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Productivity change patterns in the Romanian banking system – the impact of size and ownership on total factor productivity

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Abstract. *In this paper we analyze Romanian banking performance for the period 2006-2011 by computing a Malmquist index based on 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 multi factor productivity change. Also this study aims at identifying the relatively best performing bank categories by focusing on the sources of total factor productivity (TFP) growth. The results point out the difficulty in describing a consistent pattern of efficiency changes in time for the period considered. Overall the trend of productivity growth is a descending one. Alternatively, large and small banks manage to obtain the best scores whereas most time second ranked are medium sized banks. As the efficiency scores suggest, 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 incomes and expenses, comfortable personnel expenses corroborated with an adequate size of operations. Regarding the influence of ownership origin, the study presents evidence that foreign-owned banks outperform domestic owned banks.*

Keywords: bank performance; Malmquist index; DEA; Romanian banking system.

JEL Codes: G21, L25.
REL Code: 11C.

1. Introduction

Recent economic literature seeks to explain banking performance by appealing to the notions of competition, concentration, efficiency and productivity (Bikker, Bos, 2008). A great deal of attention is paid to the performance of banks due to the fact that banks are seen as special given their major role in providing credit to enterprises. The role of banking institutions in the process of reallocation of financial resources is even more important if other elements of the financial sector are underdeveloped. Thus, in this situation banks contribute in a larger scale to the optimal allocation of financial resources in the real sector. Recent studies (Dragotă, 2006, Dragotă et al., 2008, Dragotă et al., 2011) provide evidence that in the case of Romanian companies bank loans represent the main external source of financing exceeding by far the role of the capital market. The banking system finances nearly all Romanian listed companies on Bucharest Stock Exchange or on RASDAQ as the short-term loan represents the most preferable instrument of debt outgrowing the values of medium and long-term bank credit.

From a microeconomic point of view the problem of bank performance assessment is one of profit maximization, hence explaining the changes in the profitability of banks is the implicit or explicit subject of much of the banking literature. In this sense the use of economic profit is suitable for measuring the performance of banks. It has been argued (Kosmidu et al., 2007, Ben Naceur, Omran, 2011, Olson, Zoubi, 2011) that measures as ROA – reflecting the capacity of the bank management to transform assets into net earnings, ROE – accounting profit as a percentage of the bank's equity, NIM – net interest margin for measuring current and future profitability defined by the difference between a depository institution's interest income and interest expenses as a percentage of total assets, are the most suitable for performance assessing.

Nevertheless, this "traditional" measurement of performance by using financial ratios fails to provide a general efficiency score when multiple inputs or outputs are used (Siriopoulos, Tziogkidis, 2010). 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 a frontier analysis approach that is based on the production possibilities curve was first addressed by Farrell in 1957, and in the year 1978 Chares et al. introduced the method of data envelopment analysis

(DEA) to assess the efficiency of non-governmental and non-profit organizations. Ever since then there has been rapid and continuous growth in the field. As a result, a considerable amount of published research has appeared, with a significant interest focused on DEA applications of efficiency and productivity (Emrouznejad et al., 2008).

By implying a DEA approach the purpose of this study is to explain Total Factor Productivity changes and its components in the context of Romanian banking system for the period 2006-2011. Total Factor Productivity is reflected by a 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

Total Factor Productivity (TFP) represents a generalized index that basically captures multiple inputs and multiple outputs in order to provide a single productivity ratio. The original index proposed by economist and statistician Sten Malmquist (1953) measured the quantity of consumption that a consumer should achieve in a certain year in order to obtain the same utility level as that form a reference year. In fact the index represented a ratio of two distance function in different time periods but until 1989 the index was rarely computed. Fëre 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 the banking industry. The main advantage that Malmquist index offers is a decomposition of productivity growth sources in 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 of the components best explain 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 time of deregulation 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 but saving banks present superior productivity performance as compared to commercial banks since the latter category presents inability to improve performance at the pace of the best practice benchmark. Also, managerial inefficiency is a 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 the Greek banking system over a period of acceleration of liberalization and deregulation of the financial system (1993-1998). The results show a positive but not substantial TFP growth (2.3% on average) associated to efficiency improvements of medium sized banks (6.3% on average) and technological change improvement for larger institutions (4% on average). This conclusion is conflicting with the study of Canhoto and Dermine (2003) regarding Portuguese banks. The two authors show that the "catching-up" component has a negative impact over 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) estimates productivity change for a period of six years in advanced European economies by using both a parametric and a non-parametric method. Both approaches suggest similar conclusions: productivity growth was brought by improvements in technological change rather than managerial efficiency as there is little evidence of a "catch-up" effect of the non-best-practice institutions to the benchmark.

