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Efficiency Change of Banking Sectors and Banks in the Financial Conglomerates in Visegrad Group Countries[1]

*Iveta PALEČKOVÁ**

Abstract

The objective of this paper is to estimate the efficiency change in the banking sectors of the group of Visegrad countries during the 2009 – 2013 period and to determine whether banks that belong to a financial conglomerate are more or less efficient than other banks in the sector. We used Data Envelopment Analysis and the Malmquist index to analyse the banking efficiency. The positive efficiency change during the 2009 – 2013 period was primarily due to innovation, superior management and technological growth. There were differences in banks in the financial conglomerates across Visegrad group countries. Several banks from the financial conglomerate were less efficient than other banks in the banking industry.

Keywords: *banking sector, Data Envelopment Analysis, Malmquist index, financial conglomerate, Visegrad group countries*

JEL Classification: G21, C51

Introduction

The objective of this paper is to estimate the efficiency change in the banking sectors of the group of Visegrad countries during the 2009 – 2013 period and to determine whether banks that belong to a financial conglomerate are more or less efficient than other banks in the sector. In accordance with this paper's objective, we ask the following two research questions: "What is the main reason for the positive/negative efficiency change in Visegrad countries?" and "Is the bank that

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belongs to a financial conglomerate more efficient than other banks in the sector?" The group of Visegrad countries (V4) includes the Czech Republic, Hungary, Poland and Slovakia. In this paper, we measure the relative technical efficiency of select banking sectors. For the empirical estimation, we applied Data Envelopment Analysis (DEA) and the Malmquist index (MI) to the data of commercial banks. The MI is determined to investigate the levels of and the changes in the efficiency of the Visegrad group countries' commercial banks.

Next, we will examine whether the banks that belong to a financial conglomerate are more efficient than other banks. We will examine banks from five financial conglomerates. We divided all banks in the banking sector into two quantiles according to the median. We will examine whether the banks that belong to a financial conglomerate are below or above the median in each Visegrad group country.

The structure of the paper is as follows. The next section 1 describes the empirical literature review regarding banking efficiency. The second section presents the methodology; in addition, the data, the Data Envelopment Analysis, the Malmquist index and the selection of variables are described. Section 3 reveals and discusses the estimated results. Section 4 concludes the paper with a summary of key findings and a discussion.

1. Literature Review

Several empirical analyses of efficiency of the Czech, Slovak, Polish and Hungarian banking sectors exist; we refer to some of them. Most empirical studies evaluated banking efficiency in the 1990s; the authors investigated whether private banks were more efficient than state-owned banks. For example, Bonin, Hasan and Wachtel (2005), Grigorian and Manole (2006) and Fries and Taci (2005) found that private banks were more efficient than state-owned banks and that privatized banks with majority foreign ownership were more efficient than those with domestic ownership. In addition, Fišerová, Teplý and Tripe (2015) analysed foreign-owned banks and found that economic fundamentals affect their performance. The researchers also concluded that sound banks with higher operational efficiency operating in growing economies with low inflation rates tend to perform better than their peers. Berger (2007) examined the initial research that compared the efficiencies of foreign-owned versus domestically owned banks within the same nation using the same nation-specific frontier. The researcher found that the results were generally consistent with the hypothesis that efficiency differences help to explain the consolidation patterns. Certain empirical studies such as those by Yildirim and Philippatos (2007), Matoušek (2008) and Baruník and Soták (2010) examined banking efficiency in several

European countries; the Czech, Slovak, Polish and Hungarian banking sectors were included in the panel data. Chronopoulos, Girardone and Nankervis (2011) estimated the cost and profit efficiency of ten countries in Central and Eastern Europe, which included Visegrad group countries, using DEA models. The researchers found that banks suffer from relatively high cost and profit inefficiencies and that there are noticeable differences in the efficiency levels across countries. Pančurová and Lyócsa (2013) examined the banking efficiency of 11 countries including V4 countries. The researchers found that the average cost efficiency was higher for the Czech Republic; lower values were observed for Hungary.

Stavárek and Polouček (2004) estimated the efficiency in select banking sectors, including V4 countries; they found that the Czech and Hungarian banking sectors were, on average, evaluated as the most efficient. Stavárek (2005) estimated the commercial bank efficiency in the group of Visegrad countries before joining the EU; he concluded that the Czech banking sector is the most efficient, followed by the Hungarian sector with a marginal gap. In addition, Staníčková and Melecký (2012) estimated the banking efficiency of Visegrad countries and evaluated the banking sector of the Czech Republic as highly efficient.

