A COMPARATIVE STUDY OF EFFICIENCY IN CENTRAL AND EASTERN EUROPEAN BANKING SYSTEMS

Alina Camelia ŞARGU
"Alexandru Ioan Cuza" University of Iaşi
Faculty of Economics and Business Administration
Doctoral School of Economics
PhD Candidate
alina.sargu@feaa.uaic.ro

Angela ROMAN, PhD
"Alexandru Ioan Cuza" University of Iaşi
Faculty of Economics and Business Administration
Department of Business Administration
Associate Professor
aboariu@uaic.ro

—Abstract —

The European integration process has had a great impact on the macroeconomic environment of the new member states, some effects being more visible than other. In this context it becomes interesting to analyse if the EU ascension has triggered an increase of the banks efficiency from a series of CEE countries (two from the first wave and one from the second wave of EU expansion). The analysed period is between 2003 and 2010, covering the first years after the EU ascension of these countries. In order to estimate the efficiency of the banks from our sample we have used a non-parametric technique, namely the Data Envelopment Analysis. The overall results are suggesting that there is a slight increase of the banks operating in these countries estimated efficiency between 2007 and 2010.

Key Words: *banking sector, Data Envelopment Analysis, Central and Eastern European Countries*
JEL Classification: G21, C14; C33

1. INTRODUCTION

Over the last years the banking sectors in the new EU Member States have experienced profound changes, especially in the process of EU accession. In this context, efforts to increase bank efficiency have become a priority for policy

makers and regulatory institutions. In their paper, Fink et al. (2004) explicitly highlight the banking sector efficiency as an important source of economic development, this point being increasingly important nowadays, in the light of the current turbulent developments in the banking sectors of the CEE countries.

The main objective of our study is to examine the issue of bank efficiency for two countries from the first wave – the Czech Republic and Hungary and one from the second wave of EU expansion – Romania. The total assets held by the banks from our sample exceed 80% of the total banking assets of the analysed countries, making this research one of the most comprehensive ones on this subject. These banking markets are examined between 2003 and 2010 using the non-parametric Data Envelopment Analysis approach (DEA). We have chosen to use this analysis as it allows for an accurate estimation of efficiency with just a small number of observations.

The remainder of the paper is organized as follows. The second section describes the sample and the data used in the research. Section three presents the methodologies used and afterwards a review of the literature on banks efficiency is provided. Section four presents and discusses the results of the empirical study. The paper concludes with a summary of the findings.

2. METHODOLOGY AND REVIEW OF RELEVANT LITERATURE

In his research Farrell (1957) underlines the existence of two components of a firms efficiency, namely: technical efficiency – that underlines the firm ability to obtain a maximum level of outputs for a certain level of given inputs and allocative efficiency – that underlines the ability of a firm to use inputs in optimal proportions, taking into account their prices and the available production technology. The two efficiency measurements can be combined in order to supply an overall measurement of the total efficiency, obtaining thus the cost efficiency of a firm. The optimum or the most efficient production process, depending on a series of characteristics like the scale of a firm, is known as the efficiency frontier. The errors, the differences between a chosen production model and its implementation into practice, human inertia, communication distortions or the uncertainties can cause deviation from the efficiency frontier and are known as X-inefficiency (Leibenstein, 1966). The X-inefficiency in the banking sector of the analysed countries represents the main aim of our research.

There are two approaches used in order to estimate the X-inefficiency of a banking institution: the parametric approach (econometric) and the non-parametric approach (mathematical programming). These approaches are using

different techniques for the analysis of the data set and take into account different hypothesis regarding the random noise and the structure of the production technology. In our research we have chosen to use the Data Envelopment Analysis (DEA) as a non-parametric way of analysing the data from our sample. DEA is an approach that uses mathematical programming for the construction of the efficiency frontier and the measurement of the efficiency achieved compared to it. The DEA frontier is a combination of the dots that represent the most efficient observations from the analysed data set. As a result, de score for each decision making unit (DMU) is not defined as a standard value but as a relative value compared with the other DMUs from the sample (Stavárek, 2002).

