Cost efficiency of commercial banks in South-East Europe: a time-varying approach

Preliminary results

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Abstract

This study examined cost efficiency of commercial banks operating in seven South-Eastern European countries over the period 2003-2012. Using a stochastic frontier approach, this study aimed at investigating how the cost efficiency of banks changes over time during the period under study. The findings of this study show that the average cost efficiency of South-Eastern European banks was 72.9% over the period 2003-2012. Furthermore, when considering the type of ownership, it was found that on average foreign-owned banks were slightly more cost-efficient than domestic-owned banks, with values of 80.3% and 80% respectively. In addition, by measuring banks' size via assets, it was found that banks' cost efficiency tends to decline as banks become larger. Finally, the findings of this study show that irrespective to ownership or size, banks' cost efficiency declined over the period 2003-2012, especially during the 2007-2009 global financial crisis as well as during the 2009-2010 European sovereign debt crisis.

Keywords: commercial banks, efficiency, foreign ownership.

JEL classifications: C23, C52, G21.

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1. Introduction

Banking industries in South-East Europe are the main channel through which financial resources are allocated to economic activities carried out in the aforementioned region. area. South-Eastern European (SEE hereafter) equity markets are generally tiny and requirements for local firms aiming to list in these markets are very strict, with costs that are usually far higher than the benefits that come with having their shares traded in the aforementioned markets. SEE banks' limited financial resources are required to be managed carefully in order to generate an adequate return of capital invested by their owners as well as supporting local economic activities that contribute to economic growth across the entire region.

One of the central issues SEE banks have to deal with is whether they are cost-efficient in providing services to their customers. In order to address this issue, the present study investigates the cost efficiency of commercial banks operating in seven SEE countries (Albania, Bosnia-Herzegovina, Bulgaria, Croatia, FYROM, Serbia, and Romania) by using bank-level data. Most of the empirical studies on the cost efficiency of banks operating in Eastern Europe focus on the Central and Eastern European (CEE hereafter) countries while only a few focus on the SEE countries. Therefore, in order to expand the literature focusing on SEE countries, this study contributes to the current empirical literature on the cost efficiency of banks operating in the SEE region. By using a stochastic frontier approach (SFA hereafter), I calculated cost-efficiency scores for SEE commercial banks over the period 2003-2012. These scores were then used to evaluate whether cost efficiency at bank level differs in relation to bank' size (larger versus small banks) as well as bank ownership (domestic versus foreign ownership). The following questions were addressed in this study: firstly, are some SEE banking industries more cost-efficient than others? Secondly, do cost efficiency scores of SEE banks change over time? And lastly, do these changes differ in relation to either the size or ownership status of the banks?

The findings of this study reveal that bank size as well as ownership matter in terms of cost efficiency. Secondly, in some SEE countries, banking industries are more cost efficient than others; this might indicate that reforms adopted in some SEE countries were more successful in aligning their banking industries to benchmarks located in more advanced economies.

The rest of this paper is organised as follows. Section 2 presents a selective review of the literature dealing with banking efficiency in the Eastern European banking industries. Section 3 discusses the methodology while Section 4 presents the data. Section 5 presents the results and discusses the implications whilst Section 6 concludes this study.

2. Literature review

The concept of efficiency is relevant for banking firms, consumers, and policy-decision makers alike. In fact, the higher the bank's efficiency, the higher its profitability. On the other hand, higher efficiency also means that the bank's customers might expect lower prices, whilst policy decision makers would be concerned about ensuring the fairness of banking intermediation services (Goddard et al, 2001). Banking efficiency analysis is based on statistical techniques that aim to construct an efficient frontier for costs, profits, and production functions, thereby evaluating the efficiency of banking firms by investigating to what extent banks' costs, profits, and level of production are far from the best practice efficient frontiers. There are different approaches to the estimation of the best practice frontier. Data Envelopment Analysis (DEA hereafter) or Stochastic Frontier Analysis (SFA hereafter) are the two alternative methodologies used by recent empirical literature on banks' efficiency. The main difference between DEA and SFA is that DEA does not specify the functional form for costs, profits, or production functions while SFA assumes specific distributional forms.

The empirical literature dealing with efficiency in the Eastern European banking industries is mainly based on either SFA or DEA methodologies. For instance, Bonin et al (2005) used SFA to investigate to what extent the type of ownership (i.e. either private or state ownership) might explain differences in the costs and profit efficiency of banking firms located in the Eastern European countries. Using a sample of 225 banks over the period 1996-2000, Bonin et al (2005)'s findings show that discriminating between private and state ownership does not represent a valid reason to conclude that private banks are more cost- and profit-efficient than state-owned banks. Fries and Taci (2005) examined cost efficiency using SFA by considering banking industries of fifteen Eastern European countries during the period 1994-2001. Their findings show that larger banks are more cost-efficient than smaller banks. Fries and Taci (2005) also show that ownership does matter in terms of cost efficiency, as their findings show that privately-owned banking firms are more cost-efficient in comparison to private banks. Kasman and Yildirim (2006) investigate cost and profit efficiency in the banking industries of eight Eastern and Central European countries that joined the EU during the 1990s and 2000s. Using a sample of 195 banks over the period 1995-2002, these authors found evidence that profit and cost efficiency vary greatly across the banking firms of the countries under investigation. Moreover, comparing banks' performances by considering whether their ownership is foreign or domestic, Kasman and Yildirim (2006) found that foreign-owned banks are the most profit-efficient, whilst domestic-owned banks perform better in terms of cost efficiency. More recently, Mamatzakis et al. (2008) investigated to what extent banks located in the new EU member states are both cost- and profit-efficient. Looking at banks located in the SEE hereafter, Staikouras et al. (2008) focused on their cost efficiency over the period 1998-2003. Dividing banks in three groups, in

accordance with their size, Staikouras et al. (2008) found that medium-sized banks were the most cost-efficient. In addition, they found that foreign-owned banks were the most cost-efficient while state-owned banks were the least cost-efficient. Additional studies focusing on the differences in cost efficiency between domestic and foreign ownership, however, show mixed results. For instance, by using DEA on a sample of Polish banks over the period 1997-2001, Havrylchyk (2006) found that domestic banks were less efficient than foreign-owned banks, although the latter perform particularly well if their model of entry in the Polish banking industry had been greenfield banks rather than via acquiring domestic banks. Mamatzakis et al (2008) investigated the cost and profit efficiency of banks located in the new European Union (EU) member states banks over the period 1998-2003. By using SFA, they found that savings banks were the most cost- and profit-efficient in comparison to cooperative and commercial banks. Furthermore, by looking at the size of banking firms, Mamatzakis et al (2008) found that large banks were the most cost-efficient in comparison to small banks. Also, when considering the difference between domestic and foreign ownership, their results showed that foreign-owned banks were the most profit-efficient. More recently, Fang et al. (2011) investigated both the cost and profit efficiency of SEE banks over the period 1998-2008. By using SFA, their results show that domestic banks were more cost-efficient than foreign-owned banks. Secondly, domestic banks were less profit-efficient compared to foreign-owned banks.

The findings of the empirical literature can be summarised as follows: firstly, in some of the Eastern European banking industries, banks seem to be more efficient than in other countries of the same region. Secondly, size and ownership are two of the main factors which might explain differences in terms of efficiency across banks. Thirdly, most of the current literature has focused on the CEE region whilst only a handful of studies have focused on the SEE region. Considering these findings, this study expands Fries and Taci (2005)'s and Mamatzakis et al. (2008)'s studies in analysing the baking industries in the SEE region. However, I depart from the two aforementioned studies in a number of ways. Firstly, Mamatzakis et al. (2008)'s study is based on a period of five years, whilst Fries and Taci (2005) cover a period of seven years. These authors advocate the lack of data as a constraint for covering a longer period. I partially addressed that problem by covering a longer period of time. Secondly, Fries and Taci (2005) and Mamatzakins et al. (2008) focus their analysis by assuming time-invariant cost inefficiencies in the spirit of Battese and Coelli (1988). I extend both the studies by using time-varying efficiencies models,[2] since these models provide a better understanding to what extent gains in terms of efficiency vary over time.