Fiordelisi and Molyneux (2010) analyzed the value relevance of bank cost efficiency and TFP on shareholder value creation in European banking. The study uses both listed and non-listed banks from France, Germany, Italy and UK for the period 1995-2002. The results show that changes in TFP have the highest relative information content among shareholder value drivers since it explains about 46% of the variation of market-adjusted return in the case of listed banks and 29.3% of the variation of economic value added in the case of non-listed banks. This study also suggests that technological change is the most important component of TFP.

Tai Liu (2010) uses the case of Taiwan's commercial banks to illustrate TFP changes over the post Asian crisis. The aim of the study is to provide insight of how to improve efficiency given a source base or by changing resource allocation. The study presents a classification comprising four groups

under the criteria of competitiveness and pace of progress that aims to help banking institutions in order to create a strategy to survive a changing environment. This study also concludes that the shift in technology is the most important component of TFP whereas the catching-up effect is scarce.

Deng et al. (2011) investigates bank productivity in Malaysia in the period of internet technology waves (2001-2008). The study shows that TFP change is in average 1.4% and follows a certain pattern: TFP will initially be affected by the shift in the frontier but later on the catching up effect will suppress and dominate the frontier effect. The cycle will resume after another great wave of innovation therefore managers should not just stop after they have engaged in new technology but should furtherer innovate and expand their scale of operations.

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

Using an output orientated Malmquist index proposed by Jaffry and al. (2007), Sufian (2011) examines three points of interest in the context of Malaysian banks: whether there exists a positive and significant association between foreign ownership and bank productivity, if banks that are linked to the government tend to be less productive than banks with other forms of ownership and does the performance of public listed banks differ from their privately held counterparts. The results suggest that while domestic banks have exhibited marginal productivity increase, foreign banks showed a productivity decline. Using as a dependent variable the TFP the study shows that the more productive banks have a higher proportion of income drawn from non-interest sources. Also, bank productivity is negatively related to bank size, risk, and inflation rate. Public listed banks are relatively more productive compared to their private bank peers, the empirical findings seem to support the market discipline hypothesis.

Drawing from the two major line of research this study aims at providing an insight regarding productivity transformation patterns by grouping banks into three categories that reflect size factor (small, medium, large), and two categories that reflect control ownership impact over performance(foreign, domestic). The conclusions focus on the drivers of productivity growth (managerial efficiency or technological change) in a period of economic turmoil. The presented results offer further clarification regarding the Romanian

banking industry and completes other studies in this field that mainly address the issue of X-efficiency: Nițoi (2009) analyzes the efficiency and productivity of 15 commercial Romanian banks from 2006-08 using DEA by focusing on identifying the relatively best performing and the relatively worst performing banks; by using the frontier analysis Andrieș and Cocriș (2010) compute the efficiency scores of the main banks in Romania (six banks), the Czech Republic (six banks) and Hungary (six banks) for the period 2000-2006 and offer a comparative evolution of banking sector performance for the three countries; Roman and Șargu (2012) use DEA for analyzing Romanian banking sector efficiency evolution for the period 2002-2009 and conclude that foreign banks have been more efficient than their domestic peers, as foreign banks can benefit from the experience and superior know-how of their parent banks.

3. Methodology

3.1. Bank behaviour: intermediation vs. production approach

A single definition about bank behavior is hard to be presented since issues concerning what banks produce diverge in the views of researches. 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 the number of various financial transactions performed per unit of time. Yet, detailed transaction flow data are 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) neither of this two approaches is perfect since both fail in fully capturing the dual role of financial institutions of being providers of transaction/document processing services *and* financial intermediaries that transfer funds from savers to investors. But the

intermediation and production approach can be reconciled on empirical grounds following the assumption that transaction flows are proportional to the stock value of bank asset and liability accounts. From an empirical standpoint Van Hoose (2010) presents three methods of identifying inputs and outputs:

- the asset method that assumes that bank assets are outputs, deposits, purchased founds and other liabilities are financial inputs, and real resources such as labor and capital are real inputs;
- the value added method associates outputs with banking functions that presuppose substantial labor or capital expenditure to produce flows of banking services; commercial and industrial loans, installment loans, real estate loans are output and transaction deposits, retail savings, time deposits are outputs as well. The typical inputs are labor, capital and purchased founds;
- the user cost method understood as the cost of holding an asset during the current period minus the assets discounted net revenue in the following period. Bank balance sheets can be classified in items with negative user costs: all categories of loans and transaction deposits – outputs and positive user costs: savings, time deposits and purchased founds – inputs along with labor, raw materials and physical capital.

