COST EFFICIENCY OF SLOVAK COMMERCIAL BANKS UNDER THE STANDPOINT OF THE PRODUCTION APPROACH

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Abstract

The paper evaluates the cost efficiency in the Slovak banking sector as attained by individual commercial banks in 2012 using the non-parametric method of data envelopment analysis if the production approach is adopted to describe banking behaviour. The cost-efficiency scheme applied with the qualification of different exogenously given unit costs for individual banks and under the input-oriented treatment of technical efficiency in a variable-returns-to-scale environment showed that a total of six commercial banks had been in 2012 successful in production of banking services, in which they delivered both full technical and full allocative efficiency. The efficiency how individual Slovak commercial banks utilized resources in their provision of depository and creditory services was decomposed into a technical component and into an allocative component, and the sources of efficiency of individual commercial banks were evaluated on the basis of this decomposition. This decomposition revealed that inefficiency, if any, in the Slovak banking sector stemmed in 2012 principally from technical incapacity in transformation process to secure the given level of outputs at lower consumption or use of inputs.

Key words: cost efficiency, data envelopment analysis, Slovak commercial banks

JEL Code: D24, G21.

Introduction

The production approach to banking operations views commercial banks as producers of banking services, in which labour, physical capital and other production variables under control of commercial banks are transformed into intangible depository and creditory services. As economic entities commercial banks pursue their economic goals, which may take a variety of forms and interpretations. All the same, one of them – and in the neoclassical theory to production an ultimate one – is economic efficiency, which breaks down into two component conditions (e.g. Doll & Orazem, 1978, pp. 47-48). The necessary condition for economic efficiency in banking stipulates that commercial banks behave in a technically

efficient way, i.e. they are unable to (a.) produce the same amount of services with consumption of fewer inputs, and (b.) produce more services with the same consumption of inputs. On the other hand, the sufficient condition relates to a subjective formulation of individual or social goals and values that commercial banks resolved to work towards. Ignoring the aspect of time, which would forward the matter of economic efficiency into the bosom of value oriented management, the traditional goal of commercial bank is profit maximization, but this requires that banks can control not only the prices of their inputs but also the price of services they secure. Due to the oligopolistic structure of the Slovak banking sector (e.g. Boďa, 2014), Slovak commercial banks operate in an economic environment where prices of their services are both regulated and comparable, which make them lie outside the actual control of Slovak commercial banks. Being thus price-takers unable to compete on the basis of effective price optimization, they attempt to distinguish through cost minimization, which constitutes a valid economic goal of their production process. In recognition of this situation, the objective of the paper is to evaluate cost efficiency as exhibited by Slovak commercial banks in the production of banking services. To this end, data for the fiscal year 2012 on 15 banking institutions are utilized in the non-parametric framework of data envelopment analysis. In the evaluation of cost efficiency, the model due to Tone (2002) is employed and this assumes that individual commercial banks conduct their enterprise with divers unit costs (unit labour costs, costs of physical capital etc.) and these are exogenously given. To the best knowledge of the authors, cost efficiency in the framework of data envelopment analysis has not been investigated in the conditions of the Slovak banking sector as of yet, although it has been subject of research in a different economic environment (e.g. Almanza-Ramirez, 2012, Zheng & Chen, 2011, Liu & Xu, 2012).

Commencing with this introduction and ending with a conclusion, the body of the paper comprises two sections. The next section gives a brief exposition of the model employed with methodological notes and is followed by a section presenting results and providing discussion.

1 Methodology: cost efficiency model employed and data

Applied to banking, the model of Tone (2002) hinges on the presupposition that commercial banks have a certain degree of control over the prices of inputs they consume and/or utilize and in consequence these prices may (and do) differ amongst individual commercial banks. It is assumed with this, though, that these prices are for commercial banks fixed and they find it

somewhat difficult to optimize them towards possibly more favourable prices enjoyed by their competitors (such a situation arises when commercial banks push their costs downwards unknowingly of their competitors' prices). A different and more sophisticated approach to cost efficiency is considered e.g. by Portela and Thanassoulis (2014) who assume that prices are not fixed for individual commercial banks and that commercial banks may strive for more competitive prices, which endogenously react to technical aspects of production. Nevertheless, having regard to the basis of thought followed by Tone (2002), it is possible to set up a model of data envelopment analysis that decomposes overall efficiency (i.e. economic efficiency under the maxim of cost minimization) can be disaggregated into technical efficiency and allocative efficiency. Whereas technical efficiency is an ability to produce with/at Pareto-Koopmans optimal levels of production variables, allocative efficiency in the context of cost minimization is an ability to select such a mix of production variables that is operable at minimum cost.

