01, ** p<.05, * p<.1*

Note: This table presents the fixed-effects regression of financial stability (the natural log of the Z-score) against a set of bank regulation and supervision variables, explained in Section 3. The subscript *i* refers to banks and *t* to years. lnz is the natural logarithm of the bank's return on assets plus the equity asset ratio divided by the three-year rolling standard deviation of ROA. Tier1 is the amount of minimum Tier 1 capital adequacy ratio. CR is the total capital adequacy ratio of individual banks. OSII is the dummy variable that indicates whether the banks are identified as other systematically important institution. Activity is an index of overall activity restrictions and is composed of securities activities, insurance activities and real estate activities. License is the number of licenses required to entry into banking sector. DIP measures the power of deposit insurance authority. lnFund is the logarithm of the deposit insurance scheme coverage over the period from 2009 to 2019. OSP measures the degree to which the country's bank supervisory agency has the authority to take specific actions. It ranges from 0 to 12, where larger numbers indicate greater power. Independence measures the degree to which the supervisory authority is independent from the government. SSI takes a value of one if the bank is

classified as systematically important institution, and zero otherwise. lngdppc is the log of GDP per capita of the country. lngdp is the logarithm of GDP over the period 2009–2019. Inflation is the inflation rate of the country during 2009-2019.

From the empirical analysis, it could be seen that increasing minimum Tier 1 capital adequacy ratio through CRR/CRD IV did not significantly promote the bank stability in Hungary, Poland, Slovakia, and Slovenia. The result is consistent with the finding of Barth et al. (2004) and Klinger and Teplý (2014). One possible explanation to the result is that before the minimum common equity requirement increased, the banks in four countries had already held a Tier 1 capital above the requirement, and thus the magnitude of the requirement is not binding for the banks in four countries. Also, it is probably because the new regulation is not adequate, for example it lacks loan-to-value rules and there was not a single tool that could manage systemic liquidity risks coming with the implementation of the directive (Kisgergely and Szombati, 2014). Moreover, the increasing complexity of the capital regulations may also impede its implementation and its actual effects (Fullenkamp and Rochon, 2014). From Basel II to Basel III, the complexity of rules increased, which may create serious problems. Capital regulations have become too complex to be effective (Haldane, 2012). With more and more new mechanisms added, bank regulations may become too complicated to understand and enforce, and thus making it easier to manipulate or avoid (Fullenkamp and Rochon, 2014). Due to the complexity of the rules, a large part of the implementation power is transferred to the banks themselves. As a result, banks need to train their examiners about the details of the compliance before fulfilling their duties, which probably leads to regulatory capital arbitrage. Furthermore, different regulations may contradict one another. Therefore, the banks and regulators may be confused and hesitate to implement. However, turning to the impact of total capital adequacy ratio, it is found that it does positively and significantly influence overall insolvency risk, a finding similar to that of Shaddady and Moore (2018). The result is consistent with the Hypothesis 1 and according to theories there are several way channels through which the total capital ratio exerts positive impact. 1) Banks are likely to hold higher level of capital when they have higher total capital ratio, implying that banks can absorb more unexpected losses when crisis hits; 2) Higher total capital ratio also motivates shareholders to improve the risk management, as they will endure higher loss when the default occurs and thus have less motivation to take excessive risk and engage in more prudent

investments; 3) Higher capital ratio could reduce bank risk because it prevents the moral hazard problem.

The results suggest that when controlling other regulation and supervision, relaxing restrictions would have negative impact on bank stability measured by bank z-score. The result is in line with the finding of Boyd, Chang, and Smith (1998), Laeven and Claessens (2003) and Fernandez and Gonzalez (2005). The results support the arguments that increasing the stringency of the limitation on bank activities is beneficial for diminishing insolvency risk. There are several possible explanations on why restrictions on bank increase bank stability. Initially, loosening the restrictions on bank activities may offer more opportunities to increase and shift risk. Secondly, restricting bank activities would prevent bank from being too complex to be monitored by supervisors. In addition, with generous deposit insurance scheme, the banks that are less restricted would increase risk-taking incentives when engaging in non-fee-based activities as they will be bailed out under the scheme. Therefore, stricter regulation on bank activities is effective in reducing bank risk.

