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METHODS OF MEASURING THE EFFICIENCY OF COMMERCIAL BANKS: AN EXAMPLE OF POLISH BANKS

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Efficiency analysis is essential for the evaluation of banks' performance. To estimate banks' efficiency, we can apply different methods. Analysis of financial indicators is the most popular efficiency analysis method in banks, but the number of financial indicators can be really big and make the interpretation of the results more difficult. Another way to estimate efficiency measures is the non-parametric frontier method – Data Envelopment Analysis (DEA). This method has become increasingly popular in measuring bank efficiency in the countries with developed banking systems.

The main aim of this article is to present the results of efficiency analysis, computed by means of both methods, i. e. the classical index of balance sheet characteristics and the non-parametric DEA method.

The analysis was carried out in the biggest banks operating in Poland in 2000–2007. The empirical results show that the efficiency measures give a similar although not identical picture of Polish commercial banks' performance. These results (yielded by both methods) are complementary to each other and suggest that the non-parametric DEA method is really valuable and worth applying in bank practice.

The work presents also the reasons that would explain the achieved results. It also compares both methods, their potentials and limitations in applying them to banking.

Keywords: *bank efficiency, efficiency analysis, Data Envelopment Analysis*

Introduction

The intensive and continuously increasing competition in the financial services market creates a need for an access to information that would allow to evaluate commercial banks operating in this market. Such evaluations are really essential to both bank owners and customers who expect high-level financial profits.

To estimate banks' efficiency, we can use different methods. These methods can be classified in various ways. One of them distinguishes:

- the traditional method of financial indices based on balance sheet analysis,
- parametric methods based on the knowledge of production function,
- non-parametric methods that do not require such knowledge.

For the purpose of the present research, the traditional method of financial indices and the non-parametric DEA method were

chosen to evaluate banks' efficiency. The parametric method was omitted as it requires defining the relation between inputs and performance and also data over long periods of time.

The method based on balance sheet characteristic indexes has monopolized the banking practice. Another way to estimate the efficiency levels is the non-parametric frontier Data Envelopment Analysis (DEA) method which is commonly applied in Western Europe and is just being introduced in Polish banking.

The aim of this article is to present the results of efficiency analysis computed by both methods, i. e. using the traditional financial indicators and the non-parametric DEA method.

The analysis was carried out in commercial banks operating in Poland. The period of efficiency analysis covers the years 2000–2007.

This article presents also a comparative analysis of both methods and reveals their constraints and advantages.

1. The current situation in the Polish banking sector

In 2007, 51 commercial banks, 14 branches of credit institutions and 584 cooperative banks, i. e. altogether 649 banks and branches of credit institutions carried on operating activity in Poland. Domestic investors controlled 11 commercial banks (including four State Treasury banks) and all cooperative banks, while 40 commercial banks and 14 branches of credit institutions were controlled by foreign investors holding 70% of stakes in registered equity funds of the whole banking sector in Poland. At the end of 2007, investors from 19 countries were present in the Polish banking sector[1].

For many years, the assets of the whole sector have been showing a rising tendency, and they have exceeded PLN 785.5 billions. Moreover, all the commercial banks operating in Poland meet the minimum equity fund requirement of 5 mln euros. There are 14 domestic commercial banks listed on the Warsaw Stock Exchange. Their assets constitute 2/3 of the whole banking sector assets.

Banks in Poland operate through 13,000 branches and employ over 161,000 employees. The main factor contributing to the fast development of the Polish banking in the recent years is a very dynamic growth of credit services, particularly mortgages.

On the other hand, since 2002 there has been a steady decline in fixed term deposit accounts of households which are an important source of financing banks' activities. This decline results mainly from a change in preferences to invest financial surplus in non-bank financial institutions. The changes have been caused by the development of other segments of the financial market and the reduction of interest rates.

A dynamic growth of households' savings invested in investment funds and shares which in 2006 increased nearly twice as fast as traditional bank deposit accounts is particularly noticeable.

