Cost and Profit Efficiency of the Slovak Banking Sector

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Abstract
The paper estimates the cost and profit efficiency of the commercial banks in Slovakia during the period 2003–2012. The paper employs the parametric approach, in particular the Stochastic Frontier Approach, to estimate the cost and profit efficiency of individual banks in the Slovakia. The analysis is based on data banks representing almost 80 percent of the total banking assets in the Slovak banking sector. We obtained data from BankScope database and annual reports of 12 Slovak banks. We divided the Slovak banks into three groups according the size. We distinguished between large, medium-sized and small banks. The average cost and profit efficiency was decreasing in the Slovak banking sector during the analysed period. Estimates of the average cost efficiency ranged the value 29–92% and the average profit efficiency ranged from 56–93%. Results show that small and medium-sized banks are more efficient than the largest banks in the Slovak banking market.

Keywords: cost efficiency, profit efficiency, bank, Slovak banking sector, Stochastic Frontier Approach
JEL codes: G21, C51

1. Introduction

In empirical literature the two general approaches are used to assess efficiency of an entity, parametric and non-parametric methods, which employ different techniques to envelop a data set with different assumptions for random noise and for the structure of the production technology. The nonparametric methods are Data Envelopment Analysis (DEA) and Free Disposal Hull, which are based on linear programming tools. The parametric methods most widely used in empirical estimations are Stochastic Frontier Approach (SFA), Distribution Free Approach and Thick Frontier Approach. The Slovakia's financial system is bank-based and banks play an important role in the economy. The analysis of efficiency in industry with so many important development milestones is of high interest.

The aim of the paper is to estimate the cost and profit efficiency of the Slovak commercial banks during the period 2003–2012. We divided banks into three groups according the size. Thus we distinguished between large, medium-sized and small banks. For the practical estimation we applied the parametric method, especially the Stochastic Frontier Approach. We use the cost and profit efficiency function to estimate the cost and profit efficiency in the Slovak banking industry. The paper is organized as follows. Literature review is in Section 2, Section 3 presents methodology and data. Empirical analysis is reported in Section 4 and section 5 concludes this paper.

2. Literature review

Empirical analyses of banking efficiency which included the Slovak banking sector exist several. We mention some of them. Some empirical studies (e.g. Košak and Zajc, 2006; Yildirim and Philippatos, 2007; Bems and Sorsa, 2008; Matoušek, 2008; Mamatzakis, et al., 2008) examined the banking efficiency in several European countries and Slovak banking sector was included in panel data.

Grigorian and Manole (2006), Bonin, et al. (2005) or Fries and Taci (2005) estimated banking efficiency in 1990s and they investigated the impact of bank privatization. The result indicated that private banks were more efficient than state-owned banks, but there were differences among private banks. Privatised banks with majority foreign ownership were more efficient than those with domestic ownership. Rossi, et al. (2004) estimated average cost efficiency 0.67 in the period 1995–2002, while profit efficiency was 0.47. The banking systems of Slovakia showed significant levels of cost and profit inefficiency, indicating that on average banks operate far above (below) from the cost (profit) efficient frontiers. But they found that cost efficiency increased between 1995 and 2002.

Stavárek and Polouček (2004) estimated efficiency and profitability in the selected banking sectors, including Slovakia. They found that Central European Countries are less efficient than their counterparts in the European Union member countries. Their conclusion is the refutation of the conventional wisdom of higher efficiency from foreign-owned banks than from domestic-owned banks, and size is one of the factors that determine efficiency. To achieve high efficiency, a bank should be large, well known, and easily accessible and offering a wide range of products and services, or if small, must focus on specific market segments, offering special products. Any other structure of a bank leads to lower relative efficiency.

Stavárek (2005) examined the increasing value of the efficiency of the Slovak banking sector during the period 1999–2003, but they also found that Slovak banking sector was lower efficient banking sector than other Visegrad countries. The Slovakia's banking sector was recognized as the less efficient one. Vincova (2006), who applied the Data Envelopment Analysis to estimate banking efficiency in Slovakia during the period 2000–2004, found that the average efficiency slightly decreased and the number of efficient bank also decreased. Iršová and Havránek (2011) estimated banking efficiency in five countries of Central and Eastern Europe including Slovakia. In Slovakia the results showed that the average cost efficiency was 51.8% and profit efficiency reached 43.2% in the years 1995–2006.

