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PRODUCTIVITY CHANGE PATTERNS IN ROMANIAN BANKING SYSTEM: THE IMPACT OF SIZE AND OWNERSHIP ON TOTAL FACTOR PRODUCTIVITY

In this paper we analyze Romanian banking performance for the period 2006−2011 by computing a Malmquist index based on the data envelopment analysis. By adopting the intermediation approach in defining categories of inputs and outputs our conclusions focus on how ownership structure and size influence total factor productivity (TFP) change. The results point out the difficulty in describing a consistent pattern of efficiency changes in time for the period considered. On average in the 6 years that were taken into account total factor productivity increased by small amounts. Alternatively large and small banks manage to obtain the best scores whereas second-ranked is the group of medium-sized banks. Scale efficiency and management efficiency are responsible for most of the productivity growth. Regarding the influence of ownership origin, the study presents evidence that foreign-owned banks outperform domestic banks.
Key words: bank performance, Malmquist index, DEA, Romanian banking system.
JEL classification: G21, L25.

Анка Мунтяну

ЗАКОНОМІРНОСТІ ЗМІНИ ЕФЕКТИВНОСТІ В РУМУНСЬКІЙ БАНКІВСЬКІЙ СИСТЕМІ: ВПЛИВ РОЗМІРУ І ФОРМИ ВЛАСНОСТІ НА ПОКАЗНИКИ ЕФЕКТИВНОСТІ

У статті проаналізовано румунську банківську систему за період 2006−2011 рр., обчислено індекс Мальмквіста, заснований на аналізі середи. Застосувавши посередницький підхід до визначення категорій вхідних і вихідних даних, визначено вплив структури власності та розміру на сукупну продуктивність факторів виробництва. Результати вказують на відсутність чіткої схеми у розглянутий період. У середньому за 6 років сукупна продуктивність факторів виробництва збільшилася незначно. Великим і малим банкам вдалося домогтися кращих результатів, середні банки поступаються за показниками. Ефективність масштабу і ефективність управління відповідають за велику частку зростання продуктивності праці. Дослідження підтвердило, що іноземні банки перевершують внутрішні банки за показниками ефективності.
Ключові слова: продуктивність банку, індекс Мальмквіста, аналіз середи, банківська система Румунії.
Форм. 5. Табл. 2. Літ. 18.

Анка Мунтяну

ЗАКОНОМЕРНОСТИ ИЗМЕНЕНИЯ ЭФФЕКТИВНОСТИ В РУМЫНСКОЙ БАНКОВСКОЙ СИСТЕМЕ: ВЛИЯНИЕ РАЗМЕРА И ФОРМЫ СОБСТВЕННОСТИ НА ПОКАЗАТЕЛИ ЭФФЕКТИВНОСТИ

В статье проанализирована румынская банковская система за период 2006−2011 гг., вычислен индекс Мальмквиста, основанный на анализе среды. Применив посреднический подход к определению категорий входных и выходящих данных, определено влияние структуры собственности и размера на совокупную производительность факторов

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производства. Результаты указывают на отсутствие четкой схемы в рассматриваемый период. В среднем за 6 лет совокупная производительность факторов производства увеличилась незначительно. Большим и малым банкам удалось добиться лучших результатов, средние банки уступают по показателям. Эффективность масштаба и эффективность управления отвечают за большую долю роста производительности труда. Исследование подтвердило, что иностранные банки превосходят внутренние банки по показателям эффективности.

Ключевые слова: производительность банка, индекс Мальмквиста, анализ среды, банковская система Румынии.

1. Introduction. A great deal of attention is paid to the performance of banks due to their major role in providing credits to enterprises. The role of banking institutions in the reallocation of financial resources is even more important if other elements of the financial sector are underdeveloped. Thus, in this situation banks contribute largely to the optimal allocation of financial resources in the real sector.

From the microeconomic point of view the problem of bank performance assessment is one of profit maximization, hence explaining the changes in profitability of banks is the implicit or explicit subject of much of banking literature. For example, Stancic et al. (2012) investigates the relation between bank performance and board structure in Serbian commercial banks using as a performance indicator the return on assets ratio.

