Corporate Governance and Efficiency in Banking: Evidence from Emerging Economies

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Abstract

This paper investigates the impact of corporate governance on bank efficiency, across a sample of 139 commercial banks from 17 countries of Central and Eastern Europe during the period 2005-2012. The empirical findings indicate that implementing rigorous corporate governance structures is associated with higher costs for banks and a lower level of efficiency. But, during the crisis a tight governance mechanism significantly increases banks' cost and technical efficiencies. Also, tight risk management is associated with both higher cost and technical efficiency for more capitalized banks, while rigid supervisory boards are linked with higher technical efficiency for more capitalized banks.

Key words: bank efficiency, corporate governance, crisis, capitalization.

JEL classification: G21, G32, G34

1. Introduction

In the last decades, corporate governance has become a central issue in modern financial economics. The nature of banks and their importance in the economy, make the problems involved in their corporate governance highly specific. In the same time, having a key role in the economy (especially in firms financing and payment system) and being highly leveraged (by using the deposits taken from customers), banks are subject to more intense regulation than other firms. Hence, regulation implies several challenges in the field of corporate governance, too (Prowse, 1997; Ciancanelli and Reyes, 2001; Macey and O'Hara, 2003; Levine, 2004).

After the burst of subprime crisis of 2007, the preoccupations on banks' corporate governance intensified in order to remodel banking business models and their regulation. This is due to the idea that the financial turmoil had causes related to banking corporate governance. The failure of various governance mechanisms has often been considered among the main causes of the crisis (De Haan and Vlahu, 2015). In the same context, Kirkpatrick (2009) state that the financial crisis can, to an important extent, be attributed to failures and weaknesses in corporate governance arrangements, which did not serve their purpose to safeguard against excessive risk taking in a number of financial services companies. The Basel Committee on Banking Supervision (BCBS, 2006) underlined that "effective corporate governance practices are essential to achieving and maintaining public trust and confidence in the banking system, which are critical to the proper functioning of the banking sector and economy as a whole." Also, the National Commission on the Causes of the Financial and Economic Crisis in the United States (2011) concluded that "dramatic failures of corporate governance at many systematically important financial institutions were a key cause of this crisis."

Corporate governance is widely accepted in the empirical literature as an important determinant of bank performance (Diamond and Rajan, 2009; Bebchuk and Spamann, 2010). It is considered that banks with prudent corporate governance mechanisms are more efficient in allocating their resources (Barth et al., 2004; Caprio et al., 2007) and banks with poor governance engaged in excessive risk taking have larger losses during the crisis because they are riskier (Beltratti and Stulz, 2012). That is why, in the last period some empirical studies are oriented to assessing the implication of corporate governance on bank performances.

In this study we analyze the link between corporate governance and two alternative measures of efficiency (cost and technical efficiency) for a sample of banks from Central and Eastern Europe during the 2005–2012 period. We focus on cost and technical efficiencies as they reflect the abilities of banks to minimize costs. Previous studies show that declines in cost efficiency precede increases in problem loans (Berger and De Young, 1997). We analyze the impact of corporate governance on efficiency by employing alternatively Panel Least Squares estimator with cross-section fixed effects and Pooled Least Squares estimator. Banks' efficiency is estimated via DEA Method (Data Envelopment Analysis) using the VRS model (Variable Returns to Scale) proposed by Banker, Charnes and Cooper (1984).

We hand-collect information on various aspects of the organization structure of the risk management function and supervisory board from the banks' Annual Reports, Financial Statements, Capital adequacy and risk management reports and websites. Complete annual data is available for 139 banks that accounted for approx. 80% of the total assets of the Central and Eastern European banking systems in 2012. Based on these data we calculate 3 indices: *Risk management index*, *Supervisory board index* and *Corporate governance index*.

In sum, the empirical findings indicate that banks with lax corporate governance structures are associated with cost and technical efficiency. Analyzing its subcomponents, a tight risk management structure significantly decreases banks' cost efficiency, while its impact on technical efficiency although negative it is not statistical significant. Moreover, banks with rigid supervisory boards tend to have lower levels of cost and technical efficiency.

The economically effects are also large. Given that the mean cost efficiency is about 0.69 and the mean technical efficiency is about 0.87 percent during 2005-2012,[1] the impact of corporate governance on efficiency implies associated semi-elasticities of 20 and 12 percent, respectively. Regarding the risk management structure the effect indicates an associated semi-elasticity of 10 percent for cost efficiency, and 4 percent for technical efficiency, while the associated semi-elasticities of supervisory board index are about 9 percent for both types of efficiency.

Interestingly, the negative effects of rigid governance seem to disappear during crisis or for more capitalized banks. When assessing the impact of crisis on the relationship between

[1] Cost efficiency and technical efficiency range from 0 to 1. The higher the score is the greater the efficiency.

governance and efficiency, results reflect a strong and positive link between crisis and corporate governance structure, suggesting that banks with tight governance mechanism during crisis indeed increase their cost and technical efficiency. In an additional analysis, findings also suggest that tight risk management is associated with both cost and technical efficiency for more capitalized banks, while rigid supervisory boards are linked with technical efficiency for better capitalized banks. Various alternative specifications confirm the robustness of the results.

The results of this study enrich the literature in several ways. First of all, this paper is the first that assesses the link between corporate governance and bank efficiency in Central and Easter Europe, both for crises and non-crises period (2005-2012). Second, this study contributes to the limited, albeit rapidly growing, literature on the relationship between corporate governance, risk management and bank efficiency by using a unique set of data manually retrieved form banks' reports. In order to assess the impact of corporate governance and risk management mechanisms on bank efficiency we compute 3 indices: Risk management index, Supervisory board index and Corporate governance index. Third, we analyze not only the evolution of relationship between corporate governance and bank efficiency during crises and non-crises period, but investigate the impact of the 2008-2010 financial crisis on the relationship between banks' governance and efficiency, too. Forth, we go further and interact the governance indices with banks' capitalization and asses the impact of capitalization on the relationship between banks' governance and efficiency.

The remainder of this study is structured as follows: Section 2 presents the literature review. Section 3 discusses the methodology and describes the data. The empirical results are presented and discussed in Section 4. Finally, Section 5 offers the concluding remarks.

2. Literature review

The first considerations on corporate governance are attributed to Berle and Means (1932). They debated about the consequences of separation of corporate control and ownership. From this issues emerged the Agent Theory, which stated that agency problem could occur when cooperating parties have different goals and division of labor (Ross, 1973; Jensen and Meckling, 1976). According to European Central Bank (ECB, 2004) corporate governance is defined as the procedures and processes according to which an organization is directed and controlled. This

could be explained by the fact that corporate governance structure specifies the distribution of rights and responsibilities among different participants in the organization – such as the board, managers, shareholders and other stakeholders – and lays down the rules and procedures for decision-making.

2.1. Literature on corporate governance measures

Most studies regarding the corporate governance literature use single parameters of banks' governance (Belkhir, 2004; Adams and Mehran, 2005; Mayur and Saravanan, 2006; Bino and Tomar, 2007; Laeven and Levine, 2009), or multiple proxies (Simpson and Gleason, 1999; de Andres and Vallelado, 2008; Huang, 2010; Sufian, 2010; Kabigting, 2011; Hussein, 2012), e.g. board size, experience and independence of board members, gender diversity, etc.

Other studies, in the effort to summarize many variables into an index that could be used to assess the quality of governance, consider a Corporate Governance Index (CGI) in measuring the corporate governance of a bank (Bubbico et al., 2002; Peni and Vähämaa, 2012; Ellul and Yerramilli, 2013; Andries and Brown, 2015). In Bubbico et al. (2002) the CGI is a scoring model that analyzes four different macro-areas of governance: Board, Compensation, Shareholders' and stakeholders' rights, and Disclosure. Andries and Brown (2015) using four indicators of risk management create a composite Risk management index as an unweighted average index that takes values between 0 and 1, with 1 representing tight risk management. Ellul and Yerramilli (2013) calculates a Risk Management Index by taking the first principal component of six risk management variables.

