The Bulgarian Banking System and the EU Single Financial Market: Measuring the level of integration using DEA

Lyubomir Mirchev

Abstract:

This paper analyses the development of the Bulgarian Banking Market and its integration towards the Single European Financial Market. This analysis is made through different than the standard perspective, using Data Envelopment Analysis (DEA) for estimating and comparing the efficiency of the Bulgarian and foreign banks. For investigating the presence of integration processes, the changes in the technical efficiency levels for a sample of Bulgarian and European banks are compared. In this framework the attention is brought also over the development of the Bulgarian banking market in the period 1999 – 2008 and the effect of privatization as a form of financial integration, which is examined by distinguishing between groups of locally and foreign owned banks. The results suggest that a positive trend of efficiency development of the Bulgarian banks is in place, in which significant role play the increasing competition and the penetration of foreign players on the local market. The difference in the technical efficiency levels between the Bulgarian and European markets remains material, which supposes that the locally presented banks are utilizing their resources less optimally than the European ones. However there is strong evidence for integration in terms of convergence between the efficiency levels, provided by the presence of beta and sigma convergence.

JEL Classification: F36; G15 ; G21; D24
Key words: banking efficiency, Data Envelopment Analysis (DEA), banking integration, Bulgarian banking system, European financial market

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I. Introduction

Often bank assessment is conducted using information on realized profits, but excluding such indicators as efficiency\(^1\) and quality of the final product/service. The most used analytical method is the quantitative analysis of the financial indicators and financial ratios analysis (for example the CAMELS\(^2\) model and others). These techniques result in a variety of types of outcomes, which brings the need for further calculation and interpretation for deriving an overall assessment indicator.

For analyzing the development of the banking system is necessary to take into account its efficiency as one of the main indicators. In this process of development significant contributions are the privatization, foreign banks entry, competition, liberalization, change in legislative environment and institutional rules, technologies and new knowledge, changes in the macroeconomic environment and others. Computing the efficiency scores for Bulgaria allows us to make comparison with other banking systems. In the recent years numerous comparative analysis of particular banks and banking systems in the EU member states as well as in the developing countries, were carried out. These researches use parametric and non-parametric methods for assessment (Daniel Hollo, Marton Nagi, 2002) and Stochastic frontier approach (Yildirim and Philippatos, 2002). With these tools one can measure the influence of privatization processes on bank performance (Bonin, Hasan and Wachel, 2004a, 2004b; Athanasoglou et al., 2006) and the influence of foreign banks entry and foreign ownership with controlling power on bank efficiency (Havrylchyk and Jurzyk, 2006). Very useful is the calculation of certain aspects of the banking efficiency, like: operational efficiency (Grigorian and Manole, 2002; Tomova, Nenovsky and Naneva, 2004; Tomova, 2005), inefficiency (average X-inefficiency\(^3\), average profit-inefficiency\(^4\) or average technological inefficiency\(^5\)), technical efficiency\(^5\) (Nenkova and Tomova 2003). A significant

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1 Comparison between the actual and optimal values of input and output parameters. The different types of efficiency reflect different definitions of the optimum.

2 Capital, Asset Quality, Management, Earnings, Liquidity, and Sensitivity (CAMELS) - A rating system for the bank's overall condition. The CAMELS rating is based on financial statements of the bank and conclusions form on-site examinations, conducted by the supervisory authorities. Usually these ratings are not public.

3 Situation when a unit fails to produce on the lowest possible average and marginal cost curves. The X-inefficiency model implies a best-practice technology. No random factor could make a unit’s production function better than that best-practice one.

4 Comparison between the actual and optimal costs, income, profit or other target indicator.

5 The optimum is defined by the production possibility frontier. The technical efficiency gives a measure of how managers are able to minimise cost or maximise production by input and output allocation.
part of these researches outlines the direct relation between the efficiency and the acceleration of the convergence processes in the Single European Financial Market.