Baruník and Soták (2010) estimated the influence of different ownership forms on efficiency of Czech and Slovak banks using stochastic frontier approach during the period 1996–2005. They found that the foreign-owned banks were bit more cost efficient than domestic private banks, state-owned banks were significantly less cost efficient when compared to domestic private banks. Anayiotos, et al. (2010) estimated relative efficiency of banks in emerging Europe before the recent boom, just before the crisis and right after the crisis using the Data Envelopment Analysis. Their results suggested that the banking efficiency in Slovakia decreased during the pre-crisis boom and also fell during the crisis. They found the significant decreased in efficiency during the period 2004–2009.

Mentioned studies examined efficiency in several banking sector, on contrast Stavárek and Šulganová (2009) estimated banking efficiency in Slovakia. They applied the parametric Stochastic Frontier Approach and Cobb–Douglas production function on commercial banks in the period 2001–2005 and found that the average efficiency increased and their results point out a better ability of Slovak banks to use the inputs in the production process.

The empirical literature review concluded that only few studies examined the Slovak banking sector individually. Most of the empirical studies research several banking sector which included Slovakia and the second findings is that the most studies examined banking efficiency during 1990s. Thus, the literature review shows the motivation for this paper. This paper could fill the gap following time line in the empirical literature.

2. Methodology and data

Tables and figures should be numbered and references to them must be in the text. Acceptable labeling for a table is Table 1 and Figure 1 for a figure. The title of the table or figure is placed above

and the source below the table or figure. The text should be composed in such a manner that there are not a greater number figures or tables on a single page. Tables and figures in landscape format are not acceptable.

The stochastic frontier approach originated with two papers Meeusen and Van Den Broeck (1977) and Aigner, et al. (1977), which were published nearly simultaneously. Both papers are themselves very similar and they appeared shortly before a third SFA paper by Battese and Corra (1977). The SFA approach is one of the structural approaches to study efficiency. It is based on the economics of cost minimization or profit maximization by banks, and thus starts with a standard cost or profit function with factors of input, output, and their respective prices. It estimates the minimal cost or maximum profit based on these functions, and generates distance of its cost or profit to the frontier value. The SFA approach treats the observed inefficiency of a bank as a combination of the inefficiency specific to the bank and a random error, and tries to disentangle the two components by making explicit assumptions about the underlying inefficiency process. The parametric approach has the advantage of allowing noise in the measurement of inefficiency. However, the approach needs to specify the functional form for cost or profit.

2.1 Cost efficiency

Cost efficiency measures the performance of banks relative to the best-practice banks that produces the same output under the same exogenous conditions. Cost efficiency function is based on a cost equation that relates a bank's cost to variables that incur those expenses, such as output levels and input prices. The cost equation contains a composite error structure that distinguishes random cost fluctuations from cost inefficiencies. To put it simply, the cost function describes the relationship between the cost with quantities of output and input variables plus the inefficiency and random error. The following cost equation:

$$C_{it} = f(y_{it}, w_{it}, z_{it}) + \varepsilon_{it}, \quad (1)$$

where C_{it} measures the total costs of a bank *i* incurs at time *t*, including operating and financial costs, y_{it} is a vector of outputs, w_{it} is a vector of input prices, z_{it} represents the quantities of fixed bank parameters, such as physical capital and equity and ε_{it} is the error term. The error term ε_{it} is composed of two parts:

$$\varepsilon_{it} = \mu_i + \upsilon_{it}, \quad (2)$$

where μ_i represents the inefficiency term that captures the difference between the efficient level of cost for given output levels and input prices and the actual level of cost and υ_{it} is the random error. More specifically $\mu_i$and υ_{it} are assumed to follow the following distributions:

$$\mu_i \sim N^+\left(0, \sigma_\mu^2\right), \quad (3)$$

$$\upsilon_{it} \sim N^+(0, \sigma_\upsilon^2). \quad (4)$$

We assume μ_i follows a half-normal distribution. Alternatively, μ_i can be modelled to follow a truncated normal distribution or exponential distribution so that it can only take non negative values. It measures the difference of bank's *i* cost compared with that of the frontier $f(y_{it}, w_{it}, z_{it})$.