In their research Charnes et al. (1978) are proposing a model that is input oriented and assumes constant returns to scale (CRS). Thus, this model identifies inefficient DMUs regardless of their size. As a consequence of this, the usage of this type of model in the case of DMUs that are not operating at their optimal size can lead to the estimation of efficiency scores that are strongly influenced by the scale efficiency. This is the reason why a series of following researchers have developed a series of alternative measurement measures. The existence of variable returns to scale (VRS) has been introduced first by the research of Banker et al. (1984). Thus, the input oriented VRS for DMU_0 can be written as follows:

$$\min_{\lambda} z_0 = \Theta_0$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, \quad r=1,2\ldots,n$$

$$\Theta_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0, \; i=1,2\ldots,n$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0, \; j=1,2,\ldots,n$$

where:
Θ_0 - is the technical efficiency of DMU_0 to be estimated;
λ_j - is a n-dimensional constant to be estimated;
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 different s outputs; i - indicates the different m inputs;
j - indicates the different n DMUs.

The VRS efficiency scores are also known as technical efficiency and are obtained through the estimation of the above presented model for each DMU. The VRS model eliminates the scale component from the analysis of the efficiency this being the reason why the CRS scores for each DMU are below the VRS scores.

3. DATA

The research undertaken is based on the data for the banks that own almost 80% of the banking assets from the analysed countries. The analysed period is 2003-2010, encompassing the period after the ascension to full time EU membership of these countries, a time frame characterised by structural changes in the framework of their banking systems. We must underline that during the analysed period our sample has suffered some small changes determined by the unavailability of a full data set for all the banks and also the registration of a series of mergers and acquisitions. This is the reason why our total sample had 58 banks in 2003, 66 in 2004, 72 in 2005, 71 in 2006, 72 in 2007, 67 in 2008, 62 in 2009 and 37 in 2010. All the financial data used have been transformed from national currencies into euro in order to facilitate the analysis and the comparability of the results. In order to make the transformation we have used the official annual rate of exchange calculated by the European Central Bank, using the methodology set forth by Berg et al (1993) for such transformations. The data used have been obtained from the Bankscope database and the annual reports of the banks from our panel. For our sample we have considered only commercial banks, all the foreign banks branches, mortgage banks, housing banks, specialised banks and banking cooperatives have been excluded from our sample.

In the academic literature there are three approaches for the definition of the inputs-outputs relationship in the case of the financial institutions, namely the production approach, the intermediation approach and the asset approach. Since the intermediation approach is the most used in the academic literature on this subject we have decided to use it in our research and thus we have defined the inputs and outputs based on the original methodology employed by Sealey et Lindley (1977), making a series of small adjustments. In our approach we have chosen the number of inputs and outputs accordingly to the size of our sample and consequently used three inputs (labour, capital and deposits) and two outputs (loans and net interest income). Since our methodological approach is based on a non-parametric analysis, the usage of a large number of variables would have reduced the number of observations which underline inefficient DMUs. Taking into account this methodological inconvenience we have used in our research

three inputs and two outputs. Thus, we have considered labour as the sum of the total expenses made with the employees (PC) including salaries and social spending. The capital has been defined as the book value of the fixed assets (FA). For deposits we have considered the total amount of the demand and time deposits made by clients and also by other banks (TD). Loans were measured as the net value of the loans granted to clients and other financial institutions (TL). The net interest income was obtained as the difference between interest income and interest expenses (NII). We have also used the total assets held by banks in order to have a better look at their operational size (TA). The descriptive statistics for the inputs and outputs used in our research are presented in table 1, for the analysed period 2003-2010.