In terms of bank entry barrier, the coefficient shows that countries with more open approaches to regulation and supervision tend to have more stable banks, while tighter entry restrictions boost bank fragility, which is consistent with the conclusion of Barth et al. (2004). A higher number of licenses required—a proxy for tighter entry regulations—leads to lower bank z-score and higher levels of fragility. The explanations to the result are that compared to domestic bank, foreign banks with supportive the parent bank and abundant funding source could suffer less during crisis and that foreign banks could acquire capital and liquidity from parent banks. Although relaxing entry limitation would increase competition among banks, which drives bank owners to take more risk through franchise value and charter value, other bank regulation and supervision such as more stringent capital requirements may offset the negative impact of foreign bank entry on competition in the host countries.

As for deposit insurance scheme variables, when only taking deposit insurer power and the logarithm of deposit insurance fund as explanatory variables, the results show that the deposit insurer power does not significantly affect bank stability, but that increasing

the level of deposit insurance coverage may dampen the bank stability. However, when controlling other regulation and supervision indexes, the results do not show any significant effect of DGS on bank z-score, although the coefficients of both deposit insurer power and the logarithm of deposit insurance fund are negative. The results are partly in line with the hypothesis. It is possible that the deposit insurance scheme will cause moral hazard problem. Protected by explicit deposit insurance scheme, depositors may be reluctant to carefully examine the banks where they place their money and bank owners may have more risk-taking incentives and lend to borrowers who are not creditworthy. However, the moral hazard problem might be mitigated by effective supervision that monitor the banks regularly and thoroughly.

The results indicate that the supervision variables are not significantly associated with bank stability in sample countries. The result for official supervisory power contradicts with hypothesis 5. One possible explanation is that the changes of the supervisory power index in four countries are minor in terms of both magnitude and frequency, which may lead to the insignificant result. Nevertheless, the result for the Single Supervisory Mechanism is consistent with hypothesis. The insignificant impact of the SSM during 2009 to 2019 in four countries may come from the lag of the effect. It is likely that the mechanism still needs more time to be effective. Or in worse case, the Single Supervisory Mechanism may be in fact not sufficient to improve bank stability. In perspective of enforcement, the mechanism requires substantial supervisory resources to monitor the risks of financial institutions, needs more experienced and well-educated supervisors and also imposes additional pressure on supervisory authorities to generate, process and publish disclosure and stress test information. From the perspective of organisation, the SSM may fail to solve the agency problem that troubled CEE banking sector for long time. Furthermore, for non-euro countries, opting in BU may bring risk to the domestic banking sector because they need to give up existing and even sophisticated bank supervision framework and replace it with an incomplete organisational structure and untested mechanisms.

Conclusion

In recent decades, the frequency of severe financial crises in different regions of the world has increased. The financial crisis not only could exert a serious or even devastating impact on one area, but also has contagious effect and thus spread to the entire economy (Hellmann, Murdock, and Stiglitz, 2000). It is well acknowledged that bank instability is one of the sources of financial crisis. The global financial crisis spurred the discussion on the adequacy of bank regulation and supervision again. As a result, driven by the global financial crisis, a variety of improvements and revision on the bank regulation and supervision are taken in worldwide and EU to enhance the resilience of banking sector.

