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DISSERTATION THESIS

Financial Performance of European Cooperative Banks

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Acknowledgments

Abstract

This dissertation consists of four essays dealing with the financial performance of European cooperative banks. We focus on a comparison between the performance of cooperative banks and that of shareholder-owned commercial banks. Furthermore, we compare different cooperative banking models in Europe, paying special attention to the Czech credit union sector. In the individual essays, we examine different performance measures depicting profitability, stability and cost efficiency. The topic of the financial performance of cooperative banks is highly relevant, as cooperative banks are structurally different from the standard commercial banking model and they have a significant market share in several European countries, while most of the empirical literature focused on banking financial performance is devoted solely to commercial banks.

The first essay of this dissertation thesis empirically assesses the financial performance of Czech credit unions compared to that of cooperative banks from 15 European countries in terms of their profitability and stability. Employing dynamic panel data methods, we reveal that the performance of Czech credit unions in terms of both profitability and stability is worse than that of their European peers.

In the second essay, we compare the financial performance of cooperative and commercial banks in a low interest rate environment. We find that commercial banks maintain superior profitability compared to cooperative banks in an environment of low interest rates. Secondly, commercial banks decreased their loan loss provisioning in a low interest rate environment to maintain their profitability. Thirdly, decreased provisioning is present mainly in smaller institutions. Fourthly, cooperative banks are significantly more stable than commercial banks in terms of their Z-score in a low interest rate environment.

The third essay investigates the size–efficiency relationship of European cooperative banks. Our results show that smaller European cooperative banks are significantly more cost-efficient than their bigger peers and that the size-efficiency relationship is linear. Our results imply that no significant consolidation of European cooperative banks induced by a drive for efficiency can be expected in the near future. We conclude that it is more efficient for cooperatives to remain small in size rather than to expand.

The fourth essay assesses the situation of Czech credit unions in the context of their past development, changing environment and legislative framework evolution. We compare contemporary credit unions' performance with the performance of their

predecessors, together with the performance of commercial banks. We conclude that the Czech credit unions behave like small and risky commercial banks, which is in contradiction to the business models of credit cooperatives operating in the EU.

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Acronyms

ADZ	Czech Association of Credit Unions
AR	Autoregressive
As	Assets
CAR	Capital Adequacy Ratio
CEO	Chief Executive Officer
CEPS	Centre for European Policy Studies
ČNB	Czech National Bank
Coef.	Coefficient
CSSDA	The Co-operative Societies' Supervision and Development Authority
ČSU	Czech Statistical Office
CZ	Czech Republic
CZK	Czech Koruna
DKK	Danish Krone
EACB	European Association of Co-operative Banks
EBA	European Banking Authority
ECB	European Central Bank
DEA	Data Envelopment Analysis
DFA	Distribution Free Approach
EU	European Union
EUR	Euro (currency)

Euribor	Euro Interbank Offered Rate
FE	Fixed Effects
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
HHI	Herfindahl-Hirschman index
IBOR	Interbank Offered Rate
IMF	International Monetary Fund
Libor	London Inter-bank Offered Rate
ln()	Natural Logarithm
LtD	Loans to Deposits ratio
Max	Maximum
MFČR	Czech Ministry of Finance
mil (mn)	million
Min	Minimum
NFCI	Net Fee and Commission Income
NFCI/GDP	Net Fee and Commission Income to Gross Domestic Product Ratio
NFCI/TA	Net Fee and Commission Income to Total Assets Ratio
NFCI/TI	Net Fee and Commission Income to Total Income Ratio
NIM	Net Interest Margin
NPL	Non Performing Loan
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
RE	Random Effects

RO(A)A	Return on (Average) Assets
RO(A)E	Return on (Average) Equity
SFA	Stochastic Frontier Analysis
Sig	(statistical) significance
St. dev.	Standard deviation
St. er.	Standard error
TC	Total Costs
ÚDDZ	Bureau for Supervision over Credit Unions (Úřad pro dohled nad družstevními záložnami)
UK	United Kingdom of Great Britain and Northern Ireland
var.	variable
VIF	Variance Inflation Factor
WOCCU	World Council of Credit Unions
YLD	average yield of 10 year government bond

1 General Introduction

The European banking sector has faced many challenges in recent years. The period of the worldwide Great Recession (2007-2009) caused by the emergence of sub-prime loan losses in the United States of America not only brought increased credit risk to the economy and much more robust regulation of the banking sector (Basel III), but was also one of the triggers of the European sovereign debt crisis in the first half of the 2010s. As a reaction to the worsening macroeconomic conditions in Europe, the affected central banks sharply decreased their policy rates to support their national economies as well as government finances. This created the phenomenon of widespread negative interest rates in Europe, which put further pressure on banks' interest rate profits and caused numerous legal issues regarding the zero flooring of interest rates and the treatment of customers in general. Moreover, banks are facing challenges connected with the growing digitalization of their services and increased competition from fintech companies in recent years.

During these turbulent times, the vast majority of empirical research papers dealing with the financial performance of banks focused only on shareholder-driven commercial banks, often neglecting the specific nature of other ownership types of banks active on the market. This dissertation thesis contributes to the existing literature by examining the financial performance of cooperative banks on the European markets. We focus on the different natures, strategies and objectives of cooperative financial institutions. We compare them either to cooperative banks from other regions or to commercial banks. We pay special attention to the sector of Czech credit unions. In some of their features, they are typical cooperative banks, yet in other respects they resemble more small commercial banks. The main added value of this thesis is not only its contribution to the current empirical literature dealing with the financial performance of cooperative banks; it also produces results that can be used by policy makers and regulators.

Cooperative institutions are democratically controlled on the principle of "one member one vote". Ownership rights are often not marketable and are much more dispersed than in the case of shareholder-driven commercial banks. Cooperative

banks are created mainly to maximize the utility of their members. They can therefore also pursue objectives other than mere profit maximization (e.g. they can offer affordable financial services to their members). Nevertheless, profit is a prerequisite for the long-term survival and expansion of cooperative banks. Cooperative banks' members often share some common bond such as their place of residence or their occupation. Therefore, they may form quite a homogenous group in contrast to the clients of commercial banks. All of these facts are reasons why the financial performance of cooperative banks should differ from that of standard commercial banks.

The first essay of this thesis (Section 2) investigates the performance of Czech credit unions compared to other European cooperative banks. We assessed profitability in terms of ROAA, ROAE and NIM, and financial stability in terms of the Z-Score. We created a unique dataset of 283 European cooperative banks spanning the 2006 – 2013 period. We statistically confirmed the poor profitability and stability of Czech credit unions using dynamic panel data methods where applicable. Czech credit unions were outperformed by other European cooperative banks in both ROAA and ROAE. We found no difference in NIM for Czech cooperatives. Czech credit cooperatives also suffer from lower stability. Especially striking is the adverse development in the Z-Score of Czech credit unions over time. This was not observed in any other country in the data sample. A dangerous mix of low profitability, instability and the pseudo-cooperative nature of Czech credit unions results in the high-risk profile of these institutions. The larger Czech credit unions in particular are underperforming and are likely to face serious financial problems.

The second essay focuses on the competitiveness of European cooperative and commercial banks in a low interest rate environment. We performed the analysis using dynamic panel data methods (System GMM) on a data set of nearly 1,000 banks from 11 European countries where both ownership models are present for the 2009-2015 period. We arrived at four main conclusions. Firstly, we show that European commercial banks are more profitable in a low interest rate environment in selected profitability measures (ROAA, ROAE and NIM). This is in line with the existing empirical literature focused on a standard interest rate environment. The second conclusion of the essay is that the loan loss provision creation of commercial

banks is significantly smaller than that of cooperative banks. The provisioning of cooperative banks is stable during the observation period, but the provisioning of commercial banks decreased significantly over time. The decrease in the provisioning of commercial banks is probably attributable to pressure from shareholders to maintain short-term profitability. Cooperative banks, on the other hand, do not pursue this strategy of decreased provisioning to maintain profits in a low interest rate environment. The third conclusion of the essay is that mainly smaller banks were able to decrease provisioning, possibly thanks to less attention from the regulators. The profitability of smaller banks also managed to surpass that of the larger ones. The fourth main conclusion of this essay is that the stability of cooperative banks is significantly higher than that of commercial banks. This is, once again, in line with the existing findings in a normal interest rate environment. In addition, the difference in the financial stability of both structures increases over time. To sum up, our analysis extended the existing literature on the comparison of the financial performance of cooperative and commercial banks to cover an environment of low interest rates, showing that European commercial banks focus on maintaining their profitability using a strategy of low loan provisioning. This strategy is used mainly by smaller institutions. On the other hand, cooperative banks in a low interest rate environment focus on increasing their stability via higher capital buffers.

The third essay focuses on the size-efficiency relationship of European cooperative banks during the 2006-2015 period, which was further divided the pre-crisis, crisis + recovery. We created a dataset of 183 cooperative banks from 12 European countries. We employed Stochastic Frontier Analysis to obtain inefficiency estimates and, consequently, we estimated the determinants of cooperative banks' inefficiency. We show that small cooperative banks are more cost-efficient than their larger peers. We prove that this size-efficiency relationship is valid in both time subset periods as well. Moreover, we show that the size-efficiency relationship is linear: the bigger the institution, the greater the inefficiency. Interestingly, inefficiency remained roughly stable during the whole observation period without any substantial changes, even in the sub-samples of individual countries. All these outcomes reveal that it is more efficient for cooperative banks to remain small in size and to benefit from their traditional cooperative proximity to their members rather than to expand. Market

consolidation is therefore harmful to the efficiency and stability of the cooperative banking system.

The fourth and final essay focuses on the historical development of Czech credit unions. Their original development was similar to that of the cooperatives we know from Western Europe, but some of the very cornerstones of cooperative principles were abandoned after the rebirth of cooperative banking in the Czech Republic following the fall of the Communist regime. A poor legislative framework and insufficient supervision led to a massive crisis in the sector in 1999. Some of the problems, such as poor supervision or low capital standards, were subsequently corrected. Nevertheless, the rotten core of pseudo-cooperative principles remains: not following the basic cooperative principles, such as "one member one vote", a lack of a common bond between the members in the individual organizations and their low interest in the performance of their credit union caused by the small size of their membership shares, combine to make Czech credit unions resemble small and risky commercial banks rather than proper cooperatives. All of this, together with risky asset portfolios and unstable and expensive funding, indicates that the rollercoaster ride of Czech credit unions has not yet ended.

We mostly use dynamic panel data methods (System Generalized Method of Moments) as the main method of estimation in this dissertation thesis. Banking business performance measures typically show a certain level of time persistence. This is why standard panel data methods are inconsistent when dealing with banks' financial performance. In addition to dynamic panel data methods, we employ the Stochastic Frontier Analysis in one essay in the dissertation. Furthermore, we use descriptive statistics and simple panel data methods (OLS, FE, RE) as complementary methods for our analyses.

Because the findings of the essays are focusing on the financial performance of Czech credit unions are based on the data from the years up to 2013 and there has been an interesting development since then, Section 1.1 gives an overview of the recent development of the Czech credit union sector. Furthermore, Section 1.2 provides an updated literature

 review focussed on the performance of European cooperative banks to fill the gap.

The remainder of this dissertation thesis is organized as follows: Section 2 is based on the essay *"A Financial Performance Comparison of Czech Credit Unions and European Cooperative Banks"*. The essay in Section 3 is entitled *"Are European Commercial Banks more Profitable than Cooperative Banks? Evidence from a Low Interest Rate Environment"*. Next, in Section 4, there is an essay entitled *"Cost Efficiency, Size and Regulation of European Cooperative Banks"*, and, finally, Section 5 is based on an essay entitled *"A Rollercoaster Ride of Czech Credit Unions"*.

1.1 Recent development of Czech credit union sector

The essays in Sections 2 and 5 describe the performance of Czech credit unions until the years 2013 and 2012 respectively. We believe that it is essential to give readers an update on what has happened in the sector of Czech credit unions since then.

1.1.1 Amendment to the Czech Act on credit unions in 2015

The main turning point in the recent development of Czech credit unions is undoubtedly the year 2015, when an amendment to the Czech Act on credit unions came into force (law nr. 333/2014 Sb. replaced the old law nr. č. 87/1995 Sb).

The amendment reflects the recommendations arising from the IMF's control mission focusing on the stability of Czech financial institutions (IMF; 2012). The IMF criticized mainly the non-compliance with WOCCU standards: a lack of cooperative and democratic principles, no social function of the institutions and a focus solely on profit. Furthermore, the IMF warned that small-scale credit unions are at a competitive disadvantage compared to the standard commercial banks on the Czech market and that their potential problems may destabilize the financial system via the depletion of the Deposit Insurance Fund.

The Czech National Bank and the Ministry of Finance prepared the abovementioned amendment to the Act on credit unions which significantly restricted the business model of credit unions. Let us go through several main changes that the amendment to the Czech Act on credit unions brought about.

The minimal membership share increased from CZK 1 to CZK 1,000. Moreover, since 2015 (or since 2018 for existing members) only deposits of up to ten times the membership share are allowed to bear interest. These changes are supposed to make members more interested in the financial performance of credit unions and to promote a cooperative spirit among members. Before 2015, most of the credit unions on the Czech market set a basic membership share of CZK 1 in order not to deter new members.

Because Czech credit unions also suffered from problems caused by excessive loans granted to groups of economically connected clients (see, for example, ČNB; 2012), the amendment has, since 2018, set a limit of CZK 30 million on the size on loans granted to any one economically connected client group.

The amendment also sets a CZK 5 billion limit on the asset size of an individual credit union. Larger institutions should either decrease their balance sheet size or be transformed into commercial banks. The balance sheets of two credit unions surpassed the CZK 5 billion threshold in 2015 (MPU and Creditas). Both of them successfully managed the transition to banks and they are still operating today. No other Czech credit union has managed to get close to the CZK 5 billion threshold. The largest Czech credit union as of 2021 is Citfin, with an asset size of roughly CZK 3 billion.

The higher likelihood of the failure of credit unions compared to commercial banks and hence a higher potential threat to the Deposit Insurance Fund is reflected in the demand for higher contributions into the fund. Since 2015, credit unions have had to pay twice the amount that banks pay. Back in 2015, credit unions contributed 0.08% of covered deposits to the Deposit Insurance Fund.

The amendment to the Act on credit unions of 2015 caused heated debates, and many claimed that the new rules would lead to the liquidation of the sector. Section 1.1.2. provides an overview of the performance of the Czech credit union sector since 2015.

1.1.2 Decline of Czech credit unions after 2015

The number of Czech credit unions has been decreasing steadily since the end of 2010. At the end of 2010, 14 credit unions were operating on the market. No new credit union has been established since 2010, two have changed their legal status to commercial banks (Creditas in 2017 and MPU (now Trinity bank) in 2019) and five have gone bankrupt (Unibon in 2012, PDW in 2013, MSD in 2014, WPB in 2014,

and CSUD (previously called Akcenta) in 2021). Moreover, DZ PSD was in a long-term state of limited activity preparing itself for liquidation, which occurred in 2022. As a result, there were only six active credit unions on the Czech market at the end of 2021.

Despite the decreasing number of credit unions, the number of their members was growing until 2014. At that time, credit unions were already preparing to adopt the amendment to the Act on credit unions and the number of members started to decline. The Czech credit union sector had only about 11,000 members at the end of 2021, about one-fifth of the number of members at the end of 2014. For details, see Figure 1.1.

Figure 1.1: Number of credit unions and their members
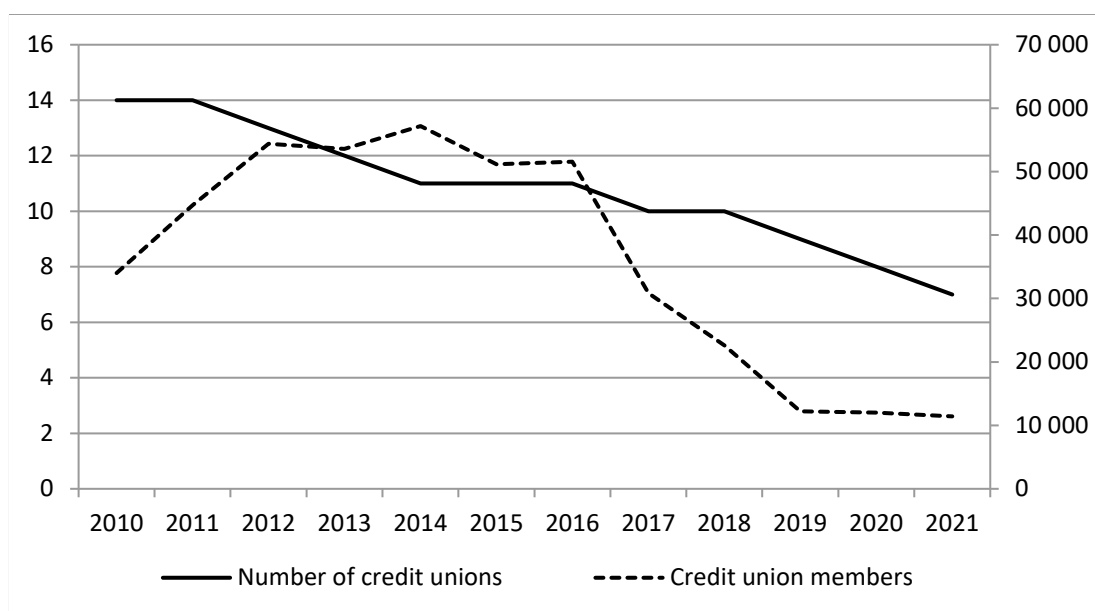
Source: Authors, based on CNB database (ARAD) and annual reports data

The share of credit unions' total assets to the assets of commercial banks is a proxy for the significance of the sector. This share peaked in 2012 at 0.82% and has decreased since then to 0.1% in 2021, as presented in Figure 1.2. This shows once again the totally marginal role of the credit unions sector, especially since 2016. The total assets of credit unions were only CZK 9 billion, and deposits totalled CZK 7.2 billion in 2021. For comparison, the Czech Deposit Insurance Fund managed a portfolio of CZK 37.3 billion in 2021 (GSFT; 2022).

Figure 1.2: Share of credit unions' assets to commercial banks' assets
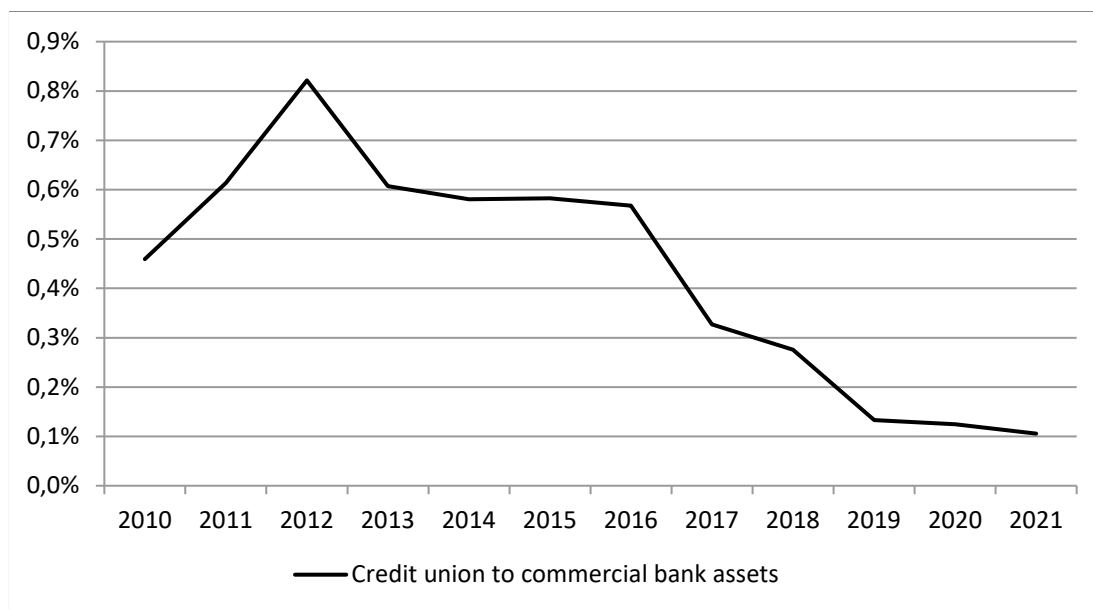
Source: Authors, based on CNB database (ARAD) and annual reports data

The only Czech credit union to go bankrupt since 2015 is CSUD (Akcenta). Its impact on the Deposit Guarantee Scheme was only minimal compared to some of the previously bankrupt credit unions (see Table 1.1).

Table 1.1: Liquidated credit unions with impact on the Deposit Guarantee Scheme after 2010

Credit union	Paid by DGS (CZK mn)	Year of disbursement
CSUD (Akcenta)	48	2021
WPB	2 780	2014
MSD	12 015	2014
PDW	20	2013
UNIBON	1 806	2012

Source: Authors based on GSFT (2022)

CSUD (Akcenta) managed to increase its asset size from CZK 867 million in 2010 to over CZK 3 billion in 2015. The amendment of the Act on credit unions forced CSUD to increase its basic membership share from CZK 1 to CZK 1 000 in 2015. Its balance sheet size then decreased to CZK 157 million in Q3 2020 (the last available financial reports). CSUD's profit was always negative after 2014 and its ROAA decreased to -12.7% in 2018. CSUD publicly declared its intention to transform into a commercial bank (see e.g. Akcenta, 2017). It was also looking for a strategic investor to stabilize it or was preparing to limit its business activities (CSUD, 2019). It was the latter that occurred.

Fio was the first credit union that successfully managed to transform into a commercial bank in 2010. Creditas and MPU (Trinity) are the only credit unions that managed this transition post 2015. Creditas and MPU were the largest credit unions of their time. Both managed to grow their balance sheets to volumes of around CZK 10bn in 2015 and then stagnated prior to transforming into commercial banks (for the financial figures of both institutions see Let us now focus on the remaining six Czech credit unions still in operation. They were all very small back in 2010, but they profited from the relaxed regulatory conditions. They managed to grow their assets until 2017 (see

Figure 1.3). The decrease in 2018 was caused by the fact that even those who had been members prior to 2015 needed to increase their basic membership share to at least CZK 1 000, or their membership would be terminated. This hit Artesa and Penezni Dum where the basic membership share was CZK 100, and Citfin, where the membership share was only 1 CZK prior to 2015. Since that time, the asset size of the remaining credit unions has decreased.

Table 1.2). The first reason for the balance sheet stagnation post 2015 may be a focus on the difficult process of obtaining a commercial banking license but credit unions of course also faced tightened requirements arising from the new amendment of Act on credit unions which severely restricted their business.

When their transformations into commercial banks were completed, both banks started to grow in size rapidly thanks to a massive deposit inflow fueled by high-interest-bearing products. Client loan growth was much more modest, and therefore, the loan to deposit ratio of both institutions decreased significantly compared to the times when they were credit unions. The share of non-performing loans to total client loans decreased significantly as well. Nevertheless, the NPL ratio was around 10% for both institutions in 2021. The NPL ratio of all Czech commercial banks was 2.5% in 2021 (ČNB, 2022). The NPL ratio of the credit unions sector in 2021 was 26.2% (ADZ, 2022). The portfolio quality of both Creditas and Trinity is improving and converging with that of average commercial banks. Both banks have positive net profits and maintain their capital ratios at comfortable levels, especially when compared to the times when they operated as credit unions. Because of all the above-mentioned trends, the conversion of these two credit unions into commercial banks may be considered to have been successful.

Let us now focus on the remaining six Czech credit unions still in operation. They were all very small back in 2010, but they profited from the relaxed regulatory conditions. They managed to grow their assets until 2017 (see

Figure 1.3). The decrease in 2018 was caused by the fact that even those who had been members prior to 2015 needed to increase their basic membership share to at least CZK 1 000, or their membership would be terminated. This hit Artesa and Penezni Dum where the basic membership share was CZK 100, and Citfin, where the membership share was only 1 CZK prior to 2015. Since that time, the asset size of the remaining credit unions has decreased.

Table 1.2: Selected financials of Trinity and Creditas

Trinity	Period	2013	2014	2015	2016	10/2017	2018	2019	2020	2021
	Legal form	CU	CU	CU	CU	CU	CU	bank	bank	bank
	Balance sheet	8 030	9 648	10 421	N/A	10 154	9 226	16 183	17 503	36 986
	Client loans	6 544	7 056	7 452	N/A	6 669	6 050	5 319	6 999	9 257
	Client deposits	6 971	8 399	9 009	N/A	8 033	6 963	14 122	14 775	32 729
	Loan/deposit ratio	94%	84%	83%	N/A	83%	87%	38%	47%	28%
	NPL share	33%	37%	38%	N/A	33%	33%	20%	18%	10%
	Net profit	-19	51	31	N/A	102	51	66	75	201
	Own funds ratio	11%	12%	12%	N/A	18%	19%	21%	19%	22%
Creditas	Period	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Legal form	CU	CU	CU	CU	bank	bank	bank	bank	bank
	Balance sheet	9 715	10 533	10 286	11 743	31 697	40 968	73 387	66 707	62 858
	Client loans	7 718	7 647	6 878	8 003	11 334	13 840	14 664	15 739	23 375
	Client deposits	8 468	9 272	8 835	10 100	25 349	35 002	68 525	61 416	56 131
	Loan/deposit ratio	91%	82%	78%	79%	45%	40%	21%	26%	42%
	NPL share	20%	20%	13%	12%	10%	6%	8%	17%	9%
	Net profit	0	11	22	-15	66	263	171	114	22
	Own funds ratio	11.7%	11.1%	14.3%	13.4%	12.5%	16.5%	19.5%	20.1%	21.4%

Notes: figures in CZK million; Trinity extended the financial year 2016 until 10/2017 and did not report financial figures for 2016YE

Source: Authors based on Annual reports of Trinity (MPU) and Creditas

Figure 1.3: Asset size of the last six Czech credit unions over time
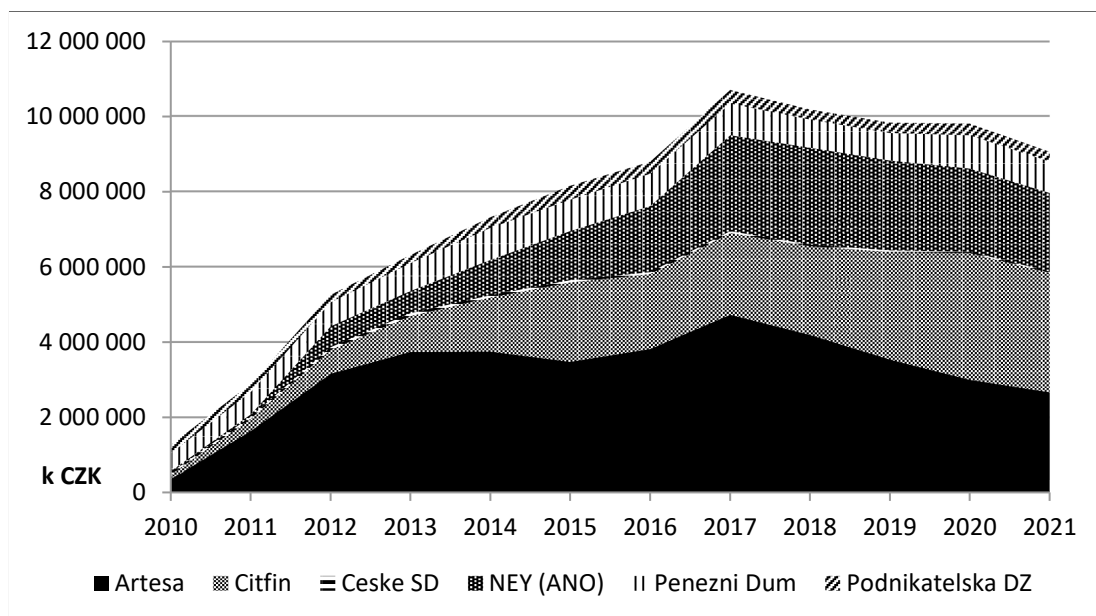
Source: Authors, based on annual report data of individual institutions

The aggregate net profit of the remaining six credit unions oscillates around zero (see Figure 1.4). The year 2021 was the best year yet for the profits of those credit unions, possibly thanks to the high interest rate environment in the Czech Republic, as the repo rate ended 2021 at 3.75%. Despite that, the net profit of two of the six credit unions was negative in 2021. Nevertheless, it is too early to judge from one year's profit whether the remaining credit unions have stabilized themselves, especially when the asset size of the sector is still decreasing.

Figure 1.4: Aggregate net profit of the last six Czech credit unions.
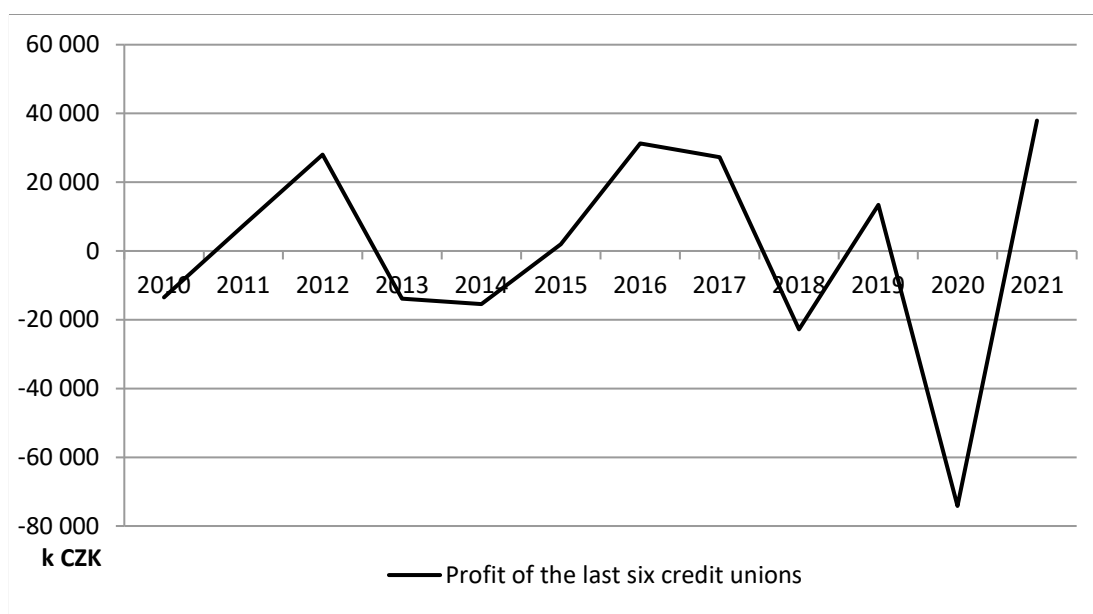
Source: Authors, based on annual report data of individual institutions

Let us sum up the development of Czech credit unions in recent years: a major turning point came in the year 2015 when the amendment to the Act on credit unions came into force, bringing much stricter regulation of their business in order to support the cooperative spirit and decrease hazard in the sector. The number of credit unions and their importance in the Czech economy have decreased significantly since then. Two institutions have successfully managed to change their status from credit union to commercial bank, and only one credit union has gone bankrupt since 2015, and moreover, it managed to terminate its business without having any material impact on on the deposit guarantee system. There are only six credit unions still in operation, their balance sheet is shrinking and their profitability is oscillating around zero. The regulation of 2015 has succeeded in achieving its goals: it reduced risk in the sector, prevented costly bankruptcies, and stopped the uncontrolled growth of institutions. Whether any credit unions will be competitive in the long run under these new rules is still in question.

1.2 Updated literature review on cooperative banking performance

Since our papers in the second and fifth sections of this thesis were written in 2014 and 2015 respectively, there is a need to update references to provide the reader with the most up-to-date empirical information about cooperative banking performance. The paper in the third section of the thesis was published in 2022, and its references are up to date. The paper in the fourth section is still at the working paper stage, and therefore, its literature review is updated directly within its text.