As noticed, all three methods recognize that loans are without any question economic outputs of banks. Regarding the nature of the deposits there is some debate, on the one hand, deposits have input characteristics because they are paid in part by interest payments and the funds raised provide the institution with the raw material of investible funds, on the other hand, deposits have output characteristics because they are associated with a substantial amount of liquidity, safekeeping and payment services to depositors.

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, three input variables are included: interest and commission expenses, staff expenses and due to costumers – deposits.

3.2. Malmquist index and total factor productivity

The field of studying and measuring bank efficiency and productivity was dominated by econometric modelling in its earlier days, but for the last 15 years the emergence of the non-parametric method DEA brought linear programming into the light of interest. Briefly formulated, DEA is a linear programming technique that reports the relative efficiency score of each decision making unit (DMU) by computing a comparative ratio of multiple outputs to multiple inputs (Avkiran, 2005).

In order to decompose the productivity change in the case of panel data a DEA algorithm can be of use for computing a Malmquist index (MI). MI is in fact the product of the catch-up effect and frontier-shift coming from DEA technologies. This kind of index represents the total factor productivity growth of a bank (DMU) reflecting the progress or regress over time of each organization considering the framework of multiple inputs and outputs.

MI is the most commonly used measure of productivity change that evaluates the change between two 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 (C.E) –represents the distance of the DMU under observation from the efficient frontier:

$$Catch\ up\ effect = \frac{\delta^{t+1}((x_i,y_i)^{t+1})}{\delta^{t}((x_i,y_i)^{t})} \quad (1)$$

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 periods t and t+1 frontier technologies.

The catch-up effect 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 C.E > 1 DMU_0 is dealing with progress in terms of relative efficiency from period t+1 to period t, while C.E=1 and C.E<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 (Dacanay, 2007).

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

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

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

$$Scale\ efficiency = \left[\frac{\delta_{vrs}^{t+1}((x_i,y_i)^{t+1})/\delta_{crs}^{t+1}((x_i,y_i)^{t+1})}{\delta_{vrs}^{t+1}((x_i,y_i)^{t})/\delta_{crs}^{t+1}((x_i,y_i)^{t})} \times \frac{\delta_{vrs}^{t}((x_i,y_i)^{t+1})/\delta_{crs}^{t}((x_i,y_i)^{t+1})}{\delta_{vrs}^{t}((x_i,y_i)^{t})/\delta_{crs}^{t}((x_i,y_i)^{t})}\right]^{\frac{1}{2}} \quad (3)$$

Pure efficiency change is entirely under the control and results from management decisions, thus this kind of efficiency is also called managerial efficiency. From this point of view inefficiency occurs when inputs are used more than should be required for producing a certain amount of output thus resulting in poor abilities of costs control and failure to maximize revenue.

Scale efficiency refers to optimal choice of production scale in terms of cost control (e.g minimization of average costs). Typically, a scale efficient firm will produce at constant returns to scale (crs). In the case of a production technology that is characterized by increasing returns to scale (irs), efficiency gains could be obtained by expanding production levels. On the other side, if the bank's technology reflects decreasing returns to scale (drs), efficiency gains could be achieved by reducing production levels.

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

$$F.S = \left[\frac{\delta^{t}((x_i,y_i)^{t})}{\delta^{t+1}((x_i,y_i)^{t})} \times \frac{\delta^{t}((x_i,y_i)^{t+1})}{\delta^{t+1}((x_i,y_i)^{t+1})}\right]^{\frac{1}{2}} \quad (4)$$

This formula describes the frontier shift effect as the geometric mean of the frontier shift at $(x_i, y_i)^t$ evaluated as the ratio of efficiency of $(x_i, y_i)^t$ with respect to period t and t+1 frontiers, respectively the frontier shift at $(x_i, y_i)^{t+1}$ evaluated as the ratio of efficiency of $(x_i, y_i)^{t+1}$ with respect to period t and t+1 frontiers. If F.S > 1 DMU_0 records progress in the frontier technology from period t+1 to t, or that the efficient frontier has shifted out compared to the previous period. F.S = 1 and F.S < 1 indicate no change respectively regress in efficiency terms.