Within EU, there are several significant changes in the bank regulation and supervision. The Basel III, which is implemented in EU through Capital Requirements Regulation and Directive, redefines the bank capital and raises the minimum Tier 1 capital requirements for banks from 2% set in Basel II to 4.5%. It also adds a 2.5% buffer capital requirement on the total capital adequacy ratio. In terms of deposit insurance scheme, the revised DGS Directive increases the level of insurance to 100,000 euro, applying to all aggregated accounts at the same bank. Moreover, there was an important reform on the bank supervision in euro area. The Single Supervisory Mechanism was launched in 2013, which builds up a centralised and unified supervision framework. The ECB will perform its supervisory practices directly on the systematically important banks in euro area and the other banks are under the supervision of national supervisory authorities. The single rulebook, the single supervisory mechanism and deposit guarantee scheme are all the pillars of Banking Union. Apart from the BU, there are also changes in other aspects of bank regulation and supervision in national level in EU. For example, the restrictions on banks' non-traditional activities are lowered but the limitations of entry into banking market are heightened in some countries.

The thesis employs fixed effect model to study the impact of European banking regulatory reforms on the stability of Central and Eastern European countries after the financial crisis with the annual data from Hungary, Poland, Slovakia, and Slovenia from

2009 to 2019. The thesis reaches several conclusions. Firstly, increasing minimum Tier 1 capital adequacy ratio through CRR/CRD IV did not significantly promote the bank stability in sample countries, which is probably because of inadequate of the new regulation and the increased complexity of the capital regulations that makes itself difficult to be effective; However, total capital adequacy ratio is found to have positive and significant association with overall insolvency risk. Secondly, relaxing restrictions would have negative impact on bank stability measured by bank z-score, because restricting bank activities would prevent bank from being too complex to be monitored by supervisors and relaxing the restrictions on bank activities offers more spaces for banks to increase and shift risk. Thirdly, countries with more open approaches to regulation and supervision tend to have more stable banks, while tighter entry restrictions boost bank fragility. Fourthly, when only taking deposit insurance variables as explanatory variables, the deposit insurer power does not significantly affect bank stability but increasing the level of deposit insurance coverage may dampen the bank stability. However, when controlling other regulation and supervision indexes, the results do not show any significant effect of DGS on bank z-score. Last but not least, the official supervisory power, the independency of supervision and the Single Supervisory Mechanism are not significantly associated with bank stability in sample countries.

According to the results obtained in the thesis, a few policy implications for CEE countries are provided. First of all, it would be better for regulators to reduce the complexity of some of the key rules of capital regulation that are imposed on banks. The new capital requirement regulation is considered too complex to be effective. By simplifying some of the key rules, the incentive to engage in regulatory capital arbitrage are likely to be reduced. Also, it could reallocate the resources and efforts of banks from reducing the capital burdens to more productive activities (Fullenkamp and Rochon, 2014). For instance, the whether the risk-weighted assets are suitable for measuring capital requirement needs more consideration, as this method of calculation minimum capital is criticized (Acharya et al., 2013; Fullenkamp and Rochon, 2014). Due to the involvement of more types of risks in the Basel III, the variety of banks' activities and the increased complexity of banks, risk weighting of assets system is more likely to result in capital arbitrage problems and to impede the effect of market discipline. As

for restrictions on bank activities, for CEE countries it might not be a good timing to relaxing the restrictions on non-fee-based activities, which may encourage banks to take excessive risks and makes the activities of banks even more complex. In terms of entry into banking market, the thesis suggests that it would be beneficial for the stability of banking sector to lower the limitations on foreign bank entry, especially the number of licenses required by the authority. The result of deposit insurance scheme shows that the scheme is likely to induce moral hazard problems which could be mitigated by supervision, and thus it is essential to improve the supervision and strengthen its enforcement in CEE countries with explicit deposit guarantee scheme. Finally, as the thesis does not find a significant relation between the single supervisory mechanism and bank stability, it is recommended for the non-euro countries examined in the thesis, which are Hungary and Poland, to remain the position of opt-out and to take wait and see approaches. The single supervisory has not shown its positive effect on the elimination of interdependencies as stated in some literature and for non-euro area countries, opting in may imply weaker powers and less supervisory attention than those actual membership. In addition, the separation of central bank and supervisory power may lead to hidden danger for non-euro area countries.