An alternative approach is to explain banking performance through inefficiency. One bank can operate at lower costs and produce higher profits if it makes better use of its inputs and transforms them into outputs in the cheapest possible way. In order to survive, every bank has to produce efficiency in the long run. The issue of measuring inefficiency by using the frontier analysis approach that is based on the production possibilities curve was first addressed by Farrell in 1957, and in 1978 Chares et al. introduced the method of data envelopment analysis (DEA) to assess the efficiency of non-governmental and non-profit organizations. Since then there has been a rapid and continuous growth in the field. As a result, a considerable amount of research appeared, with a significant interest focused on DEA applications of efficiency and productivity.

By implying DEA approach the purpose of this study is to explain the total factor productivity (TFP) changes and its components in the context of Romanian banking system for the period 2006−2011. TFP is reflected by the Malmquist index (MI) which captures efficiency changes and technical efficiency changes providing information on the sources of the overall productivity change. As a result, productivity gains will be caused by technological advancements and more efficient management.

2. Literature review. TFP represents a generalized index that captures multiple inputs and outputs to provide a single productivity ratio. The original index proposed by Sten Malmquist in 1953 represents the ratio of two distance function in different time periods but until 1989 the index was rarely computed. Fere et al. (1989) proposed a non-parametric linear programming method (DEA) that made the Malmquist index easily computable. Since then the literature examining efficiency and productivity expanded rapidly especially with application to banking. The main advantage that Malmquist index offers is the decomposition of productivity growth

sources in to two components: the frontier-shift that reflects improvements or deterioration in the performance of the best practice decision-making unit (DMU) and the catch-up effect that represents the convergence towards or divergence form the best practice on the part of the remaining DMU. Much of the early and recent research literature is devoted to establishing which component best explains the growth of TFP in time.

In 1992 Berg et al. published one of the first studies in the field of banking addressing the question of productivity change. The study showed that the productivity of Norwegian banking institutions grew rapidly in the time of deregulation as compared to the period experiencing strong regulation. Following this line of research, Griefell-Tatje and Lovell (1997) explored efficiency and productivity performance in Spanish banking. The results showed that deregulation improved productivity growth rates. Also, managerial inefficiency is the characteristic of most commercial banks as they failed to reduce operational expenses and thus to improve productivity.

Tsionas et al. (2003) also estimates TFP change of Greek banking system over the period of liberalization and deregulation of the financial system (1993–1998). The results show a positive but not substantial TFP growth associated with efficiency improvements of medium-sized banks and technological improvement of larger institutions. This conclusion is conflicting with the study of Canhoto and Dermine (2003) on Portuguese banks. Their results show that the "catching-up" component has a negative impact on the TFP index for the entire period under survey suggesting a small decrease in average efficiency relative to the period benchmark technology. Moreover, Casu et al. (2004) estimate productivity change for the period of 6 years in advanced European economies by using the parametric and a non-parametric methods. Both approaches suggest similar conclusions: productivity growth was brought by technological improvements rather than managerial efficiency as there is little evidence of the "catch-up" effect of non-best-practice institutions to the benchmark.

Using an output orientated Malmquist index Sufian (2011) analyzes Malaysian banking sector. The results suggest that while domestic banks have exhibited marginal productivity increase, foreign banks showed a productivity decline. Bank productivity is negatively related to bank size, risk, and inflation rate. Public listed banks are relatively more productive compared to their private peers; the empirical findings seem to support the market discipline hypothesis.

Another major line of research addresses the question of ownership influence on TFP. The preoccupation towards this subject was inspired by X-efficiency studies (Berger and Humphrey, 1997; Berger et al., 2000, 2005; Isik and Hasan, 2003; Hasan and Marton, 2003).

Drawing from the 2 major lines of research this study aims at providing an insight regarding productivity transformation patterns by grouping banks into 3 categories that reflect size factor and 2 categories that reflect control ownership impact over performance. The conclusions focus on the drivers of productivity growth (managerial efficiency or technological change) in the period of economic turmoil. The presented results offer further clarification regarding Romanian banking industry and completes other studies in this field that mainly address the issue of X-efficiency: Nitoi (2009), Andries and Cocris (2010), Roman and Sargu (2012).