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

$$M.I = \left[\frac{\delta^t((x_i,y_i)^{t+1})}{\delta^t((x_i,y_i)^t)} \times \frac{\delta^{t+1}((x_i,y_i)^{t+1})}{\delta^{t+1}((x_i,y_i)^t)}\right]^{\frac{1}{2}} \quad (5)$$

To calculate equation 5 the four distance functions are computed involving four linear programming (LP) problems. Because we use an input-oriented DEA measure the LP are as follows:

$$[\delta^t((x_i,y_i)^{t+1})]^{-1} = min_{\theta,\lambda}\theta \quad (6)$$

s.t

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

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

$\lambda \geq 0$

where θ is a scalar and λ is a I× 1 vector of constants. The value θ is the component score of the i-th DMU. X and Y are input and output vectors, and x and y represents the amount of input consumed and output generated by DMU_i. The remaining three 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'λ=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 a balanced panel of 19 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 six years was chosen due to data availability as data from an earlier period are difficult to obtain for a comparative framework approach. The list of the sampled banks and some descriptive statistics are presented in the Annex (Table 1).

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

4. Results

Productivity transformation patterns were examined by grouping banks into three categories that reflect the size factor, and two categories that reflect control ownership impact over performance.

We defined the size categories starting from the value of net total asset of the sampled banks. In every analyzed year five banks were considered as being large having an average value of net assets between 27.43% and 7.25%. Medium sized banks are those that have net total assets between 6.7%-2% in the total of net assets of the entire banking system whereas for the small banks values of less than 1.9% are specific. In order to assess mean differences between groups ANOVA tests were performed all indicating the validity of this classification. For all 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 2:

Table 2

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	1.1403	1.0398	1.1725	0.9028	1.0195
Small banks	1.0178	1.1222	1.1415	0.9163	1.0164
Domestic owned	1.0506	1.0217	1.0734	0.9128	0.9139
Foreign owned	1.0759	1.1050	1.1850	0.9349	1.0427
Total	1.0716	1.0907	1.1660	0.9312	1.0208

Source: own calculation.

The results indicate that on average, in the six years that were taken into account, 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 a 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 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 productivity 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-performed domestic owned banks but the patterns of performance growth follow opposite directions. As a group, Romanian banks exhibit decreasing productivity while foreign owned banks register an average productivity growth of 4.24%.

The mean differences obtained between the five groups were verified by using ANOVA method in order to obtain a generalized t-test statistic of differences between more than two groups. The F statistic 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 3, 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 a 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 in order 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 a productivity growth of 12.33%. In this case the explanation of productivity growth is synonym with 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 the 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 indexes.

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 the small banks (almost 18% lost efficiency compared to the previous year).

The year 2009 compared to 2008 reveals furtherer 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 the small sized one (7.30% productivity growth).

The year 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.

The year 2011 reveals 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%.

Regarding the impact of corporate control ownership over performance we divided the sample into domestic owned and foreign banks. Following Berger (2000) two alternative scenarios can be consider: *home field advantage* – domestic owned institutions are favored due to organizational diseconomies in operating or monitoring an institution from a 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 the costs, also raising revenues through superior investment or better diversification of risks allows foreign banks to 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 the year 2008 it seems that domestic owned banks have a greater TFP score than the foreign owned ones. The year 2010 shows the most dramatic productivity decrease of almost 41% followed by a recovery in the next year which has to be understood in the context of this huge depreciation. Even though in 2011 domestic owned banks present a higher TFP score than the foreign owned 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.

Table 3

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	1.5596	0.8793	1.3162	0.9167	1.2200
Small banks	0.9805	0.9720	0.9549	0.9518	0.9056
Domestic owned	0.9751	0.9819	0.9599	1.0498	1.0035
Foreign	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	1.1014	1.2890	1.4399	0.7353	1.0132
Small banks	1.3371	1.2743	1.6178	0.5577	0.8252
Domestic owned	1.4030	1.0504	1.5143	0.7989	1.0934
Foreign	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	0.8566	0.9753	0.8437	1.1686	0.9770
Small banks	1.0405	0.8046	0.8472	1.4647	1.0730
Domestic owned	0.9924	0.8468	0.8427	1.1456	0.8720
Foreign	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	1.2086	1.0460	1.2779	0.8330	1.0425
Small banks	0.9561	1.4228	1.3778	0.9225	1.3517
Domestic owned	0.9255	1.1502	1.0345	0.5801	0.5956
Foreign	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	0.9749	1.0093	0.9848	0.8603	0.8446
Small banks	1.0112	1.0419	1.0472	0.8922	0.9416
Domestic owned	0.9570	1.0794	1.0158	0.9897	1.0050
Foreign	1.0134	1.0073	1.0223	0.8745	0.8978

Source: own calculation.