Another index-based variable of corporate governance is used by Peni and Vähämaa (2012). They compute a corporate governance index based on different bank-specific governance attributes, which account for both internal and external governance of firms like auditing, board of directors, charter/bylaws, director education, executive and director compensation, ownership, progressive practices, and state of incorporation.

2.2. Literaure on corporate governance and bank performance

Empirical research on the link between corporate governance and banks' performance is limited. Most of the studies use for measuring bank performance accounting-based indicators like Return

on Assets (ROA), Return on Equity (ROE) (see Mishra and Nielsen, 2000; Choi and Hasan, 2005; Aebi et al., 2012; Liang et al., 2013; Pathan and Faff, 2013; Mamatzakis and Bermpei, 2015); banks' asset quality (the non-performing loans ratio (NPLs ratio), the stock of NPLs, the net charge-off ratio (NCO ratio), and the level of NCOs - see García-Herrero et al., 2009; Lin and Zhang, 2009); pre-tax operating income (POI) (Pathan and Faff, 2013; Mamatzakis and Bermpei, 2015); market-to-book value ratio (Tobin's Q) - see Andres and Vallelado, 2008; Adams and Mehran, 2012; Pathan and Faff, 2013); and, stock returns (Beltratti and Stulz, 2012).

The efficiency measures have several advantages over the traditional indicators of performance. Efficient frontier approaches have the ability to provide an overall objective numerical score and ranking, an efficiency proxy that complies with an economic optimization mechanism (Berger and Humphrey, 1997; Baueret al., 1998; Tanna et al., 2011). Also, these approaches take into account simultaneously more than one input and one output of a firm, in contrast to other performance ratios (Thanassoulis et al., 1996). Hughes and Mester (2010) argue that using Stochastic Frontier Analysis Method (SFA) for measuring bank performance reveals bank managers' preferences over revenues and costs as well as their underlying risk attitude.

The link between corporate governance and bank efficiency has been analyzed by very few studies with inconclusive results. Pi and Timme (1993) for the United States, Choi and Hasan (2005) for Korea and Tanna et al. (2011) for the UK banking sector examined the link between board structure and efficiency. The relationship between better governance and efficiency was assessed for US and other international samples by Pi and Timme (1993), Mester (1997), Amess and Drake (2003), Berger and Isik and Hassan (2003).

Pi and Timme (1993) and Choi and Hasan (2005) demonstrate no significant relationship between the number of outside board directors and bank performance for the United States and Korea respectively. They use as proxy for bank performance cost efficiency (Pi and Timme, 1993) and profit efficiency (Choi and Hasan, 2005).

Examining a sample of 17 banking institutions operating in the UK during 2001 and 2006, Tanna et al. (2011) find some evidence of a positive association between board size and composition and efficiency. Amess and Drake (2003) find a weak relationship between three measures of executive remuneration and total factor productivity.

Berger and Mester (1997) consider the proportion of stock owned by insiders, (i.e., board members and their relatives) and the proportion of stock owned by outsiders who had more than 5% of the outstanding shares as corporate governance proxy. They show that an increase in insider ownership may serve to align management's objectives with those of owners, yielding greater efficiency. They employ three distinct economic efficiency concepts: cost, standard profit, and alternative profit efficiencies, using data on U.S. banks over the period 1990-1995.

Isik and Hassan (2003) go further assessing the relationship between ownership structure, control and governance structure and five different efficiency scores, namely cost (CE), allocative (AE), technical (TE), pure technical (PTE) and scale efficiencies (SE), between 1988 and 1996 on a sample of Turkish banks.

Using a plethora of measures of the corporate governance (board structure, compensation, managerial ownership, CEO power and operational complexity), Mamatzakis and Bermpei (2015) evaluate the impact on the performance of the US investment banks over the 2000–2012 period. As proxies for bank performance they use both simple accounting-based indicators (return on average assets (ROAA), return on average equity (ROAE) and pre-tax operating income (POI) as percentage of the average total assets) and the SFA approach (estimated by a profit function). Their results are very interesting, indicating a negative association between operational complexity, the increase in the bank ownership held by the board and performance, but a positive link between CEO power, board ownership above the threshold value and performance.

3. Data and methodology

3.1. Data and methodology

The sample consists of an unbalanced dataset of 755 observation corresponding to 139 commercial banks from 17 countries of Central and Eastern Europe (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine) for the 2005 – 2012 period. The number of banks per country range from 4 in Serbia to 11 in Czech Republic, Macedonia, Poland, Romania, Slovenia and Ukraine (Table 1). We included in our sample only

active banks with information for at least 5 years and we excluded those banks with missing, negative or zero values for inputs or outputs.

[Table 1 here]

[Table 2 here]

Across CEE countries, foreign ownership in the banking sector has grown dramatically in the recent decade, and by 2008, foreign banks controlled around 80% of the assets in the region's banking industry and in countries like Estonia and Slovak Republic more than 95% (Ongena et al., 2013). The CEE banking markets can definitely not easily separate themselves from Western Europe. Western banks like Raiffeisen Bank International, Erste Bank, UniCredit, Société Générale, Intesa, KBC, or regional banks like OTP and NLB, are a dominant force in Central and Eastern Europe (EIB, 2013). The number of banks per country range from 5 in Albania and Lithuania to 12 in Poland and Romania. In terms of home countries, most foreign banks in Central and Eastern European countries are from Austria, Italy and Greece.

The recent global crisis has increased the interest in studying the behaviour of foreign banks in developing countries during periods of financial turmoil. The crisis was unique in that it emanated from the home markets of the banking groups operating in emerging Europe (De Haas et al., 2014). Previous studies show that in Central and Eastern Europe there are significant differences between foreign and domestic banks before the crisis, but more during the crisis (Cull and Martínez Pería, 2013; Choi et al., 2014; and Feyen et al., 2014). We classify banks into foreign and domestic banks depending on whether 50% or more of banks' shares are owned by foreigners or by central, local governments or domestic private actors, respectively (Claessens and van Horen, 2014).

3.2. Methodology used to test the relationship between corporate governance and efficiency

We analyze the link between corporate governance and two alternative measures of efficiency (cost and technical efficiency) in the Central and Eastern European banking systems using the following regression:

$$\mathbf{EFF}_{i,j,t} = \beta_0 + \beta_1 \mathbf{Gov}_{i,j,t-1} + \Theta \mathbf{BankCtrl}_{i,j,t-1} + \Phi \mathbf{BankingSystemCtrl}_{j,t-1} + \beta_2 \mathbf{Crisis}_{t-1} + \beta_3 \mathbf{Foreign}_{t-1} + \phi_i + \varepsilon_{i,j,t} \quad (1)$$

where $EFF_{i,t}$ is the level of cost (or technical) efficiency of bank i, in country j and year t; $Gov_{i,j,t-1}$ represents the alternative indices of corporate governance (*Risk management index*; *Supervisory board index* and *Corporate governance index)* of bank i, in country j and year t; $BankCtrl$ is a vector of bank-level control variables; *BankingSystemCtrl* is a vector of banking system-level control variables; *Crisis* represents a dummy variable that is equal to 1 during the crisis period; *Foreign* represents a dummy variable that is equal to 1 if the bank is a foreign bank; φ_i is a bank-specific effect, ε is the error term.

The bank level control variables are: Log total assets; Equity to total assets; Net loans to deposits and short term funding; and Impaired loans (NPLs) to gross loans. Also, we control for banking system characteristics: Restrictions on banking activities; Bank competition (Lerner index) and Bank concentration. Definitions of variables are given in Table 1.

In our analyses, we employ alternatively Panel Least Squares estimator with cross-section fixed effects and Pooled Least Squares. Explanatory variables are one year lagged.

3.3. Efficiency measures

In the analysis of the efficiency of the banks in CEE countries we will use the DEA Method (Data Envelopment Analysis). The DEA Method is a non-parametric method of linear programming used to create the efficiency frontier and to evaluate the efficiency of a decisions unit. The DEA method provides for the ensemble of analyzed units the efficiency frontier, according to which, each decision unit in the set of data used is evaluated in relation to this frontier and a relative efficiency is associated to it based on the units with the "best" performances. These units with the "best" performances that are on the efficiency frontier are considered to be efficient, and the others are considered inefficient and an inefficiency score is associated to them.