[2] I estimate the time-varying models by following Bellotti et al. (2006) who provide the STATA routines to address technical issues behind those models.

Table 1 – Recent studies on cost and profit efficiency in Eastern Europe banking industries

Author/s	Focus	Countries	Period	Number of Banks	Methodology	Findings
Bonin et al (2005)	Cost and profit efficiencies	Bulgaria, Czech Rep., Estonia, Croatia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia	1996-2000	225	Stochastic Frontier Analysis	Foreign-owned banks are more cost- and profit-efficient than domestic-owned banks
Fang et al. (2011)	Cost efficiency	Albania, Bulgaria, Croatia, Macedonia, Romania, Serbia	1999-2008	171	Stochastic Frontier Analysis	Foreign-owned banks are less cost-efficient than domestic-owned banks
Fries and Taci (2005)	Cost efficiency	Bulgaria, Croatia, Czech Rep., Estonia, FYROM, Hungary, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine	1994-2001	289	Stochastic Frontier Analysis	Private banks are more cost-efficient than state-owned banks. Among private banks, however, those with majority foreign ownership are the most cost- and profit-efficient
Havrylchyk (2006)	Profit efficiency	Poland	1997-2001	52	DEA	Foreign-owned banks are more profit efficient than domestic banks.
Kasman and Yildirim (2006)	Cost and profit efficiencies	Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia	1995-2002	190	Stochastic Frontier Analysis	Foreign-owned banks are more cost- and profit-efficient than domestic banks.
Mamatzakis et al (2008)	Cost and profit efficiencies	Cyprus, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia	1998-2003	-	Stochastic Frontier Analysis	Foreign-owned banks are the most profit-efficient, while state-owned banks are the most cost-efficient.
Staikouras et al. (2008)	Cost efficiency	Bosnia-Herzegovina, Bulgaria, Croatia, FYROM, Romania, Montenegro	1998-2003	-	Stochastic Frontier Analysis	Medium-sized banks are more cost-efficient than small- and large-sized banks

Note: This table summarises the findings of studies investigating the efficiency of banking industries located on Eastern European countries.

5. Methodology

5.2 Efficiency measures

A popular methodology to measure cost efficiency in banking empirical literature is SFA The efficiency of banking firms is evaluated by measuring to what extent their cost function is far from a hypothetical frontier of efficiency represented by minimum costs. That distance is calculated for each banking firm and each banking firm is supposed to have its own frontier costs. Thus, banking firm total costs are a function of a certain amount of output produced by *i-th* banking firm itself and the prices of inputs used to produce it. It is also assumed that the total cost function has two random components that are measurement errors indicated with the term *v*, and technical and allocative efficiency aspects which are indicated with the term *u*. Hence, a total cost function for the *i-th* banking firm at time *t* is represented as follows:

$$TC_{it} = f(P_{it}, Q_{it}, Z_{it}) + v_{it} + u_{it} \quad (1)$$

where TC_{it} stands for total cost for firm *i* at time *t*, P_{it} is a vector of input prices, Q_{it} is a vector of outputs, and Z_{it} is a set of control variables. The SFA approach assumes that managerial or controllable inefficiencies, i.e. u_{it}, increase costs only above the frontier or best-practice level. Hence, the term u_{it} represents inefficiency or the distance from best practice. Therefore, the higher u_{it}, the more it costs for firm *i* to produce a given output and the more inefficient the firm *i-th* is. There are two main approaches in measuring banking cost efficiency: the intermediation approach proposed by Sealey and Lindley (1977) and the production approach. The main difference is that the intermediation approach is based on the idea that a bank is a financial intermediary, in that it collects deposits from its customers and uses them to provide loans or transforms them into other earning assets. Conversely, the production approach assumes that banks are producers of a wider range of financial services. The intermediation approach is the most popular one across empirical banking efficiency studies as data this approach is based on are more easily retrieved via banks' income statements and balance sheets in comparison to the data required for the production function approach. Using the intermediation approach in this study, I assumed the variable TC_{it} as the sum of interest and noninterest costs (Bonin et al., 2005), while output variables Q_{it} are represented by total deposits and total loans (Taci, 2005; Bonin et al. 2005) respectively. The vector of input prices (P_{it}) in Eq. (1), is represented by the price of labour, measured as personnel expenses divided by total assets (Mamatzakis et al., 2008), and the price of funds, measured by the ratio of interest expenses to total deposits (Mamatzakis et al., 2008). In accordance with the empirical banking literature (see, for instance, Fries and Taci, 2005; Mamatzakis et al., 2008; Staikouras et al. 2008), the cost function is specified as a standard translog form, that is:

$$lnTC_{it} = \sum_{m}^{n} \alpha_m \, lnP_{m,it} + \sum_{s}^{t} \beta_s lnQ_{s,it} +$$

$$+ 1/2 \sum_{m}^{n} \sum_{n}^{m} \alpha_{m,n} \, lnP_{m,ijt} lnP_{n,it} + \; 1/2 \sum_{s}^{t} \sum_{t}^{s} \beta_{s,t} \, lnQ_{s,ijt} lnQ_{t,i,t} +$$

$$+ \sum_{m}^{n} \sum_{s}^{t} \phi_{m,s} \, lnP_m lnQ_{s,ijt} + Z_{j,t} + D_{j,t} + + v_{ij,t} + u_{ij,t} \qquad (2)$$

where P_m and P_n are input prices, Q_s and Q_t are output quantities, $Z_{j,t}$ is a vector of macroeconomic variables, and $D_{j,t}$ is a vector of dummy variables. In accordance with the relevant empirical banking literature, standard symmetry and linear restrictions must be assured in Eq. (2). The former is imposed as follows: $\alpha_{m,n} = \alpha_{n,m}$ and $\beta_{s,t} = \beta_{t,s}$. The liner restriction aiming at assuring liner homogeneity is achieved by imposing $\sum_{m}^{n} \alpha_m = 1$ as well as $\sum_{m}^{n} \alpha_m = \sum_{n}^{m} \alpha_n = \sum_{m}^{n} \phi_m = 0$. The composite error term in Eq. (2) is formed by two components: the random component v_{ijt} and the bank inefficiency component u_{ijt}. The random component v_{ijt} captures inefficiencies beyond the control of banks' managers, whilst the bank inefficiency component u_{ijt} captures inefficiencies due to factors that could be controlled by management. The SFA approach assumes that the inefficiency component, $u_{i,t}$, of the composite error term is positive (i.e. larger than zero), and the higher the inefficiency component is the more inefficient in terms of costs a bank is. Once Eq. (2) is estimated, bank-level measures of cost efficiencies are calculated by using the bank inefficiency component, u_{ijt}. As pointed out by Girardone et al. (2004), the related cost efficiency values are meant to be the proportion of the costs that are meant to be efficient. In other words, a bank with a cost efficiency of 0.70 is 70% efficient, while the remaining 30% is thought to be the amount of resources that are wasted. It is worthwhile to note that Eq. (2) can be used to evaluate either cost or profit efficiency of the *i-th* banks by replacing the *i-th* bank total cost with its total profits.