Empirical literature on the performance of Czech credit unions (and credit unions in the new EU member states) is still scarce. Cibulka (2017) focuses on the changes in the legal environment and provides an overview of the development of Czech credit unions. He finds positive trends in the financial performance of the sector, thanks especially to the legally enforced greater participation of members, which brings Czech credit unions closer to common international cooperative standards. Binda (2016) describes the Polish credit union sector and concludes that the condition of the sector is weak, and corrective actions, such as recapitalization, are necessary. The IMF (2019) analyses the sectors of Polish cooperative banks and credit unions and it too finds that the performance of Polish credit unions and the quality of their financial information are not yet satisfactory. Golec and Pluciennik (2017) show that Polish cooperative banks are net liquidity providers on the interbank market, which is in contrast to the European market, where cooperative banks balance their interbank money transfers.

Coccorese and Ferri (2020) studied mergers among Italian cooperative banks and found that mergers increase mutual banks' cost efficiency in only 5% of cases. Moreover, the large size of some cooperative banks may have a negative impact on those borrowers, who neglected by bigger financial institutions, use the services of smaller banks. Therefore, the current wave of cooperative banking mergers in Italy may increase inequality among clients. Coccorese and Shaffer (2021) provide further evidence that the presence of Italian cooperative banks, more than that of commercial banks, is associated with enhanced local municipal income, increased growth rates of firms and higher employment rates. This proves the traditional role of cooperative banks as credit providers to local borrowers. These results are in line with Hasan et al. (2017), who show that local cooperative banks in Poland facilitate access to bank financing, lower financial costs, boost investments, and promote the growth of SMEs.

Clark, Mare and Radic (2018) show that there exists a hump-shaped relationship between the market power (on the loan market) and the stability of European cooperative institutions. Moreover, the authors find that balance sheet diversification significantly increases banks' solvency.

The study of Van Toor et al. (2017) shows on a set of 106 banks that the profitability (ROA) of a cooperative bank significantly decreases in the two first years after a change of CEO. This decline in performance is caused almost entirely by an increases in loan loss provisions. The evidence points to two underlying motives behind this: firstly, to offset a backlog in the provisions of the old CEO, and secondly, to prepare to improve the bank's profit in the future. Skala and Weill (2018) show on a set of 365 Polish cooperative banks that banks headed by female CEOs are less risky. Furthermore, female CEOs report higher capital adequacy and equity to assets ratios.

Jones and Kalmi (2015) show that the ROAA of Finnish financial cooperatives is positively affected by membership ratios (defined as the number of members relative to the number of total customers). The positive aspects of membership, therefore, outweigh the negative aspects of dispersed ownership. Poli (2022) arrived at the same conclusion on a set of 241 Italian cooperative banks.

Lardic and Terraza (2019) use dynamic data to examine the determinants of performance (ROAA and ROAE) of German banks. The authors show that the profitability of cooperative and savings banks is lower than that of commercial banks. While there is a negative relationhsip between asset size and profit for commercial banks in crisis, no explicit relation was found for cooperative banks.

Let us sum up this literature review update: the presented studies confirm that the profitability of European cooperative banks is lower than that of commercial banks, but cooperative banks have a larger positive effect on local business. Interestingly, recent studies show that the positive aspects of membership outweigh the negative aspects of dispersed ownership. Changes of CEO and the gender of CEOs seem to affect the performance of cooperative banks, and therefore, if such data are available, they should be tested by models.

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2 A Financial Performance Comparison of Czech Credit Unions and European Cooperative Banks

Abstract

This paper empirically assesses the financial performance of Czech credit unions in relation to other European cooperative banks in terms of their profitability and stability. We created a unique dataset of 283 cooperative banks from 15 European countries in the 2006–2013 period. Using system GMM and alternative panel data methods, we reveal worse performance of Czech credit unions in terms of both profitability and stability compared to their European peers. We also argue that big credit unions in the Czech Republic has undertaken a non-sustainable business model depending on excessive risk taking while enjoying implicit subsidy via deposit insurance. In conclusion, we argue that under recent capital management policies, big Czech credit unions will likely face serious financial problems in coming years.

Keywords: credit union, cooperative banking, moral hazard, system GMM, Z-Score

JEL classification: C23, G21, L25

2.1 Introduction

Credit unions in the Czech Republic were traditional financial institutions that made financial services accessible to the general population before the Second World War. They were subsequently abolished by the political regime of that time and were no longer relevant to the mainstream development of Western Europe. Czech credit unions founded after the fall of communism suffered from a poor legislative framework that did not reflect trends and developments in cooperative banking of the second half of the 20th century. Their boom turned into the severe crisis of the sector in 1999. Czech credit unions regained lost customer confidence after few years of stagnation but some of the leading credit unions got into problems again recently, and their licenses were revoked.

The aim of this paper is to compare the financial performance of Czech credit unions with cooperative banks in other European countries. We analyze the differences in profitability and risk between Czech and European financial cooperatives. We will focus specifically on two groups of indicators: i) profitability indicators encompassing return on average assets (ROAA), return on average equity (ROAE), net interest margin (NIM) and ii) stability indicator (Z-Score). Empirical analysis will be carried out by dynamic panel data method (system GMM) where applicable. Alternative panel data methods will serve as supplementary techniques.

The structure of the paper is as follows. Section 2.2 presents a literature review covering the financial performance of cooperative banks with primary focus on Europe. In section 2.3 we describe the selection process for variables and describe the data sample. Section 2.4 explains our methodological approach (system GMM and alternative panel data methods). In Section 2.5, we test two hypotheses concerning the low profitability and the high risk level of Czech credit unions. This section also summarizes key results and findings of this paper. Finally, Section 2.6 concludes the work and states the final remarks.

2.2 Literature review

Based on literature review of relevant works, we have identified a lack of empirical studies assessing the financial performance of credit unions from the new EU member states. There are two main reasons to which we can attribute this gap: insufficient data availability and a smaller relative share of cooperative banking business in these countries. Since we are not able to find a common point, we split this literature review into two separate streams: the first one describes the general

condition of the Czech credit unions sector and the second one is focused on the performance drivers of cooperative banks' in Europe.

The first group includes the works by IMF (2012), MFČR (2014) and Tomšík (2015) and deals with a structural difference between Czech credit unions and cooperative banks elsewhere in Europe. The three mentioned analyses show that Czech credit cooperatives behave like small and risky commercial banks by denying baseline cooperative principles. However, these studies are lacking any econometrical analysis of these conclusions. Although some of the most striking problems in the legislative framework that lead to credit unions sector crisis in 1999, such as a lack of proper supervision or a limitation of scope of business, were resolved by new regulation, some issues still remained. Dvořák (2004) showed the high dependency of Czech credit unions on interest rate sensitive deposits – credit unions needed to attract members' deposits on savings products bearing significantly higher interest rates than commercial banks. Full deposit insurance of deposits and common Deposit Insurance Funds with less risky commercial banks further promoted the moral hazard of depositors who do not have to distinguish the riskiness of individual deposit taking institutions. As IMF (2012) and Tomšík (2015) pointed out, the trend of high interest rates on deposits was still present in the Czech credit union sector.

Ayadi et al. (2010) highlights that there is no single universal model of cooperative banking in Europe. However, there are basic principles shared by cooperative banking models across Europe. Interestingly, Czech credit unions do not follow some of these principles. An example is that Czech credit unions do not follow the "one member – one vote" principle as members are allowed to buy additional membership shares and consequently have higher voting power in general meetings. Members of Czech credit unions also do not seem to share common bonds as is typical for cooperatives according to the World Council of Credit Unions (WOCCU, 2015). Despite their small size, Czech credit unions typically offer whole range of products having branches all around the country – from this point of view, we cannot discern the market focus on individual institutions. By not sharing some of the cooperative best practices advised by the WOCCU, Czech credit unions are not members of this organization. Matejašák and Teplý (2013) criticized new regulation in connection with low capital levels and possible problems of larger Czech credit unions associated with required capital increases. The problem of low equity levels are further intensified by a strategy of low price for membership shares in order to attract new clients more easily. Low membership claims of members may harm the cooperative spirit of institutions as members are not motivated to follow the performance of credit union which is once again denying a basic cooperative

principle. Moreover, a significant concentration of ownership rights is suspect because additional membership shares formed more than 85% of total equity from membership shares in every Czech credit union in 2013.

The second group of literature focuses on the performance drivers of cooperative banks profitability and stability in Europe. The papers in our review cover time periods from 1979 to 2009. Data samples were created solely by banks from Western Europe. Iannotta et al. (2007) showed that bigger cooperative banks and banks with a higher share of loans to total assets are more profitable. Banks with more diversified income sources yield higher profits according to Goddard et al. (2010). Capital to asset ratio's effect on profitability is ambiguous - Goddard et al. (2004) and Iannotta et al. (2007) found positive correlation, whereas Goddard et al. (2010) negative and Beckmann (2007) no statistically significant dependence. The effect of liquidity is insignificant according to Iannotta et al. (2007). Goddard et al. (2004) found negative effect of cost to income ratio on profitability. Market concentration has either no (Beckmann, 2007) or negative effect (Goddard et al., 2010) and GDP growth seems to support banks' profitability (Iannotta et al., 2007; Beckmann, 2007). A low interest rate environment affects profitability negatively (Beckmann, 2007).

The studies interested in the risk factors of cooperative banks used distinct measures as proxies for banking stability such as Z-Score, ratio of non-performing loans or capital ratios. The effects of most of the variables on the stability of cooperative banks differ from paper to paper. Consensus was reached on the negative effect of growth rate of the bank (Beck et al., 2009; Köhler, 2012) and the cost to income ratio on bank stability (Hesse and Čihák, 2006; Beck et al., 2009; Ayadi et al., 2010). Liquidity (Iannotta et al., 2007; and Köhler, 2012) and GDP growth (Iannotta et al., 2007; Hesse and Čihák, 2006; Köhler, 2012) seem to have no effect on bank soundness. This is probably also the case for market concentration (Hesse and Čihák, 2006; Ayadi et al., 2010; Köhler, 2012), capital to asset ratio (Iannotta et al., 2007), loans to deposit ratio (Köhler, 2012) and inflation (Hesse and Čihák, 2006). A positive or no effect on stability was found for share of loans on total assets (Iannotta et al., 2007; Hesse and Čihák, 2007; Köhler, 2012) and also for income diversity (Hesse and Čihák, 2007; Beck et al., 2009; Köhler, 2012). The effect of size on stability was found positive by Beck et al. (2009), statistically insignificant (Iannotta et al., 2007; Köhler, 2012) as well as negative (Hesse and Čihák, 2007; Ayadi et al. 2010).

2.3 Data analysis

The following section of this paper consists of two parts. First, we explain the variable selection process and then we describe the dataset used.

2.3.1 Variables selection

The selection of variables is based upon empirical papers mentioned in the literature review section. Our goal is twofold: we want to assess profitability and stability. We will use *three* common measures as dependent variables that capture banking profitability:

Return on average assets: $ROAA_{i,t} = \frac{NET\ INCOME_{i,t}}{\frac{As_{i,t}+As_{i,t-1}}{2}}$

Return on average equity: $ROAE_{i,t} = \frac{NET\ INCOME_{i,t}}{\frac{Eq_{i,t}+Eq_{i,t-1}}{2}}$

Net interest margin: $NIM_{i,t} = \frac{NET\ INTEREST\ INCOME_{i,t}}{\frac{EAR\_As_{i,t}+EAR\_As_{i,t-1}}{2}}$

The risk (or stability) of bank is measured by Z-Score. Z-Score is popular measure of banks' soundness. It is a quantity of standard deviations of net income that company has to lose, under the assumption of normal distribution of income, so that all of its capital is depleted. We can alternatively imagine Z-Score as a distance to upper bound of insolvency. The higher the Z-Score, the lower is the probability of going insolvent. We will use time-varying Z-Score approach of Hesse and Čihák (2007):

$$ZSCORE_{i,t} = \frac{ROAA_{i,t} + CAR_{i,t}}{\sigma(ROAA)_i}$$

where $CAR_{i,t}$ is capital-to-asset ratio and $\sigma(ROAA)_i$ is standard deviation of ROAA for bank *i* over the whole sample period, as in our case from 2006 – 2013. For further discussion about the usage of Z-Score, we refer to Lepetit and Strobel (2013). A summary of preselected list of explanatory variables is provided in Table 2.1. Because of our focus on Czech credit unions, we put all the relevant banking figures in the Czech currency (CZK). CAR cannot be used as an independent variable in stability regressions because it is a part of a definition of a Z-Score.

Table 2.1: List of independent variables

Variable name	Description	Source
Assets	logarithm of assets	author based on BankScope and annual reports
AssetGrowth	annual growth rate of assets	
CAR	capital to assets ratio	
Liquidity	liquid assets to total asset ratio	
LtD	loans to deposits ratio	
LoansRatio	loans to assets ratio	
CostIncome	cost to income ratio	
FeeRatio	net fee income to total income ratio	
HHI	Herfindahl-Hirschman index	European Central Bank
GDP	annual growth rate of real GDP	Eurostat
Unemployment	annual unemployment rate	
Inflation	annual inflation rate	
InterestRate	long term interest rate (gov. bond yield with 10Y maturity)	
CZ	dummy for Czech credit unions	Authors

Source: Authors

2.3.2 Data description

We used the BankScope database as a data source for European cooperative banks and we enriched the dataset by using Czech credit unions' data retrieved from their annual reports to cover the lack of data about Czech credit unions in international databases. To deal with double-counting issue, we used similarly as in work of Hesse and Čihák (2007), consolidated bank statements only in the case that no unconsolidated statements were available for given institution. We used dataset for

years 2006 to 2013 because of data availability. We included only cooperative banks which were active (had financial statements uploaded) for all time periods in order to have balanced dataset. Because a disproportionately large share of cooperative banks in the sample were from Germany and Italy, we randomly deleted 50% of them to receive more representative quantities for individual countries[1]. Altogether, our data sample includes data from 15 European countries and consists of 283 cooperative banks. The data sample contains full set of 11 Czech credit unions that were in operation for the whole period.

Table 2.2: Banks in data sample by country

Country	Count	Share	Country	Count	Share
Austria	17	6,0%	Finland	1	0,4%
Belgium	1	0,4%	France	7	2,5%
Bulgaria	1	0,4%	Greece	1	0,4%
Cyprus	1	0,4%	Croatia	1	0,4%
Czech Rep.	11	3,9%	Italy	87	30,7%
Germany	139	49,1%	Malta	1	0,4%
Denmark	2	0,7%	Slovenia	1	0,4%
Spain	12	4,2%	**SUM**	**283**	**100%**

Source: Authors

Let us take a look at the medians of performance measures with Czech credit unions separated from the rest of the sample. We see similar profitability of Czech and other European banking cooperative in terms of ROAA (see Appendix Table 2.6) but Czech credit unions reached significantly lower levels of ROAE. The difference in these two profitability measures can be explained by high capital to asset ratios of Czech credit cooperatives that reflect the higher risk of their business because their capital adequacy ratios are relatively small. CNB (2014) reported a 14.3% capital adequacy of the Czech credit unions sector as of the end of 2013 while other European cooperatives in our sample had capital adequacy 2 percentage points higher. This implies that assets with higher risk weights are present in portfolios of Czech credit unions (for further details see Matejašák and Teplý (2013)).

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[1] We run the profitability and stability regressions described in Sections 2.5.1 and 2.5.2 also with a full (undeleted) dataset and the difference in results is negligible. Therefore, we decided to continue with this more representative dataset with randomly deleted Italian and German cooperative banks.

Even though median NIM of Czech credit unions is only slightly higher compared to the rest of our sample, Figure 2.1 reveals positive relation between asset size and NIM of Czech credit cooperatives, hinting that especially bigger Czech credit unions may be conducting unnecessarily risky business. Both high need for capital and high NIM may be implied by the fact that funding of credit unions is expensive (they must offer high interest rates to attract clients and compensate for worse services compared to big Czech commercial banks – fewer branches, no ATMs, typically only basic internet banking, etc). Therefore, Czech credit unions need to focus on risky business to cover higher funding costs and be profitable. A typical borrower from a Czech credit union is a client whose loan application in a bank was rejected and who is willing to pay a higher margin to get a credit. Moreover, credit unions under Czech law are not allowed to grant mortgage loans and this is one more reason they must focus on riskier activities such as consumer lending or real estate investment loans.

Figure 2.1: Dependency of NIM on asset size of Czech credit unions (2013)
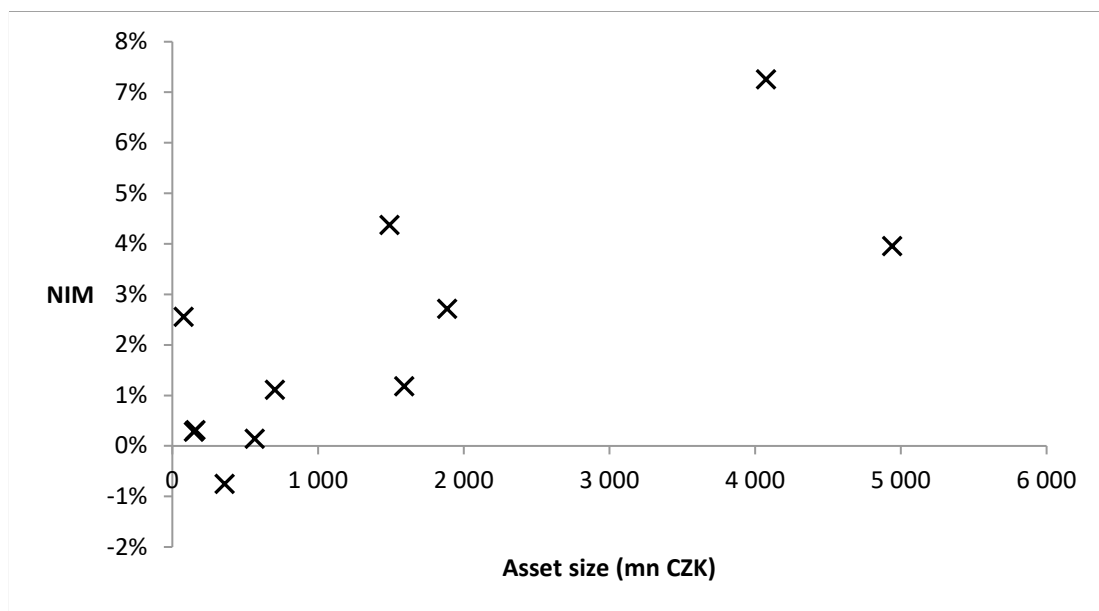
Note: crosses represent individual credit unions.

Source: Authors, based on BankScope and annual reports data

Strikingly different is the development of Z-Score for both groups (see Figure 2.2). Whereas the median Z-Score of Czech credit unions decreased considerably in time, the median of other European cooperative banks increased and proved the strong resiliency of cooperative banking schemes in a time of crisis which was discussed by Ayadi et al. (2010) or by Liikanen et al. (2012).

Figure 2.2: Medians of Z-Score of Czech credit unions (CZ) and EU credit unions (EU) in 2006-2013
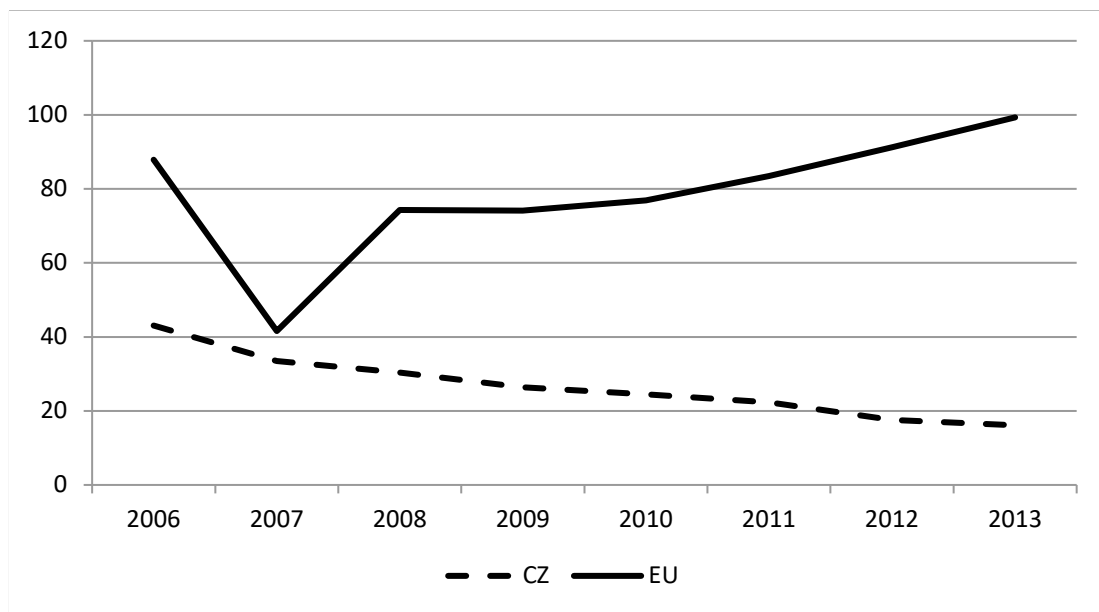
Source: Authors, based on BankScope and annual reports data

Moreover, the evolution of Z-Scores of individual Czech credit unions based on their asset size reveals an interesting pattern (see Appendix Figure 2.3): a decreasing Z-Score with an increasing size of institutions is easily recognizable for Czech credit unions. In other words, Czech credit unions grew bigger in time but their Z-Score decreased. We can see no such pattern in case of other European cooperative banks (Appendix Figure 2.4). An explanation for why mainly big Czech credit unions are vulnerable according to the Z-Score measure is quite straightforward. We already showed that Czech credit unions need a high share of capital for their business models based on risky assets. Moreover, Czech credit unions are rather young institutions that grow on average much faster than their European peers (see Appendix Table 2.6). Credit unions can raise capital either through membership shares or through retained earnings. Retained earnings form only negligible share of Czech credit unions equity – in 2013 it was only 3.6% of the equity of the whole sector and therefore, majority of equity comes from membership shares. Nevertheless, Czech credit unions charge only minimal amounts for the membership shares in order to attract new members and therefore, they are not able to raise enough equity for their growing business through methods other than selling additional membership shares to existing members (MFČR, 2014). These facts help to explain why the Czech National Bank in the last couple of years revoked the

licenses of only credit unions that expanded aggressively and belonged among largest institutions of Czech credit union sector[2].

Table 2.6 in the Appendix provides descriptive statistics of all the variables used. We observe that Czech credit unions are generally smaller than European cooperative banks. We already mentioned above that Czech credit unions grow faster and have substantially higher capital to asset ratio. Czech credit unions tend to have similar ratio of loans to asset but they have lower ratio of loans to deposits. European cooperative banks tend to be on average more effective in terms of cost to income ratio and they have higher share of their income resulting from fees.

2.4 Methodology

Berger et al. (2000) found significant persistence in bank profitability. Similar results were described by Goddard et al. (2004), Athanasoglou et al. (2008) or Shehzad et al. (2009). Delis and Kouretas (2011) and Köhler (2012) found persistence in banking risk measures and therefore suggested using dynamic panel models. Delis and Kouretas (2011) argued that the risk is persistent due to intertemporal risk smoothing, regulation, and the relationship with risky customers. Because of this evidence of persistence, we will use a dynamic panel data model which we prefer over simple panel data methods for it can deal with so called dynamic panel data bias. System GMM can deal with endogeneity and leads to robust estimates when dealing with persistent variables. This method is becoming increasingly popular in empirical studies researching banking profitability or stability (see e.g. García-Herrero et al., 2009; Liu et al., 2013). Dynamic panel data models are characterized by including lagged dependent variable ($y_{i,t-1}$) among independent variables, see Equation (2.1):

$$y_{i,t} = \alpha y_{i,t-1} + x'_{i,t}\beta + \varepsilon_{i,t}, i = 1, \dots, N; \ t = 1, \dots, T \tag{2.1}$$

$$\varepsilon_{i,t} = \mu_i + v_{i,t}$$

$$E[\mu_i] = E[v_{i,t}] = E[\mu_i v_{i,t}] = 0$$

where $x'_{i,t}$ is vector of independent variables, $i = 1, \dots, N$ is individual's index and $t = 1, \dots, T$ stands for time. Error term $\varepsilon_{i,t}$ is composed of two terms: μ_i is fixed effect and $v_{i,t}$ is idiosyncratic shock. OLS estimator is inconsistent in this case because a lagged dependent variable is correlated with fixed error term (dynamic

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[2] The paper was written in 2015. For development in the Czech credit unions sector since then, please see Section 1.1 Recent development of Czech credit union sector.

panel data bias). Nickell (1981) shows that the problem with fixed effects cannot be solved by using a groups transformation. Bond (2002) suggests using both OLS and a groups estimator as a robustness check for GMM since both methods are likely to be biased in opposite directions.

There are two popular approaches how to deal with above mentioned endogeneity problem without the need for further correction. The first one is difference general method of moments (difference GMM). Difference GMM uses first-differencing to get rid of fixed effects and therefore the problem with dynamic panel data bias (Arellano and Bond, 1991). The drawback of the difference GMM method is that it does not allow for time-invariant variables and hence we cannot use dummy variables to distinguish between different institutional types of banks. The second method is called system GMM. It uses the additional assumption that the first differences of instrument variables are not correlated with the fixed effect term and it allows using time-invariant variables. System GMM method was popularized by works of Arellano and Bover (1995) and Blundell and Bond (1998).

We use Windmeijer (2005) for the correction for standard errors because Arellano and Bond (1991) warn that the inclusion of too many instruments may create a downward bias of standard errors during two-step estimation and the method by Windmeijer (2005) corrects it. Our estimated model takes form of Equation (2.2):

$$Y_{i,s,t} = \alpha + \beta Y_{i,s,t-1} + \gamma B_{i,s,t} + \delta C_{s,t} + \epsilon D_s + \vartheta T_t + \varepsilon_{i,s,t}$$

$$\varepsilon_{i,s,t} = \mu_{i,s} + v_{i,s,t}$$

(2.2)

where

$Y_{i,s,t}$ is bank performance measure for bank i in country s at time t,

$Y_{i,s,t-1}$ is first lag of bank performance measure,

$B_{i,s,t}$ is a vector of bank specific variables,

$C_{s,t}$ is a vector of country specific variables,

D_s is dummy for Czech credit unions,

T_t is a vector of time dummies (years),

$\varepsilon_{i,s,t}$ stands for disturbance term which is composed of two components: $\mu_{i,s}$ is fixed effects term and $v_{i,s,t}$ stands for the idiosyncratic shock.

2.5 Results and findings

In order to use system GMM method correctly, we need to test the persistence of dependent variables to ensure the appropriateness of dynamic panel data estimation method. We ran Arellano-Bond test for autocorrelation for all four financial performance measures and we reject null hypothesis of no first order autocorrelation in case of ROAA, ROAE and NIM. We found no autocorrelation of Z-Score and therefore we used different methods than system GMM for stability regressions.

Our primary interest is the effect of Czech credit unions dummy variables and therefore, we leave aside variables that are highly correlated with it because of specific nature of Czech credit unions to avoid multi-collinearity problems (see correlation matrix in Appendix Table 2.7). This holds true for bank size since Czech credit unions are generally smaller than European cooperative banks and due to specific Czech legislation, Czech credit unions have much more capital relative to assets (see Appendix Table 2.6).

We decided to estimate models with the following bank specific independent variables: growth of assets, liquid asset ratio, loans to deposit ratio and loans to assets ratio. Herfindahl-Hirschman index, GDP growth rate, unemployment and inflation represent country specific variables and moreover Czech credit unions and year dummies are included. Variance inflation factor (VIF) analysis find no severe multi-collinearity among variables used in the model as all the predictor variables has VIF smaller than 10.

2.5.1 Profitability regressions results

We estimate a two-step system GMM model with robust standard errors. A lagged dependent variable is positive in all three cases and it is not significant only in ROAA regression. Such an outcome is assumed because of persistence of banking profitability measures. Regression results show that profitability of Czech credit unions is smaller in terms of ROAA at 1% significance level and in terms of ROAE at 5% significance level. The model was indecisive in case of NIM. The coefficients were significant not only statistically but also economically.

The sign of other explanatory variables was more or less expected: liquidity decreases profitability just as unemployment does. Higher loans to deposit ratio increases profitability but higher share of loans on total assets decreases it. This shows that non-traditional banking activities may be more profitable than loan

granting. NIM is higher in environment of higher inflation. Outcome that we did not expect is that GDP growth rate has negative effect on ROAA nevertheless its effect is insignificant in two other profitability regressions.

All F-tests strongly reject that variables are jointly insignificant. Arellano-Bond AR(1) and AR(2) tests for the first and second order autocorrelation have null hypothesis of no autocorrelation. We reject the null hypothesis for AR(1) in all cases which was expected because the first order autocorrelation is assumed by system GMM model with one lag. We cannot reject the hypothesis of no second order autocorrelation and that is why no second lag is included in the model. The validity of instruments is tested by the Hansen test. This test uses the null hypothesis that all instruments are valid. The null hypothesis of exogenous instruments was not rejected at 5% level in all three regressions. Standard errors are presented in the brackets of Table 2.3.

Table 2.3: Profitability regression results

Dependent variable	ROAA		ROAE		NIM	
Lagged dependent variable	0.1007		0.3262	***	0.3100	**
	(0.0680)		(0.698)		(0.1437)	
Constant	-0.0043		1,7947	***	0.0800	***
	(0.0019)		(0.6105)		(0.0238)	
gr_As	-0.0002		-0.0013		0.0000	
	(0.0002)		(0.0010)		(0.0001)	
Liquidity	-0.0755		-1.6721	***	-0,0839	***
	(0.0690)		(0.6123)		(0.0236)	
LtD	0.0006	*	0.0027	***	0,0021	**
	(0.0003)		(0.0010)		(0.001)	
LoansRatio	-0,0852		-1.8197	***	-0,068	***
	-0,0689		(0.6242)		(0.0258)	
HHI	0.0143		0.3860	*	-0,0791	***
	(0.0102)		(0.2167)		(0.0244)	
GDPgr	-0.0610	***	0.3897		-0,0403	
	(0.0191)		(0.3785)		(0.0550)	
Unemployment	-0.1560	***	-1.1352	***	0.0010	
	(0.0451)		(0.2259)		(0.0210)	

Inflation	-0.0001		0.2415		0.1524	***
	(0.0872)		(0.8227)		(0.0503)	
CZ	-0.0043	**	-0.0751	***	-0.0142	*
	(0.0019)		(0.0226)		(0.0086)	
Diagnostics						
Number of observations	1981		1981		1981	
Number of instruments	38		38		32	
F-test	309.59	***	357.71	***	312.46	***
Arellano-Bond AR(1) test	-2.18	**	-3.80	***	-2.46	**
Arellano-Bond AR(2) test	-1.61		-1.26		-1.12	
Hansen test	30.30	*	19.08		23.55	*
Year dummies	Yes		Yes		Yes	

Significance codes: *** = 0.01, ** = 0.05,* = 0.1

Source: Authors, based on BankScope and annual reports data

Moreover, we perform a robustness check described by Bond (2002). We run OLS and fixed effects (FE) models and check whether the GMM estimate of a lagged dependent variable is above the FE estimate and below the OLS estimate. Both OLS and FE should suffer from dynamic panel data bias that increases estimate of OLS and decreases the one of FE. This test proved validity of our GMM estimates (see Appendix Table 2.8).

2.5.2 Stability regression results

Arellano-Bond AR(1) test found no serial correlation in residuals. Moreover, the system GMM model with Z-Score as a dependent variable performed generally poorly. We suspect no endogeneity if we exclude lag of dependent variable from our model and we are therefore going to use simpler panel data method. We follow the methodology of Beck et al. (2009) who use random effects to estimate bank risk expressed as Z-Score. We prefer the random effects method over fixed effects since it allows us to include a time invariant dummy in regression equation which is crucial for our research.