The growing financial result of the banking sector has been a characteristic

[1] Data from *Report of Situation in Polish Banking Sector in 2007. www.knf.gov..pl*

tendency in the last few years. The positive trends are reflected in the improved basic efficiency measures of bank performance. The operating cost / income ratio of domestic commercial banks has decreased to 52.0%, ROA has risen to 2.1 and ROE to 27.0.

Despite the excellent performance of the banks in the recent time, their activity must be analysed and evaluated continuously due to competition pressure within the sector and other financial institutions, and due to the expectations of both banks' owners and customers.

2. Efficiency analysis by the method of financial indicators

Efficiency analysis is essential for the evaluation of banks' performance. Financial indicators are still an important analytical instrument, and the banks' owners and potential customers use them to compare and evaluate the performance of banks. That is why banks need to pay particular attention to the value of the traditional indicators if they want to create a positive image and to be perceived positively by general public. These indicators can be divided into four groups:

- profitability rates,
  margin rates,
  weighted result rates,
  employment efficiency rates.

The efficiency indicators may be analysed from different aspects. In the case of time as a criterion, we study the dynamics of ratios, which allows to check whether the efficiency improves or deteriorates within a given period of time. If we consider a group of banks, we can compare the banks' efficiency to the average values of the group. The banks' financial reports such as balance sheets, profit and loss accounts or, less frequently, cash-flow accounts are used to assess the efficiency indicators.

The first group of the indicators are **profitability rates**. The most common ones in this group are:

- return on assets (ROA), presented as a ratio of financial result and a bank's assets;
  return on equity (ROE) – a ratio of financial result to a bank's own fund;
  return on sale (ROS) – a ratio of financial result to a bank's income;
  costs ratio (C/I) – a ratio of costs to incomes.

The ROA, ROE and ROS ratios, which are universally applied in financial analysis, allow to evaluate the efficiency of banks' performance within a given period of time and in comparison to other market players. So, their significance for management is of comparative nature.

Chart 1 presents the values of ROA and ROE ratios obtained by commercial banks in Poland in 2000–2007. The values of both indicators, increasing since 2004, show an improvement in the profitability of commercial banks in the last few years.

Another group of efficiency indicators are **margin rates**. Two basic rates of this group are based on interest margin:

- net interest margin – a ratio of interest results to assets;
  interest spread, which can be interpreted as a difference between the average interest-bearing assets and the average expense of interest-bearing liabilities.

The additional margin rates that show the income and expenses of banks' activi-

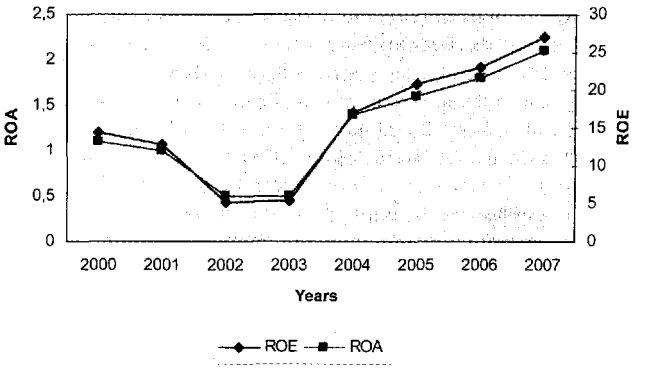

Chart 1. ***ROA and ROE rates in commercial banks, 2000–2007***

Source: our own study based on Report of Situation in Polish Banking Sector in 2007, www.knf.gov.pl

ties could also be applied, although it is not necessary to use all the margin indicators to evaluate the financial condition or efficiency of a bank.

Chart 2 presents the basic indicator of this group, i. e. the net interest margin in Polish commercial banks in 2000–2007. After the period of a visible decline, the net interest margin is constant in commercial banks in the last years.

