Kuc, Matej

Working Paper

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IES Working Paper, No. 21/2018

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Suggested Citation: Kuc, Matej (2018) : Cost efficiency of European cooperative banks, IES Working Paper, No. 21/2018, Charles University in Prague, Institute of Economic Studies (IES), Prague

This Version is available at:
https://hdl.handle.net/10419/203199

Institute of Economic Studies, Faculty of Social Sciences
Charles University in Prague

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Matej Kuc

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Institute of Economic Studies,
Faculty of Social Sciences,
Charles University in Prague

[UK FSV – IES]

Opletalova 26
CZ-110 00, Prague
E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Institut ekonomických studií
Fakulta sociálních věd
Univerzita Karlova v Praze

Opletalova 26
110 00 Praha 1

E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Bibliographic information:
Kuc M. (2018): "Cost Efficiency of European Cooperative Banks" IES Working Papers 21/2018. IES FSV. Charles University.

Cost Efficiency of European Cooperative Banks

Matej Kuc[a]

[a]Institute of Economic Studies, Faculty of Social Sciences, Charles University in Prague, Smetanovo nábreží 6, 111 01 Prague 1, Czech Republic
Email (corresponding author): matejkuc@seznam.cz

September 2018

Abstract:
This paper investigates the size–efficiency relation of European cooperative banks during the 2006-2015 period. We employ the Stochastic Frontier Analysis in order to obtain inefficiency estimates and its determinants on the set of 183 cooperative banks from 12 European countries. This work extends the existing literature by focusing on shape of size-efficiency relationship and examining also the post-crisis period after the fall of Lehman Brothers in 2008. 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. Interestingly, inefficiency remained roughly stable during the whole observation period without any substantial changes, not even on sub-samples of individual countries. These results imply that no significant consolidation of European cooperative banks can be expected in the near future. We conclude that for cooperatives, it is more efficient to remain small in size rather than to expand. From a policy perspective, we recommend regulators to reflect special nature of cooperative banks and allow them to operate at a small scale enabling their efficiency. As a result, we believe that one-size-fits-all regulation is harmful for efficient operations of cooperative banks in Europe.

JEL: D24, D61, E23, G21
Keywords: cooperative banking, efficiency, EU, Stochastic Frontier Analysis

Acknowledgements: This research was supported by the Grant Agency of Charles University in Prague (project No. 488317).

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1 Introduction

Cooperative banks are financial institutions owned by its customers. Every customer (called a member) of a cooperative bank has the same voting power on a general meeting. Ownership model of cooperative banks is originally tailored for relatively small institutions. Nevertheless, cooperative banks has grown over time, some becoming the largest players on European banking market. 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 loose information advantage arising from 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 relation between size and efficiency of European cooperative banks. Our hypothesis is that bigger cooperative banks are less cost efficient than the 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 in between years 2006 and 2015.

The outcome of the analysis helps to explain whether we can expect consolidation on the cooperative banking market in the future because it is more efficient to be bigger, or whether setup of multiple small cooperatives is optimal. We also test whether there is a change in inefficiency-size relation over time. Another value added of this study is focus solely of cooperative banks and inclusion of post-crisis data in the sample. Moreover, we would like to discuss the convenience of current regulation on small-sized cooperative.

The structure of the paper is as follows: Section 2 contains literature review providing theoretical arguments for (dis)economies of scale in cooperative banking and also empirical evidence. Further, we provide a review of papers dealing with regulatory impacts on small-size banks. We describe our methodological approach, model setup and variables selection in Section 3. In Section 4 we focus on data used and describe their origin and perform descriptive statistics. Section 5 provides empirical results and findings. Finally, we conclude the paper in Section 6.

2 Literature review

There are plenty of papers investigating efficiency of banks. We focus this literature review on papers investigating the size-efficiency relationship, particularly of cooperative banks. We

provide the reader theoretical arguments as well as empirical evidence that the balance sheet size has impact on bank efficiency. Further, we present studies researching impact of recent financial regulation on small banks, again with focus on cooperatives.

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

The bigger the cooperative bank, the more dispersed its ownership. Dispersed ownership is 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 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 institution 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.

The empirical evidence on size-efficiency relation outside of the USA is mixed. Barros, Peypoch and Williams (2010) used 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 period respectively. Spulbar, Nitoi and Anghel (2015) investigated cooperative and savings banks in nine EU countries in 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.

According to this 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.

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

To sum up, the studies mentioned in our review provide several arguments both for and against positive relation between size and efficiency of cooperative banks. It seems that large American credit unions are more efficient than their smaller peers. This relation 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 time frame in the data sample. We presented several studies pointing to difficult implementation of recent regulatory standards for smaller institutions, and for smaller cooperative banks particularly.