The cost efficiency of the bank can be written in a natural logarithm form as follows:

$$\ln TC = \ln f(y, w, z) + \ln u_t - \ln v_t, \quad (5)$$

where f denotes a functional form.

After estimating a particular cost function, the cost efficiency for bank *i* is measured as the ratio between the minimum cost ($C_{\min}$) necessary to produce that bank's output and the actual cost (C_i):

$$CE_i = \frac{C_{\min}}{C_i} = \frac{\exp[f(y,w,z)]x\exp(lnu_{\min})}{\exp[f(y,w,z)]x\exp(lnu_i)} = \frac{u_{\min}}{u_i}, \quad (6)$$

where u_{min} is the minimum u_i across all banks in the sample. Under this formulation, an efficiency score of 0.95 for example, implies that the bank would have incurred only 95 percent of its actual costs had it operated in the frontier.

2.2 Profit efficiency

Despite the wide agreement on the relevance of profit efficiency analysis, the technical difficulties with the measurement and decomposition of profit inefficiency were the main reasons for the small number of empirical studies on banking profit efficiency. Unlike the cost function, the profit function has an additive structure implying that the Shephard type distance functions, which are radial, are not the appropriate dual model of technology (Fare and Grosskopf, 2000). The profit frontier is derived as follows:

$$P = f(y,w,z) + u + v, \quad (7)$$

where *P* measures the profit of a bank, including both interest and fee income, less total costs of a bank, *y* is a vector of outputs, *w* is a vector of input prices, *z* represents the quantities of fixed bank parameters, *u* is the inefficiency term that captures the difference between the efficient level of cost for given output levels and input prices and the actual level of cost, and *v* is the random error term.

The profit function of the bank can be written in a natural logarithm form as follows:

$$\ln P = f(y,w,z) + \ln u_t - \ln v_t. \quad (8)$$

where *f* denotes a functional form. Profit efficiency is measured by the ratio between the actual profit of a bank and the maximum possible profit that is achievable by the most efficient bank.

$$PE_i = \frac{P_i}{P_{\max}} = \frac{\exp[f(y,w,z)]x\exp(lnu_i)}{\exp[f(y,w,z)]x\exp(lnu_{\max})}, \quad (9)$$

where $u_{\max}$ is the maximum u_i across all banks in the sample. For example, if the profit efficiency score of a bank is 90%, it means that the bank is losing about 10% of its potential profits to managerial failure in choosing optimum output quantities and input prices.

2.3 Data and selection of variables

The data set used in this study was obtained from the annual reports of commercial banks for the period 2003-2012. All the data is reported on unconsolidated basis. The data set consists of data of banks that represent almost 80% of the assets of the Slovak banking sector. We analyzed only commercial banks that are operating as independent legal entities due to the homogeneity of the data set. All foreign branches, building societies, specialized banks or credit unions were excluded from the estimation data set.

In order to conduct SFA estimation, inputs and outputs need to be defined. In the literature in the field, there is no consensus regarding the inputs and outputs that have to be used in the analysis of the efficiency of the activity of commercial banks (Berger and Humphrey, 1997). In empirical literature four main approaches (intermediation, production, asset and profit approach) have been developed to define the input-output relationship in financial institution behavior. The intermediation approach is considered relevant for banking industry, where the largest share of activity consists of transforming the attracted funds into loans. We adopt intermediation approach which assumes that banks' main aim is to transform deposits into loans. Consistently with this approach, we assume that banks use the two inputs and produce two outputs.

Total costs are the sum of the interest cost and operation cost. Total profit is the sum of interest income and fee income. We employed two inputs (labor and deposits), and two outputs (loans and net interest income). We measure price of labor (w_j) as a ratio of personnel expenses to number of employees, and price a deposits (*wh*) as a ratio of annual interest expenses to total deposits. Loans (*yl*) are measured by the net value of loans to customers and other financial institutions and net interest income (*ym*) as the difference between interest incomes and interest expenses. Descriptive statistics of variables is presented in Table 1.