In the literature in the field a lot of versions were developed. In the present paper we will apply the model proposed by Banker, Charnes and Cooper (1984), a model oriented towards

outputs and which had the hypothesis of variable returns to scale. This model is also met in the literature in the field as the VRS model (Variable Returns to Scale).

The DEA models can be “input oriented models” or “output oriented models”. In the case of input oriented models, the DEA Method defines the efficiency frontier, searching for each analyzed decisional unit the maximum decrease in the use of inputs so as to maintain the level of outputs constant. In the case of output oriented models the levels of the inputs are maintained constant and the possible maximum for outputs is sought. In case the productive process is characterized by a direct proportionality connection between the size of the inputs and the size of the outputs, the two measurements of efficiency produce the same efficiency scores. Otherwise the two approaches lead to different efficiency scores.

The use of the specifications of constant returns to scale is only appropriate when all decisional units in the data set are operational at the optimum scale. The imperfect competition, the constraints regarding financing, the restrictions regarding the adequacy of capital and the prudential requirements can make that some units do not operate on optimum scale. The fact that banks are confronted with constant returns to scale was empirically proven in several studies (McAllister and McManus, 1993 and Wheelock and Wilson, 1999). The use of the constant returns to scale specifications in this case leads to biased measures of the technical efficiency. Based on this, the use of the hypothesis of variable returns to scale is imposed.

In order to assess the efficiency scores of the Central and Eastern European banks, we first assume that they employ an “intermediation production process" such that one set of inputs are intermediated into another set of outputs. Second, we assume that production technology is characterized by more general variable returns to scale (VRS) technology. Third, we assume, by pooling all yearly subsamples, that the banks in the sample all face common best practice frontiers. Under these assumptions, we use non-parametric Data Envelopment Analysis to construct a number of input-oriented efficient frontiers relative to which efficiency indices are computed (Banker, Charnes and Cooper, 1984).

More specifically, following Andries et al. (2013), we initially compute the cost efficiency (CE) index for each bank in the sample. This index is simply the ratio of the minimum potential total production cost to the observed total production cost of the bank. Formally, in order to compute the cost efficiency score for each bank j (j =1…n), as a first step, we solve the following linear program to obtain minimum potential total production cost for bank j:

$$
\begin{aligned}
&\min \sum_{i=1}^{m} p_i^o \tilde{x}_{io} \\
&\text{subject to:} \\
&\sum_{j=1}^{n} \lambda_j x_{ij} \le \tilde{x}_{io}, i = 1,2,...,m; \\
&\sum_{j=1}^{n} \lambda_j y_{rj} \le y_{ro}, r = 1,2,...,m; \\
&\lambda_j, \tilde{x}_{io} \ge 0 \\
&\sum_{j=1}^{n} \lambda_j = 1
\end{aligned}
\qquad (2)
$$

where p_i^o are the unit prices of the input i of bank, y is a vector of outputs with dimension (1 x m), x is vector of outputs with dimension (1 x m), j represents bank j, and n is the number of banks.

Having potential minimum total production cost calculated for bank j, the cost efficiency of this bank is measured as:

$$
\frac{\sum_{i=1}^{m} p_i^o \tilde{x}_{io}^*}{\sum_{i=1}^{m} p_i^o x_{io}} \qquad (3)
$$

This cost efficiency score assesses the degree of "optimal input mix" utilization, given cost minimization behavior of the banks. In order to assess the TE of the banks in the sample, the following linear programming problem (LP) is solved for each bank *j* (j = 1…, n)

$$
\begin{aligned}
&\min \theta_j - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+) \\
&\text{subject to:} \\
&\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{io}, \quad i = 1,.2,..,m; \\
&\sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{ro}, r = 1,2,...,m; \\
&\lambda_j \ge 0, j = 1,2,..,T; \\
&\sum_{j=1}^{n} \lambda_j = 1
\end{aligned}
\qquad (4)
$$

where: $\theta_j \le 1$ is the scalar total technical efficiency score for the j[th] bank, s_i^-, $s_r^{\wedge}$ are input and output slack, with other variables as defined earlier. We note that the additional constraint $\sum_{j=1}^{n} \lambda_j = 1$ is imposed on the linear programming model to allow for VRS.

Following Andrieș and Căpraru (2014), we use the intermediation approach to model cost and technical efficiency and we assume that banks have 4 outputs, namely Loans (Q1), Loans and Advances to banks (Q2), Other Securities (Q4) and Off-Balance Sheet Items (Q4). In both models we consider that a bank uses three inputs (Fixed assets (X1), Labor (X2) and Total borrowed funds (X3)) to produce outputs. In all models we use three input prices: Cost of physical capital (W1), calculated by dividing Overhead expenses other than personnel expenses by the book value of Fixed assets; Cost of labor (W2), calculated by dividing the Personnel expenses by Total assets; and Cost of funds (W3), calculated as the ratio of Total interest expenses (TIE) to Total borrowed funds (Total Customer Deposits, Total Deposits from banks, Other interest bearings liabilities and Long term Funding).

The mean values of the efficiency indicators by each country sample of banks are provided in Table 2. The average score of all banks in our sample is 0.69 for cost efficiency, while for technical efficiency is 0.87. The summary statistics presented in Table 3 show that the cost efficiency score ranges from 0.11 to 1, while the minimum and maximum values for the technical efficiency score are 0.29 and, respectively, 1.

[Table 3 here]

A plot of the efficiency indicators over years is provided in Figure 1. The first graph shows the cost and technical efficiency for less capitalized banks (those with Equity to total assets ratio below the median value for entire sample of banks), while the second for more capitalized banks (those with Equity to total assets ratio above the samples' median). Both figures highlight that during crisis (2008-2010) banks are more cost efficient than in non-crisis period. Analyzing the sub-samples, less-capitalized banks appear to be more efficient both from costs and technical perspective.

[Figure 1 here]

These features are also confirmed by the difference in means analysis provided in Table 4. First, the mean of cost efficiency score changed significantly in the crisis period compared

with the pre-crisis as shown in Panel A (i.e., 0.72 during 2008-2010 versus 0.67 in the non-crisis years). Second, the differences in means of efficiency scores between more capitalized banks and less capitalized banks are statistically significant (Panel B). The mean technical efficiency score for better capitalized banks is 0.65, while for less capitalized banks is 0.73. The technical efficiency score is also higher for less capitalized banks (0.88 versus 0.86).

[Table 4 here]

3.4. Corporate governance measures

The failure of various governance mechanisms has often been cited among the key causes of the crisis (de Haan and Vlahu, 2015). Beltratti and Stulz (2012) argue that poor bank governance was a major cause of the crisis and find that banks with more shareholder-friendly boards performed significantly worse during the crisis than other banks, were not less risky before the crisis, and reduced loans more during the crisis. Kirkpatrick (2009) concludes the financial crisis can be to an important extent attributed to failures and weaknesses in corporate governance arrangements. The composition of supervisory boards is very important, the theoretical governance literature argues that boards fulfill their duties of advising and monitoring management by choosing board composition and size appropriately (Adams and Ferreira, 2007). Erkens et al. (2012) investigate the influence of corporate governance on financial firms' performance during the 2007–2008 financial crisis and find that firms with more independent boards and higher institutional ownership experienced worse stock returns during the crisis period. Ellul and Yerramilli (2013) find that banks with stronger risk management functions in place before the onset of the financial crisis have lower tail risk, a smaller fraction of nonperforming loans, better operating performance, and higher annual returns during the crisis years, 2007 and 2008. Their results suggest that a strong and independent risk management function can curtail tail risk exposures at banks.