In these lines the task of the present paper is to analyze the development of the Bulgarian banking market, the influence of the entrance of the bigger European banks in the local market as a form of bank integration, and the comparison of the Bulgarian banking system efficiency with the aggregated efficiency of the Single EU financial market for determining the degree and the speed of the integration processes. As a main instrument we will use the Data Envelopment Analysis (DEA)

II. Characteristics of the development of the Bulgarian banking system

The main characteristics, which play significant role in the development of the Bulgarian banking system, are:

The transformation of the banking system from one-tier into a two-tier with the Bulgarian National Bank (BNB) on the first and the commercial banks on the second tier. This was done through the reestablishment of the commercial banks. New legislative framework was adopted to reflect the new market structure. The Law on the Bulgarian National Bank (1991) defined the objectives and the powers of the BNB. Later the Law on the banks and credit activity (1992) defined the activities banks could perform under the license they were granted. Further almost all the banks were transformed to universal banks offering deposit and credit services to all customers. The branches of the BNB were also transformed to commercial banks (keeping in mind that before the transformations the BNB performed almost all of the functions in the banking market acting as a commercial bank and a central bank simultaneously). Later on a consolidation took place in the sector and many regional banks were merged and prepared for privatization. One of the ideas behind these activities was to improve the efficiency of the banks. Many state-owned banks were deemed to be inefficient as their lending policies were not market driven. They were imposed by the government to finance state enterprise, some of which were no in a good financial condition. To overcome this situation and lay the market-driven fundament of the banking market, a Banking Consolidation Company was established in 1992. It was intended to consolidate, restructure and privatize the state-owned banks. The low speed of these processes however led to extending the portfolios of bad loans and endangering the stability of some of the
banks. During that time the Central Bank financed largely the affected banks, operating as a lender of first instead of last resort.

Before the crisis, depositors had little interest in monitoring commercial banks because of the implicit and explicit prudential guarantees. The interest rates on loans, although very high at times, did not reflect true credit risk. An OECD analysis points out that until 1996, commercial credit was expanded to the non-financial sector in Bulgaria to a degree that was unprecedented relative to any other European transition economy. The structure of these credits was not 'healthy' and led to the accumulation of a large amount of bad loans. State-owned enterprises and banks were rescued in several waves by issuing government securities, which led to increases in the government's internal debt. The situation deepened in 1996 and turned to a full scale financial (twin) crisis.

The crisis started when in 1996 BNB took five commercial banks, three of which were private, under conservatorship. At that time, Bulgaria was unable to get loans in international financial markets because of insufficient foreign currency reserves that could be used as collateral. The attempt to stop the banking crisis by introducing a deposit insurance scheme was unsuccessful, because it lacked credibility due to the low foreign currency reserves. In addition, the BNB started to pursue a restrictive policy towards banks by increasing minimum reserve requirements, raising interest rates and at once selling US dollars to protect the lev exchange rate. The sharp increase in interest rates in the second half of 1996 further intensified the crisis. Foreign currency was increasingly used as a store of value. In February 1997 the lev depreciated by almost 250 per cent. The devaluation was accompanied by a short period of hyperinflation.

In 1997 a currency board was introduced as a tool for stabilizing the economy. New regulations in the banking sphere were adopted and more strict supervision policy was applied. Also the entry of foreign banks was eased.

In 1996 - 1997, the banking sector was composed of 33 banks including the State Savings Bank and branches of foreign banks. Most of these banks were small and with private ownership. At the beginning of 1997 there were six state owned commercial banks: Bulbank, United Bulgarian Bank (UBB), Expressbank, Bulgarian PostBank, Hebros Bank and Biochim Commercial Bank. Their major shareholder was the Bank Consolidation Company (BCC), which was in charge of bank privatization.
Bulbank, the second largest bank in Bulgaria, was acquired in July 2000 by Italy’s UniCredito with an 86% stake and Germany’s Allianz with a 5% stake. National Bank of Greece bought a 99.9% stake in the United Bulgarian Bank (UBB), the country’s third biggest bank in terms of assets at that time. Bulgarian Post Bank was originally acquired by Nomura International in 1998, but later was joint-owned by the American life-insurer ALICO (AIG group) and the international private bank group EFG. In 1999 the French group, Société Générale bought Express Bank. The banking privatization process was completed with the sale of Commercial Bank Biochim (now HVB Bank Biochim following its merger with HVB Bank Bulgaria) to Bank Austria Creditanstalt (HVB Group) at the end of 2002 and the purchase of DSK Bank (the former State Saving Bank) by Hungarian OTP Group in May 2003.