Several alternative SFA models have been proposed by the theoretical literature. One way of differentiating between them is by considering whether a time-invariant or time-varying approach is used to estimate the inefficiency scores. A time-invariant approach assumes that inefficiency scores do not change over time whilst a time-varying approach is more flexible as it allows to calculate a tie series of inefficiency scores. Two main models adopting a time-invariant approach have been proposed in the theoretical literature. The first was introduced by Pitt and Lee (1981) and was based on a Maximum Likelihood estimation method where the cost function is estimated by assuming a *normal* distribution for the random error v_{ijt} and a Half-Normal distribution for the inefficiency component u_{ijt} of the composite error. Later, Battese and Coelli (1988) generalised the Pitt and Lee

(1981) model by keeping a normal distribution for the random error v_{ijt} whilst imposing a Truncated Normal distribution for the inefficiency component u_{ijt}. In both Pitt and Lee (1981) as well as Battese and Coelli (1988)'s models the estimation of the SFA is based on the assumption of time-invariant cost inefficiency scores. That assumption has been found questionable especially when panel data sets covering a long period of time are in use (Bellotti et al. 2012). To address such a limitation, a number of time-varying SFA models have been introduced. The goal of these models is to compute time-varying inefficiency scores. A very popular model proposed by Lee and Schmidt (1993) was based on a new specification of the inefficiency component $u_{ij,t}$ of the composite error term, in the form of $u_{it} = g(t)u_i$ where the term $g(t)$ is a set of time dummy variables (Bellotti et al, 2012). Therefore the inefficiency components of the composite error term are made up of a specific temporal pattern of inefficiencies via this set of time dummy variables. An additional advantage of the Lee and Schmidt (1993) model is that no parametric form is imposed on the composite error term. The estimation method of the SFA model proposed by Lee and Schmidt (1993) is based on the iterative least squares. An alternative to the Lee and Schmidt (1993)'s model is the one proposed by Battese and Coelli (1992) who proposed a time-varying SFA model which has two major elements of novelty: namely, the use of the Maximum Likelihood as an estimation method and a specification of the inefficiency component $u_{it} = g(t)u_i$ such as $g(t) = exp[-\eta(t - T_1)]$, where u_i's are assumed to be independent and identically distributed non-negative truncations of the $N(\mu, \sigma^2)$. In accordance with Battese and Colelli (1992), the term u_{it}, which represents technical inefficiency, can decrease, remain constant, or decrease over time (i.e. as *t* increases) if $\eta > 0, \eta = 0, or\ \eta < 0$. Therefore, for example, firms enjoy a reduction of their technical inefficiency as $\eta > 0$. Because the term u_{it} could hypothetically assume very large values, it is possible to reconcile the concept of technical inefficiency with the technical efficiency *T* of the firm *i* at time *t* (i.e. T_{it}) measuring the latter on a scale from zero to one, where the most efficient firms are ones with technical efficiency values close to 1. On an operational matter, cost efficiency of the *i-th* firm at the *t-th* time period is calculated as follows:

$$CE_{it} = exp(-u_{it}) \tag{3}$$

Eq. (3) ensures that the cost efficiency of the *i-th* firm at the *t-th* time period is bounded between zero and one, where the more (less) cost efficient a bank is, the closest to one (zero) the value of its CE_{it} value is.

4. Data

This study considers banking industries of the following SEE countries: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, FYROM, Romania and Serbia. A dataset of commercial banks was drawn from the *BankScope* database, collecting data from 2003 to 2012. The dataset used in this study suffered from selection bias in the data. This was due to the selection made by *BankScope* which mainly included the larger and more financially sound banks. The downside that therefore accompanies this dataset is that the estimation results reflect the best banks rather than the entire population.[3] Data from the *BankScope* database were collected in domestic currency and converted into a common currency (i.e. U.S. Dollars) by using spot exchange rates among each domestic currency and the U.S. Dollar. Furthermore, after converting data from the common currencies the effects of inflation were then removed by using the US GDP deflator, with all values expressed in 2009 prices,[4] which had been downloaded from the U.S. National Bureau of Economic Analysis.[5] In selecting banks for the dataset, I only considered banks with at least three years of continuous data. In accordance with this criterion, I ended up with a dataset of 172 banks. Accounting banking data were integrated with data about banks' ownership by using Claessens and Van Horen's database.[6]

Table 1 presents descriptive statistics of the variables used in this study. Panel A and Panel B of Table 1 present average values of items from balance sheet and income statement data. On the other side, Panel C presents average values of variables included in Eq. (2) in addition to input data (i.e. total deposits and total loans) as per Panel A. Average total costs were around $102 million US dollars, while for inputs the average price of labour was $0.025 million, and the average price of funds was $0.041 million. Finally, the average value of total loans was around $905 million, while the average value of deposits was $301 million.

[3] This is a common problem in a large number of empirical studies (see, for instance, Al-Muharrami et al., 2006; Casu and Girardone, 2010; Delis and Kouretas, 2011; Dietrich and Wanzenried, 2011; Fang et al, 2014; Fries and Taci, 2005; Lei and Song, 2013; Lepetit et al, 2008; Mamatzakis et al, 2005; Mamatzakis et al, 2008; Weill, 2013) based on *BankScope* database.

[4] A similar procedure has been used in Goddard et al. (2001). The authors collected variables in domestic currency, converted them into ECU and removed the effect of inflation by using an ECU GDP deflator.

[5] The US GDP deflator had been calculated by the National Bureau of Economic Analysis dividing US Nominal GDP by US Real GDP at 2009 prices. I then used those values by dividing all the nominal variables of our dataset with the US GDP deflator as calculated previously.

[6] Further information about this database is available at: https://neeltjevanhoren.com/my-research/datasets/. This database provided ownership data up until the end of 2009, I collected data for the additional period 2010-2012 from the ORBIS database in order to retrieve information about the ownership of our sample banks, and whereas that was not possible, I looked at the websites of those banks for which ownership information was missing.

Table 2 – Descriptive statistics for SEE banks' variables in million US dollars, 2003-2012

	Mean	Median	Standard deviation	Min.	Max.
Panel A – balance sheet data					
Total assets	1475.694	379.007	3151.166	0.783	28334.97
Total deposits	865.302	245.993	1815.997	0.528	13492.33
Total loans	905.475	214.867	1988.175	0.006	18671.88
Panel B – income statement data					
Total interest expenses	45.031	10.184	116.451	0	1764.907
Total non-interest expenses	57.072	16.669	124.532	0.702	1584.794
Personnel expenses	21.833	7.220	49.171	0.390	821.044
Panel C – Total costs, input, and output data					
Total cost	102.417	28.406	218.333	0.897	2457.939
Price of labour	0.0253	0.016	0.142	0.001	4.712
Price of funds	0.0415	0.034	0.046	0.00	0.719

Notes: The variable *Total costs* is calculated by the sum of total interest expenses and total non-interest expenses. Price of labour is calculated as personnel expenses divided by total assets. Price of funds is calculated as interest expenses divided by total deposits. Panel C does not report input data (i.e. total deposits and total loans as they were reported under Panel A as balance sheet data)

5 Empirical results

5.1 Technically efficient results

Table 3 reports the findings of Eq. (2) which was estimated by considering *Total Costs* as a dependent variable. The coefficient estimates of the price funds (P_1) is positive and statistically significant, therefore as funds' prices rise so do the banks' total costs. The coefficient estimates of the price of labour (P_1) is positive and statistically significant, therefore as labour prices rise so do the banks' total costs. The coefficient estimates of the *Total loans* (Q_1) and *Other Earning Assets* (Q_2) have positive and statistically significant effects on *Total Costs* (TC), therefore as banks' output grows so do banks' *Total Costs*. The positive effects of both *Total loans* (Q_1) and *Other Earning Assets* (Q_2) is consistent with other empirical banking studies (see, for instance, Staikouras et al., 2008) which report a positive effect of both *loans* and O*ther Earning Assets* on *Total Costs*.

The estimated coefficients of both *squared Total Loans* (Q_1^2) as well as squared *Other Earning Assets* (Q_2^2) are positive and statistically significant. This means that increasing marginal return characterise the effects of both the variables on total costs. In other words, in the relationship between *Total Cost* and either *Total loans* or *Other Earnings Assets* there are turning points beyond that of the effects of producing additional units of both the outputs, which then result in higher costs per unit of production.