3 Methodology

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 more rigorous approach of efficiency frontier analysis. The work of Farrell (1957) laid the basics of current efficiency studies on micro level by allowing the company to depart from optimal input-output allocation and hence to operate below 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 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 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 a way how they differentiate random error from inefficiency. Distribution free approach (DFA) assumes constant inefficiency of each bank over time. Fries and Taci (2014) claim that this assumption as 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 important technological changes, such as massive digitalization take place (see e.g. Aspara, Rajala and Tuunainen (2012)). Therefore, we decided to use 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 will use model of Battese and Coelli (1995) which estimates the cost function and correlation of bank inefficiencies in a single step. 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. Using duality theorem, we can transform profit maximization into cost minimization problem. The general form of cost function within Battese and Coelli (1995) model is

$$y_{ijt} = \alpha + X'_{ijt}\beta + Z'_{jt}\gamma + \epsilon_{ijt}\ where\ \epsilon_{ijt} = v_{ijt} + u_{ijt}, \quad (1)$$

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 comprising of random error (v_{ijt}) and inefficiency term (u_{ijt}). Random error is distributed as standard normal variable and inefficiency is positive and it is independent and identically distributed with normal error. The inefficiency term of the composite error can be estimated using the formula by Jondrow et al. (1980).

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

$$\begin{aligned}
\ln\left(\frac{TC_{ijt}}{P_{l,ijt}}\right) = {} & \alpha + \beta_1 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right) + \beta_2 \ln\left(loans_{ijt}\right) + \beta_2 \ln\left(depos_{ijt}\right) \\
& + \beta_3 \frac{1}{2}\left(\ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right)\right)^2 + \beta_4 \frac{1}{2}\left(\ln\left(loans_{ijt}\right)\right)^2 \\
& + \beta_5 \frac{1}{2}\left(\ln\left(depos_{ijt}\right)\right)^2 + \beta_6 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right)\ln\left(loans_{ijt}\right) \\
& + \beta_7 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right)\ln\left(depos_{ijt}\right) + \beta_8 \ln\left(\frac{P_{f,ijt}}{P_{l,ijt}}\right)\mathrm{T} \\
& + \beta_9 \ln\left(loans_{ijt}\right) ln\left(depos_{ijt}\right) + \beta_{10} \ln\left(loans_{ijt}\right) T \\
& + \beta_{11} \ln\left(depos_{ijt}\right) T + \beta_{12} T + \beta_{13} \frac{1}{2} T^2 + \beta_{14} GDP_{lvl,jt} \\
& + \beta_{15} GDP_{gr,jt} + \beta_{16} YLD_{jt} + \beta_{17} HHI_{jt} + \epsilon_{ijt}\ where\ \epsilon_{ijt} \\
& = v_{ijt} + u_{ijt}
\end{aligned} \quad (2)$$

where TC stands for total costs of a bank in EUR. We use two input prices: price of funds P_f and price of labor P_l. Price of funds is interest paid on unit of interest bearing funds and price of labor is, similarly as in Lensink, et al. (2008), ratio of administrative expenses to total assets. Total costs and price of funds are normalized by price of labor as proposed by Kuenzle

(2005) in order to achieve linear homogeneity of the cost function. Bank outputs are represented by $loans$ and deposits ($depos$ variable) and ere expressed in EUR currency. Furthermore, we included four variables in order 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 current phase of economic cycle, 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 (2) is used to obtain inefficiency estimates while controlling for exogenous environmental variables that may affect efficiency. As stated above, model of Battese and Coelli (1995) allows for the single step estimation of bank inefficiencies and correlates of bank-specific inefficiencies. The specification of inefficiency equation is as follows:

$$u_{ijt} = \alpha + \beta_1 Size_{ijt} + \beta_2 FinAssets_{ijt} + \beta_3 Equity_{ijt} + \beta_4 Liquidity_{ijt} + \beta_5 IncomeDiversity_{ijt} + \beta_6 ROA_{ijt} + w_{ijt} \quad (3)$$

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 Data analysis

We created 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 given bank in order to avoid double counting problem. 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 the banks by country in our dataset is provided in Table 1. Presence of cooperative banks in Europe is unevenly distributed. Cooperative banking models differ significantly country by country (for more info see Ayadi et al. (2010)). Because of different levels of interconnectedness of cooperative banking system, either only one centrally governed institution or many of them can be present in a country.

Table 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

Selection of variables used in our regression analysis is made in order 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 is provided in Table A.1 in the Appendix. We can see that the diversity in terms of cooperative banks size in the sample is substantial. We can also see that 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.