We use the Hausman test to justify the usage of random effects. We cannot reject the null hypothesis of the Hausman test at 5% significance level which means that both fixed effects and random effects are consistent but random effects method is

asymptotically more efficient. We also performed Breusch-Pagan Lagrange multiplier test and we rejected the null hypothesis. It means that OLS estimate is less efficient than random effects and that we should use the latter method.

Nevertheless, we anyhow ran regressions using the fixed effects and the pooled OLS for comparison. As our data are grouped into clusters (countries), we suspect that standard errors may overstate estimator precision as was shown by Moulton (1986). Therefore, we use cluster-robust standard errors clustered on country level as advised by Cameron and Miller (2015). As expected, we find considerable higher standard errors for cluster-robust errors compared to non-clustered model. Therefore we stick with the cluster-robust estimation.

We estimated the models with year dummies, just as in profitability regressions. The results of random and fixed effects regression are very similar which points to the robustness of our estimates (see Table 2.4). Results of OLS regression differ for some variables but not for variable of our interest – dummy for Czech credit unions. Regression results showed that Z-Score of Czech credit unions is considerably lower than that of other European cooperative banks in our sample and hence Czech credit unions are much riskier.

Our FE model in Tabel 2.4 shows R-sq. 0.21. We used also OLS and RE methods for comparative purposes. They show R-sq. 0.22 and 0.10 respectively.

The surveyed studies have the following R-sq: Beckmann's (2007) FE models have R-sq of 0.26 and 0.34 respectively. Köhler's (2012) FE model has R-sq 0.35. Hesse and Čihák (2017) have average R-sq. of 0.10, Beck et al. (2009) of 0.19 and Iannotta et al. (2006) have average R-sq. of 0.40 (ranging from 0.19 to 0.58). Goddard et al (2010) do not publish R-sq.

From this survey, it is clear that our R-sq. is slightly below the average of presented studies but it does not differ significantly. It is quite typical for studies focused on banking financial performance to have similarly low R-sq. statistics because there are a lot of factors (variables) that do affect the performance of such complex institutions as banks. There is always a trade-off between the size of a sample (nr. of banks) and the amount of details that we know about them (variables available).

Table 2.4: Stability regression results

Dependent variable	ZSCORE		
Method	RE	FE	pooled OLS

Constant	96.67	**	102.0	***	-89.01	*
	(38.11)		(22.54)		(46.47)	
gr_As	-0.305	*	-0.028		-0.049	
	(0.017)		(0.017)		(0.031)	
Liquidity	-0.121		-0.230		1.769	**
	(0.257)		(0.301)		(0.606)	
LtD	0.601	***	0.609	***	-1.694	
	(0.201)		(0.192)		(1.194)	
LoansRatio	0.044		-0.049		1.814	***
	(0.212)		(0.232)		(0.480)	
HHI	66.56		112.1		-169.1	
	(65.69)		(80.37)		(102.5)	
GDPgr	0.013		0.004		9.423	
	(0.872)		(0.807)		(6.937)	
Unemployment	-2.648	***	-2.586	***	-1.710	
	(0.445)		(0.447)		(2.641)	
Inflation	-1.873	**	-1.785	*	-10.74	*
	(0.974)		(0.956)		(5.616)	
CZ	-40.66	**	omitted		-28.48	**
	(23.95)				(13.14)	
Diagnostics						
Number of observations	2264		2264		2264	
F-test			14.1	***	17.0	***
Wald test	261	***				
R-sq.	0.21		0.22		0.10	
Year dummies	Yes		Yes		Yes	

Note: * significant at 10%; ** significant at 5%, *** significant at 1%.

Source: Authors, based on BankScope and annual reports data

2.5.3 Results summary

Broadly speaking, the outcomes of our models showed the poor performance of Czech credit unions both in terms of profitability and stability measures. We found that Czech cooperatives are less profitable than other European cooperative banks in terms of ROAA and ROAE. The difference in NIM was statistically insignificant which is surprising, especially given the criticism of high delinquency and the riskiness of credit unions' loan portfolios (Matejašák and Teplý, 2013; ČNB, 2014). Nevertheless, Figure 2.1 shows that the NIM of big Czech credit unions is higher than average and their business model can be considered more risky. Another problem is the very low stability of Czech credit unions compared to European ones. Moreover, Figure 2.3 in Appendix depicts the decreasing trend of Z-Score for Czech credit unions which is striking, especially for bigger institutions. Another important fact is that Czech credit unions are relatively small in size and their capital stock in absolute value is, together with their risky asset portfolio, a highly risky combination and it may be one of the reasons why larger Czech credit unions are currently under such pressure.

Table 2.5 shows that our results are often in line with other studies focused on the stability of cooperative banks, especially with Hesse and Čihák (2007) and with Köhler (2012). We find only partial consensus with other surveyed studies. Variable which shows the different sign in our model than in other studies is GDP growth in profitability regressions - we estimated no statistically significant effect but the results of others (Iannotta et al., 2007; Beckmann, 2007) were positive. This may be caused by different time periods included in the dataset (this study's dataset is affected by current economic crisis whereas surveyed works are from pre-crisis times of moderate GDP growth). Otherwise, we see no clear contradiction to surveyed studies.

Table 2.5: Results comparison with existing literature

Dependent var.	Profitability			Stability		
	Sign	In line	Against	Sign	In line	Against
Growth of assets	0			-/0	- Beck et al. (2009) - Köhler (2012)	
Liquidity	-		0 Iannotta et al. (2006)	0	Iannotta et al. (2006) 0/+ Köhler (2012)	
Loans to dep. ratio	+			+		0 Köhler (2012)
Share of loans	-			0	Hesse and Čihák (2007) Köhler (2012)	+ Iannotta et al. (2006)
Market concentr.	0	Beckmann (2007)	- Goddard et al. (2010)	0		+ Beck et al. (2009)
GDP growth	0		+ Iannotta et al. (2006) + Beckmann (2007)	0	Iannotta et al. (2006) Hesse and Čihák (2007) Köhler (2012)	
Unemployment	-			-		
Inflation	0			-	-/0 Hesse and Čihák (2007)	+ Beck et al. (2009)

Source: Authors, based on cited papers

2.5.4 Further research opportunities

There are several ways to improve our research results, though they are robust. First, a comparative analysis of performance of Czech credit unions with credit unions from other new EU countries with primary focus on impact of different legislative and regulatory frameworks may be undertaken. For instance, the impact of the Basel III regulatory framework on EU credit unions may be analyzed as examined for the whole EU banking industry by Šútorová and Teplý (2013, 2014). Such an international comparison would shed more light on effects on cooperative practices advised by the WOCCU. In this case, a problem discussed earlier would be the poor data availability, however. Second, one may test effectiveness of new Czech credit union regulation which came into force in 2015 and focused on promoting the cooperative spirit among members to see whether new legislation changed behavior of Czech credit unions and their members. Third, to verify the outcomes of this paper, a study using different methodological approach or alternative proxies for financial performance measures is also more than welcome. Distinct performance measures such as economic value added, cost to income ratio or loan portfolio quality may be tested as dependent variables.

2.6 Conclusion

This paper empirically investigated the performance of Czech credit unions in relation with other European cooperative banks. We aimed to statistically confirm poor stability and profitability of Czech credit unions as suggested by previous researches. To do that, we created a unique dataset of 283 European cooperative banks spanning the 2006 – 2013 period. Because numerous recent studies pointed at the persistency of profitability and stability measures, we decided to employ dynamic panel data methods (system GMM) where applicable as a main econometric tool. Profitability was measured in terms of ROAA, ROAE and NIM, while Z-Score was used as stability measure.

Our results reveal the poor performance of Czech credit unions which were outperformed by other European cooperative banks in ROAA and ROAE, clearly showing the lower profitability of Czech credit union sector. We found no difference in NIM for Czech cooperatives. Moreover, Czech credit cooperatives also suffer from lower stability. Especially striking is the adverse development in Z-Score of Czech credit unions which was not observed in other countries. Signs of dependent variables used in our models are in line with findings of Hesse and Čihák (2007) whereas we

find only partial consensus with other surveyed studies. This is not surprising since these studies often draw contradictory conclusions.

In conclusion, a dangerous mix of low profitability, instability and the pseudo-cooperative nature of Czech credit unions result in a high risk profile of these institutions. Therefore we argue that with recent capital management policies, bigger Czech credit unions will likely face serious financial problems in coming years.

2.7 Reference list

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2.8 Appendix

Figure 2.3: Z-Score dynamics of Czech credit unions, 2006-2013
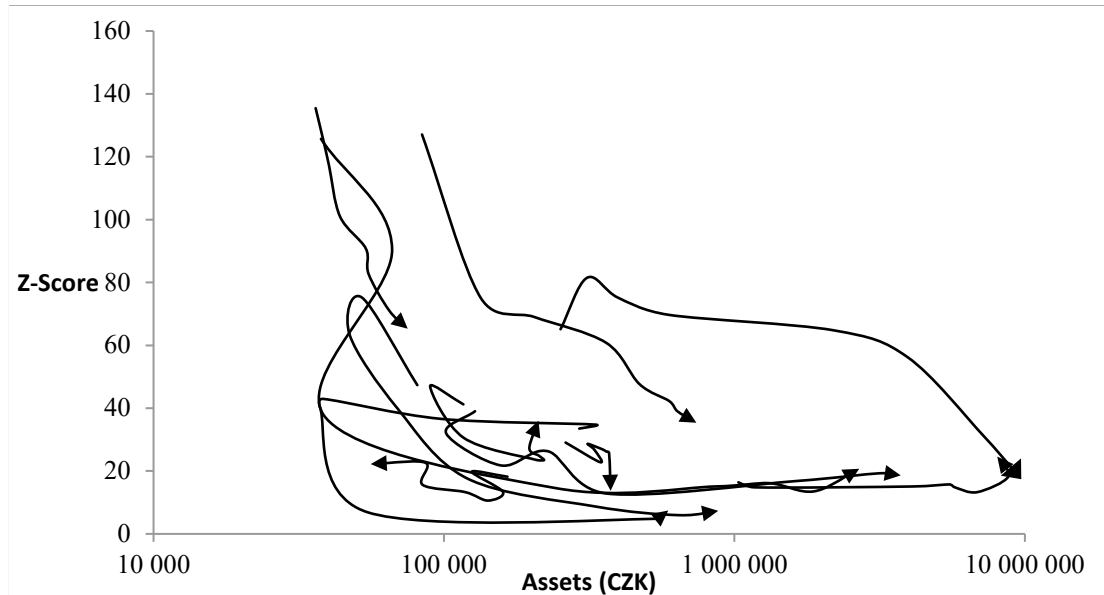
Note: arrows show time development of individual institutions

Source: Authors, based on BankScope and annual reports data

Figure 2.4: Z-Score dynamics of European cooperative banks, 2006-2013
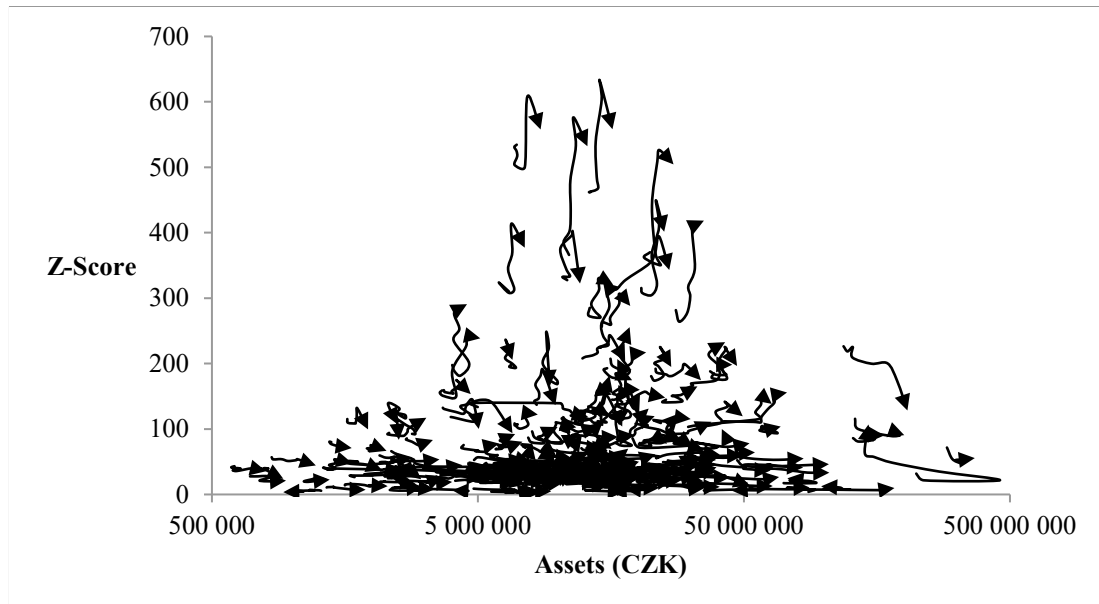
Note: arrows show time development of individual institutions

Source: Authors, based on BankScope and annual reports data

Table 2.6: Descriptive statistics

Variable		Minimum	1st quartile	Median	3rd quartile	Maximum
ROAA [%]	CZ	-7,0	0,0	0,3	0,9	3,8
	EU	-10,2	0,2	0,3	0,6	4,3
ROAE [%]	CZ	-36,9	0,1	1,6	5,2	24,0
	EU	-70,5	2,8	4,2	6,4	37,2
NIM [%]	CZ	-0,7	0,9	1,8	2,8	7,3
	EU	0,2	1,5	1,7	2,0	4,9
ZSCORE	CZ	4,7	16,3	26,9	51,0	136,5
	EU	1,1	28,6	45,1	90,7	632,4
ln_As	CZ	10	12	13	14	16
	EU	13	16	16	17	25
gr_As [%]	CZ	-68	0	12	54	567
	EU	-38	0	3	7	81
CAR [%]	CZ	3,3	12,8	18,9	31,8	100,3
	EU	2,2	6,3	7,9	9,9	41,6
Liquidity [%]	CZ	0,4	19,4	37,8	70,0	100,0
	EU	3,1	25,0	35,3	45,4	99,8
LtD [%]	CZ	0	37	76	112	5838
	EU	9	70	88	129	2542
LoansRatio [%]	CZ	0	29	59	77	100
	EU	0	52	62	72	93
CostIncome [%]	CZ	0	73	83	95	431
	EU	19	61	67	74	500
FeeRatio [%]	CZ	-591	0	3	17	191
	EU	-100	22	28	34	180
HHI	CZ	0,10	0,10	0,10	0,11	0,11
	EU	0,02	0,02	0,03	0,04	0,37
GDPgr [%]	CZ	-4,8	-0,7	2,2	3,4	6,9
	EU	-14,7	0,4	1,7	3,6	10,4
Unemployment [%]	CZ	4,4	6,4	6,9	7,0	7,3
	EU	3,4	6,1	7,4	8,4	24,5
Inflation [%]	CZ	0,6	1,4	2,1	3,1	6,3
	EU	0,0	1,6	2,1	2,7	12,0
InterestRate [%]	CZ	2,1	3,5	3,8	4,4	4,8
	EU	1,4	3,1	4,0	4,3	22,5

Source: Authors

Table 2.7: Correlation matrix

Correlation	ROAA	ROAE	NIM	ZSCORE	ln_As	gr_As	CAR	Liquid.	LtD
ROAA	1								
ROAE	0,82	1							
NIM	0,28	0,16	1						
ZSCORE	-0,06	-0,03	0,02	1					
ln As	-0,03	0,08	-0,29	0,08	1				
gr_As	-0,02	-0,02	-0,08	-0,02	0,11	1			
CAR	0,08	-0,05	0,21	-0,07	-0,45	-0,01	1		
Liquidity	-0,03	0,02	-0,24	0,09	-0,06	-0,04	-0,06	1	
LtD	-0,07	-0,04	0,06	-0,07	-0,09	0,00	0,49	-0,19	1
LoansRatio	0,05	-0,01	0,23	-0,07	0,04	0,04	0,07	-0,09	0,20
CostInc.	-0,39	-0,33	-0,09	-0,04	-0,22	0,01	0,07	-0,05	0,10
FeeRatio	0,05	0,10	-0,16	0,08	0,24	0,07	-0,17	-0,04	-0,02
HHI	-0,02	-0,08	-0,02	-0,20	-0,09	0,06	0,19	-0,14	0,07
GDPgr	0,05	0,07	0,14	0,09	-0,05	0,00	0,02	0,06	-0,01
Unemploy.	-0,19	-0,22	0,06	-0,13	0,03	0,02	-0,04	-0,14	-0,01
Inflation	0,04	-0,02	0,06	-0,13	-0,09	0,01	0,10	-0,12	0,02
InterestRate	-0,06	-0,15	0,10	-0,32	-0,06	0,00	0,12	-0,24	0,12
CZ	0,01	-0,07	0,07	-0,08	-0,51	0,00	0,54	0,12	0,16

Correlation	LoansR.	CostInc.	FeeRatio	HHI	GDPgr	Unemploy.	Inflation	InterestR.	CZ
ROAA									
ROAE									
NIM									
ZSCORE									
ln_As									
gr_As									
CAR									
Liquidity									
LtD									
LoansRatio	1								
CostInc.	0,02	1							
FeeRatio	0,03	-0,07	1						
HHI	0,11	0,08	-0,13	1					
GDPgr	-0,05	0,03	-0,01	0,07	1				
Unemploy.	0,11	0,04	-0,01	0,17	-0,18	1			
Inflation	0,11	0,00	-0,10	0,44	0,34	-0,11	1		
InterestRate	0,22	0,05	-0,07	0,20	-0,11	0,55	0,28	1	
CZ	-0,12	0,20	-0,25	0,19	0,05	-0,10	0,06	0,02	1

Source: Authors

Table 2.8: Profitability regressions robustness check

Lagged dependent var.	FE		GMM		pooled OLS	
ROAA	-0.009		0.101		0.280	***
	(0.027)		(0.068)		(0.023)	
ROAE	0.053	*	0.326	***	0.364	***
	(0.029)		(0.698)		(0.024)	
NIM	0.298	***	0,310	**	0.682	***
	(0.027)		(0.144)		(0.017)	

Significance codes: *** = 0.01, ** = 0.05,* = 0.1

Source: Authors

3 Are European Commercial Banks more Profitable than Cooperative Banks? Evidence from a Low Interest Rate Environment

Abstract

Our aim is to compare empirically the profitability of European cooperative and commercial banks in a low interest rate environment. We employ dynamic panel data methods on a data set of nearly 1,000 banks from 11 European countries where both ownership structures compete on the same market. We observed different banking strategies during the 2009-2015 period, when market interest rates reached an all-time low. Our analysis produced four main conclusions. Firstly, we find that commercial banks maintain superior profitability over cooperative banks in an environment of low interest rates. Secondly, commercial banks decreased their loan loss provisioning in a low interest rate environment in order to maintain their profitability. This trend is not present in cooperative banks. Thirdly, decreased provisioning is present mainly in smaller institutions. Fourthly, cooperative banks are significantly more stable than commercial banks in terms of their Z-score in a low interest rate environment. This finding is in line with existing findings during normal interest rates. In addition, the Z-score of cooperative banks increased during the observation period, whereas the Z-score of commercial banks remained stable. Our findings survive a battery of robustness checks. Our results also show differences in the strategies and priorities of both competing ownership types in a low interest rate environment: commercial banks focus on maintaining their profitability by decreasing loan loss provisions, whereas cooperative banks seek to

increase their stability. Therefore, regulators pursuing stability in a low interest rate environment should focus on the credit risk management of small commercial banks.

3.1 Introduction

Our motivation is to assess empirically the performance of European cooperatives and commercial banks in the current environment of low interest rates. We have found a gap in the literature, because, to the best of our knowledge, no researcher has yet examined the relative performance of European commercial and cooperative banks in a low interest rate environment. We aim to reveal the priorities of both competing ownership types regarding their profitability and stability measures on low interest rate markets and compare them with the existing literature focused on a standard interest rate environment.

Cooperative ownership is the second-most widespread banking ownership type in the European Union, with an average market share of approximately 20% (Liikanen et al, 2012; EACB, 2019). Interestingly, the cooperative banking model differs significantly from country to country because of the different evolution of the model, as discussed by Ayadi et al. (2010). In some countries there is only one fully integrated cooperative banking institution, while in others there are numerous, more or less cooperating smaller cooperative banks. Cooperatives are controlled by their customers according to the democratic principle of "one member – one vote". Cooperative banks typically also pursue different objectives than only profit maximization, and, therefore, they are occasionally termed dual bottom-line institutions (Hillman & Keim, 2001). The only focus of traditional shareholder-owned commercial banks is profit. This difference in their statement of purpose may induce these banks to implement different strategies in a low interest rate environment. Yet, both schemes compete on the same market and they usually focus on the same customer group.

After the 2008 failure of Lehman Brothers, interest rates decreased sharply. Because of the loose monetary policy of the European Central Bank, there has been an unprecedentedly long period of low interest rates in Europe (Altavilla et al., 2017). The banks are rarely fully hedged against interest rates changes, as shown by Memmel (2008) or Ampudia & Van den Heuvel (2018). Negative rates cause numerous practical problems for banks. On the one hand, it is politically difficult to charge negative interest rates on deposits, while on the other hand, it is legally difficult to apply rate floors to (existing) floating rate loan contracts. In addition,

excess liquidity is stored in the central bank for periods of negligible or even negative interest rates. These factors place pressure on profitability, and thus on the stability of the European banking sector (Claessens et al., 2017). In this paper, we also focus on the effect of a low interest rate environment on loan loss provisioning. Non-performing loans are of key interest to both policymakers (European Commission, 2019) and regulators (EBA, 2018; ECB, 2019).

The contribution of this paper is the discovery that smaller commercial banks in particular try to maintain their profitability in a low interest rate environment by using a risky strategy of insufficient loan loss provisioning, whereas cooperative banks focus on increasing stability. The greater riskiness of small commercial banks should therefore be reflected in greater attention from the side of the regulators.

The remainder of the paper is structured as follows: Section 3.2 reviews the relevant literature that compares the financial performance of different banking ownership structures and examines the effects of a low interest rate environment on financial institutions. We also identify a gap in the literature and state three hypotheses. Section 3.3 describes the paper's research objective, methodological approach and data used. Section 3.4 presents our empirical results and compares them with the work of other researchers. Finally, we conclude the paper and make a policy recommendation in Section 3.5.

3.2 Literature review

The empirical literature that examines the differences between cooperative and commercial banking under low interest rates is, so far, very limited. The reason is that the low interest rate phenomenon is of very recent origin, and most of the studies are focused solely on commercial banks. We therefore divide this literature review into two parts. The first part addresses comparisons of cooperative and commercial banks' performance in terms of their profitability and stability in the normal interest rate environment. The second part focuses on the impact of low interest rates on the performance of financial institutions. Based on this review, we formulate three research hypotheses.

3.2.1 Cooperative and commercial bank performance comparison under normal interest rates

Cooperative banks are created to maximize the utility of their stakeholders. Profit is often more a necessary prerequisite for survival and expansion than the ultimate objective. Cooperatives are, therefore, not compelled to pursue profit maximization to the same extent that commercial banks are (Fonteyne, 2007). Fama & Jensen (1983) claim that the lack of capital market discipline of mutually owned institutions causes lower efficiency compared to privately owned institutions. Altunbas et al. (2001) demonstrate that this theory does not hold for the profit inefficiency of the different ownership types of German financial institutions between 1989 and 1996. They explain this fact by the fierce competition common to both ownership types. Goddard et al. (2004) analyse data on banks from six major European economies for the period 1992-1998 and find little evidence of a systematic relationship between ownership type and profitability. Iannotta et al. (2007) compare the performance of large European banks over the 1999-2004 period. They find that mutual and government-owned banks have lower profitability than privately owned enterprises. Beckmann (2007) uses a long-term data set (1979-2003) on banks from 16 Western European countries. He finds no difference in ROA between cooperative and commercial banks. Ayadi et al. (2010) compare the profitability of the cooperative and commercial banks from seven EU countries for the time period 2000-2008. The study's results are mixed. In certain setups, the profitability of cooperative banks is higher, while in some it is lower, and in others there is no significant difference.

Groeneveld & de Vries (2009) claim that mutual banks, thanks to their cooperative structure, should be able to maintain long-term customer relationships that are subsequently reflected in more stable capitalization and in smaller credit risk. The authors demonstrate the higher stability of cooperative banks in 7 European countries. Hesse & Čihák (2007) employ the Z-score to evaluate bank soundness. They investigate a data set of more than 16,000 banks from 29 OECD countries over the 1994-2004 period and run an estimation using the OLS and fixed effects methods. The results reveal the higher stability of cooperative banks driven by lower earnings volatility. Ayadi et al. (2010) also use the Z-score as a proxy for banking stability. They find a lower likelihood of cooperative banks becoming insolvent in 5 out of 7

European countries for the 2000-2008 period (there is no statistically significant difference for the other two countries). Köhler (2012) finds no significant difference in the Z-score for cooperative and commercial banks in the EU-15 countries in the 2000-2009 period using dynamic panel data methods (System GMM). Iannota et al. (2007) use three risk measures in their study. An estimation was run on a set of 181 European banks over 1999-2004. The results reveal that cooperative banks have higher asset quality and a lower return to volatility, and that there is no significant difference in the Z-score between commercial and cooperative banks.

3.2.2 Effect of low interest rates on bank performance

Borio & Gambacorta (2017) analysed the effectiveness of monetary policy on lending using a sample of 108 large banks. Their analysis suggests that reductions in short-term interest rates are less effective in stimulating lending growth when rates are already at a low level. Claessens et al. (2017) use a sample of banks from 47 countries to examine the impact of decreasing rates on the net interest margin. The authors demonstrate that the negative impact of decreasing market rates is more than twice as strong if rates are already low. Memmel (2008) evaluates interest rate shocks and finds that the worst possible interest rate scenario for the income of German cooperative banks is a sharp decrease in yield curve steepness. Bikker & Vervliet (2017) use static and dynamic panel data methods to investigate the impact of unusually low interest rates on the profitability and risk profile of US banks. The results indicate that bank interest margins are under pressure, but that overall profit is maintained because of lower loan provisioning. They claim that unreasonably low provisioning may endanger financial stability. Altavilla et al. (2017) arrive at similar outcomes for a set of European banks: a decrease in short-term rates or yield curve flattening is not associated with lower banking profits. This outcome is again caused by lower loan provisioning, which offsets lower interest income. Bank profit is only affected when the low interest rate period is protracted. Brei et al. (2019) study the impact of a low interest rate environment on the intermediation activity of banks from 14 advanced economies. They observe that banks react to lower interest income caused by lower interest rates with a decline in the risk-weighted asset ratio and a reduction in loan loss provisions. This outcome may be a sign of so-called zombie lending (i.e., less-capitalised banks delay credit losses by rolling over loans to risky

borrowers; see Peek & Rosengren, 2005). There is a danger that low interest rates may impact the stability of banks by compelling them to take on excessive leverage and finance lower standard loans, thus weakening their lending portfolios (Dell'Ariccia & Marquez, 2013).

More recently, Hanzlík & Teplý (2020) examined the determinants of the Net Interest Margin of European and US banks and demonstrated that cooperative banks reported consistently lower NIMs than commercial banks in the 2011–2016 period. Ulate (2021) and Claeys (2021) show how negative interest rates harm banks' profitability by decreasing margins. Claeys (2021) find that negative rates could lead to a potential decline in the interest income of banks in the Eurozone because of i) the higher cost of holding excess liquidity for banks and ii) a compression of the spread between credit and deposit rates and a general flattening of the curve. Fernandez-Bollo et al. (2021) conclude that the COVID-19 pandemic has heightened profitability risks in the Eurozone banking sector and coincided with the worse performance of some banks, notably those burdened with the legacy of non-performing loans.

Let us summarize the findings presented in this review; we have found a gap in the literature, because, to the best of our knowledge, no researcher has examined the relative performance of European commercial and cooperative banks in a low interest rate environment before. The results focusing on a profitability comparison of European cooperative and commercial banks prior to the Great Recession are mixed. The outcomes differ according to the analysed data and the method that is adopted. Commercial banks are either shown to be more profitable than cooperative banks, or the results are indecisive in most of the reviewed studies. However, there is quite a strong consensus among the reviewed papers that the cooperative banks in Europe are less likely to become insolvent in a period of normal interest rates. Furthermore, the interest income of banks suffers in a low interest rate environment. Nevertheless, bank profitability remains unchanged thanks to lower loan loss provisioning. This phenomenon, together with the risk of the excessive leverage of banks in an environment of loose monetary conditions, creates pressure on banking stability.

3.2.3 Hypotheses testing

Our research objective is to assess the differences in behaviour and performance between European cooperative and commercial banks in a low interest rate environment. We formulate hypotheses based on the above-mentioned research that will enhance our knowledge about the relative performance of cooperative and commercial banks under low interest rates.

We follow up on studies that empirically compare the profitability of both ownership structures in a standard interest rate environment (Goddard et al., 2004; Iannotta et al., 2007; Beckmann, 2007; Ayadi et al. 2010, Hanzlík & Teplý, 2020) and we test the theoretical arguments for the inferior profitability of cooperatives (Fama & Jensen, 1983; Fonteyne, 2007) under the special circumstances of low interest rates. Therefore, we formulate Hypothesis #1: *Cooperative banks' profitability (in terms of ROAA, ROAE and NIM) in a low interest rate environment is lower than that of commercial banks.*

Bikker & Vervliet (2017), Altavilla et al. (2017) and Brei et al. (2019) claim that banks in a low interest rate environment maintain their profitability thanks to unreasonably low provisioning. Cooperative banks are not under such high pressure to keep their profitability, because they also pursue objectives other than profit maximization and, therefore, they may avoid such dangerous behaviour. Therefore, we state Hypothesis #2: *Cooperative banks' loan loss provisions to total loans ratio in a low interest rate environment is higher than that of commercial banks.*

Groeneveld & de Vries, 2009; Hesse & Čihák, 2007; Ayadi et al., 2010; Köhler, 2012; Iannota et al., 2007 agree on the higher stability of cooperative banks in a standard interest rate environment. We believe that this will be confirmed under low interest rates too, and therefore we formulate Hypothesis #3: *Cooperative banks' stability (in terms of Z-Score) in a low interest rate environment is higher than that of commercial banks.*

3.3 Methodology and variable selection

3.3.1 Methodology

We examine the effects of a low interest rate environment on a set of the profitability and stability measures of cooperative and commercial banks. There is extensive evidence that banking profitability and stability measures are persistent because of intertemporal performance smoothing, long-term client relationships and regulation (Shehzad et al., 2009; Delis & Kouretas, 2011 or Kuc & Teplý, 2018). We use System GMM to address the inconsistency caused by the correlation of a lagged dependent variable with an error term (i.e., dynamic panel data bias). The System GMM method is described in Arellano & Bover (1995) and Blundell & Bond (1998). System GMM addresses endogeneity and generates more robust estimates when dealing with persistent variables. We cannot use the Difference GMM method (Arellano & Bond, 1991) in our analysis, because it does not allow for time-invariant variables, and therefore does not allow us to use a dummy for ownership type, which is crucial for our research. Arellano & Bond (1991) demonstrate that standard errors suffer from downward bias during a two-step estimation because of the inclusion of too many instruments. We therefore use Windmeijer's (2005) correction. Moulton (1986) demonstrates that standard errors may overstate estimator precision when data are grouped in clusters, e.g., by country. Therefore, we use cluster-robust standard errors clustered on the country level, as in Cameron & Miller (2015). We estimate the model of the following form:

$$Y_{i,c,t} = \alpha + \beta Y_{i,c,t-1} + \gamma Coop_i + \delta B_{i,c,t} + \epsilon C_{c,t} + \theta T_t + \varepsilon_{i,c,t} \tag{3.1}$$

where

$Y_{i,c,t}$ is the bank performance measure for bank i in country c at time t,

$Y_{i,c,t-1}$ is the first lag of the bank performance measure,

$Coop_i$ is a dummy for a cooperative bank,

B is a vector of bank-specific variables,

$C_{c,t}$ is a vector of country-specific variables,

T_t is a vector of time-dummy variables for individual years,

$\varepsilon_{i,c,t}$ stands for error term.