The coefficient of the cross-output terms (Q_1Q_2) is negative (-0.116) and statistically significant. A negative value as an interaction term implies that the lower the cost of producing *loans* is, the smaller the cost of producing O*ther Earning Assets* is. Looking at the effect of macroeconomic variables on *Total Cost*, it can be observed that the effect of GDP per capita (GDP_PC) on *Total Costs* is not statistically significant. On the other hand, the *Lending_rate* variable has a positive (0.017) and statistically significant effect on *Total Cost*; therefore, higher lending rates results in higher total costs for banks. Membership of the EU, described with a *EU_dummy* variable, does not seem to have any statistical significant effect on banks' *Total Cost*. The *foreign ownership dummy* shows a negative and statistically significant effect on *Total Cost*. Therefore, foreign-owned banks seem to enjoy lower total costs in comparison to domestic-owned banks. Conversely, Green et al. (2004), when focusing on cost efficiency of banks in CEE, found that foreign-owned banks are not more cost-efficient than domestic owned banks. Similar results are reported by Havrylchyk (2006) who found that, in the Polish banking industry, foreign banks are more cost-efficient than domestic banks.

The effect of the 2007-2009 global financial crisis, as per the *GFC_dummy*, shows negative (-0.011) and statistically significant effects on *Total Cost.* This outcome is a bit surprising; we might

infer that the global financial crisis might have indirectly reduced *Total Cost* as a consequence of the reduction of the banks' activities following the downturn of economic activities at country level.

Table 3 – Cost efficiency estimation results

Panel A: Cost efficiency

	Coefficient	Standard Error
Dep variable: TC		
$\ln(P_1)$	1.256	0.229***
$\ln(P_2)$	0.636	0.152***
$\ln(Q_1)$	0.655	0.122***
$\ln(Q_2)$	0.223	0.103**
$\ln(P_1)^2$	0.066	0.028**
$\ln(P_2)^2$	0.012	0.006**
$\mathrm{Ln}(P_1)\ln(P_2)$	0.112	0.039**
$\mathrm{Ln}(Q_1)^2$	0.069	0.008***
$\mathrm{Ln}(Q_2)^2$	0.048	0.006***
$\mathrm{Ln}(Q_1)\ln(Q_2)$	-0.1	0.012***
$\mathrm{Ln}(P_1)\ln(Q_1)$	0.038	0.026
$\mathrm{Ln}(P_2)\ln(Q_1)$	0.005	0.018
$\mathrm{Ln}(P_1)\ln(Q_2)$	-0.023	0.022
$\mathrm{Ln}(P_2)\ln(Q_2)$	0.008	0.012
GDP_PC(%)	-0.002	0.002
Dcppsb	-0.001	0.001
Lending rate	0.011	0.004***
EU_dummy	-0.029	0.033
Foreign ownership_dummy	-0.122	0.03***
GFC_dummy	-0.017	0.023***
Cons	3.156	0.674

Note: This table presents the results of the Battese-Colelli (1995) time-varying SFA model. The dependent variable *TC* is calculated as the sum of interest and non-interest costs. P_1 and P_2 are *Price of Labour*, and *Price of Funds*, respectively. Q_1 and Q_2, are total amount of loan, and total amount of other earning assets respectively. *GDP_PC* is the gross domestic product per capita. *Dcppsb* is the domestic credit provided to private sectors by banks in % of the GDP. *Lending rate* is the rate of interest that banks charge for borrowing money. *EU_dummy* is a dummy variable that takes a value of 1 if a country is a member of the EU and 0 if not. *Foreign ownership_dummy* is a dummy variable that takes a value of 1 if a bank is owned by a foreign entity and 0 if not. *GFC_dummy* is a dummy variable that takes a value of 1 for the period 2008-2009 only, and 0 for years before and after that period.

5.2 The evolution of cost efficiency scores at regional and country level

The results of Eq. (2) are then used to calculate the technical efficiency costs of SEE banks at the *t-th* time period with the goal of presenting how these costs change over the period 2003-2012. Since the cost frontier is a translog function, efficiency is defined as $\exp(-u)$, where u is the estimated efficiency. Therefore, I calculated the time-varying efficiency scores as per the previous expression. The findings are presented in Table 4 – column 1, where it can be observed that, on average, cost-efficiency scores of SEE banks have been decreasing over the period 2003-2012 from 92.3% in 2003 to 72.9% in 2012. Furthermore, if we look at the maximum values (column 2), we note that there are banks with efficiency scores close to 97.8%, whilst looking at the minimum value (column 3) we observe that there are banks with cost efficiency scores of 11.9% in both 2011 and 2012. Therefore, in terms of costs, very efficient banks and very inefficient banks coexist in SEE banking industries. By focusing on the CEE region, Kasman and Yildirim (2006) examined cost efficiency on a sample of banks located in the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and Slovenia and found an average cost efficiency score of 80%. Comparing their results with the findings of Table 4, it is evident that banks located in the SEE region are, on average, less cost-efficient (72.9% as shown in Table 4 – column 1) than their counterparts located in the CEE region. This might be explained by the fact that economic reforms implemented by SEE governments in order to boost the transition towards market economies were implemented later in the SEE in comparison to CEE countries.

The downward trend in the cost-efficiency of SEE banks, as shown in Table 4 – column 1, might be partially explained by the negative effects of the 2007-2008 global financial crisis and the 2010 European sovereign debt crisis on SEE economies. The consequent economic slowdown in Western European countries, which are the main recipients of SEE exports, and the sharp reduction of foreign direct investments to the SEE region, triggered the economic slowdown of many SEE economies. In the context of banking studies, this has been explained by mechanism defined as the *bad luck hypothesis*, that is that economic slowdowns increase non-performing loans that lead banks to incur in extra-costs in order to deal with these loans that result in lowering their cost-efficiency. However, this *bad luck hypothesis* has been challenged by the *bad management hypothesis* which points out that it is the cost-efficiency that affects non-performing loans so, in other words, the lower the quality of the bank management, the lower the efficient monitoring of the loan portfolio (Berger and De Young, 1997). Both the *bad luck hypothesis* and the *bad management hypothesis* were brought forward by Berger and De Young (1997) who found empirical evidence supporting both hypotheses on a sample of US banks. However, in a more recent study, Podpiera and Weill (2008) tested both hypotheses on a sample of 43 Czech banks and found evidence in favour of the *bad management*

hypothesis. In this study I do not test which one of these hypotheses might be the predominant one in the case of the SEE banking industries as this is beyond the goals of this study.

Table 4 – SFA results: evolution of average cost inefficiency scores over the period 2003-2012

	(1)	(2)	(3)
Year	Average	Max	Min
2003	0.923	0.975	0.788
2004	0.869	0.978	0.375
2005	0.853	0.975	0.335
2006	0.837	0.973	0.296
2007	0.821	0.970	0.258
2008	0.809	0.975	0.221
2009	0.785	0.972	0.181
2010	0.763	0.969	0.149
2011	0.752	0.965	0.119
2012	0.729	0.965	0.119
Average	0.729	0.962	0.097

Note: Cost efficiency scores have been calculated as post-estimate inefficiencies by using the results of the SFA models presented in Table 3. Column (1) illustrates the average cost efficiency on an annual basis. Column (2) illustrated the maximum value of cost-efficiency reached on annual basis, while column (3) shows the minimum value of cost efficiency reached on annual basis.

Looking at the cost efficiency scores at country level across the banking industries of the SEE region, Table 5 - column 1 shows that, on average, banks located in Albania were the most efficient with an average score of 82.6% over the period 2003-2012. Conversely, banks located in Serbia were the ones with the worst performances as indicated by an average cost efficiency of 66.7%. Banks located in Croatia, Bulgaria, and Bosnia-Herzegovina performed relatively well with average cost efficiency scores of 89.3%, 85.8%, and 83.1% respectively. Banks located in FYROM and Romania scored, on average, 78.5% in terms of cost efficiency. These findings, as presented at country-level, are partially consistent with Fang et al (2012) who examined the cost efficiency of banks located in both the CEE and SEE regions over the period 1998-2008. Focusing on the banks located in the SEE region (i.e. Albania, Bulgaria, Croatia, FYROM, Romania, and Serbia), Fang et al (2012)'s findings indicate that, on average, cost efficiency scores were slightly lower than the ones presented in my study. In particular, their findings show that, over the period 1998-2008, average cost efficiency scores ranged from a maximum of 76.95% in the case of banks located in Croatia to a minimum of

54.75% in the case of banks located in Serbia, and intermediate values were presented for banks located in Bulgaria (63.39%), Albania (76.15%), FYROM (73.74%), and Romania (67%).