The next group of financial measures applied in efficiency analysis are **weighted result rates**:

- the result rate charged with reserves (reserves balance) which is shown as a difference between the building up and dissolution of reserves, and the achieved result;
- the result rate charged with operating costs, i. e. the ratio of operating costs to the result.

If the result rate charged with reserves shows a positive value, i. e. if a bank builds up more reserves than dissolves, it can be said that building up reserves charges the bank's result, i.e. 'decreases' its level.

The result following from both definitions can be interpreted in various ways. The clearest interpretation is provided by applying the result of banking activity. In this case, the indicators show the percentage of the result used to cover the operating costs or the reserves balance.

Chart 3 shows the values of result ratio charged with bank operating costs in years 2000–2007. The year 2002 seems to be the worst in this period as almost 60% of the achieved result was used to cover the operating costs of commercial banks in Poland.

In 2007, less than 53% of the achieved result was sufficient to cover the operating costs of commercial banks.

The last group of measures constitutes the **employment efficiency rates**. The most frequently used ones are:

- the rate presented as a ratio of assets to a number of employees (job positions);

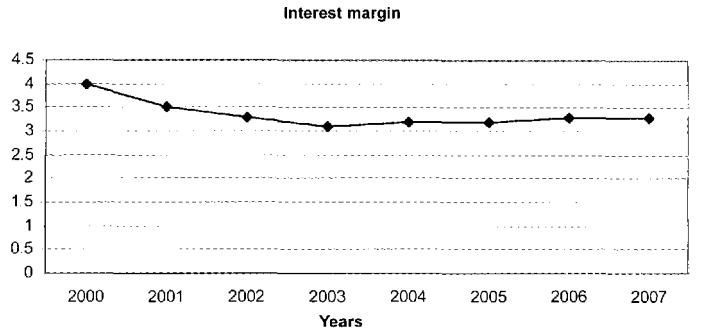

Chart 2. ***Net interest margin in commercial banks, 2000–2007***

Source: our own study based on Report of Situation in Polish Banking Sector in 2007, www.knf.gov.pl

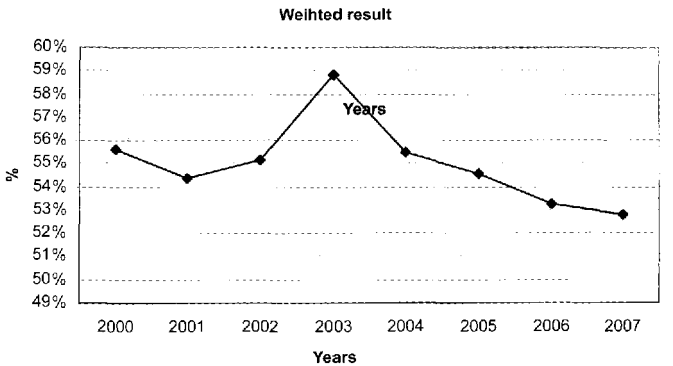

Chart 3. ***Ratio of the result charged with the operating costs of banks in years 2000–2007.***

Source: our own study based on Report of Situation in Polish Banking Sector in 2007, www.knf.gov.pl

- the rate presented as a ratio of a result to a number of employees.

These indicators show the average balance sum (sum of assets) and the result produced by one full-time employee of a bank.

As shown in Chart 4, the employment efficiency measured by the net profit achieved by one employee in commercial banks of Poland has been increasing dynamically since 2004.

Analysis of financial indicators is the most popular efficiency analysis method in banks.

Chart 4 presents the values of employment efficiency rates, i. e. the value of a net financial result per one employee in 2000–2007.