Aebi et al. (2012) investigate whether risk management-related corporate governance mechanisms are associated with a better bank performance during the financial crisis of 2007/2008. Their results indicate that banks, in which the CRO (Chief Risk Officer) directly reports to the board of directors exhibit significantly higher (i.e., less negative) stock returns and

ROE during the crisis. Minton et al. (2014) show that financial expertise among independent directors of U.S. banks is positively associated with balance-sheet and market-based measures of risk in the run-up of the 2007-2008 financial crisis. Overall, their results are consistent with independent directors with financial expertise supporting increased risk-taking prior to the crisis.

Due to limited availability of corporate and risk management-specific governance data for banks from Central and Eastern European countries in commercial governance databases, such as for example RiskMetrics and BoardEx, we hand-collect information on various aspects of the organization structure of the risk management function and supervisory board at each bank each year from the banks' Annual Reports, Financial Statements, Capital adequacy and risk management reports and websites. Complete data is available for 139 banks that accounted for approx. 80% of the total assets of the Central and Eastern European banking systems in 2012.

In order to assess the impact of corporate governance and risk management mechanisms on bank efficiency we calculate 3 indices: *Risk management index*; *Supervisory board index* and *Corporate governance index*. Similar to Andrieș and Brown (2014), in order to assess the risk management mechanisms we create a composite *Risk management index* as an unweighted average index based on the following four indicators: 1) *CRO Present* - identifies whether a CRO responsible for bank-wide risk management is present within the bank; 2) *CRO Executive* - identifies whether the CRO is an executive officer of the bank; 3) *Risk committee* - is equal to 1 if the bank has a dedicated committee solely charged with monitoring and managing risk-management efforts within the bank; and *Risk committee reports to board* - identifies whether the key management-level risk committee reports directly to the bank's board of directors instead of to the CEO. The *Risk management index* (RMI) could take values between 0 and 1, with 1 representing a tight risk management structure.

Our second index, *Supervisory board index,* assesses the structure of corporate governance as measured by the size and structure of the supervisory board and is calculated as an unweighted average index based on the following four indicators: 1) *Board size* - is measured as the natural logarithm of the number of directors on a bank's board; 2) *Board expertise* - the share of expert members on the board; 3) *Board independence* - measures the share of independent outside directors on the supervisory board; and 4) *Board foreign* - captures the share of foreign members on the supervisory board.

Following Ellul and Yerramilli (2013) we also calculate *Corporate governance index* by taking the first principal component of the all eight supervisory board and risk management variables. The main advantage of using principal component analysis is that we do not have to make subjective judgments regarding the relative importance of these categories (Tetlock, 2007).

Average values of these indices by each country sample of banks are provided in Table 2. The summary statistics presented in Table 3 show that the mean score of all banks in the sample is 0.53 for *Corporate governance index* (standard deviation 0.19), 0.48 for *Risk management index* (standard deviation 0.27), and, 0.58 for *Supervisory board index* (standard deviation 0.23). The difference in means analysis provided in Table 4 Panel A show that during crisis all three governance indices are significantly higher than in non-crisis period, suggesting stringent practices during turmoil times. Analyzing the differences in means of governance indices between more capitalized and less capitalized banks results show statistically significant differences (Table 4 Panel B). The mean corporate governance index for better capitalized banks is 0.54, while for less capitalized banks is 0.52. Regarding its subcomponents the difference of means is significant for risk management practices, better capitalized banks being more stringent (an average score of 0.50) than less capitalized banks (an average score of 0.46).

A plot of the governance indicators over years is provided in Figure 2. The first graph presents the governance situation for less capitalized banks and the second one for more capitalized banks. Before crisis less capitalized banks had tighter risk management practices and more exigent supervisory boards in comparison with better capitalized banks.

[Figure 2 here]

4. Results

4.1. Efficiency and governance

Table 5 presents the estimation results for the regression specification presented in Eq. (1). Panel A shows the output for *Cost efficiency* determinants and Panel B for the *Technical efficiency* regressors. A positive coefficient corresponds to an improved efficiency level, while a negative coefficient is related to declining efficiency of banks. [2]

[2] The dependent variable ranges from 0 to 1. The higher the score is the greater the efficiency.

Overall, the empirical findings indicate that banks with rigorous corporate governance structures are associated with cost and technical inefficiency (Table 5, Panel A, Model 1 and Table 5, Panel B, Model 7). A one standard deviation increase in the corporate governance index generates an average decrease of cost efficiency by about 13 percent and of technical efficiency by about 16 percent. Given that the mean cost efficiency is about 0.69 and the mean technical efficiency is about 0.87 percent during 2005-2012, the estimates imply associated semi-elasticities of 20 and 12 percent, respectively.

[Table 5 here]

Analyzing its subcomponents, a tight risk management structure significantly decreases banks' cost efficiency (Panel A, Model 2), while its impact on technical efficiency although negative it is not statistical significant (Panel B, Model 8). A one standard deviation increase in the index corresponding to risk management quality produces an average decrease of cost efficiency by about 10 percent. The effect is also economically significant, indicating an associated semi-elasticity of 10 percent for cost efficiency, and 4 percent for technical efficiency,

Concerning the supervisory board structure, the associated sign is negative and significant (although slightly) for both efficiency proxies, suggesting that banks with rigid supervisory boards tend to have lower levels of cost and technical efficiency. A one standard deviation increase in the supervisory board index generates an average decrease of cost efficiency by about 7 percent. The effect on technical efficiency is larger, producing an average decrease of about 31 percent. The associated semi-elasticities are about 9 percent for both types of efficiency.

The results concerning the link between size and bank efficiency suggest that large banks tend to have significant higher levels of efficiency both in cost and technical terms. A one standard deviation increase in the logarithm of total assets produces an average increase of cost efficiency of 62% and of technical efficiency of 56% percent (the associated semi-elasticities are 8% and 5%). The finding is in line with other studies related to CEE banking system (e.g., Stavárek, 2006; Altunbas et al. 2007; Yildirim and Philippatos, 2007; Chortareas et al., 2011; Chronopoulos et al., 2011). With regard to capitalization, findings show no statistical evidence

that better capitalized banks are more efficient. As for the coefficient corresponding to NPLs, it is negatively related to bank efficiency in all specifications, suggesting that higher credit risk significantly increases banks' inefficiency. A one standard deviation increase in impaired loans to gross loans ratio reduces banks' cost efficiency by about 18 percent and the technical efficiency by about 10 percent. On the other hand, liquidity risk proxied by the Net loans to deposits and short term funding ratio has no significant impact on efficiency.

The results also indicate that foreign owned banks are, on average, more efficient than domestic banks, similar to Chortareas et al. (2011). The associated coefficients show a 8% higher efficiency (both cost and technical) for banks which 50% or more of their shares are owned by foreigners. This has important implication for the emerging Europe banking system as foreign participation in this zone increased considerably after the privatization process of state-owned banks.

Finally, the significant and positive sign of the dummy variable associated with crisis suggests that during 2008-2010 banks were more cost efficient than in non-crisis period. Indeed estimates indicate a 2% higher cost efficiency during crisis. No significant evidence was found for technical efficiency.

Various alternative specifications confirm the robustness of the results. We add to the baseline specification several banking market controls which are country-level and specific for CEE countries (Restrictions on banking activities, Bank competition proxied by the Lerner index and 5-Bank asset concentration) in Panel A Models (3)-(4) and Panel B Models (9)-(10). Regarding corporate governance structure and supervisory board quality there are no important differences in comparison with the baseline regression specifications. As for the risk management index, although maintains its negative sign, turns out statistically insignificant in explaining efficiency.

Finally, we re-estimated the empirical specifications using the Pooled OLS method (Panel A Models (5)-(6) and Panel B Models (11)-(12)). Results are consistent with our previous findings in terms of sign and significance. Moreover, the results are quantitatively similar with the main specification, with the exception of corporate governance index and supervisory board index which doubled their negative effect on cost efficiency (Models Panel A Models (5)-(6)). The associated semi-elasticity of corporate governance structure increased from 13% to 32%, while for supervisory board structure increased from 7% to 24%. Also in this setting the macro

controls that reflect competition and concentration in the banking system become significantly associated with increased efficiency.