A striking aspect of Table 5, however, is the significant decrease in cost efficiency scores across all the SEE banking industries over the period 2003-2012. If we consider Albania, in 2003 the average cost-efficiency score was 0.888 while at the end of 2012 it was 0.775; a decrease of -12.8%. If we consider Bosnia-Herzegovina, in 2004 the cost-efficiency score was 0.881 while in 2012 it was 0.828; a decrease of -6.4%. In the case of Bulgaria, in 2003 the cost efficiency score was 0.847 while in 2012 it was 0.775; a decrease of -9.29%. In the case of Croatia, in 2003 the cost efficiency score was 0.938 while in 2012 it was 0.846; a decrease of -9.81%. In the case of FYROM, the average cost efficiency score was 0.978 in 2004 while in 2012 it was 0.721 representing a decrease of -26.27%. In the case of Romania, in 2003 the average cost efficiency score was 0.877 while in 2012 it was 0.785; a decrease of – 10.49%. In the case of Serbia, the cost efficiency score was 0.566 in 2004, while the value in 2012 was 0.412 with a percentage decrease of -27.2%. Therefore, banking industries in FYROM and Romania were the ones that suffered more in terms of the decline of cost bank efficiency.

Table 5 – SFA results: evolution of cost efficiency scores by country over the period 2003-2012

	(1)	(2)	(3)
Albania	Average	Max	Min
2003	-	-	-
2004	0.888	0.888	0.888
2005	0.917	0.958	0.876
2006	0.863	0.954	0.774
2007	0.855	0.948	0.752
2008	0.855	0.943	0.728
2009	0.839	0.936	0.702
2010	0.814	0.930	0.674
2011	0.795	0.922	0.644
2012	0.775	0.913	0.613
Average	0.826	0.913	0.613
Bosnia-Herzegovina	Average	Max	Min
2003	-	-	-

2004	0.881	0.961	0.819
2005	0.886	0.967	0.801
2006	0.876	0.964	0.781
2007	0.870	0.960	0.759
2008	0.867	0.955	0.736
2009	0.847	0.950	0.711
2010	0.843	0.959	0.684
2011	0.838	0.955	0.655
2012	0.829	0.950	0.624
Average	0.858	0.967	0.624

Bulgaria	Average	Max	Min
2003	0.847	0.906	0.788
2004	0.871	0.972	0.767
2005	0.866	0.968	0.744
2006	0.875	0.965	0.719
2007	0.848	0.961	0.693
2008	0.823	0.957	0.665
2009	0.823	0.952	0.634
2010	0.815	0.947	0.651
2011	0.804	0.941	0.569
2012	0.755	0.934	0.533
Average	0.831	0.972	0.533

Croatia	Average	Max	Min
2003	0.938	0.975	0.813
2004	0.928	0.973	0.794
2005	0.920	0.970	0.774
2006	0.916	0.967	0.751
2007	0.906	0.963	0.727
2008	0.892	0.959	0.701
2009	0.883	0.954	0.674

2010	0.869	0.949	0.644
2011	0.852	0.944	0.613
2012	0.846	0.938	0.663
Average	0.893	0.975	0.613
FYROM	Average	Max	Min
2003	-	-	-
2004	0.978	0.978	0.978
2005	0.910	0.975	0.844
2006	0.900	0.973	0.828
2007	0.823	0.970	0.528
2008	0.797	0.966	0.491
2009	0.762	0.948	0.452
2010	0.765	0.942	0.413
2011	0.788	0.936	0.673
2012	0.721	0.929	0.334
Average	0.785	0.978	0.334
Romania	Average	Max	Min
2003	0.877	0.948	0.806
2004	0.912	0.967	0.802
2005	0.886	0.963	0.753
2006	0.874	0.959	0.729
2007	0.858	0.955	0.703
2008	0.850	0.975	0.675
2009	0.843	0.972	0.646
2010	0.835	0.969	0.615
2011	0.797	0.965	0.471
2012	0.785	0.962	0.432
Average	**0.785**	**0.962**	**0.432**
Serbia	Average	Max	Min
2003	-	-	-

2004	0.566	0.664	0.375
2005	0.603	0.965	0.335
2006	0.548	0.961	0.296
2007	0.577	0.957	0.258
2008	0.593	0.952	0.221
2009	0.548	0.946	0.181
2010	0.475	0.834	0.149
2011	0.455	0.934	0.119
2012	0.412	0.927	0.097
Average	**0.523**	**0.965**	**0.097**

Notes. The above table presents the average cost-efficiency scores for each country and for each year. Each data is calculated by taking the average of the cost-efficiency scores of banks.

5.3 Cost efficiency scores at bank ownership level

Table 6 illustrates average cost efficiency over the period 2003-2012 for SEE banks grouped in accordance with ownership type. The findings reveal that foreign-owned banks were on average more cost-efficient than domestic-owned banks, with values of 80.3% and 80% respectively. These findings are consistent with similar studies focusing on Eastern European banking industries, where, in general, foreign-owned banks are found to be more cost-efficient in comparison to domestic-owned banks. For instance, Hasan and Morton (2003) investigate the Hungarian banking industry over the period 1993-1998, and found evidence that foreign-owned banks were more cost-efficient in comparison to domestic banks. Further, Bonin et al. (2005), using a sample of 225 banks from 11 transition countries in Eastern Europe, found that foreign-owned banks were more cost-efficient than domestic-owned banks. Fries and Taci (2005), in the same vein, examined the cost efficiency of banks in sixteen Eastern European transition countries from 1994 to 1999 and found that banks with majority foreign ownership were usually more cost efficient in comparison with banks with majority domestic ownership. However, in a more recent study, Mamatzakis (2008) found that foreign-owned banks operating in new EU member states located in Eastern Europe were less cost-efficient than domestic-owned banks. The author points out that foreign-owned banks might face higher costs due to the transfer of technology from their parent banks as well as the adoption of these improved technologies in their underlying operations which both result in higher costs. Another aspect revealed in Table 5, is the decline of cost efficiency scores for both foreign- and domestic-owned banks over the period 2003-2012. In particular, for foreign-owned banks the average cost efficiency score was 0.917 in 2003, while that value had decreased to 0.733 in 2012 with a decline of -20.06%. In the case

of domestic-owned banks the average cost efficiency score was 0.926 in 2003 and 0.728 in 2012, with a decline of -21.38% in 2012.

Table 6 – SFA results: average cost efficiency scores over the period 2003-2012 by ownership

	(1) Average	(2) Maximum	(3) Minimum
Foreign banks			
2003	0.917	0.963	0.807
2004	0.912	0.978	0.805
2005	0.867	0.975	0.337
2006	0.836	0.973	0.296
2007	0.825	0.970	0.259
2008	0.814	0.975	0.221
2009	0.792	0.972	0.186
2010	0.771	0.969	0.153
2011	0.761	0.966	0.123
2012	0.733	0.962	0.097
Average	0.803	0.978	0.097
Domestic banks			
2003	0.926	0.975	0.789
2004	0.845	0.973	0.376
2005	0.840	0.970	0.336
2006	0.842	0.967	0.424
2007	0.820	0.963	0.384
2008	0.807	0.958	0.344
2009	0.781	0.954	0.184
2010	0.758	0.960	0.151
2011	0.744	0.955	0.122
2012	0.728	0.95	0.192
Average	0.8	0.975	0.122

Note: Efficiency scores have been calculated using the SFA model in Table 5.