Table 1: Descriptive statistics of variables

	TC	*P*	w_j	w_h	y_l	y_m	*Z*
Mean	157.86	226.99	0.1323	0.8872	1972.73	112.99	315.48
Median	77.91	106.68	0.0265	0.0242	1051.50	42.27	127.00
Min	7.70	7.10	0.0113	0.0079	17.60	3.40	0.50
Max	499.10	876.93	0.7750	53.8260	7266.50	465.70	1245.08
St.Dev.	142.42	224.83	0.2305	5.7420	1971.74	122.43	327.83

Source: authors' calculations

The functional form of the stochastic frontier was determined by testing the adequacy of the Cobb Douglas relative to the less restrictive translog. As e.g. Berger and Mester (2003), Munyama (1997), Lang and Welzel (1996) or Fiorentino, et al. (2006), we normalized dependent variable (cost or profit) with all output quantities y by equity capital Z to account for heterogeneity. The frontier models estimated are defined as:

$$\ln\left(\frac{TC}{Z}\right)_{it} = \alpha_1 + \sum_{l=1}^{2}\beta_l \ln\frac{y_l}{Z} + \frac{1}{2}\sum_{l=1}^{2}\sum_{m=1}^{2}\beta_{lm}\ln\frac{y_l}{Z}_l \ln\frac{y_m}{Z} + \sum_{j=1}^{2}\gamma_j \ln w_j + \frac{1}{2}\sum_{j=1}^{2}\sum_{h=1}^{2}\gamma_{jh}\ln w_j \ln w_h + \sum_{l=1}^{2}\sum_{j=1}^{2}\beta_{lj}\ln\frac{y_l}{Z}_l \ln w_j + \ln u_{it} + \ln v_{it}, \quad (10)$$

where *C* is total cost, y_l, y_m are the outputs *l* or *m*, w_j, w_h are the price of inputs, u_{it} is the random error, v_{it} is the inefficiency term, *i* denotes the bank (*i* = 1, ..., *N*) and *t* denotes time (*t* = 1, …, *T*).

$$\ln\left(\frac{P}{Z}\right)_{it} = \alpha_1 + \sum_{l=1}^{2}\beta_l \ln\frac{y_l}{Z} + \frac{1}{2}\sum_{l=1}^{2}\sum_{m=1}^{2}\beta_{lm}\ln\frac{y_l}{Z}\ln\frac{y_m}{Z} + \sum_{j=1}^{2}\gamma_j \ln w_j + \frac{1}{2}\sum_{j=1}^{2}\sum_{h=1}^{2}\gamma_{jh}\ln w_j \ln w_h + \sum_{l=1}^{2}\sum_{j=1}^{2}\beta_{lj}\ln\frac{y_l}{Z}\ln w_j + \ln u_{it} - \ln v_{it}, \quad (11)$$

where *P* is total profit.

The use of duality implies the necessity to impose the following homogeneity restrictions:

$$\sum_{l=1}^{2}\beta_l = 1\,, \sum_{j=1}^{2}\gamma_j = 0\,, \sum_{h=1}^{2}\sum_{k=1}^{2}\gamma_{hk} = 0. \quad (12)$$

Berger and Mester (2003) indicated that normalization by equity capital has economic meaning. The dependent variable (profit) becomes the return on equity (ROE) or a measure of how well banks are using their scarce financial capital. Banking is the most highly financially leveraged industry. Shareholders are mostly interested in their rate of return on equity (ROE), which is a measure closer to the goal of the bank than maximising the level of profits. Normalization by the financial equity capital also follows from the choice of equity capital as a fixed input quantity. Equity capital is very difficult and costly to change substantially except over the long run. Equity capital is preferred as

a normalization variable besides being the fixed input quantity. Furthermore, if equity was not specified as fixed, the largest banks may be measured as the most profit efficient simply because their higher capital levels allow them to have the most loans (Munyama, 1997).

3. Estimation of the cost and profit efficiency in the Slovak banking sector

The cost and profit efficiency function is estimated using the maximum likelihood estimation of parameters in the Cobb-Douglas (Battese and Coelli, 1995). The computer programme FRONTIER 4.1 developed by Coelli (1995) has been used to obtain the maximum likelihood estimates of parameters in estimating the technical efficiency. The programme can accommodate cross sectional and panel data; cost and production function; half-normal and truncated normal distributions; time-varying and invariant efficiency; and functional forms which have a dependent variable in logged or original units.