3.3.2 Variable selection

We select the variables based on the existing empirical literature focused on banking profitability and stability, including Hesse & Čihák (2007), Iannotta et al. (2007), Ayadi et al. (2010) and Altavilla et al. (2017). This is helpful, because we can subsequently compare our results with existing findings (valid in a standard interest rate environment). We use 5 bank performance measures, 3 bank specific variables, and 5 country-specific variables to control for different characteristics in individual countries, a dummy variable to distinguish cooperative banks, and time-dummy variables for individual years to control for time specific effects such as common shocks or a change in legislation, as advised by Roodman (2006) and Köhler (2012). A description of the variables is provided in Table 3.1.

Table 3.1: Variables description

Return on average assets	ROAA	Commonly used measure showing the profitability of assets. Assets are averaged to give a more precise picture when an institution's size is changing.
Return on average equity	ROAE	Commonly used measure showing the profitability of equity. Equity is averaged to give a more precise picture when an institution's equity is changing.
Net interest margin	NIM	Commonly used profitability measure comparing interest generated and paid out. Computed as net interest income over average interest-earning assets.

Loan loss provisions to total loans ratio	Provisions	This is a proxy for asset quality (or a credit risk measure). Typically, the higher the Provisions, the higher the credit risk is. But a suspiciously low share of loan loss provisions indicates dangerous window dressing.
Z-score	ZSCORE	The Z-score is a stability measure. It indicates the distance to the upper bound of insolvency, or how many standard deviations of net income the company has to lose (assuming a normal distribution of incomes) to deplete its equity, and, therefore, the higher the Z-Score, the more stable the bank is. We use the Z-Score definition by Hesse & Čihák (2007). The higher the Z-score, the less likely that the bank will face financial problems.
Cooperative dummy	Coop	The dummy variable Coop distinguishes cooperative (1) from commercial banks (0).
The natural logarithm of asset size	Size	A commonly used proxy for bank size. Bigger banks may realize more return to scale. Transformation by natural logarithm is used to smooth out large differences in the size of banks.
Loan to deposit ratio	LtD	Reveals possible liquidity problems or inability to transfer deposits into loans. Extreme values also indicate that the bank is not following the traditional deposit taking and loan granting model.
Share of non-interest income to total income	IncDiv	A proxy for income diversity. Multiple income sources are likely to decrease income volatility.

GDP per capita in EUR ths.	GDPl	Control variable for the development level of a country.
Real GDP growth rate	GDPg	Control variable for the phase of the economic cycle.
Average one-month money market rate	IBOR	This is a proxy for short-term market rates that affect profitability. The higher the IBOR rate, the higher the profitability that can be expected.
Average yield curve steepness	Steep	The difference between the 10-year interest rate swap rate and the 1-month money market rate. This measure shows the difference in short-term and long-term market rates. Banks may take advantage of maturity transformation, but they should take into account interest-rate risk.
Average 10-year government bond yield	Bond	A proxy for alternative investment opportunity and the risk level of a given government. Investments in government bonds with higher yields bring more profit but also more risk into portfolio.
Time-dummy variables	y2010-y2015	Dummy variables for individual years to control for time specific effects. They are equal to 1 when observation is from a given year. Y2009 is dropped to avoid collinearity.

3.3.3 Data selection

We created a data set of 973 banks, 739 of which have cooperative ownership and 234 of which are commercial banks. The banks are from 11 European countries. In

our data set, we included all the banks that meet the rules described in the following paragraphs.

We use the BankScope database as the main source of banking data. We include banks from all European countries where at least one commercial and one cooperative bank was active during the whole observation period. Cooperative banking is not that widespread in Eastern Europe and, additionally, data availability in those countries is typically much lower. Our data set therefore comprises mainly Western European countries. We select only banks with all the figures needed to estimate Equation (3.1). Our data set is balanced. We employ unconsolidated financial statements, only using consolidated financial statements when there are no unconsolidated statements available for a given entity. This approach helps to avoid the double-counting of banks and is also used by Hesse & Čihák (2007).

This study focuses on European banking performance in a low interest rate environment. We define *the low interest rate environment* with the help of short-term money market rates (IBORs). As we have banks from the Eurozone and Denmark in our data set, we use 1M Euribor and 1M DKK Libor. The development of the yearly averages of the 1M Euribor rate is presented in Figure 3.1. For the sake of brevity, we do not describe the development of 1M DKK Libor – it presents a similar picture. One can clearly observe that the short-term market rates have been abnormally low since 2009. The reason is, of course, the reaction of the market to the recession following the Lehman Brothers failure. The latest year available in the Bankscope database is 2015. We therefore define the 2009-2015 period as a low interest rate environment. Our data set covers exactly this 6-year period. The observations have annual frequency, because the data availability of quarterly results is much worse. The Eurostat database is the source of the GDP measures, and the information regarding interest rates was retrieved from the Eikon Reuters database.

Figure 3.1: 1M Euribor rate in 2000-2015
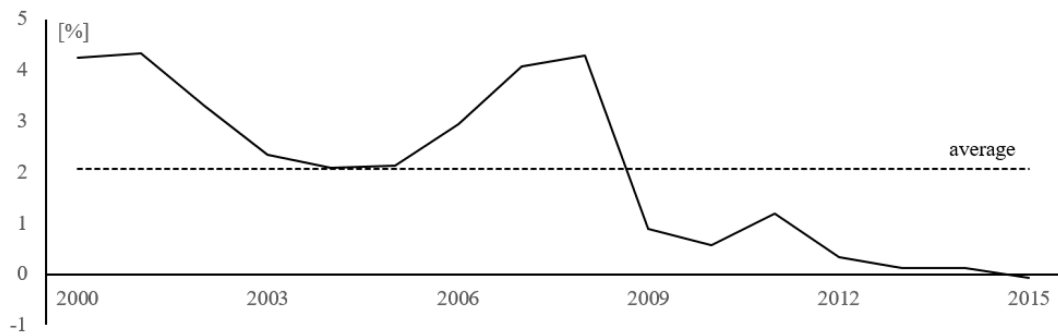
Source: own research

3.3.4 Data analysis

Table 2.1 presents the number of banks by country and ownership type. Cooperative banking institutions in certain countries merge into single entities, whereas in other countries, the organizational setup of multiple, more or less interconnected cooperative banks remains. German and Italian banks form a significant share of the whole sample, because local cooperative banks tend to be small, operating on a limited regional scale. We therefore performed a robustness check and ran a regression analysis, where we randomly deleted 75% of the cooperative banks from those two countries to get a more balanced country distribution. The regression results did not differ significantly from the results using the full scale dataset and, therefore, we decided to keep the whole dataset.

Table 3.2: Banks in the data set by country

Country	Cooperative	Commercial	Total	Country	Cooperative	Commercial	Total
Austria	61	20	81	Luxembourg	1	9	10
Denmark	2	22	24	Netherlands	1	5	6
Finland	1	3	4	Portugal	3	7	10
France	43	49	92	Slovenia	1	8	9
Germany	379	49	428	Spain	57	24	81
Italy	190	38	228	**Total**	**739**	**234**	**973**

Source: Authors' calculation

Table 3.3 provides descriptive statistics for the variables. We can observe significant differences in average values and standard deviations between both ownership types in certain measures. The Z-score of cooperative banks is more than twice as large as the commercial average. This difference is caused by the denominator of the Z-score measure. The income volatility of cooperative banks is on average significantly lower than that of commercial banks. The nominator of the Z-score (i.e., return on assets + equity to assets) of both ownership types is similar.

Table 3.3: Descriptive statistics

	Cooperative					Commercial				
	Min	Median	Average	Max	St. dev.	Min	Median	Average	Max	St. dev.
ROAA	-7.64	0.28	0.28	3.82	0.44	-13.5	0.39	0.37	21.9	1.25
ROAE	-205	3.46	3.29	63.4	6.67	-168	5.44	4.31	71.9	15.6
NIM	-0.41	2.40	2.37	12.5	0.63	-0.32	1.93	2.12	17.8	1.33
ZSCORE (tr. 325)	-1.08	49.5	86.3	326	90.4	-1.50	21.2	34.0	325	44.7
ZSCORE	-1.08	49.5	103	3142	171	-1.50	21.19	41.4	2105	124
Provisions	-8.22	0.44	0.60	14.3	1.20	-232	0.54	0.67	145	9.03
Size	16.7	20.2	20.4	28.3	1.53	18.6	21.9	22.4	28.4	2.14
LtD (tr. 1000)	16.1	91.0	109	500	58.3	0.51	116.2	139	1000	108
LtD	16.1	91.0	109	619	58.6	0.51	116	723	196230	7297
IncDiv	-50.0	22.7	23.2	100	8.26	-92.2	30.2	32.6	106	20.3

GDPl	15.6	30.5	30.0	77.4	4.85	15.6	29.10	30.4	77.4	9.41
GDPg	-8.30	0.60	0.30	4.90	2.78	-8.30	0.70	0.23	4.90	2.54
Ibor	-0.24	0.33	0.45	2.13	0.42	-0.24	0.33	0.47	2.13	0.47
Steep	0.95	1.77	1.81	2.65	0.55	0.95	1.77	1.81	2.65	0.53
Bond	0.69	3.60	3.12	4.34	1.04	0.69	3.60	3.02	4.34	1.08

Source: Authors' calculation

To ensure that our results are not affected by outliers caused by extremely small income volatility in the Z-score denominator, we truncate the Z-score at the maximal value of 325. This truncation affects approximately 5% of the population. Similarly, we truncate the loan to deposit ratio at the level of 1,000% (10x more loans than deposits). This truncation affects approximately 1% of the data. To observe the difference, we run the regression analysis for both the truncated and non-truncated data. The loan to deposit ratio is another measure that exhibits a significant difference between cooperative and commercial banks. If we filter out the extreme values using the described truncation approach, we observe that commercial banks have on average a 30% higher share of loans to deposits. This phenomenon is caused by the fact that commercial banks typically have access to much broader means of financing, whereas cooperatives typically rely primarily on customer deposits.

Figure 3.2 presents the development of the dependent variables. We observe a similar pattern for both ROAA and ROAE: commercial banks outperform cooperative banks in most years. The difference between the NIM of both ownership types is decreasing, but the cooperatives retain their lead. The average share of provisions of commercial banks decreases significantly over time. Several papers presented in the literature review (Bikker & Vervliet, 2017; Altavilla et al., 2017; Brei et al., 2019) produce the same finding. Interestingly, this does not hold for cooperative banks, in which the share of loan loss provisions is maintained nearly constant. This development may indicate that commercial banks are under greater pressure from shareholders to maintain their profitability, and, therefore, they seek to do so via lower loan provisioning. The average Z-Score of the cooperative banks increased much faster than the commercial banks' average thanks to an increased share of equity relative to total balance sheet size. This outcome indicates that cooperative

banks are focused on increasing stability (deleveraging) rather than maintaining profitability.

Figure 3.2: Development of dependent variables in 2009-2015
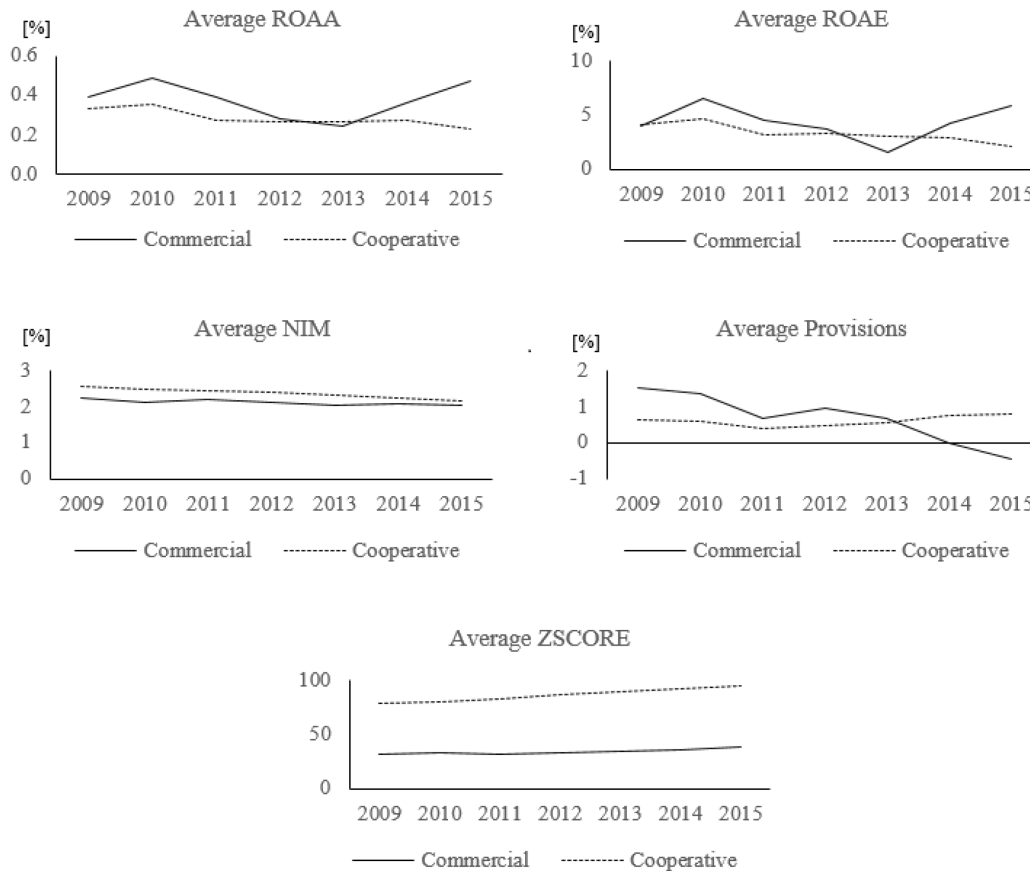
Source: own research

To complete the data analysis, Table 3.5 in the Appendix provides a correlation matrix. The high positive correlation between ROAA and ROAE is not a surprise. Similarly, one expects a high degree of correlation between market measures: the one-month money market rate (IBOR), the yield curve steepness (Steep) and the yield of a 10-year government bond (Bond). To address a possible multicollinearity issue, we run a regression with one market measure only (IBOR), leaving out *Steep* and *Bond* variables. The results of the model with only *Ibor* are essentially the same as those with all the variables included. Although these three market variables are not

key parameters in our regression, we are still interested in their estimation, so we decided to keep them in our model.

3.4 Results and discussion

3.4.1 Baseline results and discussion

Table 3.4 presents the results of the regression Equation (3.1) with truncated data. Let us first focus on the series of tests that assure the correctness of the selected approach. The Wald test results strongly reject the joint insignificance of all the variables used. The Arellano-Bond AR(1) tests reject no serial correlation of the first order except in the *Provisions* regression. However, in the *Provisions* regression, the lagged dependent variable is highly significant, and, therefore, we continue to use System GMM with one lag. The tests do not reject the hypothesis that there is no second-order autocorrelation in residuals, and, therefore, we do not include the second lag in our regressions. The Hansen tests do not reject the hypothesis that all instruments are valid. Furthermore, we perform a robustness check for GMM by Bond (2002). The test suggests using OLS and FE estimates, which should suffer from dynamic panel data bias, and, therefore, lagged dependent variables should be biased towards opposite sides (the test results are provided in Table 3.6 in the Appendix). Our results are in line with expectations regarding GMM and OLS estimates. For the FE estimation, we must omit the cooperative dummy variable, and, therefore, the results are not comparable. The lagged dependent variables in our estimations are either significantly positive or insignificant, which is in line with the dynamic panel data structure.

Table 3.4: Regression analysis results

	ROAA			ROAE			NIM			Provisions			ZSCORE		
	Coef.	St. er.	Sig.	Coef.	St. er.	Sig	Coef.	St. er.	Sig.	Coef.	St. er.	Sig.	Coef.	St. er.	Sig.
lag	0.040	0.059		0.163	0.070	**	-0.110	0.082		0.534	0.202	***	0.273	0.072	***
Coop	-3.212	1.135	***	-22.25	9.738	**	-4.119	1.734	**	99.79	29.03	***	108.8	49.47	**
Size	-1.081	0.516	**	-5.603	3.014	*	-0.434	0.198	**	36.60	13.58	***	7.971	5.130	
LtD	0.000	0.005		-0.070	0.049		0.002	0.002		0.015	0.085		-0.028	0.058	
IncDiv	-0.099	0.017	***	-0.810	0.381	**	-0.109	0.009	***	2.546	1.155	**	-1.166	0.441	***
GDPl	0.003	0.018		0.007	0.128		0.006	0.027		5.517	2.691	**	2.758	1.627	*
GDPg	0.014	0.089		-0.818	0.928		0.068	0.031	**	6.509	9.045		2.012	1.758	
Ibor	10.99	7.509		63.87	64.36		7.261	11.72		-31.68	174.6		-9.912	260.8	
Steep	19.76	8.908	**	117.6	73.32		5.076	11.73		18.56	199.4		-14.77	292.5	
Bond	1.453	3.013		0.333	8.470		5.012	2.573	*	0.823	12.51		-3.709	61.19	
cons	-39.94	40.60		-209.8	282.8		-21.57	45.89		-1042	789.0		-135.6	962.5	
Year dummy	Yes			Yes			Yes			Yes			Yes		
Wald test	0.000	***		0.000	***		0.000	***		0.000	***		0.000	***	
AR(1) test	0.021	**		0.004	***		0.048	**		0.338			0.002	***	
AR(2) test	0.677			0.247			0.084	*		0.434			0.262		
Hansen test	0.098	*		0.205			0.981			0.651			0.299		
observations	6811			6811			6811			6811			6811		

*Note: * significant at 10% level, ** significant at 5% level, *** significant at 1% level*

Source: Authors' calculation

In the following paragraphs, we analyze the estimation results in order to reject or not to reject the three hypotheses tested in this paper, and we also compare our results with those of other researchers.

Hypothesis #1 (lower profitability of cooperative banks) – not rejected: Our results reveal that cooperative banks (*Coop*) are less profitable in all three profitability measures (ROAA, ROAE and NIM) in a low interest rate environment. Our analysis therefore shows that low interest rates do not affect the relative profitability of cooperative and commercial banks. This is in line with the existing literature in a normal interest rate environment, which suggests that cooperative banks are less

profitable (Fama & Jensen, 1983; Iannotta et al., 2007; Fonteyne, 2007). Nevertheless, some papers have shown that the profitability difference is insignificant (Altunbas et al., 2001; Goddard et al., 2004; Beckmann, 2007; Ayadi et al., 2010. Hanzlík & Teplý, 2020). Our findings extended existing knowledge in the case of a low interest rate environment. The results are, of course, dependent on the selected data and methodological approach.

Hypothesis #2 (higher provisioning of cooperative banks) – not rejected: Cooperatives have a significantly higher share of loan loss provisions to total loans (*Provisions*). This is a sign of the effort by commercial banks to maintain their profitability through lower provisioning in a low interest rate environment, as suggested by the findings in our literature review (Bikker & Vervliet, 2017; Altavilla et al., 2017 and Brei et al.,2019). This is supported by Figure 2, which shows stable *Provisions* of cooperative banks but decreasing Provisions of commercial banks over time (and with decreasing interest rates). There is statistical evidence that loan loss provisions should, on the other hand, increase typically in periods of economic slowdown such as our observation period (see e.g. Laeven & Huizinga, 2019). We also show that smaller institutions keep higher profitability in a low interest rate environment, which is also a finding of Bikker & Vervliet (2017). The reason may be that the market regulators pay less attention to their credit risk practices, because they tend to focus on the big players. Our results show that regulators should pay more attention to institutions of a smaller size and to commercial banks, because we demonstrate that cooperative banks maintain their provisioning even in a low interest rate period.

Hypothesis #3 (higher stability of cooperative banks) – not rejected: Cooperative banks enjoy much higher stability in terms of their Z-score. Figure 2 shows divergence in this measure too: The Z-score of commercial banks is stable, but that of cooperative banks has a slightly increasing trend, mainly thanks to increasing capital buffers. Our evidence of the superior stability of cooperative banks is in line with the literature which analyzed the stability of both banking ownership schemes under normal interest rates, that is Hesse & Čihák (2007), Groeneveld & de Vries (2009) and Ayadi et al. (2010), whereas Iannota et al. (2007) and Köhler (2012) find no

significant difference between the financial stability of both groups in a normal interest rate environment.

Based on the results of our hypotheses and on comparisons made with existing literature, we may conclude that in a low interest rate environment, commercial banks focus on maintaining short-term profitability, but cooperative banks focus on increasing their stability.

Besides the tested hypotheses, our results reveal further interesting findings. Firstly, the logarithm of asset size (*Size*) has a negative effect on banking profitability and, at the same time, a positive effect on the level of *Provisions*. The literature suggests that, in a low interest rate environment, banks are able to maintain their profitability because of unreasonably low provisioning (Bikker & Vervliet, 2017; Altavilla et al., 2017). The explanation of the positive effect of bank size on *Provisions* may be that large financial institutions are under higher pressure from regulators and, therefore, they are not able to pursue the strategy of decreased provisioning to keep their profits. Nevertheless, conclusion on unjustifiably low provisioning of large banks needs empirical support and it is a hypothesis worth of further research.

Secondly, a higher share of non-interest income to total income (*IncDiv*) also has a negative effect on the profitability of the banks. The reason may be that non-interest income is comprised of fees and commissions and trading income. Banking trading income decreased significantly because of a change in management appetite and also because of the stricter regulation that followed the Great Recession. Banking fees connected to transactions were hit by the newly introduced regulation, and traditional banks were also put under pressure from new market entrants such as neo banks and fin-tech companies, which have, typically, very low fees, and, therefore, banks which are more focused on non-interest income suffer from a higher profitability hit in this analysis. Banks with more diversified income also have higher provisions. The explanation here is that riskier loans (such as consumer lending) traditionally earn higher fees and, therefore, it is no surprise that riskier loan portfolios create higher provisioning in a low interest rate environment. We may expect lower stability (in terms of the Z-score) induced by higher income diversity for the same reason. Similar results can also be found in Hesse & Čihák (2007), who run their analysis in a normal market rate environment.

Finally, the loan to deposit ratio (*LtD*) does not have a significant effect on the bank performance indicators in our study. Similarly, macroeconomic and market variables have a limited impact on bank performance measures. The reason is probably the relative stability of the rates during the selected time frame, because we ran our analysis on a time period when interest rates were already low.

3.4.2 Further robustness checks

Besides the above-mentioned robustness checks connected to the correct application of System GMM and running the analysis on a data sub-sample without randomly deleted banks from countries with high representation in our sample, we also ran all the regressions with non-truncated data. The estimation results are provided in Table 3.7 in the Appendix. They are essentially similar to the truncated results. The cooperative dummy, our main variable of interest, is again significant in all the regressions, and the effect has the same direction it had when the truncated data were used.

3.4.3 Limitations and further research opportunities

We see three possible opportunities that can stem from this analysis. Firstly, there is a possibility to compare our results from the European market with markets that are currently also in a situation of extraordinarily low interest rates, such as the US or Japan. Secondly, a similar analysis could be run using different performance and competitiveness measures, such as cost or profit efficiency. Thirdly, another analysis could also cover other banking ownership models, such as publicly owned banks.

3.5 Conclusion

This paper investigated the competitiveness of European cooperative and commercial banks in a low interest rate environment. We performed the analysis using dynamic panel data methods (System GMM) on a data set of nearly 1,000 banks from 11 European countries where both ownership models are present for the 2009-2015 period. Our contribution is four-fold; Firstly, we show that European commercial banks are more profitable in a low interest rate environment in terms of ROAA, ROAE and NIM. This finding is in line with existing findings in a normal interest

rate environment. Secondly, the loan loss provision creation of commercial banks is significantly smaller than that of cooperative banks. The provisioning of cooperative banks is stable during the observation period, but the provisioning of commercial banks decreased significantly. The decrease in the provisioning of commercial banks is probably attributable to pressure from shareholders to maintain short-term profitability. The important finding of this work is that cooperative banks do not pursue a strategy of decreased provisioning to maintain their profits in a low interest rate environment. Thirdly, the results show that smaller banks were able to decrease provisioning, possibly because of less attention from the regulators. The profitability of smaller banks also surpassed that of the larger ones. Fourthly, the stability of cooperative banks expressed in terms of the Z-score is significantly higher compared to that of commercial banks. This is, once again, in line with the existing findings in a normal interest rate environment. In addition, the difference in the Z-score of both ownership structures increases over time.

The practical implication of the above-mentioned findings is that regulators should focus on the dangerous credit risk practices present among the commercial practices of smaller commercial banks in a low interest rate environment. Shareholders should also be aware that keeping the banks' short-term profitability high in such an environment comes at the cost of increased risk. From a theoretical standpoint, our analysis extended the existing literature on cooperative and commercial banks' performance comparison to cover an environment of low interest rates, showing that European commercial banks focus on maintaining their profitability using a strategy of low loan provisioning. This strategy is used mainly by smaller institutions. On the other hand, cooperative banks in a low interest rate environment focus on increasing their stability via higher capital buffers.

3.6 Data availability statement

The data that support the findings of this study are available from BankScope Bureau van Dijk Electronic Publishing. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of BankScope Bureau van Dijk Electronic Publishing.

Bureau van Dijk; 2016; Bankscope; Update number 313.2, Software version 65.00; Software © 2016 Bureau van Dijk Electronic Publishing, Database © 2016 Fitch Solutions

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3.8 Appendix

Table 3.5: Correlation matrix

	ROAA	ROAE	NIM	ZSCO.	Provi.	Coop	Size	LtD	IncDiv	GDPl	GDPg	Ibor	Steep	Bond
ROAA	1													
ROAE	0.81	1												
NIM	0.21	0.11	1											
ZSCO.	-0.01	0.00	0.08	1										
Provi.	-0.25	-0.15	0.01	-0.05	1									
Coop	-0.05	-0.05	0.12	0.16	-0.01	1								
Size	0.00	0.04	-0.37	-0.12	0.01	-0.45	1							
LtD	0.03	0.05	0.14	-0.02	0.00	-0.07	0.03	1						
IncDiv	0.00	0.00	-0.37	-0.07	0.04	-0.31	0.25	-0.13	1					
GDPl	0.04	0.05	0.00	0.16	-0.08	-0.03	0.04	0.02	0.02	1				
GDPg	0.04	0.05	-0.01	0.11	-0.05	0.01	0.00	0.01	0.02	0.34	1			
Ibor	0.02	0.03	0.12	-0.05	0.01	-0.02	-0.03	-0.01	-0.06	-0.19	-0.18	1		
Steep	0.05	0.06	0.11	-0.05	0.02	0.00	-0.04	-0.01	-0.05	-0.26	-0.39	0.68	1	
Bond	0.03	0.05	0.08	-0.03	0.00	0.04	-0.04	-0.01	-0.06	-0.22	-0.23	0.81	0.75	1

Source: Authors' calculation

Table 3.6: Robustness check of GMM estimates

	ROAA			ROAE			NIM			ZSCORE			Provisions		
	FE	GMM	OLS	FE	GMM	OLS	FE	GMM	OLS	FE	GMM	OLS	FE	GMM	OLS
Coef.	0.089	0.040	0.406	0.119	0.163	0.443	0.018	-0.110	0.725	0.009	0.273	0.362	0.733	0.534	0.784
St. er.	0.036	0.059	0.059	0.084	0.070	0.065	0.088	0.082	0.068	0.003	0.072	0.067	0.19	0.202	0.235
Sig.	**		***		**	***			***	**	***	***	***	***	***

*Note: * significant at 10% level, ** significant at 5% level, *** significant at 1% level*

Source: Authors' calculation

Table 3.7: Regression analysis results (non-truncated data)

	ROAA			ROAE			NIM			Provisions			ZSCORE		
	Coef.	St. er.	Sig.	Coef.	St. er.	Sig.	Coef.	St. er.	Sig.	Coef.	St. er.	Sig.	Coef.	St. er.	Sig.
lag	0.013	0.058		0.152	0.066	**	-0.130	0.115		0.562	0.175	***	0.335	0.088	***
Coop	-3.036	1.046	***	-22.01	9.479	**	-4.045	1.479	***	93.39	29.06	***	49.26	20.35	**
Size	-1.038	0.440	**	-7.709	3.797	**	-0.413	0.160	***	34.35	13.59	**	-1.388	10.78	
LtD	0.011	0.019		0.092	0.072		-0.003	0.002	**	0.104	0.057	*	0.115	0.511	
IncDiv	-0.097	0.018	***	-0.555	0.566		-0.104	0.011	***	2.427	0.992	**	-0.928	1.024	
GDPl	-0.004	0.019		0.117	0.146		0.009	0.016		4.592	2.687	*	3.284	1.549	**
GDPg	0.061	0.093		-0.469	0.667		0.049	0.028	*	6.088	7.125		3.203	1.191	***
Ibor	13.36	9.148		18.22	81.93		8.095	7.888		-52.13	124.1		110.2	208.2	
Steep	22.54	11.01	**	68.96	95.83		6.55	8.207		-7.915	126.8		148.9	236.9	
Bond	1.631	2.752		-4.095	8.053		5.108	2.805	*	3.640	18.22		-17.49	34.73	
cons	-50.76	43.52		4.905	374.3		-27.07	34.03		-885.5	524.8		-398.0	680.9	
Year dummy	Yes			Yes			Yes			Yes			Yes		
Wald test	0.000	***		0.000	***		0.000	***		0.000	***		0.000	***	
AR(1) test	0.015	**		0.007	***		0.054	*		0.291			0.000	***	
AR(2) test	0.513			0.241			0.055	*		0.435			0.186		
Hansen test	0.111			0.355			0.993			0.761			0.331		
observations	6811			6811			6811			6811			6811		

*Note: * significant at 10% level, ** significant at 5% level, *** significant at 1% level*

Source: Authors' calculation

4 Cost Efficiency, Size and Regulation of European Cooperative Banks

Abstract

We investigate the size–efficiency relation of European cooperative banks during the 2006-2015 period. We employ the Stochastic Frontier Analysis to obtain inefficiency estimates and their determinants on the set of 183 cooperative banks from 12 European countries. Our results show that smaller European cooperative banks are significantly more cost efficient than their bigger peers and that the size-efficiency relation is linear. Inefficiency remained roughly stable during the whole observation period without any substantial changes, not even on country level sub-samples. Our results imply that no consolidation of European cooperative banks induced by thrive for efficiency can be expected in the near future. We conclude that it is more efficient for cooperatives to remain small in size rather than to expand. From a policy perspective, we recommend to reflect the special nature of cooperative banks and allow them to operate on a small scale. Pushing them to grow or merge makes them less efficient and hence increases the risk of financial difficulties.

Keywords: cooperative banking, cost efficiency, regulatory risk, Stochastic Frontier Analysis

JEL classification: D24, D61, E23, G21

4.1 Introduction

Cooperative banks are financial institutions owned by their customers. Every customer (called a member) of a cooperative bank has the same voting power on a general meeting. The ownership model of cooperative banks is originally tailored for relatively small institutions. Nevertheless, cooperative banks have grown over time, some becoming the largest players on the European banking market. The basic cooperative principle of one person - one vote, therefore, leads to much more dispersed ownership compared to commercial banks with shareholder structure. Bigger cooperative institutions may also lose information advantage arising from the proximity of cooperatives to their clients. On the other hand, bigger financial institutions are able to use economies of scale and may use advantages arising from higher diversification.