A natural question is whether cost efficiencies related to bank-ownership show any difference at country level. In other words, would it be possible that foreign and domestic banks have levels of cost efficiency that vary greatly among the countries under investigation? Table 7 addresses such as question by showing the average cost efficiencies at country level of SEE banks grouped in accordance with the ownership type. Our findings show that in countries such as Albania, Bosnia-Herzegovina, Croatia and FYROM, domestic-owned banks are more cost-efficient than foreign-owned banks. Conversely, foreign-owned banks are more cost-efficient in Bulgaria, Romania, and Serbia. In particular, the most cost-efficient foreign banks are located in Bosnia-Herzegovina with an average cost efficiency score of 0.916, while the least cost-efficient are located in FYROM with an average cost efficiency score of 0.762 (Table 7 – panel A). On the other hand, the most cost-efficient domestic banks are located in Croatia with an average cost-efficiency score of 0.887, while the least cost-efficient domestic banks are located in FYROM with an average cost efficiency score of 0.762 (Table 7 – panel B).

Table 7 – SFA results: average cost efficiency scores over the period 2003-2012 by ownership at country level

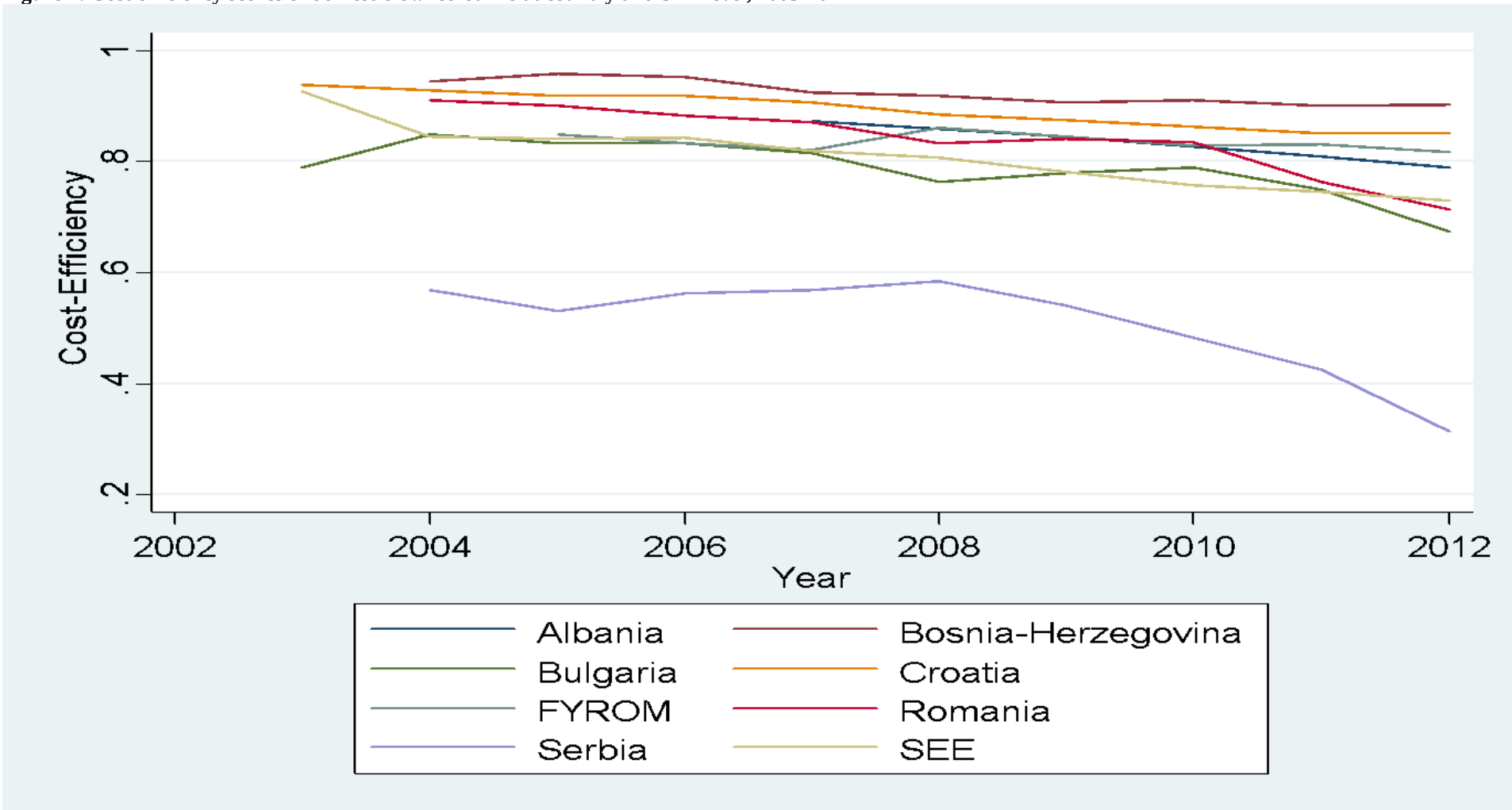
	Average	Max	Min
Panel A - Foreign banks			
Albania	0.827	0.958	0.613
Bosnia-Herzegovina	0.821	0.946	0.624
Bulgaria	0.874	0.972	0.662
Croatia	0.887	0.963	0.663
FYROM	0.762	0.978	0.334
Romania	0.853	0.975	0.557
Serbia	0.534	0.965	0.097
	Average	Max	Min
Panel B - Domestic banks			
Albania	0.821	0.862	0.776
Bosnia-Herzegovina	0.916	0.967	0.830
Bulgaria	0.789	0.961	0.533
Croatia	0.897	0.975	0.613
FYROM	0.828	0.921	0.758
Romania	0.832	0.953	0.432

Serbia	0.508	0.864	0.119

Note. Efficiency scores have been calculated by using the SFA model results as presented in Table 3.