Table 2 presents the results of the cost efficiency of the Slovak banks within the period 2003–2012. The value of average cost efficiency was in the range 29-92%. The development of the average efficiency show that the efficiency score was decreasing in the period 2003-2012.

In the period 2011–2012 the average efficiency was decreasing, we can suppose that this development was as a result of the financial crisis. Because the analyzed outputs (loans net interest income) decreased in the balance sheet of the individual banks. Although household demand for loans was stimulated by low interest rate, the situation in the corporate sector was different. As result of weakening demand for loans and tight credit standards, the outstanding amount of corporate loans initially recorded lower growth and then began to decrease in 2011 and 2012.

Table 2: Cost efficiency of the Slovak banks (in %)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	*Mean*
CSOB	N/A	N/A	75	78	67	47	40	90	62	26	*61*
DEXIA	80	54	38	47	58	61	81	89	69		*64*
Primabanka										40	*40*
OTP Banka	98	58	43	51	56	54	52	82	67	33	*59*
Postova banka	98	49	39	51	59	52	53	79	53	24	*56*
Banka Slovakia	96	67									*82*
Privatbanka			62	77	66	77	62	91	79	47	*70*
SLSP	97	48	37	48	47	50	41	85	60	21	*53*
Tatra banka	93	40	32	41	48	55	37	78	53	23	*50*
HVB Bank	98	69	54	41							*66*
UniCredit Bank					52	47	39	76	55	24	*49*
Volksbank	80	49	39	45	53	60	38	86	60	29	*54*
VUB	92	35	25	49	48	49	44	75	53	20	*49*
Istrobanka	90	45	39	56	55	62					*58*
Citibank	90	50	41	70	79	57	100				*70*
Mean	*92*	*51*	*44*	*55*	*57*	*56*	*53*	*83*	*61*	*29*	

Source: authors' calculations

Privatbanka reached the high value of the cost efficiency, the second most efficient bank was Citibank and the third most efficient bank was OTP Banka. Any bank did not operate at the 100% score of the cost efficiency. In contrast, the lowest average cost efficient bank was Primabanka, Všeobecná úverová banka (VUB) and UniCredit Bank. We do not consider Primabanka, which operated only one year in the Slovak banking sector. VUB and UniCredit Bank reached the average cost efficiency 49%, thus 51% of the cost was not required for the outputs. Next, Tatra banka and

Slovenska sporitelna (SLSP) reach average efficiency only 50%, resp. 53%. The result shows that large banks are lower efficient that other banks in the banking sector.

We can mentioned that robust and reliable estimation results should require appropriate number of inputs and outputs involved in the estimation in relation to the number of banks in dataset. The Slovak banking sector is relatively small and consisted of limited number of banks, which restricts comprehensiveness of the model. Two inputs and two outputs cannot capture the banking business completely.

Table 2: Average cost efficiency of the Slovak banks' groups (in %)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	*Mean*
Large banks	94	41	31	46	48	51	41	79	55	21	51
Medium-sized banks	91	56	48	55	57	54	51	84	60	29	58
Small banks	93	54	47	61	60	64	62	87	73	40	64

Source: authors' calculations

Next, we calculate average efficiency scores derived from model for three groups of banks classified according to volume of total assets (Table 4). We distinguished between large, medium-sized and small banks. The group of small banks seem to be frequently most efficient. The low level of average efficiency reached the largest banks in the Slovak banking sector. The development of the average efficiency in three groups of banks is practically similar. In the period 2004-2009 the average efficiency was decreasing. This period was following by increase in average efficiency in 2010, but in year 2012 average efficiency decreased in all groups. The highest decrease in average efficiency was in the group of largest banks in 2012.

Generally, we can conclude that the small and medium-sized banks in the market appeared to be more efficient than large banks. The high inefficiency was revealed in large banks. We supposed that large banks have chosen inappropriate scale of operation and simply use too many inputs or produce too few outputs.