Nowadays the banking market consists of around 30 universal commercial banks where 80% of the assets are foreign owned. There remains only one state bank “Bank for Development” which has specific functions. A distinctive feature of the banking system is the high credit growth and aggressive expansion of the larger banks. This trend was softened by the global credit crunch as the possibilities for easy attracting of foreign resources diminished. In the recent years some mergers took place consolidating the majority of banking assets in the larger foreign banks. Another evidence for the strong competition for bigger market share between the banks is the decreasing market concentration (Graphic 1).

III. Measuring banking efficiency using the Data Envelopment Analysis

In the past decade the Bulgarian banking market like the other CEE (Central and Eastern Europe) markets experienced strong development due to variety of reasons like
foreign bank entry and increasing competition, considerable change in ownership structure through the privatization processes, market liberalization, change in regulatory environment and other factors. All these processes had influenced the bank performance. It is important to analyse whether this development is only extensive, driven by the increase of the banks portfolios or is also intensive based on efficiency improvement, which is very important and crucial issue especially for transition economies.

The Data Envelopment Analysis (DEA) is a methodology for analyzing the relative efficiency of different DMUs (decision making units) using different input and output variables for the model. Generally as input and output variables are used some financial and operating indicators but also indexes and other synthetic indicators could be utilized. The efficiency is relative because the best performing unit is the benchmark for the others and is determining the efficient frontier. The DEA approach involves the use of linear programming methods to construct a nonparametric piecewise frontier over the data, so as to be able to calculate efficiencies relative to this surface (Annex 1). In other words, the purpose of DEA is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or are below the production frontier. The value of efficiency score obtained for any DMU must be less than or equal to one, with a value of 1 indicating a point on the frontier and hence a technically efficient DMU, according to the Farrell (1957) definition.

The model has several advantages and drawbacks. With the DEA approach we can calculate an aggregated efficiency score for each bank using a set of input and output variables, which is one of its advantages over the traditional accounting approaches. Another advantage of the DEA is that does not need long time series as the equivalent parametric frontier approaches: Stochastic Frontier Analysis (SFA) and Distribution Free Approach (DFA). One of the main positive sides of the model is that it does not require an assumption for the form of the production function. This allows us to eliminate the risk of wrong specification. Meanwhile the major drawback is that while this approach is non-parametrical is does not discriminate between efficiency score and random error component. It is also sensitive to extreme values of the variables.

Another main advantage of DEA in comparison with the traditional accounting indicators for efficiency – the operational coefficients ROA, ROE, net interest margin, gross profit margin, expenses / income ratio is that the latter are biased by different capital structure, services scope and structure, accounting treatment, macro and regulatory environment, etc. In
these different conditions, the indicators tend to change in a different way and cannot be used easily for comparing banks from different markets. Thus the possibility of incorporating multiple variables in the DEA model is giving us a single (comparable) measure of efficiency.

The DEA approach has different modifications according to its purpose and the peculiarities of the analyzed units. According to the sensitivity towards the return to scale there are two main modifications: CCR model developed by Charnes, Cooper and Rhodes (Charnes et al. (1978) and BCC model developed by Banker, Charnes and Cooper (Banker et al. (1984). The CCR model (called also: CRS model – constant return to scale model) compares all the DMUs in the sample ignoring the difference in the scale. The BCC model (called also: VCR – variable return to scale model) differentiate the DMU according to their return to scale. It tends to give slightly higher results.