3. Methodology

3.1. Bank Behaviour: intermediation vs. production approach. A single definition of bank behavior is hard to present since issues concerning what banks produce diverge in the views of researchers. Van Hoose (2010) presents an outlook of the major perspectives regarding this divergence, the most known conceptions being the production and the intermediation approach.

The production approach views banks as financial institutions that convert an asset portfolio into a set of financial instruments – deposits and other bank debts that surplus householders and firms desire to hold in their own asset portfolio. Banks primarily specialize in producing services for holders of loan and deposit accounts; hence the bank output should be considered as the number of various financial transactions performed per unit of time. Yet, detailed transaction flow data are a property of banks and not generally available.

In contrast, the intermediation approach focuses on the fact that banks are engaged in the process of intermediating founds between savers and borrowers. Stock values of bank assets and/or liabilities are appropriate bank output measures. Earnings assets are considered outputs whereas labor and capital are physical inputs and deposits are financial inputs.

According to Berger and Humphrey (1997), both approaches fail to fully capture the dual role of financial institutions of being providers of transaction/document processing services and financial intermediaries that transfer funds from savers to investors. The intermediation and production approach can be reconciled on the empirical grounds following the assumption that transaction flows are proportional to stock value of bank assets and liability accounts.

Beyond the general availability of data if assuming the intermediation approach, in this paper we consider some other advantages over the production approach that refers the first method as the most practical. First, by using the intermediation approach we avoid the problem on how to weight each bank service in the computation of output. Second, the production approach ignores interest costs which will be of importance in realistic situations like, for example, the increase in the number of branches that would be accompanied by falling deposits rates.

As a result, this study uses two output variables: interest and commission income and net value of loans to costumers. On the other hand, 3 input variables are included: interest and commission expenses, staff expenses and due to costumers – deposits.

3.2. Malmquist Index and Total Factor Productivity. MI is the most commonly used measure of productivity change that evaluates the change between 2 data points by calculating the ratio of the distances of each data point relative to a common technology (Casu et al., 2004). The first component of MI – the catch-up effect (CE) – represents the distance of DMU under observation from the efficient frontier:

$$CE = \frac{\delta^{t+1}((x_i y_i)^{t+1})}{\delta^t((x_i y_i)^t)}, \tag{1}$$

where x and y represents the input and output vectors, the subscript i designates the *DMU* number, δ^t and δ^{t+1} represents the efficiency score for the periods t and $t+1$ frontier technologies.

The CE is the ratio between the efficiency score of the combination input-output $(x_i, y_i)^{t+1}$ obtained by using the $t+1$ technology with respect to the efficiency score obtained from the combination $(x_i, y_i)^t$ by using period t technological frontier. If $CE > 1$ DMU_i is dealing with the progress in terms of relative efficiency from period $t+1$ to period t, while $CE = 1$ and $CE < 1$ indicate no change, respectively, regress in efficiency terms. In other words, efficiency change above unity means that the ith firm has moved closer to the best-practice DMU on the frontier and thus measures "catching up" or "falling behind" if it is less than unity.

Furthermore, the catch up effect can be decomposed into pure efficiency change (Managerial efficiency) and scale efficiency change:

$$Managerial\ \text{efficiency} = \frac{\delta_{vrs}^{t+1}((x_i y_i)^{t+1})}{\delta_{vrs}^{t}((x_i y_i)^{t})}, \tag{2}$$

vrs denotes the variable return to scale technologies, and crs denotes constant returns to scale technologies.

$$\text{Scale efficiency} = \frac{\delta_{vrs}^{t+1}((x_i y_i)^{t+1})}{\delta_{crs}^{t}((x_i y_i)^{t})} \times \frac{\delta_{crs}^{t+1}((x_i y_i)^{t})}{\delta_{vrs}^{t+1}((x_i y_i)^{t})} \times \frac{\delta_{vrs}^{t}((x_i y_i)^{t+1})}{\delta_{crs}^{t}((x_i y_i)^{t+1})} \times \\ \times \frac{\delta_{crs}^{t}((x_i y_i)^{t})}{\delta_{vrs}^{t}((x_i y_i)^{t})} \tag{3}$$