This paper examines the relationship between the size and efficiency of European cooperative banks. Our hypothesis is that bigger cooperative banks are less cost efficient than smaller ones. To do that, we use efficient frontier analysis. Specifically, we employ Stochastic Frontier Analysis (SFA) on the set of almost two hundred cooperative banks from 12 European countries between the years 2006 and 2015.

The outcome of the analysis shows whether it is more efficient for a cooperative bank to be bigger, or whether the setup of multiple small cooperatives is optimal. Efficiency is one of the key factors implying possible consolidation of the cooperative banking market and the financial stability of its participants. We also test whether there is a change in the inefficiency-size relation over time. Another value added of this study is the focus solely on cooperative banks and the inclusion of post-crisis data in the sample. Moreover, we would like to discuss the convenience of current regulation on small-sized cooperatives and whether it helps to make the sector less risky.

The structure of the paper is as follows: Section 4.2 contains the literature review of theoretical arguments for (dis)economies of scale in cooperative banking and also it provides empirical evidence. Further, it contains a review of papers dealing with regulatory impacts on risks on small-sized banks. We describe our methodological

approach, model setup and variables selection in Section 4.3. In Section 4.4, we focus on the data used and describe their origin and perform descriptive statistics. Section 4.5 provides empirical results and findings. Finally, we conclude the paper in section 4.6.

4.2 Literature review

There are plenty of papers investigating the efficiency of banks. We focus this literature review on papers investigating the size-efficiency relationship, particularly of cooperative banks. We provide the reader with theoretical arguments as well as empirical evidence that the balance sheet size has an impact on bank efficiency. Further, we present studies researching the impact of recent financial regulation on small banks, again with a focus on cooperatives.

Guinnane (1993) claims that credit cooperatives were more successful than commercial banks in providing loans to the rural population in Germany in the 19th century thanks to information advantage over commercial banks and also thanks to the possibility of imposing non-material sanctions on miscreants (public disgrace).

Lang and Welzel (1996) showed on a set of German cooperative banks that economies of scale and scope are present in all size classes and especially for small banks.

The bigger the cooperative bank, the more dispersed its ownership. Dispersed ownership is a cause of several corporate governance problems. For details see e.g. Bech, Bolton and Röell (2002). Gorton and Schmid (1998) showed that the performance of Austrian cooperative banks declines with the increasing amount of members.

Goddard and Wilson (2005) investigated that bigger American credit unions grew faster than the smaller ones during the 1992-2001 period. Wheelock and Wilson (2010) found increasing returns to scale for American credit unions during the 1989-2006 period. Also, they claim that the average size of institutions grew bigger over time, suggesting regulatory and technological changes favored larger institutions. Wheelock and Wilson (2012) pointed out that the cost efficiency of small credit unions decreased relatively more during the same period in the USA. Furthermore, DeYoung and Nolle (1996) see bigger USA banks as more efficient due to the fact

that they can attract and retain better managers. Berger and Mester (1997) studied sources of inefficiency on a set of U.S. banks using multiple inefficiency concepts. They arrived to results that the selected efficiency concept, measurement technique and functional form usually make only a little difference in average inefficiency or its ranking among institutions They also find that unexploited cost scale economies for their 1990s data are higher than in the past, possibly because of technology improvements. Hughes and Mester (2013) also find evidence that large economies of scale are present in the American banking sector. Contrary to Berger and Mester (1997) they see larger scale economies for larger banks than for smaller banks. Almanidis, Karakaplan and Kutlu (2019) used six different size groups of American banks for efficiency scores and find that two top-tier size groups were operated more efficiently. When all the banks were under one common frontier, the largest banks were 22% less efficient compared to heterogenous frontier models. Therefore regulation based on common frontier measures may be looser or stricter than needed. Interestingly, the authors found diseconomies of scale.

The empirical evidence on size-efficiency relation outside of the USA is mixed. Barros, Peypoch and Williams (2010) used the Luenberger indicator approach on cooperative banks from 10 EU member states during the 1996-2003 period. Their results showed that the productivity growth of small institutions is slow, possibly because they are unable to generate scale and scope economies. Studies on Italian cooperative banks' efficiency by Lopez, Appennini and Rossi (2002) and by Aiello and Bonanno (2015) use Stochastic Frontier Analysis and find no effect of bank size on its cost efficiency during 1995-1999 and 2006-2011 periods respectively. Agostino, Ruberto and Trivieri (2023) find that Italian cooperative banks with better institutions (especially corruption control) are associated with superior cost efficiency. Spulbar, Nitoi and Anghel (2015) investigated cooperative and savings banks in 9 EU countries between 2005 and 2011 using Stochastic Frontier Analysis. They find that the smaller institutions are more efficient. Deelchand and Padgett (2009) arrived to the same conclusion on the set of 293 Japanese cooperative banks. Yamori, Harimaya and Tomimura (2017) show on a set of Japanese cooperative banks that a large number of board members decreases efficiency measures and the presence of outside directors has a positive effect on banks efficiency.

According to these results, the effect of institution size on its efficiency is ambiguous not only for cooperative banks but for commercial banks as well. Havranek, Irsova and Lesanovska (2016) found smaller Czech commercial banks to be more efficient, while Fu and Heffernan (2008) found constant returns to scale on a set of Chinese commercial banks. Perera, Skuly and Wickramanayake (2007) found larger South Asian banks to be more efficient than their smaller competitors. These three studies are all based on Stochastic Frontier Analysis but covering different regions and arrived to totally different results.

Berger et al. (2000) estimated cross-border banking efficiencies in Western Europe and the U.S. They find that on average, domestic banks have higher profit efficiency than foreign banks. These results suggest that successful international expansion of financial firms is difficult.

Let us take a look at the cost efficiency comparison between cooperative and commercial banks in Europe. Altunbas, Evans and Molyneux (2001) find that cooperative banks in Germany are more cost efficient than commercial banks. Similarly, Giradone, Nankervis and Velentza (2009) find that cooperative and savings banks in Western Europe are more efficient than their commercial banking counterparts. Mäkinen and Jones (2015) arrived at the same result on a set of 521 European banks during 1994–2010.

Let us move now toward the literature investigating the impact of recent regulations on the riskiness of smaller banks, and cooperatives in particular. These studies show that financial regulation neglects the business model of cooperative banks but it is designed for (typically much bigger) commercial banks[3]. Fischer (2017) reaches conclusion that Basel III regulatory interest rate shock does not take into account thebusiness model of small German cooperative banks and can threaten the financing of SME business. Domikowsky, Hesse and Pfingsten (2012) discuss the significant impact of Basel III equity capital regulation on German cooperative banks. Reifschneider (2016) sees Basel III capital and liquidity requirements as challenging for Bavarian cooperative banks. Schupp, Silbermann (2017) find that the Net Stable Funding Ratio (Basel III liquidity regulatory ratio) increases the probability of

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[3] It is important to mention that some of the largest cooperative banks are classified as systemically important institutions (EACB, 2018), but most of the cooperative banks is small in size.

financial distress for credit cooperatives, but not for commercial banks. Klomp and de Haan (2012) find that capital regulations of banks from OECD countries have a higher impact on smaller banks, which are typically cooperatives or savings banks. Barth et al. (2013) find that tighter restrictions on bank activities are negatively associated with bank efficiency, while capital regulation is positively associated with bank efficiency. Jovanovic, Arnold and Voigt (2017) show that the business model of Bavarian cooperative banks is negatively affected by Basel III in all its facets, especially revenues, costs, and activities. To improve the sustainability of German cooperatives, authors suggest to adapt their strategies in terms of the value chain and political influence.

McKillop and Quinn (2017) examine the business model complexity of Irish credit unions and find that a three class system to be appropriate. This is consistent with the Irish Commission on Credit Unions (2012) which recommended that the complexity and diversity of Irish credit unions could not be accommodated within a one size fits all regulatory framework. Analysis by McKillop and Quinn (2017) also showed that two of the three classes are subject to diseconomies of scale and size reduction of Irish credit unions may improve their efficiency.

Hillier et al. (2008) claim that Australian credit unions respond to stricter capital adequacy regulation by increasing capital through the application of accounting window dressing techniques which is the opposite of the intended purpose. According to the authors, one-size-fits-all regulation causes threats to Australian cooperative banking. Brown and Davis (2009) further show that Australian credit unions manage their capital via short term profit rates which are aimed to gradually remove the discrepancy between actual and desired capital ratios. Desired capital ratios differ significantly across credit unions.

To sum up, the studies mentioned in our review provide several arguments both for and against positive the relationship between the size and efficiency of cooperative banks. It seems that large American credit unions are more efficient than their smaller peers. This relationship is not that clear in the rest of the world, and especially in Europe, where research studies have contradicting outcomes, depending on selected countries and the time frame in the data sample. We also presented several studies pointing to the difficult implementation of recent regulatory standards for smaller institutions, and for smaller cooperative banks particularly.

4.3 Methodology

The efficiency of financial institutions can be measured using several approaches. Comparing financial ratios such as a cost to income ratio belongs among the simplest ones. Most of the contemporary efficiency research is based on a more rigorous approach of efficiency frontier analysis. The work of Farrell (1957) laid the basics of current efficiency studies on a micro level by allowing the company to depart from optimal input-output allocation and hence to operate below the efficiency frontier. Two sources of inefficiency may arise: technical inefficiency (minimize inputs for given output) and allocative inefficiency (use optimal proportions of inputs).

Two approaches in measuring company efficiency are commonly used: parametric and non-parametric one. Non-parametric methods use linear programing in order to calculate the efficiency frontier. No explicit form of efficiency function is needed. Data envelopment analysis (DEA) is the most commonly used non-parametric approach for measuring bank efficiency. The drawback of DEA for our research is that it does not allow for random error. This is problematic especially for diverse datasets (such as ours) for it assumes no measurement or accounting errors, nor even luck that affects the performance because it affects the efficiency scores of all compared banks as shown by Berger and Humphrey (1997). Fiorentino, Karmann and Koetter (2006) showed on the set of German banks that DEA is much more sensitive to measurement errors and outliers compared to parametric Stochastic Frontier Analysis (SFA). Lensink, Meesters and Naaborg (2007) provide a summary table of techniques used in studies focused on estimating the efficiency of banks and DEA is rarely used in case the dataset is comprised of more than one country.

Parametric approaches on the other hand need assumption about functional form and allow for random noise. Individual parametric approaches differ in the way how they differentiate the random error from inefficiency. The Distribution Free Approach (DFA) assumes constant inefficiency of each bank over time. Fries and Taci (2014) claim that this assumption is too strong in longer time periods, especially if changes in organizational or technological structure can be expected. Our data cover ten year time horizon including the deepest economic crisis since the Second World War and moreover important technological changes, such as massive digitalization took place (see e.g. Aspara, Rajala and Tuunainen (2012)). Therefore, we decided to use the

Stochastic Frontier Approach (SFA). This method was developed by Aigner, Lovell and Schmidt (1997) and was applied to banks in the work of Ferrier and Lovell (1990). Concretely, we use the model of Battese and Coelli (1995) which estimates the cost function and correlation of bank inefficiencies in a single step. The reason is that the two-step approaches suffer from biased coefficients as shown by Wang and Schmidt (2002).

Banking is an industry with multiple outputs. Specification of production function is therefore not feasible. Nevertheless, we can transform profit maximization into a cost minimization problem. The general form of cost function within Battese and Coelli (1995) model is described in Equation (4.1):

$$y_{ijt} = \alpha + X'_{ijt}\beta + Z'_{jt}\gamma + \epsilon_{ijt} \; where \; \epsilon_{ijt} = \; v_{ijt} + u_{ijt}, \qquad (4.1)$$

where y_{ijt} is logarithm of total cost for bank i in the country j in year t, α is intercept, X'_{ijt} is matrix of logarithms of outputs and input prices, β and γ are vectors of all parameters, Z'_{jt} is matrix of country specific variables, ϵ_{ijt} is composite error term. Composite error term $\epsilon_{ijt} = v_{ijt} +$ u comprises of random error (v_{ijt}) and inefficiency term (u_{ijt}). The random error term (v_{ijt}) measures random effects and measurement errors. It is distributed as a standard normal variable. The random error term is also called random shocks term in some literature, eg. in Havranek et al. (2016). Cost inefficiency (u_{ijt}) is independent and identically distributed with a truncated normal distribution and therefore costs can never go below the frontier (for details see Berger, Hancock & Humphrey, 1993).

We can rewrite the abovementioned into: $v_{ijt} \sim iidN(0,\sigma_v^2)$, $u_{ijt} \sim N^+(e_{ijt},\sigma_u^2)$ where e_{ijt} is inefficiency and it is further specified by Equation (4.3). The separation of the error term into two components for each observation is described in Jondrow et al. (1980).

We use the translog cost function as described by Christensen, Jorgenson and Lau (1973) to estimate the efficiency frontier because Kumbhakar and Lovell (2000) showed superior behaviour of this specification relative to the traditional Cobb-Douglass functional form. Time trend is included to allow for efficiency changes as advised by Coelli, Rao and Battese (1998). Our specific form of the cost function is:

$$
\ln\left(\frac{TC_{ijt}}{P_{l,ijt}}\right) = \alpha + \beta_1 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right) + \beta_2 \ln(loans_{ijt}) + \beta_2 \ln(depos_{ijt})
$$

$$
+ \beta_3 \frac{1}{2}\left(\ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right)\right)^2 + \beta_4 \frac{1}{2}\left(\ln(loans_{ijt})\right)^2
$$

$$
+ \beta_5 \frac{1}{2}\left(\ln(depos_{ijt})\right)^2 + \beta_6 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right) \ln(loans_{ijt})
$$

$$
+ \beta_7 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right) \ln(depos_{ijt}) + \beta_8 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right) \mathrm{T}
$$

$$
+ \beta_9 \ln(loans_{ijt}) ln(depos_{ijt}) + \beta_{10} \ln(loans_{ijt}) T \tag{4.2}
$$

$$
+ \beta_{11} \ln(depos_{ijt}) T + \beta_{12} T + \beta_{13} \frac{1}{2} T^2 + \beta_{14} GDP_{lvl,jt}
$$

$$
+ \beta_{15} GDP_{gr,jt} + \beta_{16} YLD_{jt} + \beta_{17} HHI_{jt} + \epsilon_{ijt} \text{ where } \epsilon_{ijt}
$$

$$
= v_{ijt} + u_{ijt}
$$

where TC stands for total costs of a bank in EUR. We use two input prices: the price of funds P_f and the price of labor P_l. The price of funds is interest paid on a unit of interest bearing funds and the price of labor is, similarly as in Lensink, et al. (2008), the ratio of administrative expenses to total assets. Total costs and price of funds are normalized by the price of labor as proposed by Kuenzle (2005) to achieve linear homogeneity of the cost function. Bank outputs are represented by $loans$ and deposits ($depos$ variable) and are expressed in EUR currency. Furthermore, we included four variables to control for country specific effects: overall economic development of a country measured by GDP per capita in purchasing power standards expressed in relation to the European Union (EU28) average equal to 100 (GDP_{lvl}), real GDP growth rate (GDP_{gr}) to control for the current phase of an economic cycle, the average yield of 10-year government bonds (YLD) to control for the interest rate level in the economy and banking market concentration measured by the Herfindahl-Hirschman index (HHI).

The model described in Equation (4.2) is used to obtain inefficiency estimates while controlling for exogenous environmental variables that may affect efficiency. As stated above, the model of Battese and Coelli (1995) allows for the single-step estimation of bank inefficiencies and correlates of bank-specific inefficiencies. The specification of the inefficiency equation is as follows:

$$u_{ijt} = \alpha + \beta_1 Size_{ijt} + \beta_2 FinAssets_{ijt} + \beta_3 Equity_{ijt} + \beta_4 Liquidity_{ijt}$$
$$+ \beta_5 IncomeDiversity_{ijt} + \beta_6 ROA_{ijt} + w_{ijt} \tag{4.3}$$

where u is inefficiency, $Size$ stands for natural logarithm of total assets of bank i in country j and time t. $Size$ is the variable of our interest. Moreover, we tested also quadratic measure of $Size$ in order to capture possible non-linear effect but the effect was absent - the relation is linear. $FinAssets$ is ratio of financial assets to total assets, $Equity$ is equity to asset ratio, $Liquidity$ is liquid asset ratio, $IncomeDiversity$ is ratio of net fee and commission income to total income, ROA is return on average assets and finally: w is a random variable with truncated-normal distribution. Truncation point is so that $u_{ijt} > 0$.

4.4 Data analysis

We created a dataset of 183 cooperative banks from 12 European countries spanning the 2006-2015 period. Our dataset is balanced and has annual data frequency. Banks that were not active during the whole observation period were excluded from the dataset (their figures were not available in the database).

BankScope served as a key source of accounting data of the banks. We worked primarily with unconsolidated bank statements, consolidated ones were used only in case no unconsolidated statements were available for a given bank to avoid double counting problem. A similar setup is used in the work of Hesse and Čihák (2007). Macroeconomic data (GDP level, GDP growth and government bond yields) are retrieved from Eurostat and banking market concentrations (the Herfindahl-Hirschman index) are retrieved from the European Central Bank Statistical Data Warehouse.

The number of banks by country in our dataset is provided in Table 4.1. The presence of cooperative banks in Europe is unevenly distributed. Cooperative banking models differ significantly from country to country (for more info see Ayadi et al. (2010)). Because of the different levels of the interconnectedness of the cooperative banking system, either only one centrally governed institution or many of them can be present in a country.

European Association of Co-operative Banks (2017) reports that cooperative banking institutions are present in 20 European countries. Our dataset includes institutions from only 12 of them because of data availability issues. Financial data are not available in international databases mainly for financial cooperatives from Eastern European countries. Lack of continuous development because of the interruptions made by past communist regimes can have a severe negative impact on the performance of cooperative banks in new EU member states. For example, legislative framework for credit unions in the Czech Republic differs significantly from traditional cooperative principles. Czech credit cooperatives do not follow the one member, one vote principle and resemble therefore rather small commercial banks. Credit unions in the Czech Republic are not members of either the European Association of Co-operative Banks or the World Council of Credit Unions. Kuc and Teplý (2018) provide evidence of the bad performance of Czech credit unions. We therefore decide to ignore credit unions from such countries in this study because of their structural differences.

Table 4.1: Banks in dataset by country

Country	Count	Share	Country	Count	Share	Country	Count	Share
Austria	19	10.4%	France	41	22.4%	Netherlands	1	0.5%
Belgium	1	0.5%	Germany	57	31.1%	Portugal	1	0.5%
Denmark	2	1.1%	Italy	52	28.4%	Spain	2	1.1%
Finland	1	0.5%	Luxembourg	1	0.5%	Switzerland	5	2.7%

Source: Authors

The selection of variables used in our regression analysis is made to investigate the effect of cooperative bank size on its efficiency and it is also based on the experiences drawn from papers provided in the literature review section of this paper. Descriptive statistics of selected variables are provided in Table 4.4 in the Appendix. We can see that the diversity in terms of cooperative banks' size in the sample is substantial.

Furthermore, the time span of our period covers the whole economic cycle from booming economies of pre-Lehman Brothers failure, consequent economic crisis and the current recovery period. To account for possible structural changes induced by the crisis (eg. new regulations), we will estimate cost inefficiency besides the whole

period also on the subsets of the pre-crisis period (2006-2009) and the crisis + recovery period (2010-2015).

The correlation matrix of independent variables in regression Equation (4.3) is provided in Appendix Table 4.5. There is a considerable positive correlation between *IncomeDiversity* and *Size* and *Equity* variables and a negative correlation between *IncomeDiversity* and *FinAssets* ratio. Hence we decided to run the regressions also without the *IncomeDiversity* variable but the results were similar to the model including *IncomeDiversity* and therefore, we decided to keep the variable in the model.

4.5 Results and findings

First of all, let us check the results of Equation (4.2) from which we retrieved inefficiency estimates over the whole estimation period. These are provided in Table 4.2 below. Coefficient estimates have expected signs and are all significant at least at the 5% significance level except for time trend (T) and GDP_{lvl} variables. Wald test rejects the joint insignificance of the variables used. The normalized price of funds has a positive effect on the total cost which makes sense: higher input prices are connected with higher total costs while reaching the same outputs. A higher amount of outputs (loans and deposits) is also associated with higher costs as expected. The interaction terms are harder to interpret but all of them are significant. Significantly negative coefficient points that higher GDP growth (GDP_{gr}) is connected with lower costs which may be induced, for instance, by smaller risk costs during times of high economic growth. Higher long term government yields (YLD) correspond with a generally higher interest rate environment which may translate into more expensive funding and hence higher costs. Market concentration has a negative effect on banks' costs, or in the other words: a more competitive market translates into decreased costs.

Table 4.2: Estimation of the cost frontier, 2006-2015

Independent variable	Coefficient	Std. Error	Significance
constant	1.3102	0.2076	***
$\ln(P_f/P_l)$	0.0707	0.0316	**

ln(loans)	0.6092	0.0600	***
ln(depos)	0.3746	0.0646	***
$0.5 \ln(P_f/P_l)^2$	0.1119	0.0022	***
$0.5 \ln(loans)^2$	0.1405	0.0079	***
$0.5 \ln(depos)^2$	0.1833	0.0122	***
$\ln(P_f/P_l)$ x ln(loans)	0.0071	0.0028	**
$\ln(P_f/P_l)$ x ln(depos)	0.0137	0.0037	***
$\ln(P_f/P_l)$ x T	0.0045	0.0010	***
ln(loans) x ln(depos)	-0.1616	0.0098	***
ln(loans) x T	-0.0072	0.0016	***
ln(depos) x T	0.0058	0.0018	***
T	0.0144	0.0100	
$0.5\ T^2$	0.0066	0.0007	***
GDP_{lvl}	-0.0002	0.0002	
GDP_{gr}	-0.0055	0.0009	***
YLD	0.0210	0.0030	***
HHI	-0.0024	0.0003	***
Number of observations	1 830		
Wald test	11 900 000	***	

*Note: * significant at 10%, ** significant at 5%, ***
significant at 1%*

Source: Authors

Before we present outcomes of the Equation (4.3) which explains what aspects drive the inefficiency of European cooperative banks, let us take a brief look on a descriptive statistics of obtained inefficiency estimates. Interestingly, average inefficiency remained fairly stable over the whole observation period (see Appendix Figure 4.1). This holds true also for sub-samples formed by individual countries. The size-inefficiency relation gave us a fairly similar picture every year during the 2006-2015 period: bigger cooperatives are less efficient than smaller ones, regardless of the bank country (see Appendix Figure 4.2 for the year 2015).

We run the Breusch-Pagan Lagrange multiplier test and the Hausman test to decide which estimation method should be used for estimating regression Equation (4.3).

Breusch-Pagan Lagrange multiplier test strongly rejects (at a 1% significance level) the null hypothesis and therefore pooled OLS estimate is less efficient than Random Effects (RE). Hence RE method is preferred. Hausman test rejects the null hypothesis at a 1% significance level as well, showing that Fixed Effects (FE) estimation is efficient but RE estimation is not. We therefore employ the FE estimation method on Equation (4.3), RE and OLS serve only as robustness checks of FE results. We arrived at the same results when we run the tests on the subsets for the years 2006-2009 and 2010-2015.

We suspect our data to be grouped into country level clusters because of the different nature of cooperative banks in individual countries. Moulton (1986) shows that standard errors in such cases may overestimate the precision of estimators and we will therefore employ cluster-robust standard errors as advised by Cameron and Miller (2015). Our results reveal significantly higher cluster-robust standard errors in comparison with non-clustered errors and therefore, we decide to stick with the cluster-robust estimation.

Furthermore, we run a panel data unit roots test by Levin, Lin and Chu (2002). Consequently, we run a unit root test by Im, Pesaran and Shin (2003) which allows for more heterogenous coefficients. Both tests rejected unit roots presence in our panels.

Table 4.3 provides results of inefficiency regression Equation (4.3) over the whole observation period as well as for the subsets using FE estimation. Furthermore, Table 4.6 provides a comparison of different estimation techniques used on the whole dataset. We put the most trust into the FE model, based on the tests we run. Nevertheless, the results of RE and Pooled OLS methods are in line with FE regarding coefficient directions and significance with the exception of the income diversity (*IncomeDiversity*) variable.

The natural logarithm of balance sheet size (*Size* variable) has a highly significant positive effect. It means that bigger cooperative banks are more inefficient compared to their smaller peers. This holds true for the whole period as well as for both subsets. The share of financial assets on the balance sheet (*FinAssets*) does not affect efficiency while using the dataset for the whole 2006-2015 period. Nevertheless a higher share of financial assets increased stability during the pre-crisis period and

the effect turned around during the crisis. This is caused probably by investments into assets that showed problematic during the crisis. Expansion from cooperative banks traditional activities (deposit taking and loan granting) therefore negatively affected cooperative banks' efficiency during the crisis. Higher shares of equity (*Equity*) and liquid assets (*Liquidity*) on total balance sheet size increase efficiency in most cases. Exception is *Liquidity* during the crisis + recovery period. This is caused probably by overliquidity and insufficient opportunities to grant client loans during that time. Share of net fee and commission income on total income (*IncomeDiversity*) has no significant effect on banks' efficiency. Therefore, diversification of income sources between interest-bearing and fee placing seems not to matter in terms of efficiency. Interestingly, higher return on assets (*ROA*) is connected with higher inefficiency on the whole dataset as well as on the 2010-2015 subset but not on the 2006-2009 subset. A logical explanation of the positive ROA –inefficiency relation is that the banks with higher profitability of assets may not be forced to pursue cost minimization to the same extent as the less profitable banks.

Table 4.3: Fixed Effects on bank inefficiency by periods

Years	2006-2015			Subset 2006-2009			Subset 2010-2015		
Variable	Coef.	St. Error	Sign.	Coef.	St. Error	Sign.	Coef.	St. Error	Sign.
constant	6.9912	1.2844	***	-5.838	3.4135		3.5227	1.9208	*
Size	0.7364	0.0620	***	1.3396	0.156	***	0.8922	0.0897	***
FinAssets	0.0637	0.1649		-0.499	0.1314	***	0.2659	0.0674	***
Equity	-8.2946	1.4317	***	-4.273	0.3819	***	-7.0650	1.3827	***
Liquidity	-1.6662	0.5503	**	-2.374	0.9641	**	-0.2900	0.3902	
IncomeDiversity	0.0062	0.3850		0.1399	0.7936		-0.2740	0.3707	
ROA	8.7580	3.5923	**	5.7958	6.5860		6.8335	1.2922	***
Observations	1830			732			1098		
Wald test	---			---			---		
F test	758		***	895		***	269		***

*Note: * significant at 10%, ** significant at 5%, *** significant at 1%*

Source: Authors

To sum up, we showed that the smaller European cooperative banks are more efficient than the bigger ones. These results are in line with studies of Spulbar, Nitoi and Anghel (2015) and Deelchand and Padgett (2009). The theoretical explanation of our results is that the small cooperative banks are closer to their members and hence it is easier for them to overcome information asymmetry as showed by Guinnane (1993) and also that the smaller cooperative institutions suffer less from dispersed ownership problem as showed by Gorton and Schmid (1998). These effects proved to be stronger than scale economy effects which support higher efficiency of bigger institutions. We find strong evidence that the most efficient are small European cooperative banks. Nevertheless, studies in our literature survey show that these institutions are the most vulnerable to recent financial regulation which does not seem to take into account the specific business model of cooperative banks, forcing them into inefficiency and increasing the riskiness of the sector in this point of view.

Interestingly, a higher share of financial assets on the balance sheet of cooperative banks supports efficiency during prosperity times but has a negative effect during macroeconomically difficult periods as we showed using 2006-2009 and 2010-2015 subsets.

4.6 Conclusion

This paper investigates the size-efficiency relation of European cooperative banks during the 2006-2015 period, which was further separated into the pre-crisis and the crisis + recovery subsets. We tested whether arguments in favour of smaller cooperative banking institutions overcome the effects of economies of scale. We created a dataset of 183 cooperative banks from 12 European countries. Stochastic Frontier Analysis (SFA) was employed to obtain inefficiency estimates and consequently, we estimated the determinants of cooperative banks' inefficiency.

Our results show that the smaller European cooperative banks are more cost-efficient than their bigger peers. This finding is in line with the work of Spulbar, Nitoi and Anghel (2015) on European cooperative and savings banks and of Deelchand and Padgett (2009) who studied Japanese cooperatives. We prove that this size-efficiency relation is valid in both time subset periods as well. Moreover, we show that the size-efficiency relation is linear: the bigger the institution, the higher the inefficiency. Interestingly, inefficiency remained roughly stable during the whole observation period without any substantial changes, not even on sub-samples of individual countries.

These results point out that it is efficient for cooperative banks to remain small in size and gather from traditional cooperative proximity to its members rather than to expand. Market consolidation is therefore harmful to the efficiency and stability of cooperative banking system. Recent financial regulation nevertheless did not take into account the specific nature of cooperative banking scheme and the impact on the small-size cooperatives is considerable. We believe that one-size-fits-all regulation is harmful to the efficient operations of cooperative banks in Europe.