Conclusion

Though we can access a vast literature concerning the issue of bank productivity change in developed countries, the number of studies that debate this issue in emerging countries remains low. Most of them survey countries like Turkey, Malaysia, Taiwan, but also countries form Central and Eastern Europe. The present research comes to complete the overall picture by providing insight about productivity transformation patterns and productivity

growth in the case of Romanian banking system in a 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 a consistent pattern of efficiency changes in time for 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 sized banks. Also, in the case of small and large banks the main source of productivity growth comes from scale efficiency gains whereas in the case of medium sized banks managerial efficiency plays a more important role.

Overall the trend of productivity growth is a descending one excepting the year 2010 when small sized banks register the highest productivity growth of 35.17%. Nevertheless this situation should be analyzed by inspecting the previous TFP values that presented a cumulative decline.

This conclusion is in line with the research of Roman and Șargu (2012, p. 12) that shows that the years 2007-2009 registered the highest decline in efficiency which can be attributed to the depreciation of the macroeconomic environment as a result of the financial and economic downturn.

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 Romanian territory 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.

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Annex

Table 1

List of the sampled banks for the period 2006-2011

1	Alpha Bank	11	Eximbank
2	Banca Carpatica	12	Marfin Bank
3	Banca Comercială Română	13	Otp bank
4	Banca Italo-Romena	14	Piraeus Bank
5	Banca Românească	15	ProCredit
6	Banca Transilvania	16	Raiffeisen
7	BRD-Groupe Sociecte Generale	17	Romanian International Bank
8	CitiBank Romania	18	Unicredit Tiriac
9	Credit Europe Bank	19	Volksbank
10	Emporiki Bank		

Table 2

Descriptive statistics of the sample (values expressed in RON thousands)

	Variable	Obs	Mean	Std. Dev.	Min	Max
LARGE BANKS	Loans	30	21,000,000	13,300,000	5,510,000	48,000,000
	Deposits	30	24,400,000	16,300,000	5,700,000	59,700,000
	Interest income	30	2,650,000	2,080,000	499,000	8,500,000
	Interest expenses	30	1,290,000	1,150,000	136,000	4,880,000
	Personnel expenses	30	509,000	255,000	94,400	1,130,000
	Profit	30	548,000	454,000	109,000	1,950,000
MEDIUM BANKS	Loans	30	7,300,000	4,200,000	1,290,000	15,600,000
	Deposits	30	6,410,000	5,040,000	1,060,000	19,500,000
	Interest income	30	680,000	349,000	91,900	1,320,000
	Interest expenses	30	395,000	216,000	42,000	775,000
	Personnel expenses	30	110,000	36,800	32,900	176,000
	Profit	30	32,700	107,000	-404,000	185,000
SMALL BANKS	Loans	48	1,310,000	650,000	237,000	2,690,000
	Deposits	48	1,520,000	1,140,000	103,000	4,920,000
	Interest income	48	183,000	118,000	26,600	433,000
	Interest expenses	48	100,000	83,600	10,400	319,000
	Personnel expenses	48	47,000	30,600	4,464	95,600
	Profit	48	18,700	53,200	-77,600	162,000
DOMESTIC OWNED BANKS	Loans	18	4,500,000	3,630,000	237,000	12,800,000
	Deposits	18	4,920,000	4,180,000	103,000	15,400,000
	Interest income	18	524,000	418,000	26,600	1,580,000
	Interest expenses	18	284,000	237,000	11,200	925,000
	Personnel expenses	18	137,000	124,000	7,934	506,000
	Profit	18	99,700	161,000	-56,800	613,000
FOREIGN OWNED BANKS	Loans	90	9,250,000	11,800,000	315,000	48,000,000
	Deposits	90	10,100,000	14,100,000	196,000	59,700,000
	Interest income	90	1,110,000	1,630,000	27,600	8,500,000
	Interest expenses	90	559,000	854,000	10,400	4,880,000
	Personnel expenses	90	206,000	256,000	4,464	1,130,000
	Profit	90	184,000	365,000	-404,000	1,950,000

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