4.2. The effects of crisis period

Considering that the main results indicate significant higher cost efficiency during crisis we further investigate the impact of the 2008-2010 crisis on the relationship between banks' governance and efficiency. Table 6 Panel A presents output for *Cost efficiency* determinants, while Table 6 Panel B for the *Technical efficiency* regressors. Overall, the findings show a strong and positive relationship between crisis and corporate governance structure, suggesting that banks with tight governance mechanism during crisis indeed increase their cost and technical efficiency. However, several particularities need to be addressed further.

[Table 6 here]

The empirical results presented in Table 6 Panel A show that the adverse impact of corporate governance structure and internal risk management practices on technical efficiency turns positive when interacting with crisis. The coefficients on the interaction terms *Corporate governance index* × *Crisis* (i.e., 0.11***) and *Risk management index* × *Crisis* (i.e., 0.10***) are positive and statistical significant (Models (1)-(2)). As for the supervisory board structure we do not find any evidence that links internal supervisory activities and cost efficiency during crisis period (Model (2)). [3]

Regarding the impact of governance on banks' technical efficiency (Table 6 Panel B) results confirm the evidence in favor of tight internal governance (Model 3) and risk management practices (Model 4), as suggested by the positive and significant coefficients on the interaction terms *Corporate governance index* × *Crisis* (i.e., 0.10***) and *Risk management index* × *Crisis* (i.e., 0.07***). Although its associated sign is positive, no significant impact regarding the impact of supervisory board index on banks' technical efficiency is found during

[3] We run additional specifications to test the validity of results. First, we add to the baseline specification country-level banking market controls (Restrictions on banking activities, Bank competition proxied by the Lerner index and 5-Bank asset concentration) like in Models (3), (4), (9) and (10) from Table (5). Second, we re-estimated the specifications using Pooled OLS model. Unreported results confirm the robustness of our findings.

crisis (when considering the whole period the impact of supervisory board structure on technical efficiency is negative and slightly significant).

With regard to the bank-level control variables, overall findings suggest that their significance is maintained when the interaction of governance variables with crisis is added to the empirical specifications. The exceptions are the coefficients associated with foreign owned banks dummy which become insignificant, but they maintain the positive sign.

4.3. Well capitalized versus less capitalized banks

To take the analysis one step further we also interact the governance indices with banks' capitalization. To explore the hypothesis that better capitalized banks can enhance their efficiency (as suggested by Beltratti and Stulz (2012)) we alternatively consider two proxies for the banks' capitalization level: a dummy variable that takes the value 1 for more capitalized banks and 0 for less capitalized [4] and the Equity to total assets ratio. Overall, the empirical findings suggest that tight risk management is associated with both cost and technical efficiency for more capitalized banks, while rigid supervisory boards are linked with technical efficiency for better capitalized banks.

[Table 7 here]

Analyzing the impact of capitalization dummy on the relationship between banks' governance and technical efficiency results show that the negative effect of risk management index turns positive as suggested by the interaction term *Risk management index* × *Capitalization dummy* (i.e., 0.13**, Table 7, Model (2)). The significant coefficient reflects enhanced technical efficiency for more capitalized banks with tight risk management practices. With respect to technical efficiency, the coefficients on the interaction terms *Corporate governance index* × *Capitalization dummy* (i.e., 0.12**) and *Risk management index* × *Capitalization dummy* (i.e., 0.08**) also turn positive being statistically significant (Table 7, Models (5)-(6)).

[4] A bank is more capitalized if the value of its Equity to total assets ratio is above the median value for entire sample of banks, and less capitalized if its Equity to total assets ratio is below the sample's median.

All these findings are further confirmed when considering as proxy for capitalization the Equity to total assets ratio. When we interact risk management index with the capitalization ratio, results show that strict risk practices significantly increase efficiency for more capitalized banks (Table 7, Model (4)), as suggested by the positive and significant coefficient on the interaction term *Risk management index* × *Capitalization dummy* (i.e., 0.02**). Also a tight risk management structure and rigid risk management procedures have a significantly positive impact on technical efficiency in case of more capitalized banks (Table 7, Models (7)-(8)). [5]

5. Conclusions

In this paper we investigate how corporate governance mechanisms affect banks' efficiency, exploring a large dataset of governance and bank specific variables, corresponding to 139 banks from 17 European countries over the 2005-2011 period. We compute 3 indices: *Risk management index*, *Supervisory board index* and *Corporate governance index* based on a unique set of hand-collected information on various aspects of the organization structure of the risk management function and supervisory board from the banks' Annual Reports, Financial Statements, Capital adequacy and risk management reports and websites. The estimation of cost efficiency and technical efficiency is based on DEA method, while the impact of corporate governance on efficiency is estimated using Panel Least Squares estimator with cross-section fixed effects and Pooled Least Squares estimator.

The empirical findings indicate that banks with rigorous corporate governance structures are associated with cost and technical inefficiency. Analyzing its subcomponents, a tight risk management structure significantly decreases banks' cost efficiency, while its impact on technical efficiency although negative it is not statistical significant. Concerning the supervisory board structure, the associated sign is negative and significant (although slightly) for both efficiency proxies, suggesting that banks with rigid supervisory boards tend to have lower levels of cost and technical efficiency.

[5] Unreported results using additional empirical specifications confirm the robustness of our findings. First, we add to the baseline specification country-level banking market controls (Restrictions on banking activities, Bank competition proxied by the Lerner index and 5-Bank asset concentration) like in Models (3), (4), (9) and (10) from Table (5). Second, we re-estimated the specifications using Pooled OLS model. The empirical results remain unaltered.

However, these negative effects of rigid governance structures on efficiency disappear during crisis or for more capitalized banks. When assessing the impact of crisis on the relationship between governance and efficiency, results indicate a strong and positive link between crisis and corporate governance structure, suggesting that banks with tight governance mechanism during crisis indeed increase their cost and technical efficiency. The mixed results in the context of crises versus non-crises period are in line with Peni and Vähämaa (2012). The positive impact of tight governance mechanisms on bank performance during crisis is similar with Ellul and Yerramilli (2013).

In an additional analysis, the empirical findings also suggest that tight risk management is associated with both cost and technical efficiency for more capitalized banks, while rigid supervisory boards are linked with technical efficiency for better capitalized banks.

Thus, we can conclude that a better capitalized bank feature empower the risk management actions. In this context, a better adequacy of capital could be a solution for assuring a better risk control. Also, during crises periods, a tight governance mechanism is indicated.