4.7 Reference list

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4.8 Appendix

Table 4.4: Descriptive statistics

Variable	Minimum	1st quartile	Median	3rd quartile	Maximum
TC [EUR mn]	1	13	35	293	48 991
P_f	0.00	0.02	0.03	0.05	0.40
P_l	0.00	0.02	0.02	0.02	0.07
loans [EUR mn]	0.1	215	596	5 439	473 889
depos [EUR mn]	10	211	563	2 699	525 636
GDP_{lvl}	75	108	117	124	270
GDP_{gr} [%]	-8.3	0.5	1.6	2.4	8.4
YLD [%]	-0.04	1.57	3.12	3.8	10.55
HHI	41.05	75.65	83.22	85.47	99.98
Size [log]	16.62	19.73	21.26	23.05	28.18
FinAssets	0.00	0.11	0.20	0.32	0.60
Equity	0.01	0.06	0.08	0.11	0.24
Liquidity	0.00	0.01	0.01	0.02	0.33
IncomeDiversity	-0.06	0.00	0.05	0.24	10.00
ROA	-0.06	0.00	0.00	0.01	0.05

Source: Authors

Table 4.5: Correlation matrix

Correlation	Size	FinAssets	Equity	Liquidity	IncomeD.	ROA
Size	1					
FinAssets	-0.16	1				
Equity	0.08	-0.21	1			
Liquidity	-0.07	0.18	-0.05	1		
IncomeDiversity	0.41	-0.35	0.40	-0.17	1	
ROA	0.18	-0.14	0.47	-0.04	0.25	1

Source: Authors

Figure 4.1: Average inefficiency over time
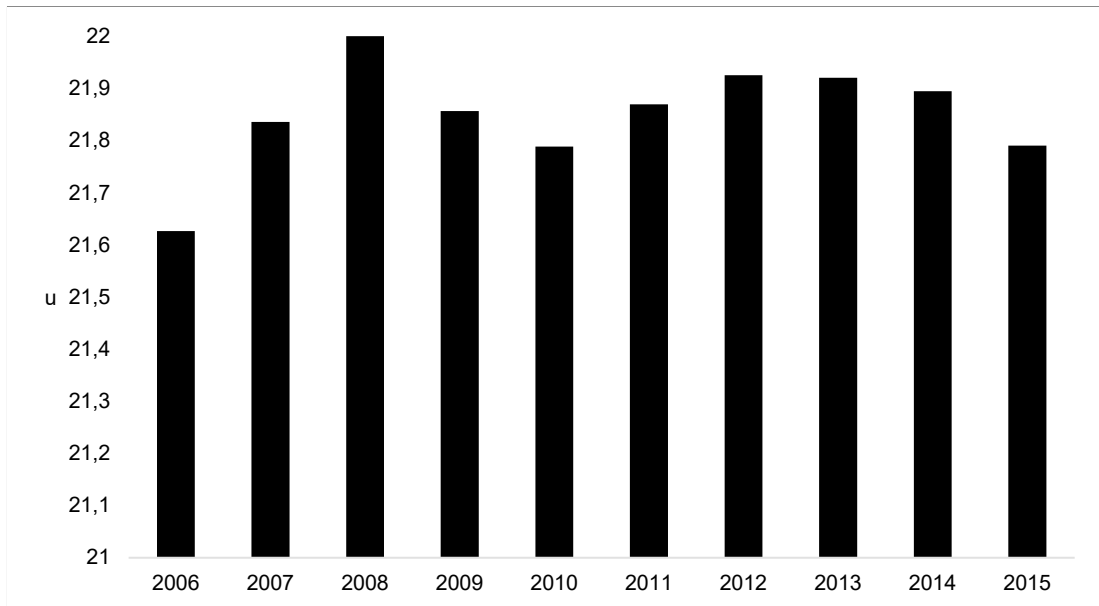
Source: Authors

Figure 4.2: Inefficiency and size relation in 2015

Source: Authors

Table 4.6: Effects on bank inefficiency – different estimation methods, 2006-2015

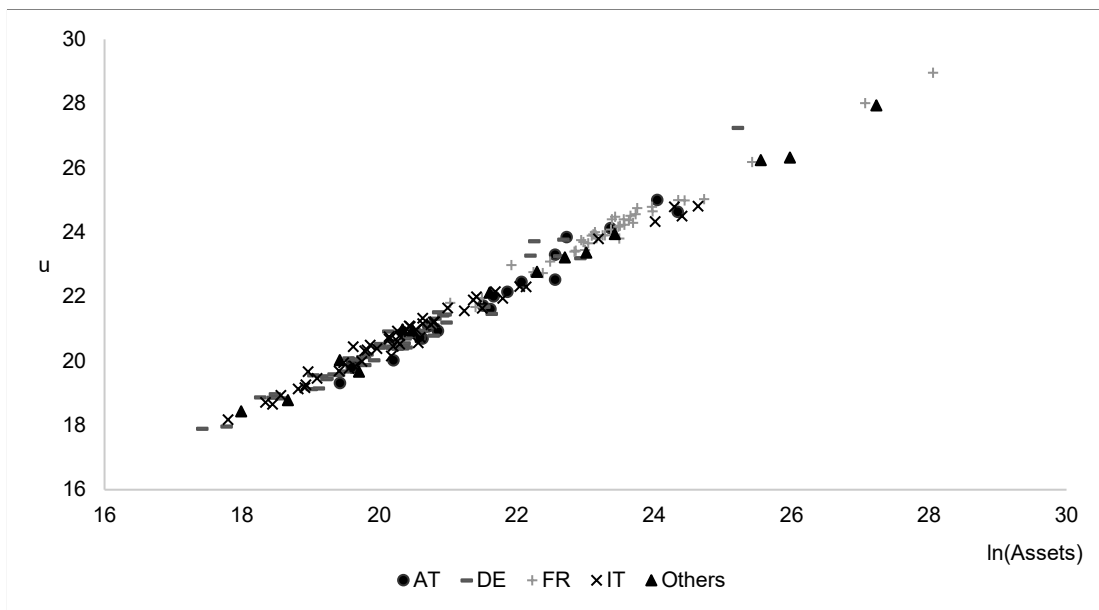| Variable	Fixed Effects			Random Effects			Pooled OLS		
	Coef.	St. Error	Sign.	Coef.	St. Error	Sign.	Coef.	St. Error	Sign.
constant	6.9912	1.2844	***	0.4865	0.2924	*	-0.8877	0.2155	***
Size	0.7364	0.0620	***	1.0387	0.0136	***	1.0995	0.0134	***
FinAssets	0.0637	0.1649		-0.2342	0.1494		-0.1582	0.1875	
Equity	-8.2946	1.4317	***	-6.2736	1.3599	***	-2.6876	0.8527	***
Liquidity	-1.6662	0.5503	**	-1.4778	0.4957	***	-3.9784	1.6998	**
IncomeDiversity	0.0062	0.3850		-0.0565	0.4856		-0.8717	0.1979	***
ROA	8.7580	3.5923	**	10.7266	2.8626	***	9.6687	2.4429	***
Observations	1 830			1 830			1 830		
Wald test	---			57 820		***	---		
F test	758		***	---			8 925		***

*Note: * significant at 10%, ** significant at 5%, *** significant at 1%*

Source: Authors

5 A Rollercoaster Ride of Czech Credit Unions

Abstract

The aim of this paper is to assess the current situation of Czech credit unions in the context of their past development, changing environment, and legislative framework evolution. We focus on the differences between the traditional cornerstones of cooperative banking and the operating principles of Czech credit unions. We compare contemporary credit unions' performance with the performance of their predecessors together with the performance of commercial banks. We conclude that despite the crisis of 1999, Czech credit unions still behave like small and risky commercial banks which contradicts to business models of the credit cooperatives operating in the EU.

Key words: cooperative banking, credit union, moral hazard, risk management

JEL classification: G21, L21

5.1 Introduction

Credit unions are retail-oriented financial institutions with a long tradition in the Czech Republic. Their development was disrupted by the Second World War and they were consequently liquidated by the communist regime. Credit unions that were founded under new legislation after the fall of communism experienced massive growth. However, the poor legislative framework did not reflect modern trends in European cooperative banking and the boom turned into a bust by the beginning of the new millennium. History repeated itself as credit unions regained lost confidence after a few years of stagnation and grew rapidly in recent years. However, some of the biggest credit unions got into trouble recently and the Czech National Bank revoked their licenses.

The aim of this paper is to try to explain the current situation of Czech credit unions in the context of their past development, changing environment, and legislative framework evolution. Section 5.2 presents the basics of cooperative banking, which is important for the understanding of the bizarre character of contemporary Czech credit unions. In Section 5.3, we provide a brief overview of the history of cooperative banking in the Czech lands, putting stress mainly on the difference between institutions that were active before the Second World War and current ones. Section 5.4 discusses the importance of the proposed legislation and its impact on credit unions in the Czech Republic. Section 5.5 summarizes the paper.

5.2 Cooperative banking in a nutshell

Stakeholder value banks are created to maximize the utility of all their stakeholders, i.e. persons influenced by the operations of a company (CEPS, 2009). Because stakeholder institutions try to maximize the utility of more, often heterogeneous groups, they cannot have only one single concrete objective for example in profit maximization. Bare profit-maximizing behavior would decrease the utility of another group of stakeholders: their clients who would have to pay more for banks' services. Therefore, cooperative banks as typical examples of stakeholder value banks may not try to maximize their profit to the same degree as commercial banks (Fonteyne, 2007). Nevertheless, profit is a necessary prerequisite for the survival and expansion of cooperative banks. Stakeholder value banks have more objectives than only profit

maximization and for that reason, they are sometimes called double bottom line institutions (see e.g. Hillman and Keim, 2001). They are created to offer favorable financial services to their members who often share some common bond (such as place of living, occupation, etc.). This is why cooperatives often focus on retail banking (Hesse and Čihák, 2007). Rich chains of branches help to create long term relationships between members and their cooperative bank. Close proximity to members helps cooperatives to better identify members' profiles and needs and creates the information advantage over commercial banks in dealing with asymmetric information (Angelini et al., 1998).

Cooperative banks are owned and democratically controlled by their members. Another difference between commercial and cooperative banks is that the ownership stakes of the latter one are usually not marketable and work on the principle of "one member one vote". It means that a member cannot sell his share and it does not matter how much money he put into the company's equity because he has got still only one vote at the general meeting. Fonteyne (2007) states that cooperative banks can enjoy the advantage of notably lower cost of capital in comparison with shareholder-driven banks. This fact can result in offering financial products by cooperatives at lower prices. Cooperative banks can face substantially more problems than commercial banks when trying to raise funds quickly. There can be significant legal restrictions imposed on cooperatives' activities on financial markets. For example, Czech credit unions are allowed to operate in financial markets only to secure risks arising from services to their members and hence cannot solve liquidity problems by bonds issuances.

During its life cycle, a cooperative bank often concludes that creating a network with similar institutions can be mutually advantageous because it is hard for a small company to compete with large commercial banks. Vast networks with different degrees of both vertical and horizontal integration were created in countries with the well-developed cooperative banking sectors. Institutions atop such a structure can provide centralized services for the whole group if economies of scale are present. Apex institutions, sometimes can become central banks of the group and manage liquidity between individual cooperatives, provide consultancy, risk management, marketing or product creation services (Guinnane, 1997). This centralization also helps in building a strong brand name.

A typical problem of cooperative corporate governance is dispersed ownership. Governance mechanisms of cooperatives were designed for small-scale organizations, not for banks owned by thousands of members. Attendance at general meetings may become fairly low and information provided by managers may not be sufficient for members to ensure effective monitoring of banks' managers. Becht et al. (2002) point out that the problem of collusion between managers and the supervisory board elected to monitor them may happen surprisingly often in the case of dispersed ownership. Weak monitoring by members (or their delegates) allows managers to pursue empire-building rather than following members' interests.

We should also mention the differences between credit unions and cooperative banks. Credit unions offer services only to their members (owners) whereas cooperative banks can serve clients (non-owners) as well. Credit unions tend to be smaller than cooperative banks. Cooperative banks are sometimes created by a network of individual credit unions. Credit unions are popular for example in the UK, Ireland, Poland, and the Baltic states (Liikanen et al., 2012).

Above mentioned properties are considered to be typical for the cooperative banking model in Europe. Nevertheless, there is not only a single model and cooperative banks differ significantly from country to country. For further details see e.g. Ayadi et al. (2010).

5.3 Historical development of (Czech) credit unions

This section serves as a brief overview of the history of cooperative banking in Czech territory[4]. For greater lucidity, it is divided into three parts. The first subchapter explains the historical context and ideas of the founding fathers of credit unions: H. Schulze-Delitzsch and F. W. Raiffeisen. Subsequently, we will focus on the development of cooperative banking in the Czech lands.

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[4] To make the picture complete, we refer to Dvořák (2010), Revenda (2013), Mandel and Tomšík (2014), Klinger and Teplý (2014) or Šútorová and Teplý (2013; 2014) for more details on the regulation of the Czech and EU banking sector. Moreover, for related risk management practices see, Janda et al. (2010; 2015), Stavárek and Vodová (2010), Jakubík and Teplý (2011), Buzková and Teplý (2012), Černohorská et al. (2012), or Stádník (2013; 2014).

5.3.1 Origins of credit unions

The industrial revolution brought dramatic changes to the socioeconomic environment of Europe. The population grew rapidly and its structure was altering. Nevertheless, not all people utilized the merits of the economic boom in the first half of the nineteenth century (CSSDA, 2004). One of the key assumptions for a better life is accessibility to financial services (Guinnane, 1997). Even though German states had well-developed banking sector at that time, most of the working class could not reach loans at reasonable rates. Guinnane (1993) considers significant information asymmetry and the high cost of enforcement as the main obstacles to making business with poor people. Operations with poor people were too costly for the banks because it was hard to get relevant information about clients from lower strata of society. Contract condition enforcement was also unprofitable considering the small amounts of money poor people operated with. Angelini et al (1998) state that credit unions could overcome these difficulties since members had often very good information about their fellows and thanks to the possibility of imposing additional immaterial penalties to members who did not fulfill their obligations. Both these advantages were resulting from the fact that members were living in the same community.

German economist Hermann Shulze-Delitzsch is considered to be the father of cooperative banking because he founded the first credit union at the beginning of the 1850s. The goal of such an institution in his view was to offer money to its members based on common credit for the needs of their shops (Schulze-Delitzsch, 1855). Volksbanks, as Shulze-Delitzsch's institutions were later called, originated in urban areas and their members were recruited mainly from craftsmen and petty traders.

Credit unions of the Volksbank type were successful in an urban environment but could not satisfy the different needs of inhabitants of rural areas who were still excluded from access to financial services (Goglio and Leonardi, 2010). Friedrich Wilhelm Raiffeisen was inspired by Schulze-Delitsch's ideas but altered some important characteristics so that the credit unions' services suited better to the needs of farmers.

With the increasing number of institutions, the need for organizations that would foster the development of credit unions appeared (Guinnane, 1993). Apex institutions

proved to be essential in process of setting common standards for individual credit unions, educating managers, and also auditing the cooperatives which helped as a signaling device towards third parties. They helped to allocate funds to individual cooperatives, smooth seasonal fluctuations, facilitate trade with banks or worked as lenders of last resort.

5.3.2 Credit unions in Czech lands until 1952

The situation in the Czech lands was not that dissimilar from that of their western neighbor. The lack of affordable credit for broad masses of society blocked growth and development. The first Czech credit union (from the nationalistic point of view) was settled in 1858, less than ten years after the first European credit union. The credit unions followed the settings of Shulze-Delitzsch (their Czech name was občanské záložny) and they spread out rapidly. There were approximately 130 Czech credit unions in 1865 (Vencovský et al., 1999) and from that time, 20 to 70 new credit unions were founded every year until the crash of Vienna's stock exchange in 1873 (Hájek, 1984). The capital of the ten biggest Czech credit unions multiplied almost ten times between 1863 and 1868 (Vencovský et al., 1999). The boom was therefore not only in the total number of credit unions but also in their size.

The development of rural credit unions (Raiffeisen type) in Bohemia was not that fast. The propagator of Czech rural credit unions was František Cyril Kampelík. He described the operating principles of these institutions and endorsed their merits in his work from 1861. Nevertheless, the ideas of Kampelík were not put into practice sooner than in the 1880s when the first rural credit unions of the Raiffeisen type were created. Later on, as an honor to the Czech propagator of this scheme and to distinguish them from their German counterparts, they were colloquially called kampeličky. Afterward, the number of rural credit unions rocketed and in 1912 there were almost 3,700 rural credit unions (Vencovský et al., 1999).

We have much more data on Czech credit unions available from the period of the first Czechoslovak Republic (1918-1938). Even though the economy went through challenging times, we can see a gradual increase of credit unions on our territory in Table 5.1.

Table 5.1: Czech credit unions, 1919-1937

Year	1919		1929		1937	
Type	Schul.	Raiff.	Schul.	Raiff.	Schul.	Raiff.
Nr. of institutions	1,413	3,735	1,866	4,190	1,983	2,919
Members (ths)	472	382	844	621	1,017	461
Deposits (CSK mil)	2,485	1,355	11,904	3,220	14,693	3,217
Loans (CSK mil)	997	234	9,934	3,221	11,195	2,236

Source: Authors based on Vencovský et al. (1999)

Even though there were more rural credit unions than urban credit unions, the overall size of urban ones was bigger in terms of members or of total loans granted. Both institution types were roughly equal in terms of deposits with a total amount close to CSK 3 billion each in 1937. Just for comparison, the total deposits of the 23 biggest Czech shareholder banks in 1936 were almost CSK 9 billion (Mervart, 1996). The size of an average cooperative financial institution also increased quite significantly in this period as is clear from Table 5.2 below.

Table 5.2: Average size of a credit union, 1919-1937

Year	1919		1929		1937	
Type	Schul.	Raiff.	Schul.	Raiff.	Schul.	Raiff.
Members	334	102	452	148	513	158
Deposits (CSK ths)	1,759	363	6,379	768	7,409	1,102
Loans (CSK ths)	706	63	5,324	769	5,645	766

Source: Authors based on Vencovský et al. (1999)

All credit unions went under the management of a single central governmentally controlled organization throughout the time of German occupation during the Second World War. The nationalization of the Czech banking industry started already in 1945. More and more financial institutions were put under state control as the power of communists and socialists grew. Finally, decree number 84/1952 from 11th December 1952 put all credit unions under state savings bank. This meant the end of cooperative banking in the Czech region for more than forty years.

5.3.3 Credit unions reborn, 1995+

The Czech banking sector had to undertake dramatic changes once again after the fall of the communist regime. A number of companies rocketed at the beginning of the nineties, causing higher demand for banking administration. The number of employees in the banking sector grew accordingly but there were not enough qualified workers available. After a lengthy debate, politicians decided to allow the return of credit unions back on the market. One of the arguments was the low willingness of shareholder banks to offer credit to small clients at the beginning of the transition from a centrally planned economy. Credit unions should have filled this hole in the market just as they did a century ago. Of course, it is questionable whether these institutions should have a place in today´s banking in countries with developed markets when the natural development of credit cooperatives was already discontinued.

Act number 87/1995 provided legislation for credit unions. It was supported by politicians from almost the whole political spectrum despite the criticism from the Czech National Bank (ČNB). According to the ČNB, the decree did reflect neither current tendencies in the Czech banking sector nor those in developed Western European markets where cooperative banks were often hardly distinguishable from shareholder banks. The most frequently mentioned pitfalls were very relaxed conditions to enter the market, ineffective supervision and insufficient deposit insurance fund.

Only CZK 100,000 of registered capital was sufficient to start a credit union. There was no licensing procedure for new entrants - it was enough to inform the authority about starting the operations. Moreover, there were no conditions imposed on theoretical education or previous experiences of founders or key managers. This meant that almost any group of people could start operations in the financial sector by creating their own credit unions. The number of institutions grew accordingly: 45 new cooperative banks were founded during the first year. The extensive growth of 1996 was transformed into an intensive one in three successive years. It had to be hard for credit unions to deal with a high increment of members and resulting quick changes in companies' structures. Members were attracted to credit unions by high interest rates on their deposits (Dvořák, 2004). Higher interest expenses had to be

financed by riskier operations which could yield higher profit but managers often failed to assess risks correctly.

The difference between the growth of deposits and the growth of loans is striking. Credit unions attracted a significant amount of funds from depositors but they did not use them to provide loans which were assumed to be one of their key functions. Loans to deposit ratio of the whole sector remained deeply below 50% until the crisis of 1999.

Table 5.3: Overview of credit union sector, 1996-2001

Year	1996	1997	1998	1999	2000	2001
Nr. of institutions	45	66	76	139	73	56
Members	7,092	25,160	63,301	126,000	9,580*	10,915*
Deposits (CZK mil)	176	1,257	4,485	10,451	628*	766*
Loans (CZK mil)	45	196	1,855	1,266*	N/A	N/A
Assets (CZK mil)	211	1,414	4,687	5,381*	793*	954*

Source: Authors based on ÚDDZ (2002); * denotes estimated value

We should stress the problem of inadequate supervision. Credit unions were not supervised by Czech National Bank but by a special bureau created for the purpose: Bureau for Supervision over Credit Unions (ÚDDZ, Úřad pro dohled nad družstevními záložnami). The bureau was established as late as 1997 when plenty of credit unions were already in operation. Holes in the law allowed credit unions to create subsidiary companies with unlimited lines of business. ÚDDZ had no competence to control such companies and credit unions used them to hide assets of poor quality or just everything they did not want to be controlled. ÚDDZ had only 5 employees at the beginning of 1999 (ÚDDZ, 2000) which was not enough to control the industry sufficiently. Furthermore, there were no special demands on auditors of credit unions unlike in the case of banks. The traditional control mechanisms of credit unions - the general meeting, failed as well. Mainly, because of the low competence of members and poor information provision by bank managers (Dvořák, 2004). Poor controlling mechanisms allowed credit unions to continue in bad operations and therefore, they created more and more losses as long as they were having enough funds to remain liquid. This changed when deposit inflow slowed down due to

adverse macroeconomic consequences at the end of 1999. Rumors about the bad condition of individual credit unions spread out as the first ones got into trouble causing further pressure on credit unions' liquidity as members massively withdrew their deposits. The total breakup of the cooperative banking industry was soon to come.

We are getting here to the next point of criticism of Act 87/1995: insufficient deposit insurance fund. It worked separately but according to similar rules as deposit insurance fund of banks. One key difference was a lower payment rate for credit unions into their fund. This originated from an idea that credit unions are less risky than banks but it proved to be wrong in the Czech setup. There were less than CKZ 20 million in the fund in 1999 (ÚDDZ, 2000). This number was ridiculous compared to estimated minimal losses at the level of CZK 6 billion (ÚDDZ, 2001). At the beginning of 2004, the overall payments to depositors were quantified at CZK 8.1 billion (ÚDDZ, 2005). The loan by the government was given to the deposit insurance fund to keep confidence in the financial system even though the state had no such obligation.

The credit union sector was relatively concentrated – the five biggest credit unions held 73 % of members' deposits of the whole sector at the end of 1999 (ÚDDZ, 2000). Unfortunately, all of them run into financial distress. Credit unions that shared some link among members, such as occupational or locational, proved to be more resilient to this crisis of the sector. In the end, credit unions that were holding more than 85 % of deposits of the whole sector underwent government receivership in 2000 (ÚDDZ, 2001). This crisis of the Czech cooperative banking scheme did not have vast consequences for the economy since the market share of credit unions was much smaller than in the time of Czechoslovakia. Deposits in credit unions accounted only for 1.3 % of total household deposits in 2000 (ÚDDZ, 2001).

New legislation was adopted as a reaction to a disappointing development in the sector. Act number 100/2000 altered Act 89/1995, fixing some long-time criticized features. It prohibited credit unions from taking ownership share in other companies, increased minimal registered capital to CZK 500,000, the newly created credit unions had to ask for permission to provide services or gave more competencies to supervising bureau which was later fully incorporated under the Czech National Bank. The situation on the market got stabilized but the problem was regaining lost

confidence in cooperative banking in the Czech Republic. Credit unions were small and growing slowly. Quantity of functioning credit unions has been shrinking since 1999. Some of the smallest credit unions were forced to leave the market as the Czech Republic unified legislation with the European Union. The crucial point of this process was rising the minimal registered capital requirement to EUR 1 million. Czech Act No. 280/2004 set the minimal amount of registered capital to CZK 35 million. This step further reduced a number of surviving credit unions by 10 to only 20 normally functioning ones at the beginning of 2005.

Despite that the number of credit unions has been shrinking, the balance sheet of the sector has been increasing. Annual growth rate of the sector in terms of members was 12 % between 2004 and 2012. Members' deposits and loans grew approximately by 40 % per annum during that period time. The annual equity growth of the sector was slower (26 %) than balance sheet growth (38 %) which meant lowering the relative safety cushion. Nevertheless, the capital ratio of the credit unions sector was 13.3 % in 2012 (ČNB, 2013) which was still well above the 8 % regulatory requirement. Matejašák and Teplý (2013) see a decrease in capital ratio as a serious threat. Their study suggests that current capital may be overvalued due to insufficient creation of asset provisions. Moreover, the fast growth of members' loans and increased capital requirements imposed by Basel 3 may build up further pressure on the creation of new capital.

Table 5.4: Overview of credit union sector, 2004-2012

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Nr. of institutions	33	20	20	19	17	17	14	14	13
Members	19,077	30,611	36,637	44,789	35,942	47,952	34,003	44,687	54,408
Deposits (CZK mil)	1,525	3,146	5,217	7,031	10,282	15,672	17,668	25,060	33,816
Loans (CZK mil)	1,337	2,756	4,133	5,189	6,718	8,778	12,569	19,327	28,178
Assets (CZK mil)	2,146	4,190	3,809	8,947	12,061	17,649	19,890	28,275	39,279

Source: Authors based on ČNB (2007, 2009, 2012, 2013)

Most credit unions that left the market after 2005 were forced to do so by the supervisor. ČNB arguments for their closure were significant insufficiencies in credit unions' activities and preventive reasons. Concretely insufficient loan securitization, poor monitoring, non-fulfillment of capital requirements, surpassing the engagement limits, or poor management were drawbacks that appeared in supervisor's announcements. Fio družstevní záložna transferred from a credit union to a bank in 2010 causing a noticeable decline in credit unions members in that year. More credit unions declared interest to transform into a bank but none has been successful yet. One of the main obstacles is probably the need for CZK 500 million of registered capital which is hardly achievable for any contemporary credit unions.

5.4 Contemporary structure of the credit unions sector and possible pitfalls

In this section, we are going to tackle some problems of contemporary Czech credit unions and we try to explain them by the structural differences of current institutions from their predecessors and their European counterparts.

Important is to realize that the Czech Association of Credit Unions (Asociace družstevních záložen) is not a member of the World Council of Credit Unions (WOCCU). This seems suspicious since associations from nine other European

countries with developed credit union systems are members of the WOCCU. One of the reasons may be that the Czech credit unions are not governed by the famous one-member one-vote principle but members can buy more membership shares and have a significant impact on the institution. In this respect, Czech credit unions resemble more commercial than cooperative banks.

An interesting feature of the Czech legal framework is that Czech credit unions are disallowed to grant mortgage loans. This is a serious restriction for the credit unions are unable to grant one of the safest loan products. Instead, they are focused on consumer credit and real estate financing which are much more risky segments. This is visible from a comparison of loan categorization of the Czech commercial bank sector with the credit union sector provided in Table 5.5. Only 60 % of loans provided by credit unions are paid on time and 15 % of the loan portfolio was more than 90 days overdue as of the end of 2012. Moreover, there is a deteriorating trend in the quality of credit unions' portfolios as the ratio of standard loans has been shrinking since 2008 as a by-effect of the economic slowdown.

**Table 5.5: Comparison of client loan categorization, 2012**

Categorization	Commercial banks	Credit unions
Standard	90 %	60 %
Watch	4 %	25 %
Sub-standard	2 %	7 %
Doubtful	1 %	3 %
Loss	4 %	5 %

Source: Authors based on ČNB (2013) and annual reports of credit unions

The higher riskiness of a loan portfolio should be compensated by a higher capital buffer to keep, ceteris paribus, the same degree of stability of both commercial banks and credit unions. That this does not hold is clear from Figure 5.1. Capital adequacy of commercial banks is gradually increasing thanks to their retained earnings but credit unions were unable to keep capital adequacy as their loan portfolios increased. Moreover, capital needs will be increasing as Basel III rules will come to life. This creates a dangerous mix for the stability of Czech credit unions.

Lack of capital is further supported by the policy of insignificant price of membership shares required to enter a credit union. Equity from membership shares cannot form a substantial amount of capital if most of the credit unions charge less than CZK 100. This is a common practice of Czech credit unions to attract clients. A drawback for the credit union is not only in lack of capital but it also destroys the cooperative spirit of an institution as the members have not inserted a lot of their own capital into the cooperative and therefore, they tend to feel more like clients of the bank than members of the cooperative. This flaw should be put aside by legislation novel which sets a minimal ratio of membership share to insured deposits to 1:10.

Figure 5.1: Capital adequacy development, 2007-2012
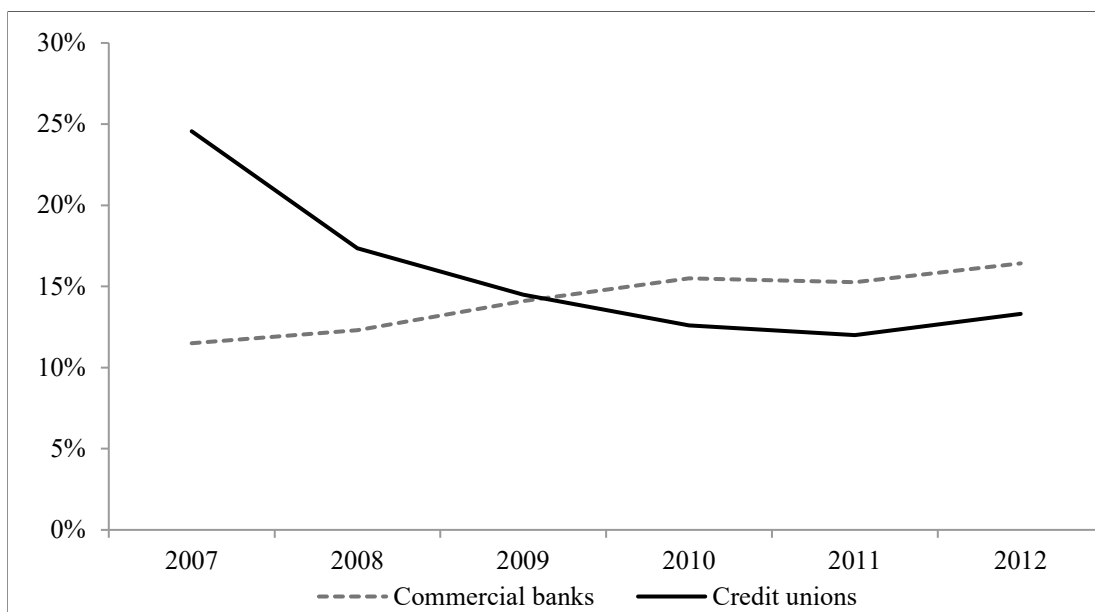
Source: Authors based on ČNB (2008, 2009, 2010, 2011, 2012, 2013)

To obtain funds for growing loan portfolios, credit unions need to attract clients. To attract them, they have to offer high-interest rates on deposits. Typical deposit products in Czech credit unions are term and savings accounts which are rather expensive sources of funding and they are also less stable than current accounts. Although credit unions are considered riskier, they profit from the moral hazard of their clients who do not have to distinguish between the stability of credit unions and commercial banks since their deposits are equally 100% insured up to EUR 100,000 in both types of banks. This fact, connected with the common deposit guarantee scheme of credit unions and commercial banks is often criticized by ČNB

representatives (see e.g. Tomšík, 2013; 2015) and academics (Matějašák, Teplý, 2013).

Talking about a growth of credit unions' portfolios, let us compare average size of a contemporary credit unions with average credit unions from 1937 and from 1998, which was the last year before the famous collapse of the sector. We took cumulated inflation (Harmonized Index of Consumer Prices and its predecessors) from Czech Statistical Office (ČSÚ) from 1939 until 2012 and we recalculated the size of an average credit union in terms of loans and deposits from 1937 and from 1998 into a price level of 2012 to make comparison with contemporary credit unions. This simple method has several flaws: lack of inflation figures for some years, monetary reforms , etc. but it can still show us how different were Czech credit unions in past and now. From the results provided in Table 5.6, it is clear that the average size of credit union increased significantly in time.

Table 5.6: Comparison of the average credit union from years 1937, 1998 and 2012

Year	1937		1998	2012
Type	Schul.	Raif.	N/A	N/A
Members	513	158	833	4,185
Deposits (CZK ths, price level of 2012)	18,144	7,878	96,581	2,585,434
Loans (CZK ths, price level of 2012)	13,822	5,475	24,407	2,132,183
Loans to deposits ratio	76 %	69 %	25 %	82 %

Source: Authors based on Vencovský et al. (1999), ÚDDZ (2002) and ČNB (2013)

Despite the growth of the average size of an institution, the balance sheet of all 13 credit unions that were operating at the end of 2012 put together is comparable to the smallest commercial banks on the Czech market. Therefore, it is striking that there does not exist any apex institution that would incorporate credit unions under one network, just as is typical in other European countries. The role of the apex institutions for Czech credit unions in the past was carried out by Živnobanka which was founded by credit unions but this system was abandoned in the difficult times of the Second World War and was not restored after the fall of the communist regime.

This lack of coordination makes standalone Czech credit unions much more vulnerable than e.g. Raiffasenbanks´ or Volksbanks´ networks in Austria.

Another principle of cooperative banking is that members of a bank should be interconnected by some common bond such as place of living, occupation, etc. This also does not seem to be true in the current Czech setup. Whereas for example in Poland, we can see credit unions focused on certain regions or communities such as miners or farmers, no such thing can be traced in the Czech Republic. Despite the small size, bigger Czech credit unions try to operate mostly nationwide with branches spreading across the country. They tend to offer a whole range of products for retail, corporate and real estate investments. With small portfolios consisting only of hundreds of borrowers, this lack of specialization can cause problems. It is hard to imagine that the Czech credit unions, where the biggest institutions have only around one hundred workers, can have a sufficient amount of specialists for each segment.