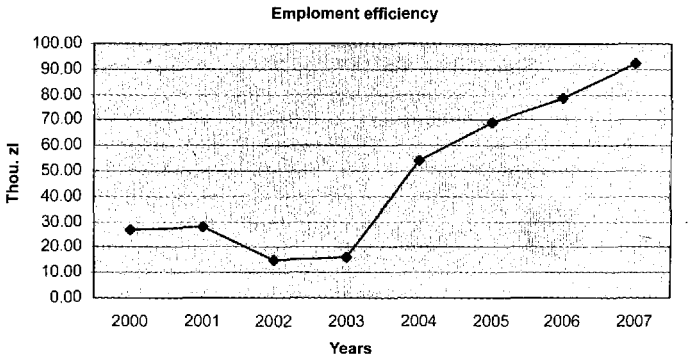

Chart 4. ***Employment efficiency rates, 2000–2007***

Source: our own study based of Report on Situation in Polish Banking Sector in 2007, www.knf.gov.pl

The number of financial indicators applied can be really big, and interpretation of achieved results in this case it more difficult. On the other hand, a single indicator provides too little information whether or not a given value is correct.

3. Evaluation of efficiency measures by the DEA method

The non-parametric DEA method has become increasingly popular in measuring efficiency in the countries with developed banking systems (Grigorian, Manole, 2002). The method was first proposed by Charnes, Cooper and Rhodes (Charnes, Cooper, Rhodes, 1978). The authors, relying on Debreu and Farell's concept of productivity, in which the efficiency measure was defined as a ratio of a single input to a single output, applied the method in a multidimensional situation in which there were more than one outputs and more than one inputs. The efficiency is measured in relation to other units in the group under study. The proof of economic efficiency can be the fact that the examined unit is on the efficiency frontier which means that it fully utilizes the available resources and also that it is not possible to increase the production of particular goods (for example, a bank's services). In this method, any units on the efficiency frontier are said to be efficient and their efficiency rates equal 1. The units below the efficiency frontier line have efficiency rates less than 1, which show a level of their inefficiency. The efficiency rate defined in this way takes the values from 0 to 1.

Depending on whether we are interested in maximizing outputs or minimizing inputs, we can calculate the input-oriented technical efficiency which shows how much a company's inputs should be decreased to be efficient leaving outputs unchanged, or output-oriented technical efficiency which presents how much a company's productivity should be increased using the same values of inputs.

The input-oriented analysis is particularly useful for evaluating banks' performance as it measures cost efficiency.

An important stage in applying this method is building up the behavioural model of a bank and defining the inputs and outputs of its activity. The main approaches used in modeling a bank's behaviour are production approach, intermediation approach and modern approaches, i.e. the ones that involve characteristic features of banks' activity, i. e. risk management and data processing for the classical theory of enterprise.

In the case of production approach, a bank's activities are treated as a production of services for deposit account holders and borrowers. However, one of the problems in this approach is the way of assessing the volume of products. The question is: what is the most suitable way of presenting the volume of products: the number of accounts, the number of transactions on these accounts or maybe the sums of turnover? Due to the access to data, the sums of turnover in nominal value are used most frequently.

The intermediation approach is complementary to the production approach, and it differs in the way of specification of a bank's activities. In this model, an emphasis is put on the role of a bank in transforming the means borrowed from the deposit account holders into granted credits. Apart from these classical models, there are also other approaches such as the assets approach, value-added approach and user cost approach.

The literature on the subject presents a lot of arguments for and against particular models. However, there are no explicit conclusions which approach is the best.

In the model application of the DEA method to evaluate commercial banks' efficiency presented below, the value-added approach has been chosen. In this approach, an output of a bank's performance is any activity consuming its resources. The choice of a model determines the classification of inputs and outputs. So, in this case, the volume of loans, deposits and non-interest income are outputs, and the net fixed assets and the total number of employees are defined as inputs (Resti, 1997).

The definitions of inputs and outputs are presented in the following way:

Inputs:

- assets,
- number of employees.

Outputs:

- loans,
- deposits,
- non-interest income.

While evaluating efficiency by the DEA method, various assumptions referring to the economy of scale can be made, and so we can assume constant scale effects (e_crs), variable scale effects (e_vrs) or non-increasing scale effects of performance (e_nirs).

Table 1 presents the results of efficiency evaluation of commercial banks operating in Poland for years 2000–2007, considering the division of efficiency measures into scale effects.