Table 4: Profit efficiency of the Slovak banks (in %)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	*Mean*
CSOB	N/A	N/A	86	80	73	65	52	82	46	48	*67*
DEXIA	73	83	51	75	60	98	100	98	61		*78*
Primabanka										65	*65*
OTP Banka	92	84	58	72	59	78	68	82	57	57	*71*
Postova banka	87	81	59	72	61	80	72	94	56	51	*71*
Banka Slovakia	87	88									*88*
Privatbanka			73	81	69	97	83	99	70	71	*80*
SLSP	97	77	54	64	51	83	62	99	51	56	*69*
Tatra banka	98	77	53	64	51	93	67	90	45	46	*68*
HVB Bank	96	88	75	72							*83*
UniCredit Bank					52	98	59	100	56	53	*70*
Volksbank	84	78	58	71	56	83	53	95	72	64	*71*
VUB	97	73	41	64	56	95	64	93	54	48	*69*
Istrobanka	80	77	53	72	59	80					*70*
Citibank	96	81	59	74	93	94	99				*85*
Mean	*90*	*81*	*60*	*72*	*62*	*87*	*71*	*93*	*57*	*50*	

Source: authors' calculations

The results of the profit efficiency scores of the Slovak banks during the period 2003–2012 are presented in Table 3. The value of average profit efficiency was estimated in the range 50–93%. The development of the profit efficiency is similar as the development of the cost efficiency in the Slovak banking sector. Decrease in banking efficiency was estimated in the period 2003–2012 in the Slovakia. In the period 2011–2012 the average profit efficiency decreased significantly. The decrease in the net profit was registered in the balance sheet of the most Slovak banks. Macroeconomic conditions in the euro area deteriorated severely in 2012.Although household demand for loans was stimulated by low interest rate, the situation in the corporate sector was different. As result of weakening demand for loans and tight credit standards, the outstanding amount of corporate loans initially recorded lower growth and then began to decrease in 2011 and 2012.

We estimated that the most profit efficient was Banka Slovakia, Citibank, HVB Bank Slovakia and Privatbanka which reached the average efficiency over then 80%. We analysed that Primabanka, Československá obchodní banka (CSOB) and VUB were the lowest efficient during the period 2003–2012. The reason for lower level of efficiency of ČSOB and VUB can be found in the fact that net interest income and total profit decreased during the last two analysed years.

Average profit efficiency had higher value than average cost efficiency in the most analyzed years (except 2003). Thus, Slovak banks were more profit efficient then cost efficient in the most of the estimated period.

Next, we calculate average profit efficiency scores derived from model for three groups of banks classified according to volume of total assets (Table 7). We distinguished between large, medium-sized and small banks.

Table 2: Average profit efficiency of the Slovak banks' groups (in %)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	*Mean*
Large banks	97	76	49	64	53	90	64	94	50	50	69
Medium-sized banks	88	83	65	74	60	84	67	94	58	56	73
Small banks	84	82	62	75	63	86	83	91	64	64	75

Source: authors' calculations

Small banks seem to be frequently most efficient. The least efficient was estimated in the group of the large banks. The mean efficiency score in the small banks was 75%, the mean efficiency in the medium-sized banks was estimated 73% and the mean efficiency in the large banks was found 69%. The development of the average profit efficiency in three groups of banks is practically similar. The average profit efficiency was decreasing in the period 2004–2007. In 2011 and 2012 the average efficiency was decreasing. The result show that the biggest decrease was in the largest banks in the banking sector. Generally, we can conclude that the small banks and medium sized-banks in the market appeared to be more profit efficient than group of large banks.