5.5 Conclusion

This paper shows that the development of Czech credit unions more or less copied track of their German counterparts in the past, but some of the very cornerstones of cooperative principles were abandoned after the rebirth of cooperative banking in the Czech Republic. Poor legislative framework and insufficient supervision lead to a massive crisis of the sector in 1999. Some of the problems like poor supervision or low capital standards were consequently corrected. Nevertheless, the rotten core of pseudo-cooperative principles remains. Not-following basic WOCCU principles of cooperative banking such as one member one vote, lack of common bond between members in individual organizations, and their low interest in the performance of credit union induced by small membership shares make Czech credit unions resemble rather small and risky commercial banks than proper cooperatives. This all, together with hardly sufficient capital buffers, risky asset portfolios, unstable and expensive funding, and with challenging low interest rate macroeconomic environment may point out that a rollercoaster ride of Czech credit unions has not yet ended.

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6 Appendix

6.1 Advisor's Pre-defense Report on Dissertation Thesis (prof. PhDr. Petr Teplý Ph.D.)

Note: advisor's text is in standard font, author's response is in *italics*.

Prof. Petr Teplý lists three recommendations in his report: i) to update references; ii) to expand General Introduction and add a brief analysis of the Czech credit unions industry in both qualitative (e.g., the legislation framework) and qualitative (e.g. financial statistics) terms in the recent period; iii) English proofreading of General Introduction and Chapter 4 is needed before submitting the final version of the thesis.

All these recommendations have been reflected in this final version of the thesis.

6.2 Opponent's Pre-defense Report on Dissertation Thesis (doc. Ing. Zdeněk Tůma CSc.)

Note: opponent's text is in standard font, author's response is in *italics.*

Matěj Kuc focused on a specific segment of the financial sector in this thesis, namely on the sector of cooperative banks/credit unions. This focus is valuable as the economic research deals primarily with the banking sector in general, or commercial banks. The structure of owners as well as the corporate governance is different and it might have implications to the performance of cooperative banks vis-à-vis their commercial peers.

The thesis consists of four published papers. The first one deals with the comparison of Czech and European cooperative banks; the second one is focused the performance of European commercial and cooperative banks; the third paper looks in detail at the cost efficiency and regulation of European cooperative banks and the fourth paper describes the development of this sector within the Czech financial system.

Let me mention some issues I would appreciate it if Matej could explain during his pre-defence.

1.   P. 18 – I am lost in his argumentation when he explains differences between the profitability of Czech and European credit cooperatives. ROAA is comparable, but ROAE is lower for Czech institutions. Matej argues that ROAE is lower for Czech cooperative banks compared to their European peers because the Czech ones have lower capital. But the opposite should be true: having higher denominator (return/equity), the ratio should be lower for European institutions. Matej argues with risk weights in portfolio, but these ratios are not risk adjusted so it should play no role. I may have missed something, I would be glad if Matej could explain it.

Median capital to asset ratios (CAR; not risk weighted) of Czech credit unions is more than two times higher than that of other European cooperative banks in the sample: 18.9% vs. 7.9% (see table 2.6 in the Appendix of the first paper). We know that ROAA profitability of both groups is comparable (from the same table). From these two facts is clear that ROAE of Czech credit unions is lower compared to

European cooperative banks.

What was misleading from my side, is that I mentioned in the same paragraph that despite Czech credit unions having more capital to assets (not risk weighted) their capital adequacy (risk weighted) is similar to that of European cooperative banks I just wanted to mention that Czech credit unions have higher risk weights density. Nevertheless, I did not put capital adequacy into the overview table (T2.6) for the majority of European cooperative banks lacked capital adequacy figures in the BankScope database so I just mentioned it in one sentence.

2.   P. 19, 27 & Figure 2.1: Depending of NIM on asset size of Czech credit unions – I do not think that this chart can be interpreted in the way how Matej presents. His interpretation is highly speculative and I have not found any arguments in the text for it. I cannot agree that the fact that credit cooperatives cannot provide mortgages must lead to riskier business such as real estate loans etc. They can provide standard loans to corporates and SME. The problem is that clients typically turn to (bigger) commercial banks and credit cooperatives take riskier clients. I do not think that this is about a product (mortgage), but rather about behavioral patterns (and the fact that cooperative banks do not have any tradition in the Czech financial system – the history 100 years ago does not have any relevance today).

The explanation in the thesis was misleading and imprecise indeed. Credit unions funding is expensive (they must offer high interest rates to attract clients and compensate for worse services compared to big Czech commercial banks – fewer branches, no ATMs, typically only basic internet banking, etc). Therefore, Czech credit unions need to focus on risky business to cover higher funding costs and be profitable. A typical borrower from a Czech credit union is a client whose loan application in a bank was rejected and who is willing to pay a higher margin to get a credit.

The positive size-NIM relationship in Figure 2.1 shows high risk appetite of bigger credit unions. To achieve NIM above 4% in 2013 when CNB repo was 0.05% for the whole year and moreover, credit unions bore non-zero funding costs means that loans needed to bear significant interest and hence be risky. The text was enriched to include this more thorough explanation.

3.   P. 20 – "… the CNB … revoked licences of only credit unions that expanded aggressively and belonged among largest institutions …" Really? E. g. MPU and Creditas have managed the expansion successfully and were transformed into banks later on.

The article was originally written in 2014-2015 and this statement referred to revoked licences of credit unions that grew fast and belonged among the biggest on the market when they lost their licences at that time - specifically Unibon (2012), MSD (2014) and WPB (2014). Nevertheless, the statement in the paper was misleading and was explained with a footnote.

Moreover, the thesis is supplemented with expanded Introduction section focused on recent development on Czech credit union market to cover e.g. both succeffull transformations of credit union into banks mentioned by the opponent (MPU transformed into bank in 2019 and Creditas in 2017). See Section 1.1 Recent development of Czech credit union sector.

4.   Model does not capture the role of increasing regulation, which was tightening more in the Czech Republic as compared to other European countries (based on the move of regulation from the Finance Ministry to the Czech National Bank). It may influence the interpretation of results, primarily in terms of "lower stability of the Czech credit unions".

As mentioned above, this paper of the thesis was written before the new Czech regulation of credit unions came to force. The thesis was supplemented with an expanded Introduction section discussing the impact of new Czech credit union legislation (Section 1.1.1 Novel of Czech Act of credit unions, 2015).

5.   In the part 3, dealing with the comparison of profitability between commercial and cooperative banks (in low interest rate environment), there is one of major conclusions that (smaller) banks create lower provisions than cooperative banks. There are two arguments: (i) banks are more focused on profit, and credit cooperatives more on stability and that´s why cooperative banks maintain higher provisioning, (ii) regulators are more focused on larger banks and that´s why smaller banks have lower provisions and higher profit than larger banks.

I am not sure whether these conclusions are so straightforward: without the knowledge about the loan portfolio quality, we can hardly say whether lower/higher provisioning is appropriate. There is an unspoken assumption in the paper that the quality of portfolio develops in the same direction both in banks and credit cooperatives, but it does not have to be true. One can also argue that banks have stricter (credit) risk management and, therefore, provisioning is more flexible as compared to credit cooperatives. Secondly, the argument about higher profitability of smaller banks is questionable – typically larger banks have higher profitability because they can better return per unit cost (economies of scale).

The papers of Bikker & Vervliet (2017) and Altavilla et al. (2017) suggest that lower provisioning may be a sign of dangerous window-dressing. Indeed, our assumption of the same portfolio quality of both cooperative and commercial banks was too strong even though both types of banks compete for the same customers on the same markets (Ayadi et al; 2010). The selected part of the paper will be rewritten and the statement of "unjustifiably decreased provisioning of the commercial banks" will be put forward only as a hypothesis that may be interesting to test in some future research. This is by the way a solution that also opponent prof. Witzany suggests.

Secondly, regarding the higher profitability of smaller institutions: Table 3.4 shows that we estimated a negative effect of the size of banks on ROAA and NIM and a statistically insignificant effect of size on ROAE. These findings are in line with e.g Bikker & Vervliet (2017) who found a negative effect of size on NIM and an insignisicant size effect on profit as a whole. The debate about the size-profitability of banks is quite extensive and one can find theoretical arguments explaining both the higher (e.g. economies of scale) and lower profitability (e.g. slow processes) of bigger financial institutions. A nice discussion about the size-profitability relation of financial institutions is provided by Shezead, De Haan & Scholtens (2013). Therefore, I do not find our findings about size and profitability to be in conflict with empirical findings.

Ayadi, R. et al. (2010). Investigating Diversity in the Banking Sector in Europe – Key Developments, Performance and Role of Cooperative Banks, CEPS.

Altavilla, C., Boucinham, M., Peydró, J. L. (2017). Monetary Policy and Bank

Profitability in a Low Interest Rate Environment. Centre for Studies in Economics and Finance, 486.

Bikker, J., Vervliet, T. (2017). Bank profitability and risk-taking under low interest rates. De Nederlandsche Bank WP, 560.

Shehzad, C. T., De Haan, J., Scholtens, B. (2013) The relationship between size, growth and profitability of commercial banks, Applied Economics, 45:13, 1751-1765, DOI: 10.1080/00036846.2011.637896

6.   A similar question arises in another paper "cost efficiency, size and regulation of European cooperative banks" where there is also the argument that smaller cooperative banks are more efficient than larger ones. Regarding the test of efficiency, it is based on the cost function (p. 75, eq. 4.1). But this function does not reflect the business model of the bank (e. g. a mortgage bank has typically extremely low C/I ratio). Why is the efficiency not measured/tested through RoA and RoE ratios? In this respect, there is an interesting remark (p. 82) that "higher RoA is connected with higher inefficiency"?! In my view, managers of banks are interested in the cost efficiency just because it is an important parameter for profit maximization. From this point of view, the conclusion that "market consolidation is therefore harmful for efficiency … of cooperative banking system" does not make much sense: the objective function of the private company is profit, and the efficiency is just one input in this exercise.

In this paper, we focused solely on the cost efficiency of cooperative banks. Profit is typically not the only purpose for cooperative banks to exist. There are plenty of reasons for a cooperative bank to be more cost efficient than its larger peers, e.g. using information advantage in the community (Guinnane; 1993), not suffering from dispersed ownership to the same extent as bigger cooperatives (Bech, Bolton and Röell; 2002). Gortonac & Schmid (1999) showed in the sample of Austrian cooperative banks that the financial performance of larger cooperatives is inferior compared to the smaller ones.

Of course, banking efficiency may be measured by simply comparing financial ratios (such as C/I). RoE and RoA are rather used as measures of profitability than efficiency. Moreover, we explained that profitability is typically not the main purpose

of cooperative financial institutions (that is why they are sometimes called the double bottom line institutions).

We decided to follow recent empirical literature that estimates cost function and the extent to which banks deviate from optimal allocation. Bank outputs are represented by loans and deposits which is pretty common. Sometimes also investments/financial assets are used as the third outcome but we did not include this variable since this is not the most typical output of cooperative banks (in fact, financial investments for cooperative banks are often restricted in individual countries).

High RoA may indeed be connected with cost inefficiency – an institution may not be forced to pursue cost optimization to the same degree in good times (cost-cutting programs are rather typical for crises times when RoA goes down).

I agree with your statement that "the objective function of the private company is profit, and the efficiency is just one input in this exercise". Yet a highly profitable company may not be the most cost efficient one and profit is not the sole purpose of cooperative banks.

Becht, M., Bolton, P., Röell, A. (2002). Corporate Governance and Control. European Corporate Governance Institute - Finance Working Paper, No. 02/2002.

Gortonac, G., Schmid, F. (1999). Corporate governance, ownership dispersion and efficiency: Empirical evidence from Austrian cooperative banking. Journal of Corporate Finance. Volume 5, Issue 2, pp. 119-140.

Guinnane, T. W. (1993). Cooperatives as Information Machines: The Lending Practices of German Agricultural Credit Cooperatives, 1883-1914. Economic Growth Center Yale University. Center Discussion Paper, No. 699.

7.   In the last chapter of the thesis, Matej discusses the rebirth of credit cooperatives in the Czech financial sector after 1990. He explains that due to poor legislative framework and insufficient supervision, this sector has gone through a crisis period when the number of these institutions has shrunk substantially. He also emphasizes that the core principles of cooperative banking were not respected. But there might be another explanation for the quite unsuccessful attempt to rebuild the

sector of credit cooperatives: these types of institutions belonged to the previous century and do not have a place in today´s banking. The fact that they still operate in some countries does not mean that it can be replicated in other countries; checks are still massively used in the US but they are an archaic financial instrument which has not found its way into modern banking systems.

Yes, it is a very good remark that the attempt to resurrect Czech credit unions at the end of the 20th century is problematic also from the fact that the reasons for the emergence of credit unions are long gone. I plugged this remark into section 5.3.3 Credit unions reborn, 1995+. Moreover, updated literature review in Section 1.2 shows that the financial performance of Polish credit unions is similarly problematic.

I appreciate the focus of Matej Kuc´s thesis as there is not much research in the area of cooperative banks. It is also true that this segment was new for the Czech financial system and has been undergoing a very volatile development both in terms of regulation and efficiency. Thus, the contribution of this research is valuable and brings better understanding of this sector. Matej has contributed to papers independently and provided relevant references. I believe that the thesis is defendable at the IES FSV UK presuming that Matej will respond to aforementioned comments and questions in this report. The papers have been published so that I consider this requirement fulfilled. My overall assessment of Matej Kuc´s thesis is affirmative and I recommend the thesis for defence presuming appropriate responses to my comments and questions.

6.3 Opponent's Pre-defense Report on Dissertation Thesis (Prof. David Tripe Ph.D.)

Note: opponent's text is in standard font, author's response is in *italics*.

1.   The current form of this thesis is, unfortunately, something of a disappointment, and there are a number of issues which would seem to need to be addressed before it could be successfully defended. I can appreciate that the writing of a thesis takes time, and that this has been written over a number of years, but it is somewhat surprising to find a series of predictions being made based on data covering the period 2006 to 2013 (as in Chapter 2 of the thesis) with no commentary in a conclusion, summary chapter or elsewhere as to whether the predictions have been validated by experience over the subsequent period of almost 10 years. Is there any impact from the new regulations that came into effect in 2015? Alternatively, this chapter might be updated, but with a note retained to the effect that an earlier version of the chapter had been published as detailed. I am surprised, in fact that the referees of the version that was published in 2018 did not require some comment on this.

The General introduction of the thesis is now extended by section 1.1 Recent development of Czech credit union sector. This section covers new legislation and its impact on the credit unions sector. Further, it describes cases of credit unions that managed to change their legal status into commercial banks, credit unions that went bankrupt, and also it provides financial statistics of remaining credit unions.

2.   Along with the minor issues and questions that I will comment on further below, there are some other major issues that need to be addressed. It is difficult to assess the quantum and quality of literature referred to without there being a single list across the whole thesis (an issue which must be addressed), but it is my impression that the examination and review of prior research is not sufficient or adequate (another issue which needs to be addressed). Too low a proportion of the references cited would seem to be from refereed sources.

The author saw both options used in Ph.D. theses of other students: 1) a complete list of references at the very end of the thesis or 2) references after each of the papers presented in the thesis. I considered the latter as more user friendly. Of course, I

have no problem presenting a complete list at the end of the thesis as well. Therefore, please find a complete list of references in section 6.5.Bibiliography.

Moreover, along with the update on the Czech credit unions sector, references were updated as well. Since the papers Sections 2 and 5 were written in 2014 and 2015 respectively, there is a need to update references to provide a reader with the most up to date empirical information about cooperative banking performance. The paper in the Section 3 of the thesis was published in 2022 and its references are up to date. The paper in the Section 4 is still in a working paper phase and therefore, its literature review is updated directly in its text.

Compared to the pre-defense version of the thesis, more than 50 sources (mainly refereed ones) were added.

3.   A key point on which some clarification is required is in terms of the distinction between cooperative banks and credit unions (or are they regarded as the same?). Although both types of organisations are cooperatives, they are generally subject to differing regulatory regimes, which are likely to impact on their performance. Is it therefore reasonable to compare Czech credit unions with cooperative banks in other European countries?

The main difference between credit unions and commercial banks is that credit unions typically provide financial services only to their members whereas cooperative banks may also service non-member clients. From this point of view, credit unions can therefore be seen as a subset of cooperative banks. For more details regarding the definition of a credit union please see WOCCU (2015).

Indeed, there is not a single model for cooperative banking in Europe and they differ from country to country (see e.g. Ayadi et al., 2000). Nevertheless, regulatory environment such as capital, liquidity, or interest rate risk management requirements are derived from Basel II (and later Basel III) accords that are common to institutions across all surveyed EU countries (Coelho, R. et al., 2019). Of course, proportionality is embedded in the regulatory frameworks (for details see Hohl et al. 2018). Therefore, we believe that the comparison of Czech credit unions with cooperative banks in other European countries is reasonable.

Coelho, R. et al. (2019). Regulation and supervision of financial cooperatives. FSI Insights on policy implementation, No 15. Financial Stability Institute (FSI) of the Bank for International Settlements (BIS)

Hohl, S. et al. (2018). The Basel framework in 100 jurisdictions: implementation status and proportionality aspects. FSI Insights on policy implementation, No 11. Financial Stability Institute (FSI) of the Bank for International Settlements (BIS)

WOCCU (2015). Model Law for Credit Unions. World Council of Credit Unions.

4.   It is noted (page 13) that there may be a lack of prior empirical studies on the financial performance of credit unions in the new EU member states. It would be worth looking at the literature on microfinance institutions, some of which are not much different from more orthodox credit unions in their operation.

This is a good point. I was of course studying microfinance and credit unions' performance in other regions. I find such institutions in the developing world too dissimilar from the credit unions of the new EU member states. The regulatory framework and the practical problems of the institutions are too distant in my eyes. The members of the credit unions in the new EU member states do not suffer from inaccessible financial services etc. I also surveyed credit unions in North America (see Kuc, 2019). Still, from the economic, historical, and cultural context, I believe that if there is a lack of empirical studies on the financial performance of credit unions in the new EU member states, then the performance of cooperative banks from Western Europe is the best proxy.

Kuc, M. (2019) Performance Comparison of Cooperative Banks in the EU, USA and Canada, Proceedings ICEBI 2019: International Conference on Economics and Business Innovation.

5.   The data set reported in Table 2.2 is quite limited in its scope (8 countries with only one institution), which raises issues as to its usefulness, especially as a rather broader sample is shown in Table 3.2 (which shows much larger numbers of banks for Austria, France and Spain in particular). Some comment is required. I was also somewhat concerned about the deletion of banks from Italy and Germany: the way in which this is addressed in Chapter 3 of the thesis (page 52) looks preferable,

noting that in the latter case the effects of the deletions are tested. Table 4.1 provides yet another grouping of banks to include in Chapter 4.

The reason that so many countries are represented by only one cooperative bank is because of historical development. In these countries, individual cooperative banks merged and formed only one cooperative bank (such as OP Pohjola in Finland). In some countries, cooperative banks remained more dispersed (such as in Italy and Germany). An extensive overview including the historical development of cooperative banking sectors is presented by Ayadi et al. (2010).

I checked the BankScope database (the primary source of bank level data we use) and the reason that we have more cooperative banks in a paper in Section 3 compared to the paper in Section 2 is data availability. Both papers cover different period (2006-2013) vs. (2009-2015) and fewer bank data are included in the database for more distant years. A comment will be added to the paper as well. Similar logic applies to the number of banks in Table 4.1: the number of banks differs based on bank level data availability (different time frames and variables used for Stochastic Frontier Analysis).

Regarding the deletion process of banks from Italy and Germany: the description of the process in Chapter 2 was reworked according to Chapter 3 as advised. The mention of robustness tests results was also added to the text.

Ayadi et al. (2010). Investigating Diversity in the Banking Sector in Europe – Key Developments, Performance and Role of Cooperative Banks. Brussels: CEPS.

6.   I am a little surprised by the dispersion in size of Czech credit unions shown in Figure 2.1, in light of the comment on page 14 to the effect that Czech credit unions typically have branches all around the country. Some of the credit unions in the sample seem to be extraordinarily small, and I wonder how diversified their loan portfolios are.

Despite the largest credit unions either transformed into banks (Creditas in 2017 and MPU in 2019) or came out of business (MSD and WPB both in 2014), the current largest credit unions (asset size ca. CZK 2bn, i.e. EUR 80m) still operate in multiple

branches. Ney credit union has three branches as of 11/2022 (in Prague, Brno and Havlíčkův Brod) and Artesa has two (in Prague and in Ostrava).

7. Some discussion is also required of the equity in Czech credit unions. Internationally, credit union equity is generally derived only from retained earnings, with member shares being treated as deposit liabilities (acknowledging that they are generally repayable to members on demand). This does not seem to apply to the Czech credit unions in this case. Is there some rule for determining the split between deposits and equity? Does this account for the low proportion of retained earnings in equity (page 20)?

To use the financial services of the Czech credit union, one has to become a member of a union. One of the prerequisites of becoming a member of a credit union is to pay a membership share (it is an equity, not a liability). It is paid back to you only when you terminate a membership (under the condition that the Czech National Bank (regulator) agrees with paying out the equity). When you are a member of a credit union, you can place deposits (liabilities) there.

The majority of credit unions charged only an insignificant amount of money for membership shares, not to deter potential members. Seven out of eleven credit unions charged CZK 100 (ie. ca EUR 4) or less for their membership shares (the novel of the credit union law increased minimal membership share price to CZK 1 000 to stop this practice since 2018).

The balance sheet size of the four biggest credit unions increased 22 times in just 8 years between 2006 and 2013. Two of them (ANO and MPU) had negative net income throughout the period. Possibly, because they prioritized growth over current financials. Moreover, Czech credit unions are young, most of them started to operate in the late 1990s or at the beginning of 2000s. They, therefore, did not have time to accumulate retained earnings. These are the main reasons why retained earnings of Czech credit union sector formed only 3.6% of the equity in 2013. This is in sharp contrast to typical banking institutions, where retained earnings form the most significant part of their capital.

Most of the equity, therefore, comes from additional membership shares. Additional membership shares formed more than 90% of the equity of Czech credit unions in

2013. This is one of the reasons why we claim that Czech credit unions resembled rather small and more risky commercial banks than financial cooperatives.

8.   An implication of this is that, if some of the equity is not really equity, the already low Zscores (which have equity in the numerator of the ratio) of the Czech credit unions would be even lower!

I hope I managed to explain the differences between the equity and liabilities of Czech credit unions in the previous comment. This should have clarified that the equity in the numerator of Z-score is used correctly in this case.

9.   Rather than using a working paper to identify the persistence of bank profitability (page 21), reference should be made to Berger et al (2000a), which is published in a high reputation journal.

The reference was adjusted accordingly.

10.   Is some comment warranted on the low R2 statistics shown in Table 2.4. Is there some other factor that impacts on variability?

Our FE model in Tabel 2.4 shows R-sq. 0.21. We used also OLS and RE methods for comparative purposes. They show R-sq. 0.22 and 0.10 respectively.

The surveyed studies have the following R-sq: Beckmann's (2007) FE models have R-sq of 0.26 and 0.34 respectively. Köhler's (2012) FE model has R-sq 0.35. Hesse and Čihák (2017) have average R-sq. of 0.10, Beck et al. (2009) of 0.19 and Iannotta et al. (2006) have average R-sq. of 0.40 (ranging from 0.19 to 0.58). Goddard et al (2010) do not publish R-sq.

From this survey, it is clear that our R-sq. is slightly below the average of presented studies but it does not differ significantly. It is quite typical for studies focused on banking financial performance to have similarly low R-sq. statistics because there are a lot of factors (variables) that do affect the performance of such complex institutions as banks. There is always a trade-off between the size of a sample (nr. of banks) and the amount of details that we know about them (variables available). The comments were incorporated into the thesis.

Beck, T. et al. (2009). Bank Ownership and Stability: Evidence from Germany. WP, Deutsche Bundesbank.

Beckmann, R. (2007). Profitability of Western European banking systems: panel evidence on structural and cyclical determinants. Deutsche Bundesbank. Discussion Paper, No. 2007/17.

Goddard, J. et al. (2010). Do bank profits converge? European Financial Management.

Hesse, H., Čihák, M. (2007). Cooperative Banks and Financial Stability. IMF WP, No. 07/02, Washington D.C.: IMF.

Iannotta, G. et al. (2007). Ownership Structure, Risk and Performance in the European Banking Industry. Journal of Banking and Finance, Vol. 31/7, pp. 2127-2149.

Köhler, M. (2012). Which banks are more risky? The impact of loan growth and business model on bank risk-taking. No. 33/2012, Deutsche Bundesbank.

11.   In Chapter 3, I am surprised that loan loss provisions can be discussed without a discussion of what is required by accounting standards (and auditor response to these). The effects of the difference in governance arrangements make sense, but it would be good to have clarification of whether all the commercial banks are publicly listed (and thus more impacted by a need to report to markets which may be impacted by short-term performance measures). This discussion would also have been enriched by some discussion of the relevant literature.

We did not have the aspiration to go into any deeper discussion regarding accounting or regulatory treatment of credit loan provisioning of European banks. The reason is that we wanted the paper to be concise.

The International Accounting Standards Board (2014) published International Financial Reporting Standard (IFRS) 9 standards in 2014. These standards require the use of forward looking approach to credit risk - expected credit loss (ECL).

The regulatory treatment of loan loss provisions and the differences between accounting and regulatory view on loan loss provisions is described in Basel Committee on Banking Supervision (2011; 2016; 2017). All the banks in the sample have to follow the same accounting and regulatory standards. There is indeed some degree of discretion that allowed for local supervisory lower (see e.g. IMF; 2014) but generally the conditions allow for effective comparison between banks from different European countries.

The Interal Ratings-Based (IRB) approach offers room for discretionary loan loss provisioning behaviour (see e.g. Jutasompakorn et al.. 2021). There is also evidence that banks decrease loan loss provisions in periods of low interest rates to maintain their profitability (Bikker & Vervliet, 2017; Altavilla et al., 2017; Brei et al., 2019). On the other hand, there is evidence that loan provisioning was substantially higher during the times when GDP growth was low (and therefore typically also interest rates) prior to usage of forward looking loan loss indicators – see e.g. Bikker & Metzemakers (2005) or Borio, Furfine & Lowe (2001), Lowe (2002).

No, all the commercial banks in the sample are not publicly listed.

Furthermore, our assumption of the same portfolio quality of both cooperative and commercial banks was too strong even though both types of banks compete for the same customers on the same markets (Ayadi et al; 2010). The selected part of the paper will be rewritten and the statement of "unjustifiably decreased provisioning of the commercial banks" will be put forward only as a hypothesis that may be interesting to test in some future research. This is by the way a solution that also prof. Witzany suggests.

Altavilla, C., Boucinham, M., Peydró, J. L. (2017). Monetary Policy and Bank Profitability in a Low Interest Rate Environment. Centre for Studies in Economics and Finance, 486.

Ayadi, R. et al. (2010). Investigating Diversity in the Banking Sector in Europe – Key Developments, Performance and Role of Cooperative Banks, CEPS.

Basel Committee on Banking Supervision (2011). Basel III: A global regulatory framework for more resilient banks and banking systems. Bank for International Settlements.

Basel Committee on Banking Supervision (2016). Regulatory treatment of accounting provisions. Discussion Paper. Bank for International Settlements.

Basel Committee on Banking Supervision (2017). Regulatory treatment of accounting provisions – interim approach and transitional arrangements. Standards. Bank for International Settlements.

Bikker, J., Metzemakers, P.A.J. (2005). Bank provisioning behaviour and procyclicality. Journal of International Financial Markets, Institutions and Money, Vol., pp. 141-157.

Bikker, J., Vervliet, T. (2017). Bank profitability and risk-taking under low interest rates. De Nederlandsche Bank WP, 560.

Borio, C., Furfine, C., Lowe, Ph. (2001). Procyclicality of the financial system and financial stability: issues and policy options. BIS Papers No. 1, 1-57.

Brei, M., Borio, C., Gambacorta, L. (2019). Bank intermediation activity in a low interest rate environment. BIS WP, 807.

International Accounting Standards Board (2014). IFRS 9 Financial instruments. International Financial Reporting Standards

IMF (2014). Supervisory Roles in Loan Loss Provisioning in Countries Implementing IFRS. International Monetary Fund Working Paper WP/14/170.

Jutasompakorn, P., et al. (2021). Impact of Basel III on the discretion and timeliness of Banks' loan loss provisions. Journal of Contemporary Accounting & Economics, Vol. 17, Issue 2.

Lowe, P. (2002). Credit Risk Measurement and Procyclicality, Monetary and Economic Department, Bank for International Settlements.

12. In the Chapter 3 regressions, I was surprised to see the inclusion of all three of the IBOR, Steep and Bond variables, as these are mathematically related to each other (and the correlations are relatively high). I would also expect a high degree of persistence in provision levels (as is observed), as it will often take more than one accounting period to clear a nonperforming loan.

Yes, I also suspected possible multicollinearity problems arising from these three market rate oriented variables based on common sense and the correlation matrix presented in Table 3.5. I also estimated several models with one or two of these variables left out (keeping only IBOR) to check how it will affect the results. Since the difference in the result was insignificant, I decided to keep all three variables (as discussed at the end of Section 3.3). They are all proxies for something different: IBOR for short term funding costs, steepness of the yield curve future expectations regarding rates, and finally yield on government bonds show long-term alternative investment opportunities for the banks.

13. Please confirm that the data set for Chapter 3 is a balanced panel (the description on page 51 is somewhat unusual in its expression).

Yes, it is a balanced data set. I will rewrite the mentioned part on that page to make it more clear.

14. Could I also suggest that Figure 3.1 should be described as showing the trend in the 1- month Euribor rate (the word "development" suggests a method of calculation)?

The caption of Figure 3.1 was changed.

15. It would have been interesting to have seen bank size tested for in Chapter 3, as smaller banks (a category which includes most of the cooperative banks) are not generally able to reduce their funding costs by as much as large banks in a very low interest rate environment.

The bank size variable is included in the regressions in Table 3.4. I am not sure about the lower ability of smaller banks to reduce their funding costs in a very low interest rate environment. Every bank in our database has access to ECB facilities (except for

24 Danish banks that are under Danmarks Nationalbank). The ECB's deposit facility was at -0.3% at the end of 2015. Deposits rates of the banks in our data sample are mostly floored at 0 (except for very large deposits and professional counterparties, ie. mostly financial institutions). Another possible source of funding is via own issues (covered bonds/pfandbriefe) are typically the cheapest ones). Smaller banks will have a disadvantage mainly in their own issues and in professional counterparties' deposit channels. Figure 6.1 shows interest expense per unit of liabilities (ie. a proxy for a cost of funds) in a relationship with the asset size of a bank (ln(As)) for data from 2015. Even from this simple data analysis, it does not seem that smaller banks have higher funding costs in a low interest rate environment.