The literature review concluded that banking efficiency was estimated using the Stochastic Frontier Approach or static DEA models. For example, Iršová and Havránek (2010) conducted a meta-regression analysis of the studies on frontier efficiency measurement in banking; they found that the translog parametric choice does not return results significantly different from the non-parametric approaches. In the empirical analysis, there is a lack of studies in Visegrad countries' banking sectors examining an efficiency change; this creates an opportunity for this research. As far as the author knows, only a few studies exist in the empirical literature that estimated the efficiency change in the V4 country banking sectors. For example, Řepková (2012) estimated the efficiency change in the Czech banking sector using the Malmquist index. Hančlová and Staníčková (2012) measured the efficiency change in Visegrad group countries, and Lyroudi and Angelidis (2006) estimated the efficiency change in select European Union countries. The contributions of this paper are that the Malmquist index approach will be applied to the data of the Czech, Slovak, Polish and Hungarian commercial banks.

We will focus on the effect of the financial conglomerate on banking efficiency. Only a few studies investigated the efficiency of financial conglomerates. Vander Vennet (2002) analysed the cost and profit efficiency of European conglomerates and universal banks and found that conglomerates were more efficient than their specialized competitors. Casu and Girardone (2004) estimated the efficiency of Italian financial conglomerates in the 1990s.

2. Methodology and Data

2.1. Data Envelopment Analysis

Data Envelopment Analysis is a mathematical programming technique that measures the efficiency of a decision-making unit (DMU) relative to other similar DMUs with the simple restriction that all DMUs lie on or below the efficiency frontier (Seiford and Thrall, 1990).

The CCR model (Charnes, Cooper and Rhodes, 1978) presupposes that there is no significant relationship between the scale of operations and the efficiency by assuming constant returns to scale (CRS); additionally, it delivers the overall technical efficiency. The CRS assumption is only justifiable when all DMUs are operating at an optimal scale.

However, firms or DMUs in practice may encounter either economies or dis-economies of scale. Thus, if one makes the CRS assumption when not all DMUs are operating at the optimal scale, the computed measures of technical efficiency will be contaminated with scale efficiencies. Banker, Charnes and Cooper (1984) extended the CCR model by relaxing the CRS assumption. The resulting BCC model was used to assess the efficiency of DMUs characterized by variable returns to scale (VRS).

DEA begins with a fractional programming formulation. Assume that there are *n* DMUs to be evaluated. DMU_j consumes x_{ij} amounts of input to produce y_{rj} amounts of output. It is assumed that these inputs, x_{ij}, and outputs, y_{rj}, are non--negative, and each DMU has at least one positive input and output value. The productivity of a DMU can be written as:

$$h_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \tag{1}$$

In this equation, *u* and *v* are the weights assigned to each input and output. By using mathematical programming techniques, DEA optimally assigns the weights subject to the following constraints. The weights for each DMU are assigned subject to the constraint that no other DMU has an efficiency greater than 1 if it uses the same weights, implying that efficient DMUs will have a ratio value of 1. The objective function of DMU is the ratio of the total weighted output divided by the total weighted input:

$$\max h_0(u,v) = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \tag{2}$$

subject to
$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1,\ j = 1,2,\ldots, j_0,\ldots,n \tag{3}$$

$$u_r \geq 0,\ r = 1,2,\ldots,s \tag{4}$$

$$v_i \geq 0,\ i = 1,2,\ldots,m \tag{5}$$

where h_0 is the technical efficiency of DMU_0 to be estimated, u_r and v_i are weights to be optimized, y_{rj} is the observed amount of output of the r^{th} type for the j^{th} DMU, x_{ij} is the observed amount of input of the i^{th} type for the j^{th} DMU, r indicates the s different outputs, i denotes the m different inputs and j indicates the n different DMU_s. The CCR and BCC model conditions can be found in Palečková (2015).

2.2. Malmquist Index

The Malmquist index evaluates the efficiency change over time. The Malmquist index, based on DEA models, is one of the prominent indexes for measuring the relative productivity change of DMUs in multiple time periods. This index separates this change into various components. The index provides a useful means of distinguishing between changes in technical efficiency, pure technical efficiency, total factor productivity (TFPC) and shifts in the efficiency frontier (technological change) over time. This index is the geometric mean of two TFPC indices.