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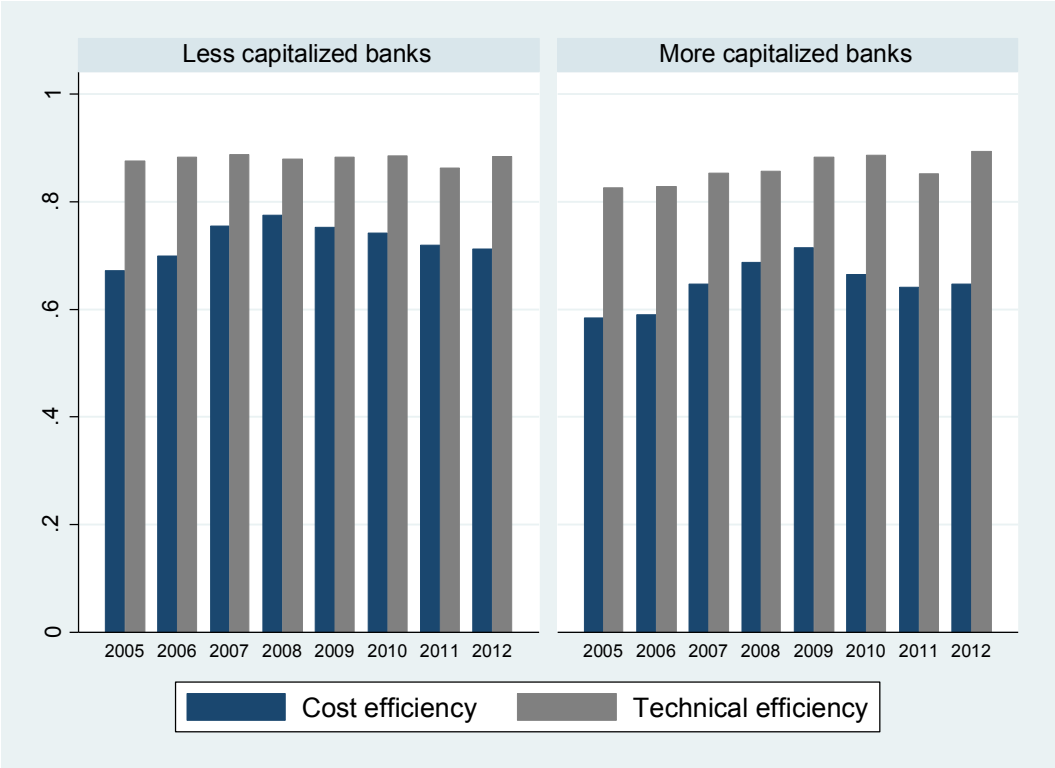
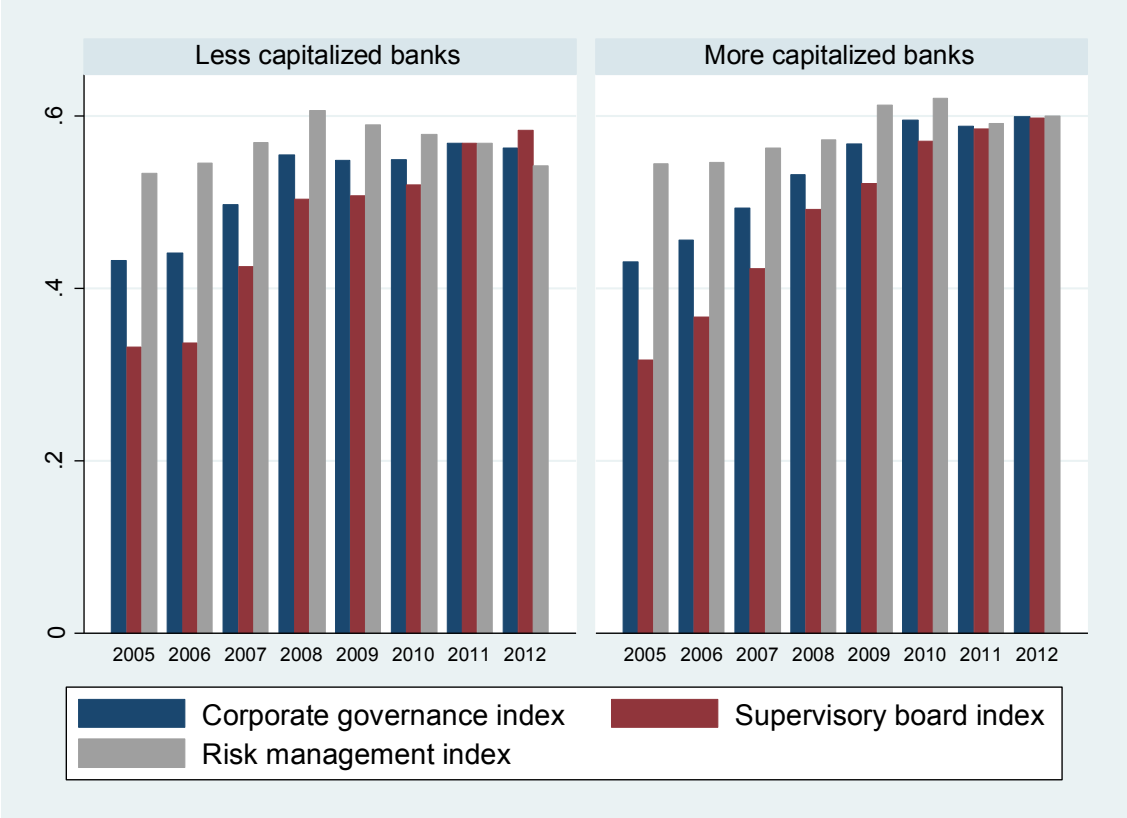
Figure 1. CEE banks' efficiency during 2005-2012 by capitalization



Note: The figure displays mean Cost efficiency and Technical efficiency during 2005-2012 for more capitalized banks and less capitalized banks. A bank is more capitalized if the value of its Equity to total assets ratio is above the median value for entire sample of banks, and less capitalized if its Equity to total assets ratio is below the sample's median. Definitions of variables are provided in Table 1.

Figure 2. CEE banks' governance during 2005-2012 by capitalization



Note: The figure displays mean Corporate governance index, Risk management index and Supervisory board index during 2005-2012 for more capitalized banks and less capitalized banks. The indices take values between 0 and 1, with 1 representing a tight corporate governance structure. A bank is more capitalized if the value of its Equity to total assets ratio is above the median value for entire sample of banks, and less capitalized if its Equity to total assets ratio is below the sample's median. Definitions of variables are provided in Table 1.

Table 1. Description of variables

Variable name	Definition	Units	Source
Dependent variables (bank level)			
Cost efficiency	Cost efficiency scores using DEA Method	0-1	Own calculations[a]
Technical efficiency	Technical efficiency scores using DEA Method	0-1	Own calculations[a]
Governance (bank level)			
Corporate governance index	Corporate governance index is calculated by taking the first principal component of the all eight supervisory board and risk management variables (CRO present, CRO executive, Risk committee; Risk committee reports to board; Board size, Board expertise; Board independence; and Board foreign).	0-1	Own calculations[b]
Risk management index	Risk management index (RMI) is an unweighted average index of 4 indicators (CRO present, CRO executive, Risk committee; and Risk committee reports to board) that could take values between 0 and 1, with 1 representing a tight risk management structure.	0-1	Own calculations[b]
Supervisory board index	Supervisory board index (SBI) is an unweighted average index of 4 indicators (Boar size, Board expertise; Board independence; and Board foreign) that could take values between 0 and 1, with 1 representing a tight supervisory board index.	0-1	Own calculations[b]
Balance sheet data (bank level)			
Log total assets	log(Total assets)	log(thousands EUR)	Bankscope
Equity to total assets	Equity/Total assets	%	Bankscope
Net loans to deposits and short term funding	Net loans/Deposits and short term funding	%	Bankscope
Impaired loans(NPLs) to gross loans	Impaired loans(NPLs)/Gross loans	%	Bankscope
Capitalization dummy	Dummy variable that takes the value 1 for more capitalized banks, and 0 for less capitalized banks. A bank is more capitalized if the value of its Equity to total assets ratio is above the median value for entire sample of banks, and less capitalized if its Equity to total assets ratio is below the sample's median.	0/1	Bankscope
Banking system variables (country level)			
Restrictions on banking activities	A composite index of regulatory restrictions on bank activities. It measures the degree to which banks face regulatory restrictions on their activities in: (1) securities markets, (2) insurance, (3) real estate, and (4) ownership of shares in nonfinancial firms. The index takes a value from 0 to 16, with higher values indicating more stringent restrictions.	0-16	SBRS
Bank competition (Lerner index)	Lerner Index, a measure of market power in the banking market which compares the output pricing and the marginal costs.	%	GFDB
Bank concentration	Assets of three largest commercial banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax assets, discontinued operations and other assets.	%	GFDB
Other variables			
Foreign dummy	Dummy variable that takes the value 1 if 50% or more of banks' shares are owned by foreigners and 0 otherwise.	0/1	Bankscope
Crisis dummy	Dummy variable that takes the value 1 for period 2008-2010 and 0 otherwise.	Years	

Note: [a] Calculations are based on data from Bankscope. [b] Calculations are based on data from data from banks' annual reports, financial statements, capital adequacy and risk management reports and websites. SBRS stands for World Bank Survey of Bank Regulation and Supervision (2003, 2007 and 2011). GFDB is Global Financial Development Database of World Bank. All variables have annual frequency.