In the formulation of the cost-efficiency model employed, let the production of commercial bank o, $o \in \{1, ..., n\}$, represent by the m-dimensional input vector $\mathbf{x}_o$ (such that $\mathbf{x}_o \in \mathbf{R}_+^m$) and by the s-dimensional output vector $\mathbf{y}_o$ (whilst $\mathbf{y}_o \in \mathbf{R}_+^s$). Let assume that the use of the input vector $\mathbf{x}_o$ is associated with unit input costs arranged in the vector $\mathbf{c}_o$ (of course with $\mathbf{c}_o \in \mathbf{R}_+^m$). The technical aspects of banking production in this set-up are captured by matrices $\mathbf{X} = (\mathbf{x}_1 \mid ... \mid \mathbf{x}_n)$ and $\mathbf{Y} = (\mathbf{y}_1 \mid ... \mid \mathbf{y}_n)$. In evaluating the allocative aspects it is, however, necessary to account for the assumed operating conditions of Slovak commercial banks: (i.) prices of outputs are pre-determined, comparable and in point of fact preordained to individual commercial banks, (ii.) prices of inputs may be exogenously given but are differentiated across individual commercial banks, being a matter of their managerial position and a specific entrepreneurial situation. This implies that one needs to convert the natural volumes of inputs in the matrix $\mathbf{X}$ into the their costs, which is done by pricing them in a usual fashion as $\mathbf{X}^c = (\mathbf{c}_1 \circ \mathbf{x}_1 \mid ... \mid \mathbf{c}_n \circ \mathbf{x}_n)$. In this context, the symbol $\circ$ indicates an operation of elementwise multiplication of two vectors. The costs of inputs for commercial bank o are thus included in the vector $\mathbf{x}_o^c = \mathbf{c}_o \circ \mathbf{x}_o$.

Two linear programs are then solved for each commercial bank under the most general assumption of variable returns to scale. Denoting by $\mathbf{1}$ the vector of ones, for commercial bank o, $o \in \{1, ..., n\}$, the linear program

$$\theta_o = ! \min_{\theta, \lambda} \qquad \text{subject to} \qquad \theta \mathbf{x}_o^c \geq \mathbf{X}^c \lambda, \quad \mathbf{y}_o \geq \mathbf{Y}\lambda, \quad \lambda \geq \mathbf{0}, \quad \mathbf{1}'\lambda = 1 \qquad (1)$$

yields the (optimized) score $\theta_o^{\#}$ of technical efficiency valid in the conditions of divers prices affecting the selection of input mix in production process. This is an analog of the input-orientated model of Banker, Charnes and Cooper (1984), known under the acronym BCC, save the fact that now it is worked with costs of inputs rather than with inputs expressed in natural units of measurements. The second linear program run for this commercial bank

$$\mathbf{1}'\mathbf{x}_o^{\mathfrak{c}} = ! \min_{\theta, \lambda} \qquad \text{subject to} \qquad \mathbf{x}_o^{\mathfrak{c}} \geq \mathbf{X}^{\mathfrak{c}}\lambda, \quad \mathbf{y}_o \geq \mathbf{Y}\lambda, \quad \lambda \geq \mathbf{0}, \quad \mathbf{1}'\lambda = 1 \qquad (2)$$

is used in establishing the score of cost efficiency derived from the optimized value $\mathbf{x}_o^{\mathfrak{c}\#}$. The technical efficiency is measured by the score $\theta_o^{\#}$ (with $\theta_o^{\#} \in [0,1]$) and the cost efficiency (i.e. economic efficiency with the environment of cost minimization) is measured by the computed score $\mathcal{G}_o^{\#} = \mathbf{1}'\mathbf{x}_o^{\mathfrak{c}\#} / \mathbf{1}'\mathbf{x}_o^{\mathfrak{c}}$ (again with $\mathcal{G}_o^{\#} \in [0,1]$). In (2) the perspective of variable returns to scale is adopted again. Insomuch as allocative efficiency is required to comply with the decomposition of the form

$$[\text{overall efficiency}] = [\text{technical efficiency}] \times [\text{allocative efficiency}], \qquad (3)$$

the score of allocative efficiency for commercial bank o is then $\zeta_o^{\#} = \mathcal{G}_o^{\#} / \theta_o^{\#}$ (and it may be checked easily that $\zeta_o^{\#} \in [0,1]$). Note that all the three efficiency measures, $\theta_o^{\#}$, $\mathcal{G}_o^{\#}$ and $\zeta_o^{\#}$, are units invariant since $\mathbf{X}^{\mathfrak{c}}$ is expressed in monetary units.