Correlation matrix of independent variables in regression equation (3) is provided in the Appendix Table A.2. There is considerable positive correlation between $IncomeDiversity$ and $Size$ and $Equity$ variables and 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.

5 Results and Findings

First of all, let us check the results of Equation (2) from which we retrieved inefficiency estimates. These are provided in Table 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 joint insignificance of the variables used. Normalized price of

funds has positive effect on the total cost which makes sense: higher input prices are connected with higher total costs while reaching the same outputs. 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 generally higher interest rate environment which may translate in more expensive funding and hence higher costs. Market concentration has negative effect on banks costs, or in the other words: more competitive market translates in decreased costs.

Table 2: Estimation of the cost frontier

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	1830		
Wald test	11 900 000	***	

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

Before we will present outcomes of the regression (3) which explains what aspects drive 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 A.3). This holds true also for sub-

samples formed by individual countries. The size-inefficiency relation gave us also fairly similar picture in every year during the 2006-2015 period: bigger cooperatives are less efficient than smaller ones, regardless of the bank country (see Appendix Figure A.4 for year 2015).

We run the Breusch-Pagan Lagrange multiplier test and the Hausman test in order to decide which estimation method should be used for estimating regression (3). Breusch-Pagan Lagrange multiplier test strongly rejects (at 1% significance level) null hypothesis and therefore pooled OLS estimate is less efficient than Random Effects (RE). Hence RE method is preferred.

Hausman test rejects null hypothesis at 1% significance level as well, showing that Fixed Effects (FE) estimation is efficient but RE estimation is not. We will therefore employ FE estimation method on equation (3), RE and OLS will serve only as robustness checks of FE results.

We suspect our data to be grouped into country level clusters because of different nature of cooperative banks in individual countries. Moulton (1986) shows that standard errors in such case 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.

Table 3 provides results of inefficiency regression equation (3). We put most trust into FE model, based on the tests we run. Nevertheless, results of RE and Pooled OLS methods are in line with FE regarding coefficient directions and significance with the exception of income diversity variable. Natural logarithm of balance sheet size ($Size$ variable) has highly significant positive effect meaning that bigger cooperative banks are more inefficient compared to their smaller peers. The share of financial assets on the balance sheet ($FinAssets$) has no effect on efficiency of the banks. Higher shares of equity ($Equity$) and liquid assets ($Liquidity$) on total balance sheet size increase efficiency. It is of mayor importance to maintain sufficient liquidity during the crisis time (which was included in our analysis) and also to have sufficient amount of capital in order to be able to grant new loans, hence the positive effect on efficiency. Share of net fee and commission income on total income ($IncomeDiversity$) has no significant effect on banks efficiency. Possible diversification of income sources seems to have no effect on efficiency. Interestingly, higher

return on assets (ROA) is connected with higher inefficiency. Logical explanation 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 3: Effects on bank inefficiency

	Fixed Effects			Random Effects			Pooled OLS		
Variable	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	1830			1830			1830		
Wald test	---			57820		***	---		
F test	758		***	---			8925		***

*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 effecient than the bigger ones. This results is in line with studies of Spulbar, Nitoi and Anghel (2015) or of Deelchand and Padgett (2009) who arrived to the same outcome on the set of Japanese cooperative banks. Theoretical explanation of our results is that the small cooperative banks are closer to its 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 specific business model of cooperative banks.

Interested extension of this study would be inclusion of Eastern European cooperative banks into the dataset, to test whether the results are the same for the new EU member states where cooperative banking is also present. Lack of continuous development because of the interruptions made by past communist regimes can have severe negative impact on performance of cooperative banks in such countries. For example Kuc and Teplý (2018) provide evidence about bad performance of Czech credit unions. The pain point is the accessibility of financial data of cooperative financial institutions from these countries. Another interesting research topic would be to explain the different size-efficiency relationship of American credit unions compared to European cooperative banks.

6 Conclusion

This paper investigates the size-efficiency relation of European cooperative banks during the 2006-2015 period. We tested whether arguments in favor of smaller cooperative banking institutions overcome the effects of economies of scale. We created dataset of 183 cooperative banks from 12 European countries. Stochastic Frontier Analysis (SFA) was employed in order 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 work of Spulbar, Nitoi and Anghel (2015) on European cooperative and savings banks or of Deelchand and Padgett (2009) who studied Japanese cooperatives. We prove that this size-efficiency relation is valid also in the current post-crisis period. Moreover, 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 imply that we will probably not face any significant consolidation on the European cooperative banking market for it is efficient for cooperative banks to remain small in size and gather from traditional cooperative proximity to its members. Recent financial regulation nevertheless did not take into account specific nature of cooperative banking scheme and the impact on the small-size cooperatives is considerable.