The original idea of the Malmquist index was proposed by Malmquist (1953) who suggested comparing the input of a firm at two different points of time in terms of the maximum factor by which the input in one period could be decreased such that the firm could still produce the same output level of the other time period. Caves, Christensen and Dievert (1982) extended the original MI index and introduced the first MI type; then Fare et al. (1992) showed that the Malmquist index can be calculated using a nonparametric DEA-like approach, given that suitable panel data are available. The researchers applied DEA to measure the Malmquist index. The researchers assumed constant returns to scale and identified the technological change and the change of technical efficiency as two components of the productivity changes over time. Next, Fare et al. (1994) considered the variable return to scale and offered an extended decomposition of the Malmquist index with another important factor capturing the change in the scale efficiency.

In accordance with Fare et al. (1994), we use DEA to construct an input-based MI between period t (the base period) and period s:

$$M_I\left(y^s,x^s,y^t,x^t\right) = \left[\frac{D_I^t\left(y^s,x^s\right)}{D_I^t\left(y^t,x^t\right)} * \frac{D_I^s\left(y^s,x^s\right)}{D_I^s\left(y^t,x^t\right)}\right]^{\frac{1}{2}} \tag{6}$$

where $M_I\left(\cdot\right)$ is the input-oriented MI, and $D_I^t\left(y^s,x^s\right)$ is the distance function showing a maximal proportional reduction of the observed period *s* inputs under the period *t* technology. The distance function is defined as follows:

$$D_I^t\left(y^s,\, x^s\right) = \min_{\theta,\lambda} \theta \tag{7}$$

subject to

$$y_{is} \leq \lambda Y^t \tag{8}$$

$$\theta x_{is} \geq \lambda X^t \tag{9}$$

$$\lambda_i \geq 0,\; i = 1,\ldots,n \tag{10}$$

where θ is a scalar and λ is a vector of constants. The value of θ obtained is the component score of the *i*-th firm; *X* and *Y* are input and output vectors, and the amounts of the i^{th} input consumed and output generated by the DMU_0 are denoted by *x* and *y*.

The above measure is actually the geometric mean of two Malmquist productivity indexes. Fare et al. (1992) specified that $M_I > 1$ indicates a productivity gain; $M_I < 1$ indicates a productivity loss; and $M_I = 1$ means no change in productivity from time *t* to *s*. Relaxing the Caves, Christensen and Dievert (1982) assumption that $D_I^t\left(y^t,x^t\right)$ and $D_I^s\left(y^t,x^t\right)$ should equal one and allowing for technical inefficiency, Fare et al. (1992) decompose their Malmquist productivity index into two components:

$$M_I = \left[\frac{D_I^t\left(y^s,x^s\right)}{D_I^t\left(y^t,x^t\right)} * \frac{D_I^s\left(y^s,x^s\right)}{D_I^s\left(y^t,x^t\right)}\right]^{\frac{1}{2}} = \frac{D_I^s\left(y^s,x^s\right)}{D_I^t\left(y^t,x^t\right)}\left[\frac{D_I^t\left(y^s,x^s\right)}{D_I^s\left(y^s,x^s\right)} * \frac{D_I^t\left(y^t,x^t\right)}{D_I^s\left(y^t,x^t\right)}\right]^{\frac{1}{2}} \tag{11}$$

The first component measures the change in technical efficiency (technical efficiency change – TEC). The second component measures the technology frontier shift (technological change – TCC) between time period *t* and *s*. TCC can be viewed as an average aggregated change in technology of a DMU from time period *t* to *s*. Fare et al. (1992; 1994) note that a value of $TCC > 1$ indicates a positive shift or technical progress, a value of $TCC < 1$ indicates a negative shift or technical regress, and a value of $TCC = 1$ indicates no shift in technology frontier. In this paper, we used the decomposition of the Malmquist index into two components, technological change and efficiency change (EC), which is a catch-up effect.

2.3. Data and Selection of Variables

The data set used in this study was obtained from the BankScope database and the annual reports of commercial banks during the 2009 – 2013 period; all the data are reported on an unconsolidated basis. We analysed only commercial banks that are operating as independent legal entities. The dataset consists of 376 observations for 85 commercial banks within the 2009 – 2013 period. All data are reported in EUR. In accordance with Pančurová and Lyócsa (2013), the data are adjusted for inflation using Gross Domestic Product (GDP) deflators. The values of the GDP deflators were obtained from the World Bank Database. As Pančurová and Lyócsa (2013) stated, these adjustments were performed to increase data comparability.