In studies of banking efficiency there is an intense debate concerning the selection of input and output variables that would most appropriate reflect and describe production process in banking. The major approaches that have been developed both in theory and practice in describing the conduct and undertaking of commercial banks are the intermediation approach, the production approach and their modifications (for a concise exposition on this issue consult e.g. Ahn & Lee, 2014). The most frequently discussed issue is the role of deposits, which have both input and output characteristics. Under the production approach, receiving deposits is just one of banking services and therefore deposits are treated as an output production variable in banking transformation process. This approach was first suggested by Benston (1965) and its most relevant deficiency is neglect of interest costs.

In this paper, two input and two output variables are used for individual Slovak commercial banks as of 2012. The inputs recognized are of technical nature and they include labour force (measured by the yearly average number of employees expressed in full time equivalents) and fixed assets (measured by the total of property and equipment in thousand euro as disclosed as of 31 Dec 2012). The inclusion of fixed assets may perhaps be subjected to criticism, but this variable represents physical infrastructure that is used in production of commercial banks. Deposits taken and loans granted (measured by their totals disclosed as of

31 Dec 2012 in thousand euro) are output variables in the study. In solving the programs formulated in (1) and (2), the cost-transformed inputs were employed in the form of total wages (measured by total personnel costs incurred in 2012 in thousand euro) and "fixed assets costs" (measured by a sum of operating costs related to fixed assets maintenance, IT administration and common purchases and of total depreciation and amortization charges recognized in 2012 in thousand euro). The data used in the empirical study are the yearly data of balance-sheet and income-statement items covering year 2012 disclosed by the TREND Holding, s.r.o., Bratislava.

In the analysis, the banking sector in the Slovak Republic is represented by fifteen banking institutions. Ten banks enjoy the status of commercial banks residing in the Slovak Republic with or without foreign capital participation (Slovenská sporiteľňa, a. s. – denoted as SLSP; Všeobecná úverová banka, a. s. – denoted as VUB; Tatra banka, a.s. – denoted as TATRA; Československá obchodná banka, a. s. – denoted as CSOB; UniCredit Bank Slovakia, a. s. – denoted as UNI; Poštová banka, a.s. – denoted as POSTBA; Prima banka Slovensko, a. s. – denoted as PRIMA; OTP Banka Slovensko, a. s. – denoted as OTP; Sberbank Slovensko, a. s. till 2013 VOLKSBANK Slovensko, a. s. – denoted as SBER; Privatbanka, a. s. – denoted as PRIVAT) and five are the branch offices of foreign banks operating in the Slovak Republic (Citibank Europe plc, branch office of foreign bank – denoted as CITI; Oberbank AG, branch office of foreign bank in the Slovak Republic – denoted as OBER; Komerční banka, a. s., branch office of foreign bank – denoted as KOBA; J & T Banka, a. s., branch office of foreign bank – denoted as J&T; Commerzbank Aktiengesellschaft, branch office of foreign bank – denoted as COMMERZ). This group of fifteen banking institutions exhausts almost the full scope of operations in the banking sector of the Slovak Republic as it covers more than 90 % of its banking assets. Hence, the results achieved in this paper can be interpreted as representative of the entire banking sector in Slovakia. In order to assure consistency of the analysis, building societies and special financial institutions are discarded out of consideration. On the other hand, the well-established branch offices of foreign banks are taken under consideration, what enables to test into whether they are technically and cost efficient as well as they benefit from the cost-saving schemes of their head quarters.

2 Empirical results and discussion

The analysis was in its entirety executed in Microsoft Excel using the DEA SolverPro (version 10), which is commercially distributed for use with the textbook by Cooper, Seiford and Tone (2007). In calculating the (estimates of) technical efficiency scores for each of the

fifteen banking institutions under evaluation, the input-orientated variable-returns-to-scale model shown in (1) was utilized, and in calculating the (estimates of) cost efficiency scores the cost efficiency model presented in (2) was made use of. Combining technical efficiency scores and cost efficiency scores, the decomposition following (3) was considered so as to establish allocative efficiency scores. The results are shown in Table 1.