Figure 6.1: Cost of funds and size of banks in 2015
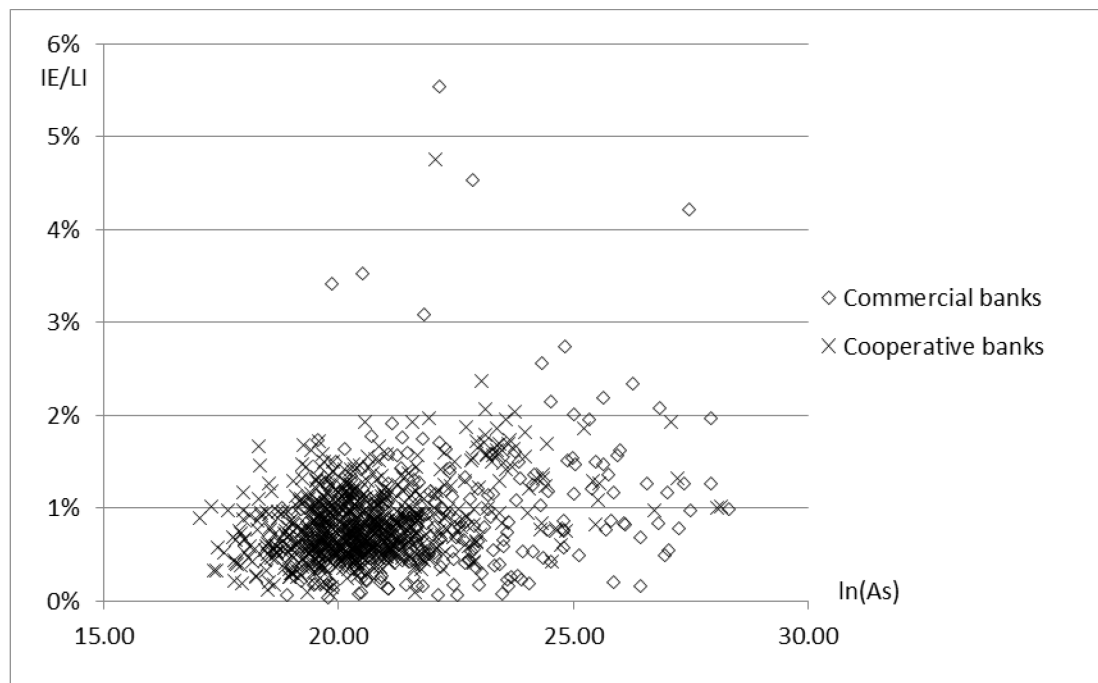
Source: Authors' calculation

16. Chapter 4 would also have been assisted by a more extensive and thorough literature review, including on co-operative banks (e.g Lang & Welzel, 1996). Cross-country studies often build on the foundation provided by Berger et al (2000b). Discussion of scale effects would be assisted by reference to Berger & Mester (1997) and Hughes & Mester (2013). Despite this, the methodological approach followed is generally consistent with the usual approaches in the literature (even if the price of labour is in fact measuring non-interest costs more broadly).

As the literature on banking efficiency is quite extensive, we tried to be as concise as possible in the previous version. Now, we enriched the literature review section with the abovementioned papers (thank you for the suggestions) and moreover by ca. 15 more studies focused on the size-efficiency relationship and the effects of regulation on cooperative banks.

17.   I was surprised, however, by the relatively limited amount of variation in inefficiency over time, and relative to size, shown in figures 4.1 and 4.2. Why should ROA be a right-hand side variable impacting inefficiency, as per equation 4.3?

Let us transform our inefficiency estimates in a way that the highest efficiency is equal to 1 and the lowest one to 0. Then we have a standard deviation of this transformed efficiency equal to 0.0576 which is higher compared to the findings of Aiello & Bonanno (2015) who compute standard deviation of cost (in)efficiency of Italian banks 0.0247 in their paper using this very approach. It is also comparable (in some models higher, in some smaller) with standard deviations of cost inefficiencies published by Bos et al. (2005) (0.042 – 0.079).

ROA, or similar profitability measures such as ROE, are often included as explanatory variables for inefficiency estimates using the SFA method. Profitability is a measure of bank performance or e.g. Lensink (2008) sees ROA also as a measure of management efficiency which of course influences general bank cost efficiency. The theoretical argumentation of the positive ROA–inefficiency relationship is that the banks with higher profitability of assets may not be forced to pursue cost minimization to the same extent as the less profitable banks. On the other hand, high profitability may be caused by overall good management of a bank and therefore high ROA may also decrease inefficiency. Econometric models give mixed results. Nevertheless, ROA (or other profitability measures) is often used in inefficiency estimates "on the right hand side" (see eg. Carbo et al., 2002; Lensink, 2018; Spulbar, 2014 or Perera, 2007).

Aiello, F., Bonanno, G. (2015). Bank efficiency and local market conditions. Evidence from Italy. Journal of Economics and Business 83, pp. 70–90.

Bos, J., et al. (2005). Inefficient or just different? Effects of heterogeneity on bank efficiency scores. Deutsche Bundesbank Discussion Paper Series 2: Banking and Financial Studies No 15/2005.

Carbo, S., J. Williams, and E. P. M. Gardener (2002). Efficiency in Banking: Empirical Evidence from the Savings Banking Sector, The Manchester School, 70, 204–28.

Lensink, N., Meesters, A., Naaborg, I. (2008). Bank efficiency and foreign ownership: Do good institutions matter? Journal of Banking & Finance, Vol. 32, pp. 834-844.

Perera, S., Skully, M., Wickramanayake, J. (2007). Cost Efficiency in South Asian Banking: The Impact of Bank Size, State Ownership and Stock Exchange Listings. International Review of Finance, Vol. 7:1–2, pp. 35–60.

Spulbar, C., Nitoi, M., Anghel, L. (2015). Efficiency in Cooperative Banks and Savings Banks: A Stochastic Frontier Approach. Romanian Journal of Economic Forecasting, Vol. XVIII (1), pp. 5-21.

18.   The last sentence of the second to last paragraph on page 83 ("Nevertheless studies in our literature survey…..") discusses some issues around recent financial regulation, which I would be interested to see explained at greater depth.

The abovementioned sentence is referring to the last but one paragraph of Section 4.2 Literature review where outcomes of five papers were discussed in the small defence version of the thesis. I will go through their findings in a little bit more detail here in the following paragraphs. Furthermore, we enriched the literature review section with several more papers that tackle the effects of recent financial regulation on small institutions of cooperative origin.

The studies of Schupp & Silbermann (2017), Domikowsky, Hesse & Pfingsten (2012), Reifschneider (2016), Reifschneider (2016), Fischer (2017) focus on the impact of Basel III on European cooperative banks. Fischer (2017) focuses on interest rate risk measures, Schupp & Silbermann (2017) on liquidity risk, and finally Domikowsky, Hesse & Pfingsten (2012) and Reifschneider (2016) on both capital adequacy and liquidity risks.

Schupp & Silbermann (2017) focus on Basel III's NSFR. They show that German cooperative and savings banks benefit from financing their loans with stable deposits and that a higher share of stable deposits lowers the probability of financial distress. The introduction of the NSFR is therefore expected to support the financial health of cooperative and savings banks, although it may be hard for them to comply with the ratio. For commercial banks which are more heterogenous than cooperatives, no positive effect of stable funding was found.

Domikowsky, Hesse & Pfingsten (2012) show that German cooperative banks have problems with the acknowledgement of their specific forms of capital under Basel III capital requirements. Moreover, they argue that the NSFR and LCR liquidity ratios will impose additional competition on cooperative banks from the size of bigger banks and that it may endanger their business model and stability.

Reifschneider (2016) shows that Basel III's capital and liquidity requirements are difficult to achieve with the business model of a cooperative bank. He proves it on a set of Bavarian cooperative banks which as he claims do not otherwise face any existential threat.

Fischer (2017) shows that the definition of Basel III's sudden parallel 200bps yield curve downward shock is problematic mainly for small German cooperative banks and that such uniform regulation of interest rate risk on the European level that neglects cooperative business model could also jeopardize the culture of fixed interest financing for mid- and long-term loans for German SMEs.

Klomp and de Haan (2012) find that capital regulations of banks from the OECD countries have a higher impact on smaller banks, which are typically cooperatives or savings banks.

Domikowsky, Ch., Hesse, F., Pfingsten, A. (2012). Die neuen Eigenkapitalvorschriften nach Basel III – Was deutsche Kreditgenossenschaften erwartet. Zeitschrift für das gesamte Genossenschaftswesen, Vol. 62(2), pp. 89-102.

Fischer, M. (2017). The impact of financial regulation on business models of cooperative banks in Germany. Journal of Financial Transformation. vol. 46, pp. 116-127.

Klomp, J., de Haan, J. (2012). Banking risk and regulation: Does one size fit all? Journal of Banking & Finance, Volume 36, Issue 12, pp. 3197-3212.

Reifschneider, A. (2016). Eigenkapitalmanagement in Kreditgenossenschaften unter besonderer Berücksichtigung der möglichen Auswirkungen von Basel III, Zeitschrift für das gesamte Genossenschaftswesen, Vol. 64(3), pp. 165-184.

Schupp, F., Silbermann, L. (2017). The Role of Structural Funding for Stability in the German Banking Sector. Discussion Paper, Deutsche Bundesbank, No 03/2017.

19.   Chapter 5 provides an interesting account of the Czech credit union sector, but it would be interesting to be provided with some information on what has happened since 2012.

The introduction section of the thesis was extended by section 1.1 which covers recent information about the Czech credit union sector.

20.   There are also a few minor errors in English, correction of which would be desirable.

I will do my best to correct them.

<u>Summary:</u>

a) Can you recognize an original contribution of the author?

(1) There would appear to be an original contribution of the author.

b) Is the thesis based on relevant references?

(2) The thesis is based on relevant references, but there are not enough of these (reading does not appear to have been sufficiently wide) and too few of the references are from published refereed sources such as high-quality academic journals. The small number of additional references that I have listed below are not sufficient to remedy this deficiency. This is a factor which will limit the quality of journals in which publications can be achieved.

c) Is the thesis defendable at your home institution or another respected institution where you gave lectures?

(3) The limitations in the review of prior literature would make this thesis difficult to defend at my home institution or at other institutions for which I have conducted examinations. I would also expect some serious questioning of developments (in the Czech credit union sector in particular) subsequent to the period covered by the thesis.

d) Do the results of the thesis allow their publication in a respected economic journal?

(4) The results from the thesis have, for the most part, been published in journals, but a more thorough undertaking might have allowed for publication in journals of higher quality/ranking.

e) Are there any additional major comments on what should be improved?

(5) I have identified a number of points above where improvement should be undertaken.

f) What is your overall assessment of the thesis? (a) I recommend the thesis for defense without substantial changes, (b) the thesis can be defended after revision indicated in my comments, (c) not-defendable in this form.

(6) Significant revision would be required before this thesis could be successfully defended.

References:

Berger, A. N.; Bonime, S. D.; Covitz, D. M. & Hancock, D. (2000a). Why are bank profits so persistent? The roles of product market competition, informational opacity and regional/macroeconomic shocks. Journal of Banking and Finance. 24. 1203-1235.

Berger, A. N.; DeYoung, R.; Genay, H. & Udell, G. F. (2000b). Globalization of financial institutions: evidence from cross-border banking performance. Brookings-Wharton Papers on Financial Services. 23-158.

Berger, A. N. & Mester, L. J. (1997). Inside the black box: what explains differences in the efficiencies of financial institutions? Journal of Banking and Finance. 21. 895-947.

Hughes, J. P & Mester, L. J. (2013). Who said large banks don't experience scale economies? Evidence from a risk-return driven cost function. Journal of Financial Intermediation. 22. 559-585.

Lang, G & Welzel, P. (1996). Efficiency and technical progress in banking: empirical results for a panel of German cooperative banks. Journal of Banking and Finance. 20 (6). 1003-1023.

6.4 Opponent's Pre-defense Report on Dissertation Thesis (Prof. Jiří Witzany)

Note: opponent's text is in standard font, author's response is in *italics*.

The dissertation consists of an introductory chapter and four additional chapters corresponding to four papers, out of which the first two were published in impacted journals (Prague Economic Papers – JCR Q4, International Journal of Finance and Economics – JCR Q4, SJR – Q2), one as an IES Working Papers, and the last one in a reviewed journal (Procedia Economics and Finance).

The first paper compares profitability and stability of Czech credit unions with European cooperative banks based on a dataset from the period 2006-2013. The conclusions are not favorable for the Czech credit unions and the authors discuss possible reasons, in particular an unsuitable business model, or regulations not allowing credit unions to offer mortgages and pushing them to more risky loan products such as consumer loans or real estate investment loans. I have the following comments to the empirical study:

1)   The only variable used in the study to measure stability is the time varying z-score defined as

$$ZSCORE_{i,t} = \frac{ROAA_{i,t} + CAR_{i,t}}{\sigma(ROAA)_i}$$

where ROAA and CAR are time-varying, but the standard deviation is calculated over the whole sample period. In my opinion, this definition is problematic since it does not capture the dynamics of volatility which is a key factor of stability. In addition, the logic of z-score is that it should be predictive in terms of default probability, i.e. not using forward looking information in the definition. It is true that this approach is mentioned in Lepetit and Strobel (2013) as one of five possibilities (the standard approach having time dependent standard deviation of the asset returns), but they point out that this approach is very similar to the approach when ROAA is also taken as an average across the whole sample, i.e. when the dynamics of the z-score is almost fully determined only by the development of CAR. In my

opinion, by using the definition with fixed (*ROAA*) the study omits changing volatility of returns as an important factor of the credit union stability dynamics. Hence, the question is why the author did not use a more dynamic z-score definition or an alternative stability measure such as NPL ratio etc.?

Let us discuss the z-score approaches described in Lepetit and Strobel (2013) to justify our choice:

1) *Approach Z1 and Z2 - Boyd et al. (2006) and Yeyati and Micco (2007) are the ones using moving mean and standard deviation estimates for ROA and σ(ROA) and in the case of Boyd et al. (2006) also for CAR. They use a window of three years calculated for each period (ie. for (ROA) from 2000, they use ROA from years 2000, 1999 and from 1998). By using this approach, we would either shorten our time periodby two years, ie. from 2006-2013 to 2008-2013, or we would need to obtain bank level figures also from 2004 and 2005 to be able to compute figures for 2006. Problem is, that the database we use (BankScope) has significantly less data for these two years and our data sample would reduce quite significantly. This is one of the reasons why we started the analysis in 2006 – data available before this year is much smaller.*

2) *Approach Z3 – Hesse and Čihák (2007) is the one we used, ie. the one with fixed σ(ROA). The advantage of this measure is that it is the one most commonly used in our empirical literature survey and hence it allows for better comparison between the results. And moreover, it does not shorten the time-span of our analysis (or reduce the sample by leaving out the banks with no data). The disadvantage is the abovementioned omission of changing volatility of returns.*

3) *Approach Z4 – Boyd et al. (2006, section III.B) use "instantaneous" standard deviation estimates σ(ROA)=abs($ROA_{i,t}$-μ_{ROA}) where μ_{ROA} is calculated over the full sample and all time periods of all the banks in the data sample. CAR and ROA are computed using current period values.*

4) *Approach Z5 – is rather a theoretical one, since it has not been used in any study so far. This approach uses (ROA) and μ_{ROA} calculated over all periods and the current value of CAR. We do not see any value added in the inclusion of this approach of computing z-score in our thesis.*

We run the RE regressions using approaches Z1, Z3, and Z5 to define the z-score. Obviously, the results are slightly different because we changed nature of the dependent variable and in the case of approach Z1 also shortened the time span of our database (to get a window of three periods for (ROA)). Yet, we can find commonalities across all three approaches: Czech credit unions a have lower Z-score (CZ variable) and high unemployment has a negative effect on the z-score. Since our main focus is to assess the stability of Czech credit unions, different definitions of z-score did not change our results. Please see Table 6.1 for the results.

Table 6.1: Different Z-score approaches

Z-Score type	App. Z1		App. Z3 (used)		App. Z4	
Method	RE		RE		RE	
Constant	-76,7		96.67	**	-678.6	*
	(112.1)		(38.11)		(409.7)	
gr_As	-0,245	*	-0.305	*	-0.278	**
	(0,143)		(0.017)		(0.132)	
Liquidity	7.992		-0.121		6.909	*
	(4.874)		(0.257)		(3.741)	
LtD	-0.322	*	0.601	***	0.568	
	(0.186)		(0.201)		(3.011)	
LoansRatio	9.209	*	0.044		8.032	*
	(4.747)		(0.212)		(4.691)	
HHI	-153.9		66.56		-223.5	
	(756.8)		(65.69)		(557.8)	
GDPgr	-24.93		0.013		-12.45	
	(17.44)		(0.872)		(14.29)	
Unemployment	-1.836	***	-2.648	***	-5.529	***
	(0.134)		(0.445)		(0.720)	
Inflation	10.23		-1.873	**	16.00	
	(40.53)		(0.974)		(31.16)	
CZ	-40.98	**	-40.66	**	-66.56	**
	(21.43)		(23.95)		(28.31)	
Diagnostics						
Number of observations	1698		2264		2264	
Wald test	117	***	261	***	31.47	**
R-sq.	0.13		0.21		0.15	
Year dummies	Yes		Yes		Yes	

Note: * significant at 10%; ** significant at 5%, *** significant at 1%.

Source: Authors

Regarding alternative stability measures such as the NPL ratio. We find two main flaws in using the NPL ratio. The first one is that a significant share of cooperative banks in the BankScope database does not have information about the NPL ratio and therefore, we would lose a lot of information, mainly about small European cooperative banks. The second problem is that using the NPL ratio for Czech credit may overestimate their stability. The problem is that they are young institutions that are growing really fast – the balance sheet size of the four biggest Czech credit unions increased 22 times in just 8 years between 2006 and 2013. It usually takes some time for a loan to become non-performing and when a majority of loans were provided just recently, the NPL ratio should underestimate the problem compared to the almost constant balance sheets of European cooperative banks (their average asset growth rate is much smaller compared to Czech credit unions, see Table 2.6). Moreover, the CNB criticized Czech credit unions, e.g. MSD (see ČNB, 2013b) for underestimating credit risk so even from this point of view, the NPL ratio may be misleading.

Boyd, J., De Nicoló, G., Jalal, A. (2006). Bank risk-taking and competition revisited: new theory and new evidence. IMF Working Paper 06/297, Washington DC: International Monetary Fund.

ČNB (2013b). Metropolitní spořitelní družstvo ztratilo povolení. ČNB press release, published 18.12.2013, available here: https://www.cnb.cz/cs/cnb-news/tiskove-zpravy/Metropolitni-sporitelni-druzstvo-ztratilo-povoleni/.

Hesse, H., Čihák, M. (2007). Cooperative Banks and Financial Stability. IMF WP, No. 07/02, Washington D.C.: IMF.

Lepetit, L., Strobel, F. (2013). Bank insolvency risk and time-varying Z-score measures. Journal of International Financial Markets Institutions and Money, Vol. 25, pp. 73–87.

Yeyati, E.L., Micco, A. (2007). Concentration and foreign penetration in Latin American banking sectors: impact on competition and risk. Journal of Banking & Finance 31, 1633-1647.

2)   Table 2.1 suggests CAR as a possible independent variable, but it should not be definitely used due to the definition of z-score and the discussion above. Indeed, it is not reported in the final model, but the logic of its elimination is not explained.

This is a good remark. The explanation logic was missing in a small defence version of a thesis and now we put it there. The reason that CAR is left out from the model is obviously that CAR is a part of a definition of a z-score.

3)   The dataset consists solely of the credit unions that were active during the whole sample period 2006-2013. Does not this restriction cause a survivorship bias in the dataset? In particular, in case of Czech credit unions, those that have got into financial difficulties and defaulted in the period are omitted in the dataset. Are not those cases more important in terms of the stability analysis?

Yes, indeed it would be great to have in the data sample as well credit unions that ceased to exist during the observed time period. The problem is that their data are non-existent or not trustworthy. During the 2006-2013 period, three Czech credit unions ceased to exist. Two of them were absolutely marginal: Czech Deposit Guarantee Scheme paid together less than CZK 100 million for covered deposits of Vojenská Družstevní záložna and Úvěrní družstvo PDW together (see GSFT 2022). So the only material that failed Czech credit union during that time was Unibon which lost its licence in 2012. There is no available source of their data as they do not have a web page anymore where they would have published obligatory information required by the ČNB. The ČNB does not share such data with the public and Unibon's annual reports which can be found on the web of the Ministry of Justice do not contain all the information needed for the analysis. Moreover, the ČNB warned (ČNB, 2012b) that there are significant deficiencies and limit breaches in the business of Unibon and therefore, it is hard to assess to what extent are their figures trustworthy.

ČNB (2012). Odejmutí povolení záložně UNIBON - spořitelní a úvěrní družstvo. Press release from 8.3.2012. Czech National Bank. Available here: https://www.cnb.cz/cs/cnb-news/tiskove-zpravy/Odejmuti-povoleni-zalozne-UNIBON-sporitelni-a-uverni-druzstvo/

GSFT (2022). Výroční zpráva za rok 2021. Garanční systém finančního trhu.

4)	The second paper compares profitability of European cooperative banks and commercial banks in the low interest rate period 2009-2015. The main conclusions are that commercial banks are more profitable than the cooperative banks in the period, and on the other hand that the stability of the cooperative banks measured by the z-score (defined as in the first paper) is better than the stability of the commercial banks. The higher profitability of commercial banks appears related to the level of provisioning that is lower than in case of cooperative banks. The abstract and the conclusion emphasizes that "commercial banks unjustifiably decreased their loan loss provisioning in a low interest rate environment in order to maintain their profitability" as if this was one of the main empirical findings of the paper. However, I do not find this conclusion empirically supported, it seems to be just a subjective judgement or a hypothesis worth of further research. One can formulate alternate hypothesis such as that the low provisioning of commercial bank compared to cooperative banks is related to different regulatory or accounting rules, etc. Hence, the question is whether the paper does contain any empirical evidence supporting the finding on "**unjustifiably**" decreased provisioning of the commercial banks?

The papers of Bikker & Vervliet (2017) and Altavilla et al. (2017) suggest that lower provisioning may be a sign of dangerous window-dressing. We indeed made an assumption of the same portfolio quality of both cooperative and commercial banks which is too strong without empirical justification. Even though both types of banks compete for the same customers on the same markets (Ayadi et al; 2010). The affected parts of the paper were rewritten and the statement of "unjustifiably decreased provisioning of the commercial banks" will be put forward only as a hypothesis that may be interesting to test in some future research, just as suggested.

Ayadi, R. et al. (2010). Investigating Diversity in the Banking Sector in Europe – Key Developments, Performance and Role of Cooperative Banks, CEPS.

5)	The third paper analyses the efficiency of European cooperative banks and finds that smaller cooperative banks are significantly more efficient than the bigger ones, which is an interesting and important finding. The empirical study uses the method of Stochastic Frontier Analysis. The model is briefly described in equation (4.1), but some details seem to be omitted. In particular, the inefficiency term probability distribution needs to be clear specified in order to estimate the model. The

formulation "inefficiency is positive and it is independent and identically distributed with normal error" seems to be contradictory – a variable with normal error is not always positive, and the following statement "The inefficiency term of the composite error can be estimated using the formula by Jondrow et al. (1980)" appears to be rather an escape formulation when the estimation is done by a software package (not specified in the paper) and the author does not exactly know what is inside. The set-up of the SFA model is also puzzling, normally an output variable is on the left-hand side (explained) of the equation while input variables are on the left-hand side. Nevertheless, in the paper set up the right-side involves both input (funds, labor) and output (loans) prices and volumes. Could the author explain better the logic of the SFA equation and compare it with the more standard DEA approach used for banks?¨

The reason why there is not an output variable on the left-hand side of the SFA equation is that banking is an industry with multiple outputs. Therefore, a specification of production function is not feasible but we can transform the profit maximization problem (with output function) into a cost minimization problem (with cost function). Berger & Mester (1997) measure cost inefficiency as the distance between a bank's actual cost to the best practice bank's would-be cost when producing the same output under the same conditions. Cost inefficiency measures cost abundance compared to the most efficient bank (efficient cost frontier) because of allocative and technical inefficiencies.

The two most typical functions used for banking inefficiency measures are the Cobb-Douglass function and the translog cost function as described by Christensen, Jorgenson and Lau (1973). Kumbhakar and Lovell (2000) showed superior behaviour of translog cost function relative to traditional Cobb-Douglass functional form for SFA analysis. A detailed overview of functional forms is provided in Kumbhakar et al. (2015). The use of the translog cost function for measuring bank efficiency is common in the current empirical literature (see eg. Lensink, 2008; Aiello & Bonanno, 2015 or Havranek et al, 2016).

Empirical papers focused on banking efficiency use mostly two to three different outputs: volume of loans, volume of deposits, and sometimes also volume of financial assets. Since we are dealing with cooperative banks in our paper and typically, they are mostly focused on loan and deposit business, we use only these two output

measures. In fact, the use of financial assets for cooperative banks is restricted in some European countries, see Ayadi et al. (2010) for details. Therefore, a specific form of our cost function used to determine cost inefficiency is described in Equation (4.2). Again, similar functional forms derived from the translog cost function can be seen in the abovementioned empirical papers.

Composite error term $\epsilon_{ijt} = v_{ijt} + u$ from Equation (4.1) comprises of random error (v_{ijt}) and inefficiency term (u_{ijt}). The random error term (v_{ijt}) measures random effects and measurement errors. It is distributed as a standard normal variable. The random error term is also called random shocks term in some literature, eg. in Havranek et al. (2016). Cost inefficiency (u_{ijt}) is independent and identically distributed with a truncated normal distribution and therefore costs can never go below the frontier (for details see Berger, Hancock & Humphrey, 1993).

We can rewrite the abovementioned into: $v_{ijt} \sim iidN(0, \sigma_v^2)$, $u_{ijt} \sim N^+(e_{ijt}, \sigma_u^2)$ where e_{ijt} is inefficiency and it is further specified by Equation (4.3). The separation of the error term into two components for each observation is described in Jondrow et al. (1980). It is true indeed, that the model in the paper was introduced in too abbreviated manner and it should have been described more thoroughly. It is corrected in the current version of the thesis.

Now, let me focus on why we preferred the SFA method over DEA. The DEA method is a commonly used non-parametric approach for measuring bank efficiency. The method was developed by Charles, Cooper and Rhodes (1978). DEA is a linear programming method where a set of best practices forms frontier observations. The frontier is formed part by part by linear combinations connecting the best-practice observations. Non-parametric methods such as DEA attribute all the deviations from the efficient frontier to technical inefficiency. DEA does not require explicit specification of production or cost function. The drawback of DEA for our research is that it does not allow for random error. This is problematic especially for diverse datasets (such as ours) for it assumes no measurement or accounting errors, nor even luck that affects the performance because it affects the efficiency scores of all compared banks (Berger and Humphrey; 1997).

Fiorentino, Karmann and Koetter (2006) showed on the set of German banks that DEA is much more sensitive to measurement errors and outliers compared to parametric Stochastic Frontier Analysis (SFA). Our paper deals with a quite diverse dataset of almost 200 cooperative banks from 12 countries that differ significantly in size. Lensink, Meesters and Naaborg (2007) provide a summary table of techniques used in studies focused on estimating the efficiency of banks and DEA is rarely used in case the dataset is comprised of more than one country. Another extensive comparison of parametric and non-parametric approaches for measuring bank inefficiency is provided by Matousek & Taci (2004).

The SFA method was developed by Aigner, Lovell and Schmidt (1997) and was applied to banks in the work of Ferrier and Lovell (1990). For this paper, we use the SFA model by Battese and Coelli (1995) cost function and correlation of bank inefficiencies in a single step. The reason is that the two-step approaches suffer from biased coefficients as shown by Wang and Schmidt (2002). The Battese and Coelli (1995) model is probably the most widespread SFA model for measuring bank inefficiency (see eg. Lensink, 2008 or Aiello & Bonanno, 2015).

Aiello, F., Bonanno, G. (2015). Bank efficiency and local market conditions. Evidence from Italy. Journal of Economics and Business 83, pp. 70–90.

Aigner, D. J., Lovell, C. A. K., Schmidt, P. (1977). Specification and estimation of frontier production, profit and cost functions. Journal of Econometrics, Vol. 25, pp. 21–37.

Ayadi et al. (2010). Investigating Diversity in the Banking Sector in Europe – Key Developments, Performance and Role of Cooperative Banks. Brussels: CEPS.

Battese, G. E., Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Economics, Vol. 20, pp. 325–332.

Berger, A.N., Hancock, D., Humphrey, D.B., (1993). Bank efficiency derived from the profit function. Journal of Banking & Finance, Vol. 17, pp. 317–347.

Berger, A. N., Humphrey, W. C. (1997). *Efficiency of Financial Institutions: International Survey and Directions for Future Research. European Journal of Operational Research, Vol. 98, pp. 175–212.*

Berger, A.N., Mester, L.J., (1997ú. *Inside the black box: What explains differences in the efficiencies of financial institutions? Journal of Banking & Finance 21, 895–947.*

Charnes, A., Cooper, W.W., Rhodes, E. (1978). *Measuring the Efficiency of Decision Making Units. European Journal of Operational Research, 2 (1978), pp. 429-444.*

Christensen, L. R., Jorgenson, D. W., Lau, L. J. (1973). *Transcendental logarithmic production frontiers. Review of Economics and Statistics, Vol. 55, pp. 28-45.*

Ferrier, G., Lovell, C. A. K. (1990). *Measuring the cost efficiency in banking: Econometric and linear programming evidence. Journal of Econometrics, Vol. 46, pp. 229–245.*

Fiorentino, E., Karmann, A., Koetter, M. (2006). *The cost efficiency of German banks: a comparison of SFA and DEA. Deutsche Bundesbank Discussion Paper Series 2: Banking and Financial Studies, No 10/2006.*

Havranek, T., Irsova, Z., Lesanovska, J. (2016). *Bank efficiency and interest rate pass-through: Evidence from Czech loan products. Economic Modelling, Vol. 54, pp. 153–169.*

Jondrow, J., et al. (1980). *On Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model. Journal of Econometrics, Vol. 19, pp. 233-238.*

Kumbhakar, S. C., Lovell, C. A. K. (2000). *Stochastic Frontier Analysis. Cambridge University Press.*

Kumbhakar, S. C., Wang, H., Horncastle, A. P. (2015). *A practitioner's guide to stochastic frontier analysis using Stata. Cambridge University Press.*

Lensink, N., Meesters, A., Naaborg, I. (2008). *Bank efficiency and foreign ownership: Do good institutions matter? Journal of Banking & Finance, Vol. 32, pp. 834-844.*

Matousek, R., Taci, A., (2004). Banking efficiency in transition economies: Empirical evidence from the Czech Republic. Economics of Planning 37, pp. 225–244.

Wang, H. J., Schmidt, P. (2002). One-step and two-step estimation of the effects of exogenous variables on technical efficiency. Journal of Productivity Analysis, Vol. 18, pp. 129–144.

6)   The last paper is a rather historical and analytical overview and analysis of the Czech credit unions development and their current situation. Although it is not a more involved empirical study, the paper contains just a few figure and statistical tables, I like it a lot and consider it as an important contribution to the discussion on possible regulatory reforms of the domestic credit unions. I have only one technical remark or question: Table 5.3 shows the development deposits and assets of the credit union sector in 1996-2001. If assets are interpreted as total assets being equal to total liabilities, and if deposits are just part of liabilities, then assets should be larger than reported deposits. However, this is not the case in 1997 and significantly in 1999. Could the author comment the numbers?

The explanation why deposits (as part of liabilities) were higher than total assets is that the Czech credit union sector underwent a major crisis at that time and the equity of the sector as a whole was negative. As of the end of 2002, only 46 out of 127 Czech credit unions listed in the Register of Companies were in standard operation, others were in state of bankruptcy (ÚDDZ; 2003).

ÚDDZ (2003). Zpráva o činnosti a hospodaření Úřadu pro dohled nad družsteními záložnami za rok 2002. ÚDDZ, Prague, 2003.

To summarize, the answers to the "mandatory" questions are as follows:

g) Can you recognize an original contribution of the author? **Yes, there are original and valuable contributions of the author.**

h) Is the thesis based on relevant references? **Yes, it is based on relevant references**.

i) Is the thesis defendable at your home institution or another respected institution where you gave lectures? **Yes, the thesis would be defendable at my home institution.**

j) Do the results of the thesis allow their publication in a respected economic journal? **Three of the four papers have been published in respected economic journals and the fourth one, after possible improvements, can be also published in a good journal.**

k) Are there any additional major comments on what should be improved? **There are a few comments and questions requiring clarifications or improvements.**

l) What is your overall assessment of the thesis? **The thesis can be defended after revisions and/or clarifications indicated in my comments.**

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