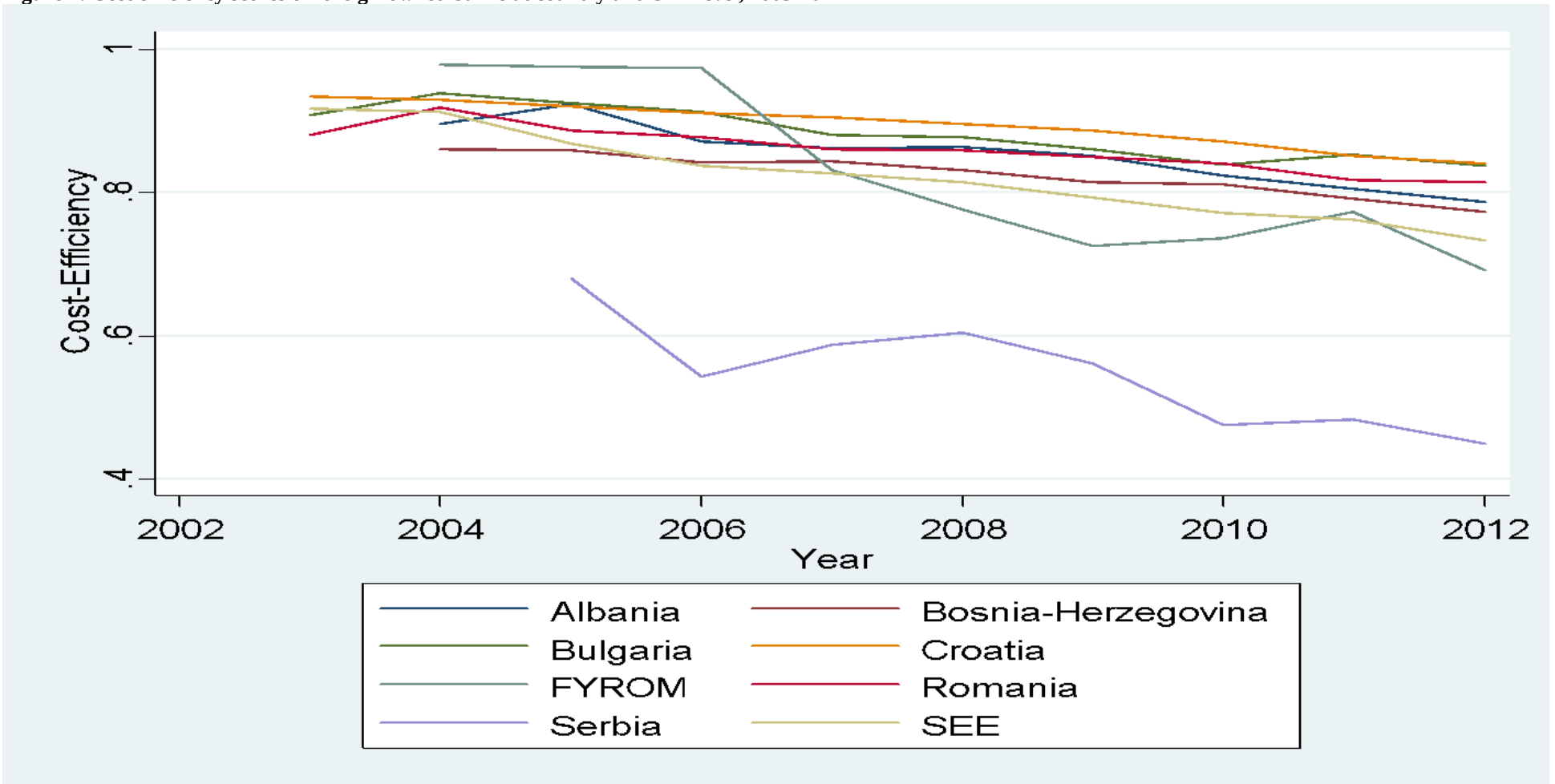
A graphical representation of the evolution of cost efficiency scores of SEE banks over the period 2003-2012 is presented in Figures 1 and 2. In particular, Figure 1 illustrates the evolution of cost efficiency scores for domestic-owned banks and shows that banks located in Serbia have the lowest cost efficiency scores since 2003 with an abrupt further reduction from 2008 onward. A drop in cost efficiency scores is consistent with other studies. Conversely, domestic-owned banks located in Romania were the most cost-efficient and experienced a slight reduction over the second half of the 2000s. On the other hand, Figure 2 illustrates the evolution of cost efficiency scores in the case of foreign-owned banks operating in SEE. Results show that over the period 2003-2012 the least cost-efficient foreign banks were those operating in Serbia. On the other hand, foreign-owned banks operating in Croatia were the most efficient since 2006, while previously foreign-owned banks operating in FYROM were the most cost-efficient.

Figure 1: Cost efficiency scores of domestic-owned banks at country and SEE level, 2003-2012



Note: This Figure illustrates the trend of cost efficiency scores for domestic-owned banks in the SEE region over the period 2003-2012.

Figure 2: Cost efficiency scores of foreign-owned banks at country and SEE level, 2003-2012



Note: This figure illustrates the trend in cost efficiency scores for foreign-owned banks operating in the SEE region.

5.4 Bank size and cost efficiency

A further question is whether bank size accounts for cost efficiency. In other words, it might be the case that larger banks could benefit from economies of scale that would allow them to reduce their costs, whilst smaller banks might not benefit from such economies. Therefore, I that issue by dividing SEE banks in accordance with their asset size. I break down the size class in asset-quartiles and present the relationship between bank size and cost efficiency levels in Table 11. The findings reveal that, in general, cost efficiency scores tend to decrease as banks become larger (i.e. from 1st quartile to the 3rd quartile as depicted in Table 8). However, when banks become much larger (i.e. 4th quartile) their average cost efficiency tends to increase. As pointed out by Hasan and Marton (2003), the largest banks venture into different areas of banking business and might experience substantial economies of scale that substantially improve their efficiency, coupled with the ability of these banks to attract and retain better managers.

Table 8 – Cost efficiency and bank size

	Total asset range	Average cost efficiency (%)	Min (%)	Max (%)	St. Dev. (%)
1st Quartile	13.96 - 164.13	87.73	77.77	95.11	0.049
2nd Quartile	164.14 - 445.08	80.70	74.65	91.79	0.042
3rd Quartile	445.09 - 1209.58	75.92	66.71	85.65	0.055
4th Quartile	1209.59 - 19125,65	80.68	73.12	93.96	0.056

Notes: Values of total assets range (column 1) are in millions of US dollar.

If we look at the changes of the cost efficiency scores over the period 2003-2012 for the overall SEE banking system, Table 9 reveals that the scores have been declining for the entire period, irrespective of the quartile considered. In 2012, the decline of cost efficiency in comparison to the value in 2003 was 18% for banks included in the 1st quartile, 17.33% for banks in the 2nd quartile, 22.07% for banks included in the 3rd quartile, and 22.15% for banks included in the 4th quartile.

Table 9 – SEE banking system: average cost efficiency scores over the period 2003-2012 by asset-based size

Year	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
2003	0.951	0.917	0.856	0.939
2004	0.896	0.826	0.834	0.927
2005	0.889	0.822	0.819	0.889
2006	0.910	0.816	0.751	0.881
2007	0.906	0.829	0.801	0.803

2008	0.851	0.827	0.798	0.793
2009	0.857	0.792	0.755	0.782
2010	0.807	0.763	0.722	0.775
2011	0.811	0.746	0.714	0.759
2012	0.777	0.758	0.667	0.731

Furthermore, Table 10 lists cost efficiency scores for asset-based banks divided by quartiles and grouped by country. As shown in Panel A, over the period 2003-2012, asset-based first quartile banks in Albania were the most cost-efficient with a score of 94.1%, and the least cost-efficient banks were in Serbia with an average score of 61.7%. Overall, except for banks located in Bosnia and Romania, Panel A indicates that cost efficiency levels have deteriorated in the late 2000s for the asset-based first quartile banks across SEE countries. Looking at second quartile asset-based banks (Panel B - Table 10), I observe that banks in Croatia are the most cost-efficient while the least cost-efficient are in Serbia, with values of 89.5% and 43% respectively. The other second quartile asset-based banks located in the remaining SEE countries had average cost-efficiency scores either above or quite close to 80%. Looking at third quartile asset-based banks (Panel C - Table 10), I observe that banks in Croatia attain 84.9% cost-efficiency, closely followed by banks in Romania (84.5%), and Bosnia (82.2%). The least cost-efficient banks are in Serbia (56%) and FYROM (74%). Overall, the most striking difference between cost efficiencies can be seen in Croatian and Serbian banks. Observing fourth quartile asset-based banks (Panel C - Table 10), I find that banks in Croatia are the most cost efficient (89.1%). The least cost-efficient banks are in Serbia (51.2%).

The results of this analysis show that cost efficiency scores are generally larger in comparison to the findings of previous studies of Eastern European banking systems based on the SFA methodology. Fries and Taci (2005), for instance, investigated cost efficiency on a sample of 289 banks located in fifteen Eastern-Europe countries. Their findings show an average cost efficiency score of 63% for these banks over the period 1994-2001. Further, Yildirim and Philippatos (2007) find average cost efficiency scores of 77% for a sample of 325 banks located in the twelve Eastern European countries over the period 1993-2000. In a more recent study, Fang et al (2011) investigated cost efficiency for a sample of 380 banks located in CEE and SEE countries over the period 1998-2008. Their results show that the average cost efficiency of the banks located in CEE was 70.77% while for the banks located in SEE the cost efficiency was 68.59%. We can assume that the higher cost efficiency scores reported in this study might reflect a relatively more recent period of data in comparison to previous studies. The implementation of reforms in the banking sector of many SEE countries, together with

fiscal and monetary policies aiming at creating economic conditions to meet the requirements for the accession to the EU, might have contributed to discipline even more SEE banks especially in the late 2000s. It is also relevant to note that during the 2008-2009 global financial crisis, cost efficiency scores dropped significantly for SEE banks

Table 10 – SEE banking system: average cost efficiency scores over the period 2003-2012 by asset-based size