While analysing the achieved result, we should note that the evaluated measures of efficiency applied in the commercial banks under study are not homogeneous. In years

Table 1. Measures of commercial banks' efficiency, 2000–2007

Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Average value e_crs	**0.50**	**0.58**	**0.58**	**0.41**	**0.60**	**0.66**	**0.64**	**0.65**
Number of efficient banks	2	7	5	4	15	7	8	9
Percentage of efficient banks	5%	21%	19%	14%	41%	23%	20%	24%
Average value e_nirs	**0.69**	**0.59**	**0.56**	**0.42**	**0.74**	**0.72**	**0.76**	**0.77**
Number of efficient banks	12	10	6	5	11	12	14	14
Percentage of efficient banks	30%	29%	23%	18%	30%	40%	35%	40%
Average value e_vrs	**0.67**	**0.69**	**0.63**	**0.55**	**0.70**	**0.72**	**0.79**	**0.76**
Number of efficient banks	14	11	7	5	12	13	25	22
Percentage of efficient banks	35%	32%	27%	18%	32%	43%	63%	52%

Source: our own calculations applying software EMS version1.3 authorized by Holger Scheel.

2000–2007, efficiency in the Polish banking sector improved slightly (although it did not increase in 2003). An increase of the value of assessed measures in the last three years reflects positive changes in the Polish banking system. On the other hand, the achieved results prove a poor efficiency of commercial banks, i. e. that there are vast reserves of improving banks' efficiency.

For example, assuming that banks operate according to a constant scale effect, the efficiency index 0.65 achieved in 2007 shows the inefficiency of examined banks, i. e. these banks produce 65% of what fully efficient banks would produce.

Nearly ¼ of the examined banks (9) operated efficiently, i. e. transformed inputs into result in an optimal way. The remaining ¾ of banks were not efficient in their performance, which means they should have used their inputs better to achieve better results.

4. Concluding remarks

A comparison of results achieved both by the DEA method and the classical method of financial indicators seems to be interesting. Two basic indicators of financial analysis, i.e. return on equity (ROE) and employment efficiency rate (presented as a ratio of the financial result produced by one employee) and also two efficiency measures assessed by means of DEA (e_crs – a constant scale effect measure and e_vrs – a variable scale effect measure) have been chosen to compare the results.

Chart 5 compares the above-mentioned measures achieved by commercial banks in Poland in 2000–2007 and shows a convergence of results achieved by both methods (financial indicators and DEA).

The results achieved by both methods show an increase of the efficiency of banks' performance in recent years. We can trace the reasons for efficiency increase in a significant rise of the scale of banks' performance. The balance sheet total of the banking sector has increased from 500 bln in 2004 to nearly 800 bln in 2007. The decisive factor for the development of the banking sector in Poland was a very dynamic increase of credit activity. The increase in the value of granted credits resulted from the high demand for credits among households and enterprises. In the

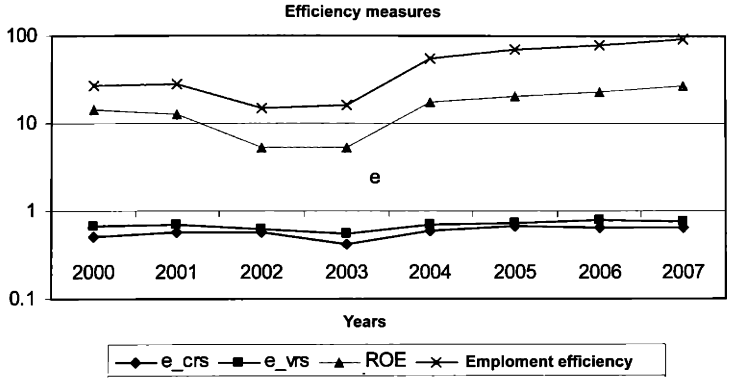

Chart 5. ***Efficiency measures assessed by DEA method and by analysis of financial indicators***

Source: our own calculations

recent years, a particularly high demand for mortgages has been noted, and the upturn in the financial situation and the optimistic view of the future resulted in an increase in consumption credits.