What needs to be admitted is that this paper still has many shortcomings and needs to be improved. First of all, there are some restrictions on the data. The data collected from the World bank survey measures five-year banking regulation and supervision situation in countries, which means that the data change very small in magnitude and in low frequency. In addition, as pointed out by Barth et al. (2004) and Beck et al. (2006), the change in bank regulation and supervision variables is usually very small. In addition, due to the data availability, there are only four countries and 35 banks examined. Therefore, the data might be less explanatory. Secondly, the empirical estimation does not take the endogeneity of supervision into account. The sounder banks may face less burden in enforcing more rigorous supervision than distressed banks. Also, it is possible that countries that were more affected by crisis may have the stronger incentives to improve their supervisory framework. So, the endogeneity of supervision may bias the result in either direction. To improve the model, the instrument variable is necessary to be included and employing the 2SLS.

References

Acharya, V.V., H. Mehran, A.V. Thakor, 2011, "Caught between Scylla and Charybdis? Regulating bank leverage when there is rent seeking and risk shifting", Unpublished working paper. New York University, Federal Reserve Bank of New York, and Washington University.

Acharya, V., R. Engle, D. Pierret, 2013, Testing Macroprudential Stress Tests: The Risk of Regulatory Risk Weights, *NYU Stern mimeo*.

Agarwal, S.; D. Lucca; A. Seru; and F. Trebbi. "Inconsistent Regulators: Evidence from Banking." NBER Working Paper No. 17736 (2012).

Agoraki, M.E.K., Delis, M.D. and Pasiouras, F., 2011. Regulations, competition and bank risk-taking in transition countries. *Journal of Financial Stability*, 7(1), pp.38-48.

Aiyar, S., Calomiris, C.W., & Wieladek, T. (2014). Does Macro-Prudential Regulation Leak? Evidence from a. UK Policy Experiment. *Journal of Money, Credit and Banking* 46(1), 181- 214.

Alter, A., & Schüler, Y. S., 2012. Credit spread interdependencies of European states and banks during the financial crisis. *Journal of Banking and Finance*, 36, 3444–3468.

Anginer, Deniz, Demirguc-Kunt, Asli & Zhu, Min, 2014. How does deposit insurance affect bank risk? Evidence from the recent crisis. *Journal of banking & finance*, 48, pp.312–321.

Anginer, D. and Demirgüç-Kunt, A., 2014. Bank capital and systemic stability. *World Bank Policy* research working paper, (6948).

Anginer, D., Demirgüç-Kunt, A., 2018. Bank runs and moral hazard: a review of deposit insurance, Policy Research Working Paper (No. WPS8589). Washington, DC.

Anginer, D., Bertay, A.C., Cull, R., Demirguc-Kunt, A. and Mare, D.S., 2019. Bank regulation and supervision ten years after the global financial crisis.

Barth, James R, Caprio, Gerard & Levine, Ross, 2004. Bank regulation and supervision: what works best? *Journal of financial intermediation*, 13(2), pp.205–248.

Barth, J., Caprio, G., Levine, R., 2008. Bank regulation and supervision database. The World Bank.

Barth, J. R., G. Caprio Jr. and R. Levine, 2013. Bank Regulation and Supervision in 180 Countries from 1999 to 2011. *Journal of Financial Economic Policy*, 5 (2013), 111–219.

Beck, T. and L. Laeven. 2006. "Resolution of Failed Banks by Deposit Insurers: Cross-Country Evidence." World Bank Policy Research Working Paper 3920.

Belke, A., Dobrzańska, A., Gros, D. and Smaga, P., 2016. (When) should a non-euro country join the banking union?. *The Journal of Economic Asymmetries*, 14, pp.4-19.

Beltratti, A. and Stulz, R.M., 2012. The credit crisis around the globe: Why did some banks perform better?. *Journal of financial economics*, 105(1), pp.1-17.

Bermpei, Theodora, Kalyvas, Antonios & Nguyen, Thanh Cong, 2018. Does institutional quality condition the effect of bank regulations and supervision on bank stability? Evidence from emerging and developing economies. *International review of financial analysis*, 59, pp.255–275.