The second component of MI reflects the effects of innovation or technological change. The frontier shift effect is given by the formula:

$$FS = \left[\frac{\delta^{t}((x_i y_i)^{t})}{\delta^{t+1}((x_i y_i)^{t})} \times \frac{\delta^{t}((x_i y_i)^{t+1})}{\delta^{t+1}((x_i y_i)^{t+1})} \right]^{1/2} \tag{4}$$

If $FS > 1$ DMU_i records progress in the frontier technology for the period s to t, or that the efficient frontier has shifted out compared to the previous period. $FS = 1$ and $FS < 1$ indicate no change, respectively, regress in efficiency terms.

Malmquist index is the product of the catch-up effect and frontier shift effect and is given by the formula:

$$MI = \left[\frac{\delta^{t}((x_i y_i)^{t+1})}{\delta^{t}((x_i y_i)^{t})} \times \frac{\delta^{t+1}((x_i y_i)^{t+1})}{\delta^{t+1}((x_i y_i)^{t})} \right]^{1/2} \tag{5}$$

To calculate MI 4 distance functions are computed involving 4 linear programming (LP) problems. Because we use the input-oriented DEA measure the LP are as follows:

$$\left[\delta^{t}((x_i y_i)^{t+1}) \right]^{1} = \min_{\theta, \lambda} \theta$$

$$s.t.$$

$$y_{it} + Y_s \lambda \geq 0$$

$$\theta x_{it} - X_s \lambda \geq 0$$

$$\lambda \geq 0,$$

where θ is the scalar and λ is the $I*1$ vector of constants. The value θ is the component score of the i-th DMU. X and Y are the input and output vectors, and x and y repre-

sent the amount of input consumed and output generated by DMU_i. The remaining 3 LP problems are simple variants of the former. The calculation of pure and scale efficiency components requests two additional LP problems with the convexity restriction $N1'\lambda = 1$ added to each of the LP's of the upper right term for pure efficiency and lower left term of MI for scale efficiency.

3.3. Data. The present study uses the balanced panel of 18 commercial bank from 2006−2011. The sample covers a significant variety of banking institutions that accounts for more than 80% of the net assets of credit institutions. The dataset is constructed from the bank's published statements: profit and loss account, balance sheet and notes on the financial statements. Due to accounting policy bias only those banking institutions that use the International Financial Reporting Standard (IFRS) framework were selected. The period of 6 years was chosen due to data availability as the data from an earlier period are difficult to obtain for the comparative framework approach.

This study uses 3 output variables: interest income, net value of loans and profit, and 3 input variables: interest expenses, staff expenses and due to costumers — deposits.

4. Results. We defined the size categories starting from the value of net total asset of the sampled banks. In every analyzed year 5 banks were considered as being large having the average value of net assets between 27,43% and 7,25%. Medium-sized banks are those that have the net total assets between 6,7−2% in the total of net assets of the entire banking system whereas for small banks the values of less than 1,9% are specific. In order to assess the mean differences between groups ANOVA tests were performed all indicating the validity of this classification. For all the variables considered in the model the mean differences between groups are significantly different from each other. The average results for the entire period are presented in Table 1:

Table 1. **Average productivity scores for the period 2006−2011**

Type	Pure efficiency change (1)	Scale efficiency change (2)	Catch-up effect (3)=(1)*(2)	Frontier shift (4)	Total Factor Productivity (5)
Large banks	1.0615	1.1037	1.1778	0.9597	1.0245
Medium-sized banks	1.1403	1.0398	1.1725	0.9028	1.0195
Small banks	1.0178	1.1222	1.1415	0.9163	1.0164
Domestic-owned banks	1.0506	1.0217	1.0734	0.9128	0.9139
Foreign-owned banks	1.0759	1.1050	1.1850	0.9349	1.0427
Total	1.0716	1.0907	1.1660	0.9312	1.0208