To perform the DEA estimation, inputs and outputs need to be defined. In the empirical literature, four main approaches have been developed to define the input-output relationship in financial institution behaviour (intermediation, production, asset and profit approach). We adopt an intermediation approach that assumes that the banks' main objective is to transform liabilities into loans. The bank collects deposits to transform them into loans.

Consistent with this approach, we assume that banks use three inputs (labour, fixed assets and deposits) and two outputs (loans and net interest income). Golany and Roll (1989) established a rule of thumb that the number of units should be at least twice the number of inputs and outputs considered. We measure labour by the total personnel costs covering wages and measure all associated expenses and deposits by the sum of demand and time deposits from customers, interbank deposits and sources obtained by bonds issued. Loans are measured by the net value of loans to customers and other financial institutions; net interest income (NII) is measured as the difference between interest income and interest expenses.

We tested the data for an independence assumption using correlation analysis; we found that there is no dependence between individual variables. The correlation coefficients between input and output variables confirmed that select input and output variables for efficiency evaluations are appropriate.

Next, we tested the separability assumption; we used regression-based tests in accordance with Ruggiero (2005). Nataraja and Johnson (2011) concluded that this method is easily implemented and performs better than the bootstrap approach; they also found that the bootstrap requires a long run time and has either similar or slightly worse performance. Ruggiero (2005) suggested a variable selection approach in which an initial measure of efficiency is obtained from a set of known production variables. Efficiency is then regressed against a set of candidate variables; if the coefficients in the regression are statistically significant and have the proper sign, the variables are relevant to the production process. The results of the regression model show that all variables are significant with an adequate coefficient value. All variables are relevant, and the results of the efficiency could be explained. The descriptive statistics of the inputs and outputs are presented in Table 1.

T a b l e 1

Descriptive Statistics of Variables (in million EUR)

Variable	Deposits	Labour	Fixed assets	Loans	NII
Mean	606	110	177	4 373	191
Median	31	11	38	1 675	64
Minimum	0.61	0.27	0.01	0.00	0.01
Maximum	9 101	9 467	2 800	105 792	3 368
St. Dev.	1 572	570	419	7 947	355

Source: Author's compilation.

3. Empirical Analysis and Findings

The banking efficiency has been estimated using the DEA models and the input-oriented model with variable returns to scale. We used unbalanced panel data from 13 Czech commercial banks, 11 Slovak commercial banks, 23 Hungarian banks and 38 Polish commercial banks (with regards to the mergers and acquisitions of banks). We estimated the relative technical efficiency. When the frontier is applied to each sample country, and when the performance of each individual banking institution is compared against the best-practice bank in that country, the efficiency results cannot be compared across borders. Thus we use a multi-country and multi-year frontier because we want to compare the efficiency in Visegrad group countries.

T a b l e 2

Average Efficiency Score in Visegrad Group Countries

	2009	2010	2011	2012	2013
Visegrad group countries	0.653	0.682	0.681	0.638	0.675
Czech Republic	0.572	0.656	0.607	0.571	0.656
Hungary	0.454	0.452	0.374	0.334	0.366
Poland	0.833	0.849	0.896	0.860	0.880
Slovakia	0.609	0.669	0.737	0.660	0.675

Source: Author's calculation.

Table 2 presents the average efficiency in Visegrad group countries' banking sectors within the 2009 – 2013 period. The average efficiency was between 64 to 68%. The most efficient banking sectors were found to be in Poland, Czech Republic and Slovakia. The Hungarian commercial banks were the least efficient from the group of Visegrad countries.

Table 3

Average Malmquist Indices in Visegrad Group Countries

	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013
EC	1.142	1.239	0.862	0.976
TCC	1.042	0.733	1.379	0.992
MI	1.190	0.908	1.188	0.968

Source: Author's calculations.

Table 4

Average Malmquist Indices in Banking Sectors

	2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013		2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013
Czech Republic					***Poland***				
EC	1.12	1.11	0.97	1.02	EC	1.23	1.16	0.92	0.99
TCC	1.00	0.85	1.27	1.02	TCC	1.08	0.89	1.40	0.92
MI	1.12	0.95	1.23	1.04	MI	1.34	1.03	1.29	0.91
Hungary					***Slovakia***				
EC	1.02	1.33	0.77	0.90	EC	1.17	1.51	0.75	1.04
TCC	1.05	0.50	1.43	1.06	TCC	0.95	0.72	1.37	1.05
MI	1.07	0.66	1.10	0.96	MI	1.12	1.08	1.02	1.09

Source: Author's calculations.