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Appendix

Table A.1: 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

Table A.2: 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

Figure A.3: Average inefficiency over time

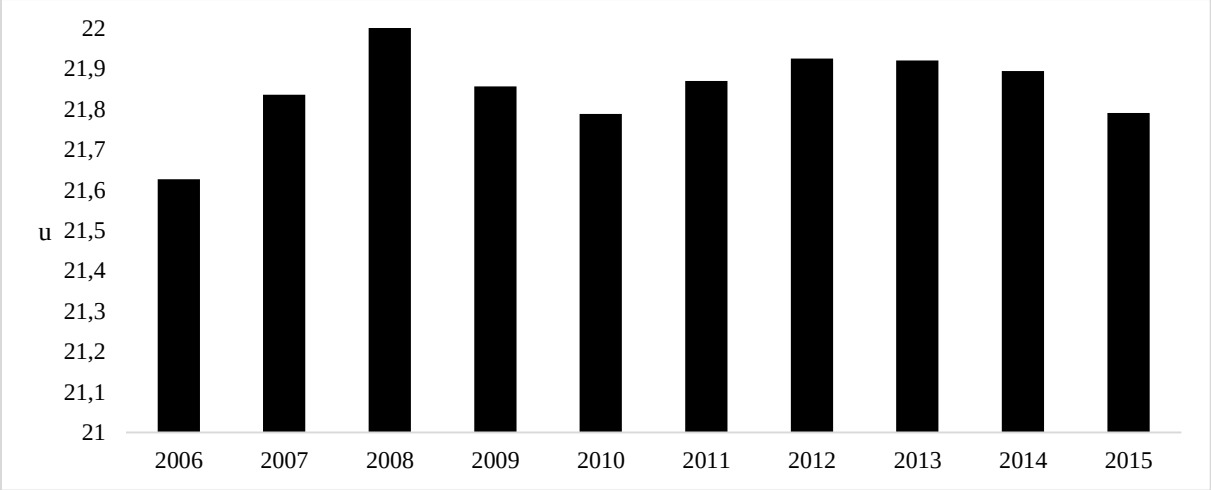
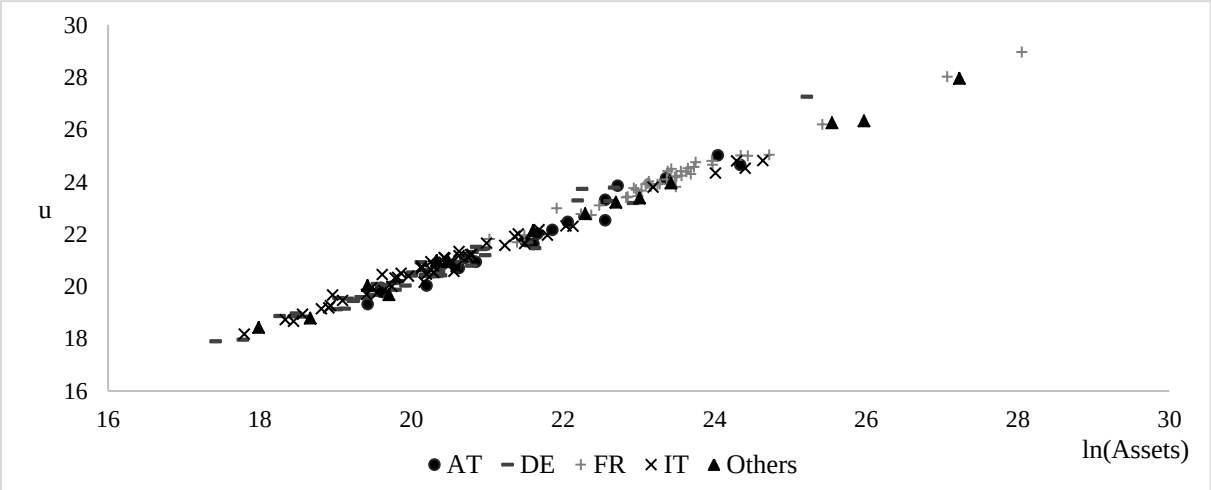


Figure A.4: Inefficiency and size relation in 2015



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Univerzita Karlova v Praze, Fakulta sociálních věd
Institut ekonomických studií [UK FSV – IES] Praha 1, Opletalova 26
E-mail : ies@fsv.cuni.cz http://ies.fsv.cuni.cz