Source: own calculations

The results indicate that on average in 6 years that were taken into account the total factor productivity increased by small amounts. The highest average productivity growth for the entire period (2.45%) is registered in the large banks group. Productivity growth is explained by the catching-up effect that results from increasing of scale economy efficiency. Managerial efficiency reflected in the ability of cost-revenue optimization increased by 6.15% and is also responsible for the total factor productivity growth. These positive effects are weight down by the technological innovation effect — the frontier shift — that presents values smaller than 1 suggesting that from one period to another, large banks fail to adapt to the new frontier of efficiency wasting amounts of inputs relative to the amounts of produced outputs. This pattern of pro-

ductivity growth is similar for the small banks group. In the case of medium sized banks the catch-up effect also dominates the frontier shift with the difference that this category of financial institutions benefits most from managerial efficiency rather than scale efficiency. It can be concluded that small and large banks succeed to optimize the size of their operations, thus generating positive scale economy effects.

Regarding ownership origin the differences between the two groups are significant. Not only that on average foreign-owned banks out perform domestic banks but the patterns of performance growth follow opposite directions. As a group, Romanian banks exhibit decreasing productivity while foreign banks register the average productivity growth of 4.24%.

The mean differences obtained between the 5 groups were verified by using ANOVA method in order to obtain the generalized t-test statistics of differences between more than two groups. The F-statistics obtained by introducing the variables "catch-up effect" and "frontier shift" in order to verify mean differences between groups were large enough in order to reject the null hypothesis of means being equal.

A more detailed view is offered in Table 2 which captures changes in terms of productivity as indices reflecting gains/losses from one year to another.

For the first period analyzed a remarkable score is achieved in the group of medium-sized banks that accomplish the productivity growth in 2007 of 22% compared to 2006. As the improvement from one year to another in terms of 55.96% efficiency growth suggests this gain is the result of financial management practice. In 2007 compared with 2006 medium-sized banks manage to optimize the cost-revenue structure to obtain higher productivity scores. This result is weight down by poor scale efficiency and inability to reach the new frontier technology existing in 2007. Second ranked is the group of large banks that displays the productivity growth of 12.33%. In this case the explanation of productivity growth is a synonym to optimal firm size. The overall productivity improvement was triggered by the 20.78% efficiency growth in terms of scale efficiency. The less efficient bank group considering the size classification is the one of small banks. In 2007 small banks display the highest depreciation of almost 10% compared to 2006. This depreciation is explained by decreasing productivity scores in all the indices.

The years 2008–2007 are of particular interest since they mark the beginning of the global financial crisis. Overall, the scores reflect some depreciation in terms of TFP, but general improvements in terms of scale economies. The most productive banks are large banks and the most inefficient are small banks (almost 18% lost efficiency as compared to the previous year).

2009 compared to 2008 reveals further deterioration of the overall situation. In this period the frontier shift is responsible for the slight improvement. We assist to smaller scores for the catch-up effect suggesting inefficient financial management. In this year the only group that registers productivity growth is small banks (7.30% productivity growth).

2010 presents a more positive outcome. This is the first and only year when banks of all sizes present incising productivity values. The most remarkable growth is that of small banks (35.17%) explained by increasing scale efficiency. In the case of large and medium sized banks, productivity growth is the result of management activity. Also in this year the frontier shift acts as a productivity diminishing factor.

2011 reveals the overall decline of TFP. Even though some improvements are made in terms of catch-up efficiencies, the frontier shift counterbalances this gains presenting productivity decreases of almost 16%.