Bolton, P. & Jeanne, O., 2011. Sovereign default risk and bank fragility in financially integrated economies. *IMF Economic Review*, 59(2), 162–194.

Borio, C., 2003. Towards a macroprudential framework for financial supervision and regulation? *CESifo Econ. Stud*. 49, 181–215.

Boyd, J.H. and S.L. Graham. 1986. "Risk, Regulation, and Bank Holding Company Expansion into Nonbanking." *Quarterly Review – Federal Reserve Bank of Minneapolis* 10.

Chan-Lau, J.A., 2010. Regulatory capital charges for too-connected-to-fail institutions: A practical proposal. *Financial Markets, Institutions & Instruments*, 19(5), pp.355-379.

Cantero Sáiz, María, Sanfilippo Azofra, Sergio & Torre Olmo, Begoña, 2019. The single supervision mechanism and contagion between bank and sovereign risk. *Journal of regulatory economics*, 55(1), pp.67–106.

CGFS, 2011. The impact of sovereign credit risk on bank funding conditions. CGFS papers (Vol. 43).

Chaikovska, I., 2019. THE ROLE OF POST-CRISIS BANKING REGULATIONS IN. MAINTAINING THE SECURITY OF THE BANKING SYSTEM. *International journal of arts & sciences*, 12(1), pp.165–175.

Chortareas, G.E., Girardone, C. and Ventouri, A., 2012. Bank supervision, regulation, and efficiency: Evidence from the European Union. Journal of Financial

Stability, 8(4), pp.292-302.

Coman-Kund Florin, Karatzia Anastasia & Amtenbrink, Fabian, 2018. The Transparency of the European Central Bank in the Single Supervisory Mechanism. *Credit and capital markets (Berlin)*, 51(1), pp.55–72.

Constâncio, V., 2014. The European Crisis and the Role of the Financial System. *Journal of macroeconomics*, 39, pp.250–259.

Correa, R., Lee, K. H., Sapriza, H., & Suarez, G. A., 2014. Sovereign credit risk, banks' government support, and bank stock returns around the world. *Journal of Money, Credit and Banking*, 46(1), 93–121.

Cull, R.J., Senbet, L.W. and Sorge, M., 2001. Deposit insurance and financial development (Vol. 2682). *World Bank Publications.*

Darné, O., Levy-Rueff, G. and Pop, A., 2013. Calibrating initial shocks in bank stress test scenarios: an outlier detection based approach.

De Bruyckere, V., Gerhardt,M., Schephens, G.,&Vander Vennet, R., 2013. Bank/sovereign risk spillovers in the European debt crisis. *Journal of Banking and Finance*, 37, 4793–4809.

De Haas, Ralph & van Lelyveld, Iman, 2006. Foreign banks and credit stability in Central and Eastern Europe. A panel data analysis. *Journal of banking & finance,* 30(7), pp.1927–1952.

Demirel, P. and Danisman, G.O., 2019. Eco-innovation and firm growth in the circular economy: Evidence from European small-and medium-sized enterprises. *Business Strategy and the Environment,* 28(8), pp.1608-1618.

Demirguc-Kunt, A., Detragiache, E., 2002. Does deposit insurance increase banking system stability? An empirical investigation. *Journal of Monetary Economics* 49(7), 1373–1406.

Demirguc-Kunt, A., Kane, E.J., Laeven, L., 2008. Determinants of deposit-insurance adoption and design. Journal of Financial Intermediation 17 (3), 407–438.

Diamond, D.W. , Dybvig, P.H. , 1983. Bank runs, deposit insurance, and liquidity. *J. Polit. Econ*. 91 (3), 401–419 .

European Central, B., 2005. Assessing financial stability: conceptual boundaries and challenges.

Ferrarini, G., 2015. Cross-border Banking and the SSM. *European economy (Roma)*, (3), p.57.

Ferrarini, G., 2015. Single Supervision and the Governance of Banking Markets: Will the SSM Deliver the Expected Benefits? *European business organization law review*, 16(3), pp.513–537.