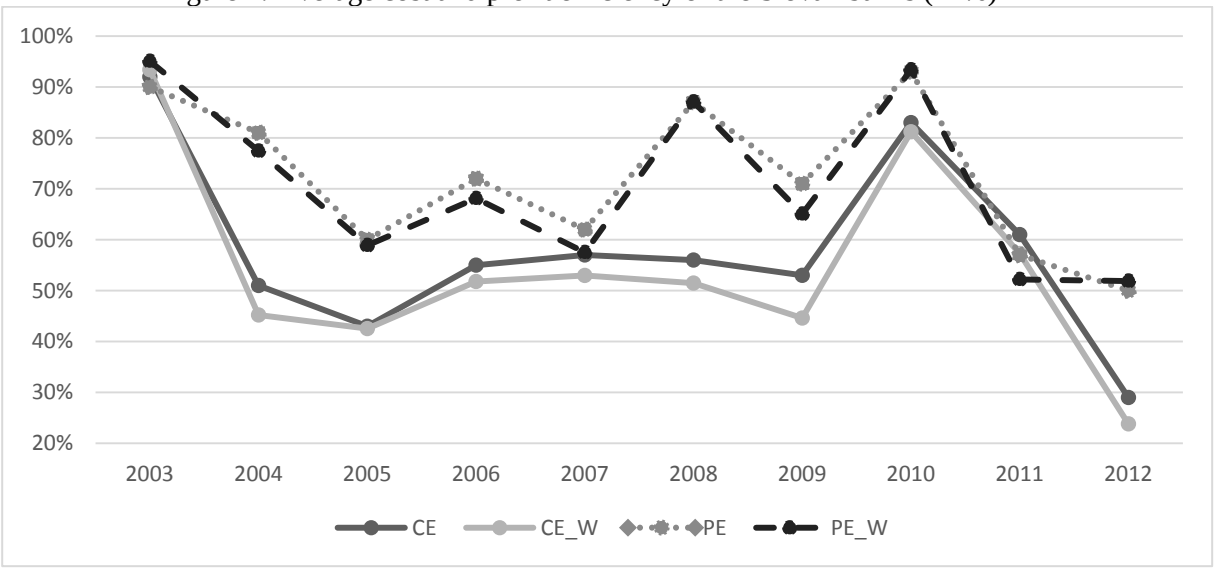
We are aware of the fact that averaging without any respect to the size of banks causes loss of information, and therefore, we implemented in our analysis a size-adjusted average efficiency (SEA) calculated as:

$$SEA = \sum_{i=1}^{n} w_i \Theta_i, \tag{13}$$

where *SEA* is the size-adjusted average efficiency, w_j is the weight computed as a share of j^{th} bank's assets on total assets of all estimated banks, Θ_i is the observed efficiency for the j^{th} bank, and j indicates the different n banks.

Results of the SEA calculation for cost and profit efficiency are presented in Figure 1.

Figure 1: Average cost and profit efficiency of the Slovak banks (in %)



Source: authors' calculations

The average cost efficiency (CE) achieves the higher value than the average size-adjusted cost efficiency (CE_W). The average profit efficiency (PE) also reached higher values than size-adjusted profit efficiency (PE_W). This indicated that the size of bank is a key factor influencing banking efficiency. Thus, large banks register lower cost and profit efficiency than small and medium-sized banks. The result indicate that large banks are too large and they did not choose the optimal combination of inputs to produce outputs.

3. Conclusion

The aim of this paper was to estimate the level of the cost and profit efficiency of the Slovak commercial banks during the period 2003–2012. We divided banks into three groups according the size. Thus we distinguished between large, medium-sized and small banks. This paper uses Stochastic Frontier Approach, the cost and profit efficiency function. The development of the average cost and profit efficiency showed that the efficiency score was decreasing in the period 2003–2012.

The cost and profit efficiency significantly decreased in the period 2011–2012. It can be caused by decreasing in the total profit and analysed outputs (net interest income and total loans) in balance sheet of the individual bank. We found that the Slovak commercial banks were more profit efficient then cost efficient in the most of the estimated period. The average cost efficiency ranged the value 29–92%. The highest average cost efficiency achieved Banka Slovakia and Privatbanka which were followed by Citibanka and Dexia banka. Conversely, the lowest average cost efficiency achieved Všeobecná úverová banka and UniCredit banka, where the average cost efficiency was only 49%. Estimates of the average profit efficiency ranged from 56–93%. The highest value of the profit efficiency achieved Banka Slovakia, Citibank and HVB Bank, while the lowest average profit efficiency reached Primabanka, ČSOB and VUB.

It can be concluded that small and medium-sized banks were higher efficient than the group of large banks. When we calculated size-adjusted average efficiency, we found that the size of bank is a key factor influencing banking efficiency. Results showed that the largest banks in the banking sector were the lowest efficient. The largest banks were too large and chose an inadequate size.

The results of this paper confirm the study of Anayiotos, et al. (2010) who presented that the banking efficiency in Slovakia decreased during the pre-crisis boom and also fell during the crisis. They found the significant decreased in efficiency during the period 2004–2009.

Acknowledgement

Research behind this paper was supported by the Czech Science Foundation within the project GAČR 13-03783S 'Banking Sector and Monetary Policy: Lessons from New EU Countries after Ten Years of Membership'.

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