Table 2. **Detailed Productivity Scores**

Type	Pure efficiency change (1)	Scale efficiency change (2)	Catch-up effect (3) = (1) * (2)	Frontier shift (4)	Total Factor Productivity (5)
2007/2006					
Large banks	0.9766	1.2078	1.1747	0.9690	1.1233
Medium-sized banks	1.5596	0.8793	1.3162	0.9167	1.2200
Small banks	0.9805	0.9720	0.9549	0.9518	0.9056
Domestic-owned banks	0.9751	0.9819	0.9599	1.0498	1.0035
Foreign banks	1.1871	1.0210	1.1613	0.9244	1.0747
2008/2007					
Large banks	1.0002	1.3956	1.3957	0.8738	1.1249
Medium-sized banks	1.1014	1.2890	1.4399	0.7353	1.0132
Small banks	1.3371	1.2743	1.6178	0.5577	0.8252
Domestic-owned banks	1.4030	1.0504	1.5143	0.7989	1.0934
Foreign banks	1.1185	1.3708	1.5052	0.6740	0.9341
2009/2008					
Large banks	0.8831	0.9434	0.8323	1.0218	0.8423
Medium-sized banks	0.8566	0.9753	0.8437	1.1686	0.9770
Small banks	1.0405	0.8046	0.8472	1.4647	1.0730
Domestic-owned banks	0.9924	0.8468	0.8427	1.1456	0.8720
Foreign banks	0.9363	0.8993	0.8419	1.2822	1.0043
2010/2009					
Large banks	1.2083	1.0642	1.2837	0.7835	1.0374
Medium-sized banks	1.2086	1.0460	1.2779	0.8330	1.0425
Small banks	0.9561	1.4228	1.3778	0.9225	1.3517
Domestic-owned banks	0.9255	1.1502	1.0345	0.5801	0.5956
Foreign banks	1.1305	1.2322	1.3818	0.9148	1.2951
2011/2009					
Large banks	1.0211	1.0000	1.0211	0.9331	0.9541
Medium-sized banks	0.9749	1.0093	0.9848	0.8603	0.8446
Small banks	1.0112	1.0419	1.0472	0.8922	0.9416
Domestic-owned banks	0.9570	1.0794	1.0158	0.9897	1.0050
Foreign banks	1.0134	1.0073	1.0223	0.8745	0.8978

Source: own calculations

Regarding the impact of corporate control ownership over performance we divided the sample into domestic and foreign banks. Following Berger (2000) 2 alternative scenarios can be considered: home field advantage − domestic institutions are favored due to organizational diseconomies in operating or monitoring an institution from the distance (e.g., turf battles between staff in different nations, high costs and turnover in persuading managers to work abroad, or differences in language, culture, currency, regulatory and supervisory structures); global advantage hypothesis superior managerial skills or best-practice policies and procedures of foreign banking institutions can lower costs, also raising revenues through superior investment or better diversification of risks allows foreign banks undertake higher expected returns on investment. Both hypotheses seem plausible but the results suggest that in the case of Romanian banking system the global advantage seems more adequate. Only in 2008

it seems that domestic-owned banks have a greater TFP score than the foreign ones. 2010 shows the most dramatic productivity decrease of almost 41% followed by the recovery in the next year which has to be understood in the context of this huge depreciation. Even though in 2011 domestic banks present a higher TFP score than the foreign ones we have to consider the outstanding fall from 2010 and the fact that this 0.5% productivity growth is in fact a small compensation compared to the situation of the previous year.

Conclusion. Though we can access vast literature on the issue of bank productivity change in developed countries, the number of studies that debate this issue in emerging countries remains low. The present research comes to complete the overall picture by providing insight on productivity transformation patterns and productivity growth in the case of Romanian banking system in the period of economic turmoil.

This study focuses on how corporate control ownership and size influence total factor productivity change. The results point out the difficulty in describing the consistent pattern of efficiency changes in the period considered (2006—2011).

If we consider TFP index alternatively, large and small banks manage to obtain the best scores whereas most time second ranked are medium banks. Also, in the case of small and large banks the main source of productivity growth comes from the scale efficiency gains whereas in the case of medium-sized banks managerial efficiency plays a more important role.

On average in the 6 years that were taken into account the total factor productivity increased by small amounts. Nevertheless, the trend of productivity growth is a descending one except 2010 when small banks register the highest productivity growth of 35.17%. This particular situation should be analyzed by inspecting previous TFP values that presented a cumulative decline.