Table 2. Efficiency and governance characteristics of banks across CEE zone during 2005-2012

Country	Number of banks	Total assets[a] at the end of 2012 (billion EUR)	Cost efficiency[a] (mean)	Technical efficiency[a] (mean)	Corporate governance index[b] (mean)	Risk management index[b] (mean)	Supervisory board index[b] (mean)
Albania	5	4.29	0.66	0.85	0.67	0.60	0.74
Bosnia and Herzegovina	6	5.65	0.51	0.75	0.49	0.41	0.57
Bulgaria	9	30.24	0.59	0.86	0.61	0.57	0.65
Croatia	10	50.02	0.62	0.83	0.49	0.38	0.61
Czech republic	11	151.53	0.91	0.98	0.48	0.45	0.51
Estonia	5	13.63	0.89	0.98	0.38	0.31	0.46
Hungary	8	84.30	0.85	0.96	0.53	0.52	0.53
Latvia	10	19.90	0.68	0.87	0.38	0.35	0.41
Lithuania	5	10.42	0.65	0.84	0.47	0.52	0.41
Macedonia	11	4.94	0.55	0.78	0.65	0.68	0.61
Montenegro	2	1.02	0.57	0.75	0.48	0.34	0.61
Poland	11	197.85	0.87	0.98	0.61	0.55	0.68
Romania	11	60.10	0.59	0.77	0.64	0.59	0.69
Serbia	4	3.85	0.45	0.85	0.63	0.53	0.73
Slovakia	9	44.52	0.65	0.89	0.49	0.43	0.55
Slovenia	11	39.68	0.80	0.93	0.51	0.41	0.61
Ukraine	11	46.17	0.64	0.82	0.43	0.39	0.47
Total	139	768.11	0.69	0.87	0.53	0.48	0.58

Note: [a] Calculations are based on data from Bankscope. [b] Calculations are based on data from data from banks' annual reports, financial statements, capital adequacy and risk management reports and websites. Definitions of variables are provided in Table 1.

Table 3. Summary statistics of all variables

Variables	Level	Observations	Mean	Standard deviation	Min	p25	p50	p75	Max
Cost efficiency	Bank	1,086	0.69	0.20	0.11	0.55	0.67	0.84	1.00
Technical efficiency	Bank	1,086	0.87	0.12	0.29	0.79	0.89	1.00	1.00
Corporate governance index	Bank	1,104	0.53	0.19	0.00	0.38	0.50	0.63	1.00
Risk management index	Bank	1,104	0.48	0.27	0.00	0.25	0.50	0.75	1.00
Supervisory board index	Bank	1,104	0.58	0.23	0.00	0.50	0.50	0.75	1.00
Log total assets	Bank	1,092	14.48	1.50	9.97	13.59	14.56	15.57	17.67
Equity to total assets	Bank	1,086	11.32	6.23	-11.29	7.74	10.14	12.89	84.00
Net loans to deposits and short term funding	Bank	1,083	85.32	48.59	0.02	66.72	81.31	94.19	663.16
Impaired loans(NPLs) to gross loans	Bank	897	10.51	11.96	0.00	2.99	6.68	12.94	99.47
Capitalization dummy	Bank	1,112	0.49	0.50	0.00	0.00	0.00	1.00	1.00
Restrictions on banking activities	Country	1,112	6.87	1.53	3.00	6.00	7.00	8.00	11.00
Bank competition (Lerner index)	Country	792	0.21	0.06	0.05	0.17	0.21	0.25	0.37
Bank concentration	Country	973	60.63	15.11	26.16	53.56	60.10	70.72	99.64
Foreign dummy	Bank	1,112	0.72	0.45	0.00	0.00	1.00	1.00	1.00

Note: Definitions of variables are provided in Table 1.

Table 4. Difference in mean analysis of bank governance and efficiency

Panel 1. Crisis versus non-crisis

Variables	Non-crisis				Crisis				Difference in means	
	Obs.	Mean	Std. dev.	Median	Obs.	Mean	Std. dev.	Median	Crisis vs. non-crisis	
Dependent variables										
Cost efficiency	671	0.67	0.20	0.64	415	0.72	0.18	0.71	0.053	***
Technical efficiency	671	0.87	0.13	0.89	415	0.88	0.11	0.90	0.012	
Governance	687	0.51	0.19	0.50	417	0.56	0.19	0.63		
Corporate governance index	687	0.46	0.27	0.50	417	0.52	0.26	0.50	0.050	***
Risk management index	687	0.56	0.23	0.50	417	0.60	0.23	0.50	0.065	***
Supervisory board index	671	0.67	0.20	0.64	415	0.72	0.18	0.71	0.036	**

Note: Definitions of variables are provided in Table 1. Crisis denotes the period 2008-2010 and non-crisis denotes the other period.

Panel 2. More versus less capitalized banks

Variables	Less capitalized banks				More capitalized banks				Difference in means	
	Obs.	Mean	Std. dev.	Median	Obs.	Mean	Std. dev.	Median	More vs. less capitalized banks	
Dependent variables										
Cost efficiency	570	0.73	0.19	0.71	516	0.65	0.20	0.63	-0.079	***
Technical efficiency	570	0.88	0.12	0.91	516	0.86	0.13	0.88	-0.018	**
Governance										
Corporate governance index	568	0.52	0.18	0.50	536	0.54	0.20	0.50	0.026	**
Risk management index	568	0.46	0.27	0.50	536	0.50	0.27	0.50	0.036	**
Supervisory board index	568	0.57	0.23	0.50	536	0.58	0.23	0.50	0.017	

Note: Definitions of variables are provided in Table 1. A bank is more capitalized if the value of its Equity to total assets ratio is above the median value for entire sample of banks, and less capitalized if its Equity to total assets ratio is below the sample's median.

Table 5. The impact of banks' governance on efficiency: main results

Variables	Panel A: Cost efficiency						Panel B: Technical efficiency					
	(1) OLS FE	(2) OLS FE	(3) OLS FE	(4) OLS FE	(5) Pooled OLS	(6) Pooled OLS	(7) OLS FE	(8) OLS FE	(9) OLS FE	(10) OLS FE	(11) Pooled OLS	(12) Pooled OLS
Governance												
Corporate governance index	-0.135***		-0.116**		-0.218***		-0.102***		-0.091**		-0.103***	
	(0.05)		(0.05)		(0.07)		(0.03)		(0.04)		(0.04)	
Risk management index		-0.070*		-0.038		-0.067*		-0.036		-0.021		-0.039*
		(0.04)		(0.04)		(0.04)		(0.03)		(0.03)		(0.02)
Supervisory board index		-0.064*		-0.090**		-0.168***		-0.075**		-0.086**		-0.069**
		(0.04)		(0.04)		(0.05)		(0.03)		(0.04)		(0.03)
Bank characteristics												
Log total assets	0.081***	0.081***	0.067**	0.065**	0.070***	0.068***	0.046***	0.043***	0.035**	0.032*	0.047***	0.046***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Equity to total assets	-0.002	-0.002	-0.003	-0.003	0.004*	0.004*	0.000	0.000	-0.001	-0.001	0.005***	0.005***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Net loans to deposits and short term funding	0.000	0.000	0.000	0.000	0.000***	0.000***	0.000	0.000	0.000	0.000	0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Impaired loans(NPLs) to gross loans	-0.003***	-0.003***	-0.003***	-0.003***	-0.001	-0.001*	-0.001**	-0.002**	-0.001**	-0.001**	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Banking system characteristics												
Restrictions on banking activities			-0.013	-0.013	0.001	0.000			-0.010	-0.010	-0.002	-0.002
			(0.01)	(0.01)	(0.01)	(0.01)			(0.01)	(0.01)	(0.00)	(0.00)
Bank competition (Lerner index)			0.125	0.122	0.424***	0.427***			-0.039	-0.043	0.144*	0.145*
			(0.12)	(0.11)	(0.15)	(0.15)			(0.09)	(0.09)	(0.08)	(0.08)
Bank concentration			-0.000	0.000	0.002***	0.002**			0.001	0.001	0.001**	0.001**
			(0.00)	(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)	(0.00)
Other controls												
Foreign bank dummy	0.077**	0.077**	0.086**	0.090**	0.019	0.031	0.073*	0.076*	0.075*	0.080*	0.039**	0.043***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.02)	(0.02)
Crisis dummy	0.020**	0.020**	0.026**	0.026**	0.016	0.015	-0.006	-0.006	0.000	-0.000	-0.005	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of observations	755	755	601	601	601	601	755	755	601	601	601	601
Number of banks	139	139	139	139	139	139	139	139	139	139	139	139
Adjusted R-squared	0.144	0.143	0.128	0.129	0.323	0.328	0.057	0.059	0.052	0.057	0.353	0.354
F test (p values)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.013	0.017	0.000	0.000
Country FE	YES	YES	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO
Cluster	Banks	Banks	Banks	Banks	Banks	Banks	Banks	Banks	Banks	Banks	Banks	Banks