Table 1: Descriptive statistics for the inputs and outputs used in our research

2003	Romania (22 banks)				Czech Republic (16 banks)				Hungary (20 banks)			
	mean	st.dev.	min	max	mean	st.dev.	min	max	mean	st.dev.	min	max
TL	295.4	525.2	3.4	2224.2	1445.9	2244.0	5.8	7225.3	1372.3	2035.0	24.4	8070.1
NII	34.5	68.6	0.2	306.4	102.2	177.2	1.1	498.4	83.0	155.4	1.8	696.0
PC	19.5	41.0	0.1	189.2	42.8	74.5	0.7	215.3	31.7	54.7	1.4	241.7
FA	53.6	118.7	0.1	496.5	89.6	74.5	0.2	520.5	241.7	105.4	0.1	463.2
TD	521.2	931.6	4.3	4212.7	3334.3	5186.7	14.5	14621.6	1748.4	2580.7	23.2	11104.1
TA	633.8	931.6	6.8	5167.0	4125.1	6457.3	33.3	19044.1	2182.6	3201.7	35.4	13645.7
2007	**Romania (25 banks)**				**Czech Republic (23 banks)**				**Hungary (24 banks)**			
TL	1717.8	2596.8	22.4	11275.4	2999.6	4440.6	18.5	14860.1	2744.3	4981.0	0.5	22209.8
NII	87.5	140.0	1.4	588.5	148.9	257.8	0.2	889.2	150.1	365.9	0.1	1800.5
PC	48.1	76.2	1.2	357.8	48.0	87.9	0.8	304.1	60.2	123.0	0.1	588.1
FA	74.5	120.3	1.2	493.0	67.6	146.6	0.1	549.7	70.5	157.8	0.1	749.8
TD	2257.2	3520.2	30.0	15790.8	4661.0	7665.6	15.9	549.7	3183.7	5391.8	0.3	24103.4
TA	2844.7	4241.3	36.0	18996.4	5960.1	9450.7	36.9	33329.3	4025.8	7307.3	0.5	33665.7
2010	**Romania (17 banks)**				**Czech Republic (12 banks)**				**Hungary (8 banks)**			
TL	2367.2	2996.2	27.7	11251.5	5418.7	6640.2	445.3	17431.9	6541.5	7984.0	84.5	24470.1
NII	168.0	229.4	1.2	890.2	301.6	438.8	5.2	1196.9	437.4	744.2	2.7	2241.0
PC	57.6	58.6	2.0	207.4	84.1	119.4	1.9	328.2	131.7	190.1	0.7	583.4
FA	83.7	109.7	0.9	402.1	114.3	197.3	0.6	633.4	183.4	269.3	0.1	791.3
TD	3110.0	3645.2	36.9	14161.7	8318.6	11425.1	89.3	29469.7	7705.7	8876.7	101.1	27365.2
TA	3880.2	4605.0	43.2	17476.0	10189.4	13685.0	472.7	35004.5	9720.9	11427.2	141.3	35503.8

Source: Authors calculations

4. EMPIRICAL RESULTS

Using the methodology presented previous we have evaluated the efficiency for all the banks from our sample using DEA, estimating separately the efficiencies in the case of the CRS and VRS model. We have combined the cross-border data and we have used them in order to define a common efficiency frontier for all the banks from the analysed countries. This approach has allowed us to determine the relative differences between the analysed banking sectors. A similar approach has been used in the academic literature by: Berg et al. (1993), Dietsch et Weill

(2000), Grigorian and Manole (2002), Stavárek (2005), Toçi (2009) or Fang et al (2011). Table 2 presents the descriptive statistics of the efficiency scores obtained considering the CRS and VRS model.

Table 2: Descriptive statistics of the efficiency scores between 2003 and 2010

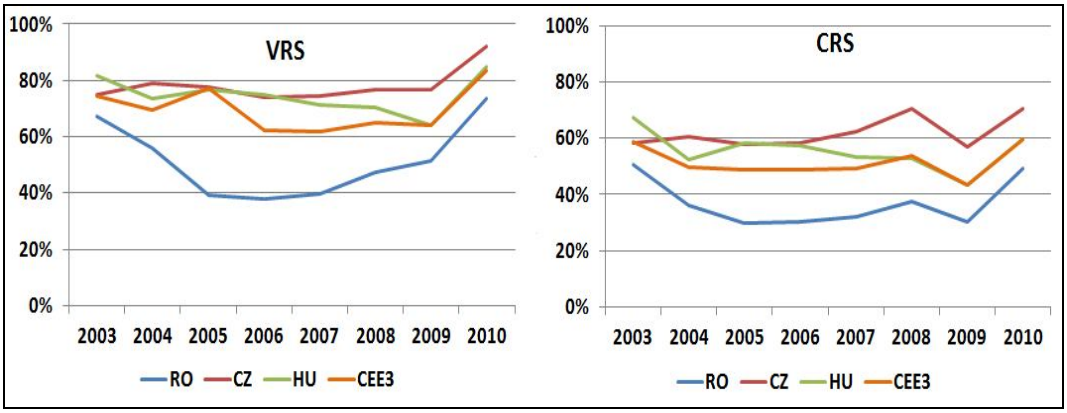
	CRS model						
	No. DMUs	**No. Effic. DMU**	**mean**	**med**	**st.dev.**	**min**	**max**
2003	57	7	0.584	0.538	0.221	0.184	1.000
2004	65	6	0.488	0.456	0.235	0.122	1.000
2005	71	8	0.415	0.415	0.265	0.093	1.000
2006	70	8	0.482	0.398	0.261	0.134	1.000
2007	71	10	0.489	0.400	0.268	0.124	1.000
2008	66	11	0.505	0.420	0.260	0.196	1.000
2009	61	7	0.421	0.298	0.280	0.070	1.000
2010	36	4	0.584	0.521	0.228	0.146	1.000
	VRS model						
	No. DMUs	**No. Effic. DMU**	**mean**	**med**	**st.dev.**	**min**	**max**
2003	57	21	0.743	0.747	0.242	0.187	1.000
2004	65	18	0.685	0.720	0.281	0.135	1.000
2005	71	16	0.634	0.572	0.303	0.106	1.000
2006	70	16	0.616	0.544	0.298	0.134	1.000
2007	71	16	0.613	0.553	0.296	0.124	1.000
2008	66	19	0.636	0.578	0.288	0.196	1.000
2009	61	15	0.627	0.588	0.309	0.144	1.000
2010	36	16	0.820	0.930	0.246	0.156	1.000