Regarding the sources of productivity growth the results presented are different from the research literature that takes the case of developed economies banks that suggests the frontier shift as the main source TFP growth. Nevertheless, the study of Deng (2011) that takes the case of an emerging economy presents similar conclusion to this study. In the case of Romanian banks there is evidence of a higher catching-up effect. As the efficiency scores suggest in the case of banking institutions that operate in Romania scale efficiency and management efficiency are responsible for most of the productivity growth. In terms of the selected variables this means good financial management of liquidity (reflected by the input output ratio of loans and deposits), a well-considered ratio of interest income and expense, comfortable personnel expenses corroborated with an adequate size of operations.

References:

Andries, A.M., Cocris, V. (2010). A comparative Analysis of the Efficiency of Romanian Banks. Romanian Journal of Economic Forecasting, 4: 54—75.

Berg, S.A., Forsund, F.R., Jansen, E.S. (1992). Malmquist Indices of Productivity Growth during the Deregulation of Norwegian Banking 1980—1989. Scandinavian Journal of Economics, 94: Supplement, 211—228.

Berger, A., DeYoung, R., Genay, H., Udell, G. (2000). Globalization of financial institutions: Evidence from cross-border banking performance. Brookings-Wharton Papers on Financial Services, 3: 23–158.

Berger, A., Humphrey, D.B. (1997). Efficiency of financial institutions: International survey and directions for future research. European Journal of Operational Research, 98: 172–212.

Berger, A. N., Clarke, G. R. G., Cull, R., Klapper, L., Udell, G. F. (2005). Corporate governance and bank performance: A joint analysis of the static, selection and dynamic effects of domestic, foreign and state ownership. Journal of Banking and Finance, 29: 2179–2221.

Canhoto, A., Dermine, J. (2003). A note on banking efficiency in Portugal, New vs. Old banks. Journal of Banking & Finance, 27: 2087–2098.

Casu, B., Giardone, C., Molyneux, Ph. (2004). Productivity change in European Banking: A comparison of parametric and non-parametric approaches. Journal of Banking and Finance, 28: 2521–2540.

Deng, Q., Wong, W.P., Wooi, H.C., Xiong, C.M. (2011). An Engineering Method to Measure the Bank Productivity Effect in Malaysia during 2001–2008. Systems Engineering Procedia, 2: 1–11.

Fere, R., Grosskopf, S., Lindgren, B., Roos, P. (1989). Productivity developments on Swedish hospitals, A Malmquist output index approach. Mimeo.

Grifell-Tatje, E., Lovell, C.A.K. (1997). The sources of productivity change in Spanish banking. European Journal of Operational Research, 98: 364–380.

Hasan, I., Marton, K. (2003). Development and efficiency of the banking sector in a transitional economy: A Hungarian experience. Journal of Banking and Finance, 27: 2249–2271.

Isik, I., Hassan, M. K. (2003). Efficiency, ownership and market structure, corporate control and governance in the Turkish banking industry. Journal of Business Finance and Accounting, 30: 1363–1421.

Nitoi, M. (2009). Efficiency in the Romanian Banking System: An Application of Data Envelopment Analysis, 29: 162–176.

Roman, A., Sargu, A.C. (2012). Bank Efficiency Evaluation: Evidence from a Panel of Romanian Banks. Journal of Eastern Europe Research in Business & Economics, Article ID 592522, available at: http://www.ibimapublishing.com/journals/JEERBE/2012/592822/592822.pdf.

Sufian, F. (2011). Banks total factor productivity change in a developing economy: Does ownership and origins matter? Journal of Asian Economics, 22: 84–98.

Stancic, P., Cupic, M., Barjaktarovic Rakocevic, S. M. (2012). Influence of Board Size and Composition on Bank Performance: Case of Serbia. Actual Problems of Economics, 8(134): 466–475.

Tsionasa, E. G., Lolosb, S.E.G, Christopoulos, D. K. (2003). The performance of the Greek banking system in view of the EMU: results from a non-parametric approach. Economic Modelling, 20: 571–592.

Van Hoose, D. (2010). The Industrial Organization of Banking: Bank Behavior, Market Structure, and Regulation, Springer Publisher, 1st Edition.

Стаття надійшла до редакції 10.01.2013.