Note: The table reports the estimation results of the following regression $Efficiency_{ij,t} = \beta_0 + \beta_1 \times Governance_{ij,t-1} + \Theta \times Bank\ controls_{ij,t-1} + \Phi \times Banking\ system\ controls_{j,t-1} + Crisis_{t-1} + \varphi_j + \varepsilon_{ij,t}$. In Panel A the dependent variable is the *Cost efficiency* of bank i from country j in year t, while in Panel B the *Technical efficiency* of bank i from country j in year t. Definitions of variables are given in Table 1. The sample consists of 139 banks from CEE, analyzed during 2005 - 2012. Method used is *OLS FE* in Panel A Models (1)-(4) and Panel B Models (7)-(10), and, *Pooled OLS* in Panel A Models (5)-(6) and Panel B Models (11)-(12). Explanatory variables are one year lagged. All models include an unreported constant. Bank clustered standard errors in parentheses.*, ** and *** denote significance levels of 10%, 5% and 1%.

Table 6. The impact of banks' governance on efficiency during crisis

	Cost efficiency		Technical efficiency	
	(1)	(2)	(3)	(4)
Variables	OLS FE	OLS FE	OLS FE	OLS FE
Governance				
Corporate governance index	-0.184***		-0.143***	
	(0.05)		(0.03)	
Risk management index		-0.112**		-0.062**
		(0.04)		(0.03)
Supervisory board index		-0.057		-0.087**
		(0.04)		(0.03)
Corporate governance index * Crisis dummy	0.110***		0.098***	
	(0.04)		(0.03)	
Risk management index * Crisis dummy		0.098***		0.067***
		(0.03)		(0.02)
Supervisory board index * Crisis dummy		0.002		0.025
		(0.03)		(0.02)
Bank characteristics				
Log total assets	0.095***	0.098***	0.050***	0.048***
	(0.02)	(0.03)	(0.01)	(0.01)
Equity to total assets	-0.002	-0.003	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Net loans to deposits and short term funding	0.000**	0.000**	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Impaired loans(NPLs) to gross loans	-0.003***	-0.003***	-0.001**	-0.001**
	(0.00)	(0.00)	(0.00)	(0.00)
Other controls				
Foreign bank dummy	0.024	0.017	0.060	0.060
	(0.03)	(0.04)	(0.05)	(0.04)
Crisis dummy	-0.066**	-0.056**	-0.066***	-0.062***
	(0.03)	(0.02)	(0.02)	(0.02)
Number of observations	755	755	755	755
Number of banks	139	139	139	139
Adjusted R-squared	0.141	0.146	0.084	0.087
F test (p values)	0.000	0.000	0.000	0.000
Country FE	YES	YES	YES	YES
Cluster	Banks	Banks	Banks	Banks

Note: The table reports the estimation results of the following regression $Efficiency_{ij,t} = \beta_0 + \beta_1 \times Governance_{ij,t-1} + \beta_2 \times Governance_{ij,t-1} \times Crisis_{t-1} + \Theta \times Bank\ controls_{ij,t-1} + \Phi \times Banking\ system\ controls_{j,t-1} + Crisis_{t-1} + \varphi_j + \varepsilon_{ij,t}$. In Panel A the dependent variable is the *Cost efficiency* of bank i from country j in year t, while in Panel B the *Technical efficiency* of bank i from country j in year t. Crisis dummy takes the value 1 for period 2008-2010 and 0 otherwise. Definitions of variables are given in Table 1. The sample consists of 139 banks from CEE, analyzed during 2005 - 2012. Method used is *OLS FE*. Explanatory variables are one year lagged. All models include an unreported constant. Bank clustered standard errors in parentheses.*, ** and *** denote significance levels of 10%, 5% and 1%.

Table 7. Banks' governance, capitalization and efficiency

	Cost efficiency				Technical efficiency			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	OLS FE	OLS FE	OLS FE	OLS FE	OLS FE	OLS FE	OLS FE	OLS FE
Governance								
Corporate governance index	-0.194***		-0.281**		-0.154***		-0.245***	
	(0.06)		(0.12)		(0.04)		(0.07)	
Risk management index		-0.133***		-0.239**		-0.073**		-0.158***
		(0.05)		(0.10)		(0.03)		(0.05)
Supervisory board index		-0.048		0.001		-0.086**		-0.078
		(0.04)		(0.08)		(0.03)		(0.05)
Corporate governance index * Capitalization dummy	0.128				0.119**			
	(0.08)				(0.06)			
Risk management index * Capitalization dummy		0.126**				0.084**		
		(0.06)				(0.04)		
Supervisory board index * Capitalization dummy		-0.020				0.023		
		(0.04)				(0.04)		
Corporate governance index * Equity to total assets			0.014				0.014**	
			(0.01)				(0.01)	
Risk management index * Equity to total assets				0.017**				0.013***
				(0.01)				(0.00)
Supervisory board index * Equity to total assets				-0.006				-0.000
				(0.01)				(0.00)
Bank characteristics								
Log total assets	0.086***	0.088***	0.092***	0.091***	0.044***	0.042***	0.047***	0.043***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Equity to total assets	0.002	0.001	-0.008*	-0.005	0.002	0.002	-0.005**	-0.004
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Net loans to deposits and short term funding	0.000*	0.000	0.000*	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Impaired loans(NPLs) to gross loans	-0.003***	-0.003***	-0.003***	-0.003***	-0.001**	-0.001**	-0.001**	-0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Capitalization dummy	-0.119**	-0.098**			-0.082**	-0.072**		
	(0.05)	(0.05)			(0.04)	(0.04)		
Other controls								
Foreign bank dummy	0.010	0.010	0.012	0.014	0.049	0.052	0.048	0.053
	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Crisis dummy	-0.003	-0.002	-0.006	-0.007	-0.011**	-0.012**	-0.013**	-0.014**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of observations	755	755	755	755	755	755	755	755
Number of banks	139	139	139	139	139	139	139	139
Adjusted R-squared	0.160	0.167	0.138	0.149	0.087	0.090	0.081	0.091
F test (p values)	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	Banks	Banks	Banks	Banks	Banks	Banks	Banks	Banks

Note: The table reports the estimation results of the following regression $Efficiency_{ij,t} = \beta_0 + \beta_1 \times Governance_{ij,t-1} + \beta_2 \times Governance_{ij,t-1} \times Capitalization_{ij,t-1} + \Theta \times Bank\ controls_{ij,t-1} + \Phi \times Banking\ system\ controls_{j,t-1} + Crisis_{t-1} + \varphi_j + \varepsilon_{ij,t}$. In Panel A the dependent variable is the *Cost efficiency* of bank i from country j in year t, while in Panel B the *Technical efficiency* of bank i from country j in year t. Definitions of variables are given in Table 1. Models (1)-(2) from Panel 1 and (5)-(6) from Panel B include as proxy for capitalization a dummy variable that takes the value 1 for more capitalized banks and 0 for less capitalized banks, while Models (3)-(4) from Panel 1 and (7)-(8) from Panel B include as proxy for capitalization the Equity to total assets ratio. The sample consists of 139 banks from CEE, analyzed during 2005 - 2012. Method used is *OLS FE*. Explanatory variables are one year lagged. All models include an unreported constant. Bank clustered standard errors in parentheses.*, ** and *** denote significance levels of 10%, 5% and 1%.