Tables 3 and 4 present the average Malmquist indices. The average Malmquist index achieves annual average growth of 5.6%. This positive efficiency change can be dichotomized into its catch-up and frontier-shift components. A catch-up or recovery component (efficiency change, EC) below 1.00 indicates regress or a negative efficiency change. A mean value of catch-up that registers 1.00 or above 1.00 indicates progress or positive efficiency change. The catch-up effect is composed of pure and scale efficiency changes. A pure efficiency change represents a core efficiency due to improved operations and management, while a scale efficiency change is associated with return to scale effects. In the Visegrad region, the average annual efficiency change (EC) was 4.4%. On a year-by-year score, the efficiency change registered below the 1.0 mark for the 2011 – 2013 period. This score was probably due to reduced operations and management and a decreased effect of the return to scale. A technological change (TCC) or frontier-shift represents the innovation in the banking system that has been developed, adapted or absorbed by players. TCC achieved an average value of 1.01; this indicated positive average annual growth of 1%. This low average growth was due to the negative growth in 2010 – 2011, which was probably caused by a financial crisis.

In most banking sectors analysed (except Hungary), the average Malmquist index was above 1.00. This result shows the positive efficiency change in the Czech, Polish and Slovak banking sectors. The technological change achieved positive growth in the Czech and Polish banking sectors.

Next, we analysed the individual banks of financial conglomerates. We analysed banks from five financial conglomerates (Erste Group, KBC Group, Raiffeisen Bank International AG, Société Générale Group and UniCredit Group). Table 5 presents the average efficiency score (Efficiency) and the Malmquist indices in banks that belong to a financial conglomerate. We analysed the efficiency and the efficiency change of banks that belong to a financial conglomerate. We investigated whether these banks achieved a value above or below the median value in each Visegrad group country.

We found that all banks in Visegrad group countries that belong to the KBC Group (KBC) had lower efficiencies than the median in these countries. According to the average Malmquist index, banks that belong to the KBC Group achieved a value of MI below the median value but above 1.00 (except K&H Bank). Thus, CSOB in the Czech Republic and Slovakia achieved a positive efficiency change. The banks that belong to KBC Group achieved very low efficiency results; we found that the frontier-shift effect, rather than the catch-up effect, was primarily accountable for the productivity growth, suggesting that the banks in the KBC Group had made technological progress in the past five years.

T a b l e 5

Average Indices in the Banks of Financial Conglomerates

Group	DMU	Efficiency	EC	TCC	MI
	Poland				
Poland – Median		0.99	1	1.06	1.06
RBI	Raiffeisen Bank Polska	0.96	0.95	1.04	0.99
SG	Euro Bank	0.97	1	1.11	1.11
UNIC	Bank Pekao	0.94	1	1.03	1.04
	Slovakia				
Slovakia – Median		0.67	1.09	0.99	1.07
ERSTE	Slovenská sporitelňa	0.98	1.09	1.02	1.11
KBC	ČSOB	0.56	1.04	1.02	1.06
RBI	Tatra banka	0.96	1.05	0.99	1.04
UNIC	UniCredit Bank	0.64	1.10	1.02	1.12
	Hungary				
Hungary – Median		0.40	0.98	1	0.99
ERSTE	Erste Bank Hungary	0.84	0.94	1.01	0.95
KBC	K&H Bank	0.27	0.88	0.99	0.97
RBI	Raiffeisen Bank	0.48	1.06	1.05	1.11
UNIC	UniCredit Bank	0.18	0.97	1	0.97
	Czech Republic				
Czech Republic – Median		0.61	1.03	1.05	1.07
ERSTE	Česká spořitelna	0.48	0.92	1.09	1
KBC	ČSOB	0.45	0.97	1.07	1.04
RBI	Raiffeisenbank	0.98	0.93	1.05	0.97
SG	Komerční banka	0.60	0.93	1.09	1.01
UNIC	UniCredit Bank	0.67	1.02	1.12	1.14

Source: Author's calculations.

When we analysed the Erste Group (ERSTE), we found that Slovenská sporitelňa and Erste Bank Hungary were more efficient than the median in the banking sector. However, Česká spořitelna was less efficient than the median in the Czech banking sector. Only Slovenská sporitelňa achieved a positive efficiency change; the average annual growth was 11%. The reason for the positive efficiency change was the catch-up and frontier-shift effect. Conversely, Erste Bank Hungary achieved a negative efficiency change within last five years, although Česká spořitelna and Erste Bank Hungary achieved a positive technological change.