Fiordelisi, Franco, Ricci, Ornella & Stentella Lopes, Francesco Saverio, 2017. The Unintended Consequences of the Launch of the Single Supervisory Mechanism in Europe. *Journal of financial and quantitative analysis*, 52(6), pp.2809–2836.

Fullenkamp, C. and Rochon, M.C., 2014. Reconsidering bank capital regulation: A new combination of rules, regulators, and market discipline. *International Monetary Fund*.

Gambacorta, L. and Mistrulli, P.E., 2004. Does bank capital affect lending behavior?. *Journal of Financial intermediation*, 13(4), pp.436-457.

Gambacorta, L. and Karmakar, S., 2016. Leverage and risk weighted capital requirements.

Gersl, A., Jakubík, P., Konecný, T. and Seidler, J., 2013. Dynamic Stress Testing: The Framework for Assessing the Resilience of the Banking Sector Used by the Czech National Bank. *Finance a Uver,* 63(6), p.505.

Haldane, A., 2012, The Dog and the Frisbee, Speech at the Federal Reserve Bank of Kansas City's 36th Economic Policy Symposium, Jackson Hole, Wyoming.

Hannan, T.H. and G.A. Hanweck. 1988. "Bank Insolvency Risk and theMarket for Large Certificates of Deposit." *Journal of Money, Credit and Banking* 20:203–211.

Hellmann, T.F., Murdock, K.C. and Stiglitz, J.E., 2000. Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough?. *American economic review*, 90(1), pp.147-165.

Hoggarth, G., Reis, R. and Saporta, V., 2001. Costs of banking system instability: some empirical evidence. Available at SSRN 276182.

IMF, 2015. Staff Report on Cluster Consultations–Common Policy Frameworks and Challenges. IMF Country Report No.15/97, *Central and Eastern Europe: New Member States (NMS) Policy Forum*.

Issing, O., 2003. Monetary and financial stability: is there a trade-off? BIS Pap. 18, 16–23.

Ioannidou, V.P. and Penas, M.F., 2010. Deposit insurance and bank risk-taking: Evidence from internal loan ratings. *Journal of Financial Intermediation*, 19(1), pp.95-115.

Jean Pisani-Ferry, André Sapir & Cédric Tille, 2010. Banking crisis management in the EU: an early assessment [with Discussion]. *Economic policy*, 25(62), pp.341–373.

Jones, D., 2000. Emerging problems with the Basel Capital Accord: regulatory capital arbitrage and related issues. *J. Bank. Financ.* 24, 35–58.

José C Moreno & Ricardo Davico, 2009. Flows to Eastern Europe. *Finance & Development*, 46(3), p.57.

Jumreornvong, S., Chakreyavanich, C., Treepongkaruna, S. and Jiraporn, P., 2018. Capital adequacy, deposit insurance, and the effect of their interaction on bank risk. *Journal of Risk and Financial Management*, 11(4), p.79.

Keeley, M. C., and F. T. Furlong. 1990, "A Re-Examination of the Mean-Variance Analysis of Bank Capital Regulation", *Journal of Banking and Finance*, 15, 69-84.

Kisgergely, K. and Szombati, A., 2014. Banking union through Hungarian eyes: The MNB's assessment of a possible close cooperation (No. 115). *MNB Occasional Papers*.

Klinger, T. and Teplý, P., 2014. Systemic risk of the global banking system-an agent-based network model approach. *Prague Economic Papers*, 23(1), pp.24-41.

Kupiec, P.H., O'Brien, J.M., 1995. A Pre-commitment Approach to Capital Requirements for Market Risk. In: Board of Governors of the Federal Reserve System(U.S.) F*inance and Economics Discussion Series* 95–36.

Laeven, L. and Claessens, S., 2003. What drives bank competition? Some international evidence. *Some International Evidence* (August 6, 2003).