A high dynamics of credits for enterprises has also been noted. Due to higher incomes from taxes and the inflow of funds from the EU, deposits of supervisory and self-government institutions have increased significantly. The Gross Domestic Product went up by (6.6% in 2007) (6.2% in 2006) and that has been the fastest growth in this decade. The favourable macroeconomic situation and the increasing scale of banking sector activity have been reflected in the increase of banks' financial results, and this influenced the efficiency of banking in Poland.

The results of efficiency measurement by both methods prove these positive tendencies.

The increase in efficiency can be clearly seen in absolute values obtained by the method of financial indicators (i. e. ROE and employment efficiency). However, it is less spectacular in the measurements obtained by the DEA method (e_crs, e-vrs). The reason may be the fact that the numerators of the ROE and employment efficiency indicators present the value of the financial result that has been growing dynamically in the recent years. On the other hand, efficiency measure in the DEA method is calculated in a different way and considers far more factors affecting banks' performance.

The applied methods complement each other, and each of them has advantages and constraints.

The main advantages of the method of financial indicators are:

simplicity and easiness of application,

universality of application,

obtained measures are absolute values and thus can be used for evaluations, comparisons, rankings, etc.

availability of data.

Financial indicators can be used by all those interested in evaluating a bank's per-

formance – banking supervision, owners, managements or customers.

The method of financial indicators has certain drawbacks. The basic one is a vast number of the indicators used. In banking practice, a few hundreds of such factors are used. Applying so many measurements can make a comparison of banks debatable. However, limiting the number of measurements does not give the whole picture of the situation since particular indicators provide only fragmentary information.

That is why it is advisable to supplement the method of financial indicators with a synthetic measure, i. e. the efficiency measure evaluated by the DEA method.

The main advantages of this method are:

a greater extensiveness in comparison with the method of financial indicators;

it does not require access to data over long periods of time.

This method has also certain constraints. First of all, the efficiency measure evaluated by this method is a relative value and is measured only in relation to objects within a study group. Secondly, DEA is fairly sensitive to incorrect information, which means that one incorrect piece of data may significantly change the results of calculations.

Chart 5 shows a convergence of results obtained by both methods (financial indicators and DEA). The trends of changes of the assessed values are similar in both methods. This allows applying the non-parametric method in the banking system as a method complementary to the analysis of traditional financial indicators.

However, it should be stressed once again that financial indicators are absolute values, whereas efficiency measurements achieved by means of DEA are relative values. These results show only whether banks transfer their inputs into effects in an optimal way and whether they have certain reserves – and thus can achieve better effects using the intended inputs.

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KOMERCINIŲ BANKŲ EFEKTYVUMO MATAVIMO METODAI REMIANTIS LENKŲ BANKŲ PAVYZDŽIU

Grazyna Wozniewska

Santrauka

Efektyvumo analizė yra labai svarbi vertinant bankų veiklą. Pagrindinis šio straipsnio tikslas yra pristatyti bankų veiklos efektyvumo analizės rezultatus, kurie apskaičiuoti dviem metodais – tai klasikinė balanso rodiklio charakteristika ir neparametrinis DEA (duomenų apgaubimo analizės) metodas, kuris tampa vis

populiaresnis matuojant efektyvumą šalyse, kur išsivysčiusi bankininkystės sistema. Tyrimas buvo atliktas didžiausiuose bankuose, veikusiuose Lenkijoje 2000–2007 metais. Rezultatai rodo, kad neparametrinis DEA metodas yra išties vertingas ir verta jį taikyti bankų veikloje. Straipsnyje taip pat nurodomos priežastys, paaiškinančios pasiektus rezultatus. Taip pat abu metodai lyginami, apibendrinamas jų naudojimo bankininkystėje galimybės ir apribojimai.