The efficiency of Raiffeisen Bank International (RBI) illustrated the different findings in banks in Visegrad group countries. While Raiffeisen Bank Polska was less efficient than the median, other banks in the RBI Group were more efficient than the median. In Slovakia and Hungary, banks had a positive catch-up effect and a positive Malmquist index; thus, these banks achieved positive average growth of efficiency. In the Czech Republic and Poland, the results were very similar, Raiffeisenbank experienced a negative value of the Malmquist index and the efficiency change; only the technological change was positive. These banks experienced negative average efficiency growth of 3% and 1%, respectively. The banks in the Société Générale Group (SG) achieved different results. While Euro Bank in Poland was less efficient than the median value and achieved a positive efficiency change, the Czech Komerční banka was less efficient than the median and achieved a positive efficiency change due to a positive value of the technological change.

The efficiency results in the UniCredit Group (UNIC) were different. Most of these banks were less efficient than the median. UniCredit Bank in Slovakia and in the Czech Republic achieved a value of the MI above the median. Except for UniCredit in Hungary, banks achieved a positive value for the catch-up effect and the technological change. This result means that these banks progressed in innovation, better management and positive technological growth.

We can conclude that most banks that belong to the group of financial conglomerates achieved a positive technological change (except Hungarian K&H Bank and Tatra banka in Slovakia).

T a b l e 6

Average Indices in Financial Conglomerates in V4

Financial conglomerate	Efficiency	EC	TCC	MI
V4 median	0.66	1.01	1.03	1.05
ERSTE	0.77	0.98	1.04	1.02
KBC	0.43	0.96	1.03	1.02
RBI	0.85	1.00	1.03	1.03
SG	0.79	0.96	1.10	1.06
UNIC	0.86	1.02	1.04	1.07

Source: Author’s calculations.

When we analysed the banks in financial conglomerates Visegrad group countries together (Table 6), we found that only banks in the KBC Group were less efficient than the median in Visegrad group countries. Other groups achieved a higher efficiency than the median. The efficiency change was higher than the median in the UniCredit Group, and the technological change was more than the median in the banks in the ERSTE, SG and UNIC Groups. Only banks in Société Générale Group and UniCredit Group had higher values of the Malmquist index than the median value. Therefore, we do not confirm that banks in a financial conglomerate were more or less efficient than other banks in the sector.

4. Conclusion and Discussion

The objective this paper was to estimate the efficiency change in the banking sectors of the group of Visegrad countries during the 2009 – 2013 period and to determine whether banks that belong to the financial conglomerate were more or less efficient than other banks in the sector. The results show that the average efficiency slightly decreased during the 2009 – 2011 period. In 2012, the average efficiency slightly decreased in the banking sectors of Visegrad group countries. This decrease was probably due to the financial crisis. Our finding confirms the study by Anayiotos, Toroyan and Vamvakidis (2010) who concluded that the banking efficiency decreased during the financial crisis period. The Polish and the Slovak banking sectors were the most efficient. The Hungarian banking sector was the least efficient.

We asked the following research question: "What is the main reason for the positive/negative efficiency change in Visegrad countries?" The positive efficiency change is primarily due to the catch-up effect and to technological growth. The average efficiency change (catch-up) achieved a positive average annual growth of 4%. The results of the technological change indicate a positive average annual growth of 1%. This slight growth because of technological change is due to the negative growth in 2010 – 2011, which was probably caused by the financial crisis. The efficiency change was above 1 in the 2009 – 2011 period. The value below 1 in 2011 – 2013 was probably caused by reduced operations and management and a decreasing effect of the return to scale. Our findings are consistent with the results of Hančlová and Staníčková (2012) who concluded that all Visegrad group countries had a total efficiency increase.

The second research question was "Are the banks that belong to the financial conglomerates more efficient than other banks?" We found that there are differences in the banks in the financial conglomerates across Visegrad group countries. This study does not confirm the results of Vander Vennet (2002), who found that conglomerates were more efficient than their specialized competitors. We found that several banks were less efficient than other banks in the banking industry. We cannot state that banks in the financial conglomerate are more or less efficient than other commercial banks.

Further research could consider costs in the model and could analyse the cost and profit efficiency of commercial banks; in addition, the estimated time period could be extended. We found that an affiliation with a financial conglomerate is not the determinant of efficiency; thus, we would examine the determinants of banking efficiency in select banking sectors.

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