Tab. 1: Results of cost efficiency analysis for the Slovak banking sector in 2012

Commercial bank	Efficiency score			Reference set	
	Technical	Allocative	Cost	Technical efficiency	Cost efficiency
SLSP	1.000	1.000	1.000	SLSP	SLSP
VUB	1.000	1.000	1.000	VUB	VUB
TATRA	0.855	0.918	0.785	VUB, POBA, J&T	VUB, POBA, J&T
POBA	1.000	1.000	1.000	POBA	POBA
CSOB	0.811	0.903	0.732	VUB, POBA, J&T	VUB, POBA, J&T
UNI	1.000	0.881	0.881	UNI	VUB, J&T, KOBA
PRIMA	0.713	0.996	0.710	VUB, J&T, KOBA	VUB, J&T, KOBA
OTP	0.658	0.842	0.554	UNI, J&T, KOBA	VUB, J&T, KOBA
J&T	1.000	1.000	1.000	J&T	J&T
SBER	0.780	0.909	0.709	VUB, UNI, J&T, KOBA	VUB, J&T, KOBA
PRIVAT	0.662	0.919	0.608	J&T, COMMERZ	J&T, COMMERZ
KOBA	1.000	1.000	1.000	KOBA	KOBA
OBER	0.594	0.973	0.578	J&T, KOBA, COMMERZ	KOBA, COMMERZ
COMMERZ	1.000	1.000	1.000	COMMERZ	COMMERZ
CITI	0.497	0.964	0.479	J&T, COMMERZ	J&T, COMMERZ

Source: the authors.

The results reveal that in 2012, out of the 15 Slovak commercial banking institutions under evaluation, a total of six of them were fully cost efficient, which means that these banking institutions were able to produce the given extent of banking services (deposits and loans) at minimum costs, being both technically efficient and allocatively efficient. Not only does this suggest that their production was both Farrell-Debreu efficient in terms of production volumes, but it also means that this production was carried out at a cost-optimal mix of labour and fixed assets. The list of such banks include the largest two banks of the Slovak banking sector (SLSP and VUB), three small banks which specialize in corporate clientele (KOBA and COMMERZ) or investment banking (J&T) as well as a rather small bank with an extensive retail branch network (POBA). This sextette acts as references (benchmarks) for the other nine commercial banks and these nine banks should attempt to move their operations in greater unity with their reference set. In technical production of depository and creditory services, one more bank (UNI) was found efficient and appears as an exemplar for other commercial banks as well. Despite this, UNI failed to be allocatively

efficient and was unable to optimize (i.e. lower) its unit costs. The worst outcome in the area of cost efficiency was for the year 2012 found in the production of four banks whose cost efficiency scores were about 0.60 or worse (CITI, OTP, OBER and PRIVAT). The decomposition of cost efficiency points to the sources of their unfavourable status and reveals they all are feeble in technical production of deposits and loans, being relatively able to optimize their unit costs. This is only natural for most of them, e.g. PRIVAT centres on providing investment services rather than on producing ordinary deposits and loans. Relatively high allocative efficiency scores for 13 commercial banks implies that in 2012 the Slovak commercial banks were able to economize and squeeze their unit costs of production. Only two banks were an exception to this general tendency (OTP and UNI). What is further of interest is that the third largest bank of the Slovak banking sector (TATRA) delivered a good performance neither in technical production nor in allocation of input resources, having three other banks as references, each of them capturing a certain aspect of the essence of this bank's undertaking (VUB describing the "size" of TATRA, POBA representing its vast territorial coverage of the Slovak territory by branches, and J&T acting as a model bank for TATRA's investment services).

Conclusion

Adopting the production approach to interpreting the essence of banking business and building upon the cost-minimizing paradigm predominant of the Slovak banking sector, the paper conducts an investigation into the cost efficiency of the fifteen Slovak commercial banks as delivered during the production of banking services in 2012. This constitutes the original contribution of the paper inasmuch as no such research has been conducted for the Slovak banking sector within the framework of data envelopment analysis.

The cost efficiency model proposed by Tone (2002), working upon input prices exogenously given, showed that the management of six commercial banks was successful in receiving deposits and making loans at minimum costs. The banks holding the status of cost-efficient production facilities in 2012 comprise the two largest Slovak commercial banks (Slovenská sporiteľňa, a. s., and Všeobecná úverová banka, a. s.). The sample of banks evaluated contained institutions of all size (large, medium-sized and small commercial banks). The banking industry in Slovakia was in 2012 allocatively competitive as 13 commercial banks were able to manage their unit costs satisfactorily. The worst performer was Citibank Slovakia, a. s., which is a branch office of a foreign bank, and which offers a limited range of highly specialized banking services to specific enterprise customers, which is but a highlight

that its poor performance in this analysis must inevitably be interpreted with caution and on the scale of operations on which it concentrates.

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