Source: Authors calculations

We must underline that the efficiency scores for the VRS are considerably higher than in the case of the CRS and also that the efficiency frontier in the case of the VRS model encompasses more DMUs than in the case of the CRS model. We also must emphasize that, during the analysed period 2003-2010, there is a slight increase of the overall banks efficiency, more visible between 2007 and 2010.

Also, by comparison with the results registered by Berger et Humprey (1997) we can observe an improvement of the overall efficiency of the sample banks. Thus, the authors are reviewing 130 studies, from which 69 are using non-parametric analysis methods in order to estimate the efficiency of the financial institutions. They underline that in the case of this type of research on European banks the average estimated efficiency was 72% with a standard deviation of 0.17. We can thus observe that our results do not differ significantly.

Figure 1: VRS and CRS average efficiency by country between 2003 and 2010



Source: Authors calculations

As it is highlighted in Figure 1, the Czech banking sector has registered the highest efficiency score, both in the case of the CRS and VRS models. During the analysed period the estimated average efficiency of the banks from Romania has increase with 6.55 percentage points, the banks from the Czech Republic have registered an increase of the average efficiency of 16.93 percentage points, while the banks from Hungary have registered an increase of the average efficiency of only 3.24 percentage points during the analysed period. The banks from Hungary have started the analysed period with an advantage of 6.75 percentage points compared with the average efficiency of the banks from the other analysed countries, but the banks from the Czech Republic have managed to become the best performers by increasing their overall average efficiency with 16.93 percentage points, from 74.95% in 2003 to 91.88% in 2010. A similar evolution has been registered also in the case of the average efficiencies estimated through the CRS model. Based on these results, we can conclude that the banks from Hungary and the Czech Republic are forming a distinctive group with an average efficiency for the analysed period of 76.41%. At the same time the banks from Romania have registered a V shape evolution of their efficiency during the analysed period, being by far the least efficient ones from our sample.

There are several reasons for the low level of overall efficiency registered by the countries from our panel. Thus, firstly a negative impact on the efficiency of the intermediation process is determined by the high level of non-performing loans, the low scoring of the potential borrowers and the dormant crediting potential of the households. Thus, in 2010 the ratio of the credits granted to households in GDP was 20.42% for Romania, 30.65% for the Czech Republic and 29.67% for

Hungary while in the case of Austria for example this was 52.41% (ECB, 2010). To this we must add that most of the investments realized in the analysed countries have been made by foreign investors using their own resources or the ones obtained from the banks operating abroad or attracted from the foreign capital markets. As a result of these, the potential borrowers and the high quality clients have chosen not to use the local banks or capital markets regardless of their investment activities (privatisation, mergers and acquisitions, green-field investments). As a result of the high average interest rates that were employed by the banks from the analysed countries a large number of local companies have chosen to finance their activities and expansions from abroad, based on the funds obtained from foreign banks, thus managing to diminish their capital costs. In the case of the analysed countries, the indebtedness level of the domestic companies to domestic creditors is almost equal to the level of indebtedness to foreign creditors.

5. CONCLUSION

In conclusion the registered results underline that even after 20 years from the fall of communism in Central and Eastern Europe and despite the transformations, the reform process, the convergence and harmonisation process necessary for EU ascension, the analysed countries are not a homogenous club as they are portrayed most of the times. This is underlined by the results obtained through our analysis showing that the banks operating in these countries have not registered a substantial improvement of their estimated efficiency in the period 2003-2010.