Laeven, L. and R. Levine. 2009. "Bank Governance, Regulation and Risk Taking." *Journal of Financial Economics* 93:259–275.

Leblond, P., 2014. The logic of a banking union for Europe. *Journal of Banking Regulation*, 15(3/4), 288–298.

Li, J., & Zinna, G., 2014. How much of bank credit risk is sovereign risk? Evidence from the eurozone. *Bank of Italy working papers* No. 990.

Li, X., Tripe, D.W. and Malone, C.B., 2017. Measuring bank risk: An exploration of z-score. Available at SSRN 2823946.

Loipersberger, F., 2017. The effect of supranational banking supervision on the financial sector: Event study evidence from Europe. *Journal of Banking & Finance*, 91, pp.34-48.

Méró, K. and Piroska, D., 2016. Banking Union and banking nationalism—Explaining opt-out choices of Hungary, Poland and the Czech Republic. *Policy and society*, 35(3), pp.215-226.

Melecky, M. and Podpiera, A.M., 2013. Institutional structures of financial sector supervision, their drivers and historical benchmarks. *Journal of Financial Stability*, 9(3), pp.428-444.

Nier, E. and Merrouche, O., 2010. What Caused the Global Financial Crisis: Evidence on the Drivers of Financial Imbalances 1999: 2007. *International Monetary Fund*.

Nowotny, E. (2014). The future of European monetary integration. *Atlantic Economic Journal*, 42(3), 229–242.

Pawlowska, M., 2016. Does the size and market structure of the banking sector have an effect on the financial stability of the European Union? *Journal of economic asymmetries*, 14, pp.112–127.

Prean, Nora & Stix, Helmut, 2011. The effect of raising deposit insurance coverage in times of financial crisis – Evidence from Croatian microdata. *Economic systems*, 35(4), pp.496–511.

Reinhart, C.M. and Rogoff, K.S., 2009. The aftermath of financial crises. *American Economic Review*, 99(2), pp.466-72.

Ristolainen, K., 2018. Getting better? The effect of the single supervisory mechanism on banks' loan loss reporting and loan loss reserves. (May 23, 2018). *Bank of Finland Research Discussion Paper*, (11).

Rochet, J. C. 1992, “Capital requirements and the behaviour of commercial banks”. European Economic Review, 36(5), 1137-1170.

Saunders, A. and Walter, I., 1994. Universal banking in the United States: What could we gain? What could we lose?. *Oxford University Press*.

Schoenmaker, D. and Oosterloo, S., 2007. Cross-border issues in European financial supervision. In: D.G. Mayes and G.E. Wood (eds.) *The Structure of Financial Regulation*. London: Routledge, pp. 264–291.

Shaddady, Ali & Moore, Tomoe, 2019. Investigation of the effects of financial regulation and supervision on bank stability: The application of CAMELS-DEA to quantile regressions. *Journal of international financial markets, institutions & money*, 58, pp.96–116.

Shehzad, C.T. and De Haan, J., 2015. Supervisory powers and bank risk taking. *Journal*

of International Financial Markets, Institutions and Money, 39, pp.15-24.

Tabak, Benjamin M et al., 2016. Financial stability and bank supervision. *Finance research letters*, 18, pp.322–327.

Teplý, P. and Šútorová, B., 2014. The level of capital and the value of EU banks under Basel III. *Prague Economic Papers*, 23(2), pp.143-161.

Terazi, E. and Şenel, S., 2011. The effects of the global financial crisis on the central and eastern European Union countries. *International Journal of Business and Social Science*, 2(17).

Udo Braendle (2018). The impact of the European Banking Union's Single Supervisory Mechanism on corporate governance practices in European banks. *Banks and Bank Systems*, 13(2), 164-177.

Yin, H., 2019. Foreign bank entry and bank competition: Cross-country heterogeneity. *Global Finance Journal,* 48, p.100558.

Zigraiova, D. and Havranek, T., 2016. Bank competition and financial stability: Much ado about nothing*?*. *Journal of Economic Surveys*, 30(5), pp.944-981.