Panel A: 1st Quartile

	Albania	Bosnia	Bulgaria	Croatia	FYROM	Romania	Serbia
2003	-	-	-	0.951	-	0.950	-
2004	-	0.892	0.922	0.937	0.978	0.930	0.642
2005	0.961	0.924	0.937	0.923	0.912	0.952	0.582
2006	0.956	0.929	0.930	0.932	0.973	0.944	0.507
	0.868	0.909	0.923	0.948	0.906	0.951	0.817
2007							
2008	0.895	0.906	0.910	0.934	0.833	-	0.593
2009	0.931	0.888	0.900	0.936	0.789	0.906	0.778
2010	0.923	0.897	0.889	0.907	0.750	-	0.595
2011	0.858	0.889	0.877	0.835	0.845	-	0.562
2012	0.843	0.891	0.781	0.799	0.723	-	0.498
Average	0.887	0.902	0.902	0.921	0.866	0.941	0.617

Panel B: 2nd Quartile

	Albania	Bosnia	Bulgaria	Croatia	FYROM	Romania	Serbia
2003	-	-	-	0.917	-	-	-
2004	0.894	0.924	0.851	0.904	-	0.881	0.514
2005	-	0.860	0.875	0.918	-	0.875	0.596
2006	0.783	0.861	0.890	0.908	0.833	0.923	0.568
2007	0.912	0.881	0.948	0.917	0.816	0.923	0.478

2008	0.842	0.933	0.930	0.883	0.827	0.931	0.457
2009	0.831	0.917	0.923	0.884	0.809	0.932	0.428
2010	0.815	0.792	-	0.887	0.782	0.905	0.305
2011	0.867	0.893	-	0.876	0.792	0.805	0.281
2012	0.853	0.904	-	0.856	0.718	0.777	0.277
Average	0.850	0.878	0.886	0.894	0.798	0.883	0.430

Panel C: 3rd Quartile

	Albania	Bosnia	Bulgaria	Croatia	FYROM	Romania	Serbia
2003	-	-	0.848	0.921	-	0.807	-
2004	-	0.861	0.783	0.950	-	0.949	0.513
2005	0.883	0.846	0.780	0.945	-	0.854	0.671
2006	0.870	0.850	0.825	-	-	0.816	0.529
2007	0.809	0.870	0.822	0.830	0.818	0.881	0.681
2008	0.854	0.835	0.791	0.865	-	0.886	0.653
2009	0.834	0.847	0.804	0.795	-	0.863	0.601
2010	0.805	0.881	0.786	0.820	-	0.816	0.481
2011	0.759	0.789	0.795	0.794	0.730	0.750	0.498
2012	0.736	0.756	0.741	0.834	0.706	-	0.464
Average	0.804	0.829	0.792	**0.849**	0.740	**0.845**	**0.560**

Panel D: 4th Quartile

	Albania	Bosnia	Bulgaria	Croatia	FYROM	Romania	Serbia
2003	-	-	-	0.939	-	-	-
2004	-	-	0.934	0.926	-	0.924	-
2005	-	-	0.866	0.911	-	0.879	-
2006	-	0.849	0.853	0.909	-	0.871	-

2007	-	0.809	0.828	0.900	-	0.832	0.469
2008	-	0.789	0.796	0.888	0.828	0.821	0.606
2009	0.847	0.768	0.797	0.879	0.810	0.818	0.549
2010	-	0.745	0.821	0.859	0.791	0.821	0.532
2011	-	0.754	0.800	0.853	0.771	0.804	0.505
2012	-	0.730	0.756	0.840	0.769	0.791	0.411
Average	0.847	0.777	0.828	**0.891**	0.794	0.840	**0.512**

Conclusions

In this paper I investigated the cost efficiency over the period 2003-2012 of commercial banks located in the SEE region. The findings show that on average, the level of cost efficiency for SEE commercial banks is 77.5%. By taking the size of the bank into consideration, the findings show that, on average, small banks are more cost- efficient than larger banks. The most cost-efficient commercial banks are those located in Albania and Bulgaria, while the lowest levels of cost efficiency were found for banks located in FYROM and Serbia. By taking into account domestic- or foreign-ownership, the findings of this study show that domestic banks are slightly more cost efficient than foreign-owned banks. On the other hand, looking at the size of banking firms, this study demonstrates that small banks are more cost-efficient than larger banks. In conclusion, this study provides evidence that the structural changes, such as privatisation processes as well as EU membership requirements, SEE banking industries have gone through have led to significant progress in lower levels of concentration, increased competition and reduced cost inefficiencies.

References

Al-Muharrami, S., Matthews, K. and Y. Khabari (2006). Market Structure and competitive conditions in the Arab GCC banking system, *Journal of Banking and Finance*, 30, 3487-3501.

Battese, G., and T. Coelli (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. Journal of Econometrics 38, 387-399.

Berger, A., and De Young, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking and Finance*, 21. 849-870.

Bonin, J.P., Hasan, I. and Wachtel, P. (2005) Bank performance, efficiency and ownership in transition countries. *Journal of Banking and Finance*, 29, 31-53.

Bonin, J., Hasan, I., Wachtel, P. (2014). Banking in transition countries. Bank of Finland, Institute for Economies in Transition, Discussion paper, 8, 1-34.

Casu, B., and Girardone, C. (2010). Integration and efficiency convergence in EU banking markets, *Omega*, 38, 260-267.

Delis, M.D., Kouretas, G.P. (2011). Interest rates and bank risk-taking. *Journal of Banking and Finance*, 35, 840-855.

Dietrich, A., Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money*, 21, 307-327.

Fang, Y., I. Hasan, and K., Morton (2011). Bank efficiency in South-Eastern Europe. The role of ownership, market power and institutional development. *Economics of Transition*, 16, 495-520.

Fries, S. and Taci, A. (2005). Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking and Finance*, 29, 55-81.

Goddard, J., Molyneaux, P. and Wilson J.O.S. (2001). *European banking. Efficiency, Technology* and *Growth*. Wiley & Sons, West Sussex, England.

Green, C.J., Murinde, V., Nikolov, I. (2004). The Efficiency of Foreign and Domestic banks in Central and Eastern Europe: Evidence on Economies of Scale and Scope. *Journal of Emerging Market Finance*, 3(2), 175-205.

Havrylchyk, O. (2006). Efficiency of the Polish banking industry: Foreign versus domestic banks. *Journal of Banking and Finance*, 30, 1975-1996.

Kasman, A. and Yildirim, C. (2006). Cost and profit efficiencies in transition banking: the case of new EU members. *Applied Economics*, 38, 1079-1090.

Lee, Y., and P. Schmidt (1993). The measurement of productive efficiency: techniques and applications. Oxford University Press.

Lei, A.C.H., Song, Z. (2013). Liquidity creation and bank capital structure in China. *Global Finance Journal*, 24, 188-202.

Lepetit, L., Nys, E., Rous, P., Tarazi, A. (2008) Bank income structure and risk: an empirical analysis of European banks. *Journal of Banking and Finance*, 32, 1452-1467.

Mamatzakis, E., Staikouras, C., N. Koutsomanoli-Filipaki (2008). Bank efficiency in the new European Union member states: Is there convergence? *International Review of Financial Analysis*, 17, 1156-1172

Pitt, M. and L. Lee (1981). The measurement and sources of technical inefficiency in the Indonesian weaving industry. *Journal of Development Economics* 9, 43-64.

Podpiera, J. and L. Weill (2008). Bad luck or bad management? Emerging banking market evidence. *Journal of Financial Stability*, 4, 135-148.

Staikouras, C., Mamatzakis, E., Koutsomanoli-Filippaki, A. (2008). Cost efficiency of the banking industry in the South Eastern European region. *International Financial Markets, Institutions and Money*, 18, 483-497.

Weill, L. (2013). Bank competition in the EU: how has it evolved? *Journal of International Financial Markets, Institutions and Money*, 26, 100-112