According to the estimated average efficiencies for the analysed period, 2003-2010, the banking sectors from the analysed countries can be considered more or less efficient. In general the banks from the Czech Republic tend to have the highest average efficiency score. At the opposite pole is Romania with an average efficiency for the analysed period of 51.49%. One of the most spectacular evolutions was in the case of the banks from Hungary, were the enhance of the average estimated efficiency can be explained through the positive effects determined by the rapid real convergence process and also by the early restructuring and privatisation process of the banks from this country. The results regarding the estimated efficiency scores are not significantly different from the ones of previous studies in the academic literature. Still even if the results obtained are based on a different data set they cannot underline that the estimated efficiency are close to the average ones estimated in the case of the EU-15 countries. In the academic literature there were several attempts made in order to compare the efficiency of the banks from the new EU member states with the ones

estimated for the EU-15 countries (e.g. Stavárek and Polouček, 2003, Stavárek, 2005). The obtained results suggested each time that the banks from the new EU member states are less efficient than their EU-15 peers. Still, the efficiency estimated for the banks from Romania is well below the standard one registered in the case of the EU-15 countries and also under the average estimated efficiency for the banks from the Czech Republic and Hungary.

To sum up, despite the privatisation process and the dominance of foreign banks, the banking sectors of the analysed countries continue to register a very low level of loans granted to corporations and households compared with the EU-15 average. Still, it is to be expected that the overall average efficiency of the banks from our sample will increase in the future, once the macroeconomic problems faced by the analysed economies are overcome and the SMEs sector will be reenergised again.

BIBLIOGRAPHY

Banker, R., Charnes, A. and Cooper, W.W. (1984), "Some Models for Estimating Technical and Scale Efficiencies in Data Envelopment Analysis", *Management Science.* vol. 30, pp. 1078-92.

Berg, A., Forsund, F.R., Hjarmarsson, L. and Suominen, M. (1993), "Banking Efficiency in the Nordic Countries", *Journal of Banking and Finance.* vol. 17, pp. 371-88.

Berger, A.N. and Humprey, D.B. (1997), "Efficiency of Financial Institutions: International Survey and Directions for Future Research", *European Journal of Operations Research*, vol. 98, pp. 175-212.

Charnes, A., Cooper, W. and Rhodes, E. (1978), "Measuring the Efficiency of Decision Making Units", *European Journal of Operations Research*, pp. 429-44.

Dietsch, M. and Weill, L. (2000), The Evolution of Cost and Profit Efficiency in the European Banking Industry, in Hasan, I. and Hunter, C. (eds) *Advances in Banking and Finance,* vol. 1 (London: JAI Press).

ECB, 2010, Statistical Data Warehouse,
http://sdw.ecb.europa.eu/browse.do?node=2116082 [Accessed 10.03. 2012]

Fang, Y., Hasan, I., Marton, K. (2011), "Bank efficiency in transition economies: recent evidence from South-Eastern Europe", *Bank of Finland Research Discussion Papers*, no. 5.

Farrell, M.J. (1957), "The Measurement of Productive Efficiency, *Journal of the Royal Statistical Society (Series A)* ", vol. 120, pp. 253-81.

Fink G., Haiss P. and Mantler H. C. (2004), "Financial sector macro efficiency: Concepts, measurement, theoretical and empirical evidence", (in: Balling M., Lierman F. and Mullineux A. (eds.), *Financial Markets in Central and Eastern Europe. Stability and efficiency perspectives*, Routledge: SUERF), pp. 61-98.

Grigorian, D.A. and Manole, V. (2002), "Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis", (Washington, D.C.: World Bank).

Leibenstein, H. (1966), "Allocative Efficiency vs. X-Efficiency", *American Economic Review*, vol. 56, pp. 392-415.

Sealey, C.W. and Lindley, J.T. (1977), "Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions", *Journal of Finance*, vol. 32, pp. 1251-66.

Stavárek, D. (2002), Essential Methods of Banks. Efficiency Measuring, In Future of the Banking after the Year 2 000 in the World and in the Czech Republic. V. Comparison of the Banking Sector in Transition Economies.(Karviná: Silesian University), pp. 98-110.

Stavárek, D. and Polouček, S. (2003), "Efficiency and Profitability in the Banking Sector", (in Polouček, S. (ed.), *Reforming the Financial Sector in Central European Countries*, Houndmills: Palgrave Macmillan), pp. 75-135.

Stavarek, D. (2005), "Efficiency of Banks in Regions at Different Stage of European Integration Process", *Finance 0502020*, EconWPA.

Toçi, V. Z. (2009), "Efficiency of banks in South-East Europe: with special reference to Kosovo", *CBK Working Paper*, no. 4.