The model could be output oriented or input oriented. To know exactly which modification should be used, we must take a look at the nature of the analyzed units, at the way they are conducting their business. If the unit is trying to maximize the production given the available resources, then we can choose the output oriented model. And if the unit is trying to minimize the costs for resources given its fixed target for production volume, then we can use the input oriented version of the model.

According to the input and output data, the DEA model has a number of variants. Choosing the input and output variables is essential to the analysis. This choice is connected with data availability and reliability. That is why the analysis of the banking efficiency is a complex task. Relative is the point of view from which the banks are analyzed, as producers of financial services or mediators of funds between savers and investors. Also data availability has its own influence.

There are couple of approaches, which had been used in different researches: production approach, operating approach, intermediation approach, value-added approach and others. These approaches are suitable for analysing different types of enterprises. In the literature on banking efficiency the most commonly used are the operating approach and the intermediation approach. We consider using the intermediation approach as for the purpose of this research we consider the banks as intermediaries reallocating funds, transforming the attracted funds into credits and securities while incurring different costs like fixed assets, salaries etc.
The empirical results form various researches show that there is no a significant difference between the results obtained using the above mentioned methods (SFA and DEA).

For the calculations in this paper we use the prebuilt software: Efficiency Measurement System (EMS) developed by Holger Scheel, Dortmund University.

IV. The efficiency of the Bulgarian Banking System

For the purpose of the current analysis we use balance sheet and income statement data for the Bulgarian banks for the period 1999 – 2008.

The efficiency assessment is crucial for finding the necessary corrective measures when certain deficiencies are found in the functioning of a bank. This leads for example to finding ways for minimizing the costs or maximizing the income according to the meanings of the target indicators, identified in the process of comparative analysis.

The object of the analysis are 23 of the banks presented on the Bulgarian market for the period 1999 – 2008. Increase in certain banking indicators, like assets, loans portfolio, the profit and others, is typical for the given period. Logically the focus should be put on the questions about the quality of this growth, the efficiency of each bank, and about the peculiarities of the development of the Bulgarian banking sector.

We will use Output oriented, variable to scale, DEA with inputs and outputs matching the intermediary approach. We consider that the banks are driven by commercial goals and so they are trying to maximize the output and the profits so we will opt for the Output oriented DEA. Further on taking into accounting the differences in the size of the banks, we will use the Variable to Scale (VRS) DEA modification. And finally considering the banks as companies who transform the savings into loans, we will use a data set matching the ‘intermediary approach’. Thus we will assess the technical efficiency (x-efficiency) of the analyzed units. In economics, x-efficiency is the effectiveness with which a given set of inputs are used to produce outputs. If a firm is producing the maximum output it can, given the resources it employs, such as men and machinery, and the best technology available, it is said to be x-efficient. X-inefficiency occurs when x-efficiency is not achieved. The efficiency score is measured form 0 to 1 (1 represents the most efficient banks).
The sample will encompass data for 23 banks for ten years from 1999 to 2008. The included banks represent around 90% of the total banking assets in the Bulgarian banking system. By excluding the remaining 10% total assets we eliminate from the sample some banks with specific structure and policy (including one state-owned bank), smaller banks with specific capital structure (including banks with lower than average leverage ratio (assets to equity) and higher Capital Adequacy Ratio), branches of foreign banks (which do not have to comply with the local minimum capital requirements). As we noted before the DEA model is vulnerable to extreme values, so by eliminating these outliers we are making the sample more homogeneous and thus avoiding unnecessary distortion of the efficiency results.

Each bank from each year will be considered as a separate DMU (decision making unit) and will be compared with the performance of the other banks from the same time period as well as its own performance and the performance of the rest of the banks from the other time periods. By this means we can calculate the performance development of the banks in the given time horizon.

As input parameters we use year-end data for: Fixed assets, Deposits, Administrative costs; and for output data: Total loans, Securities.

From the results of the model (Table 1) we can see that efficiency score of the banking system in 1999 was 0.71. In other words the average bank uses only 71% of its inputs (in our case: fixed assets, operating costs and deposits) to produce its current outputs. For comparison, in 2007 the average efficiency of the banks is 0.87, which means that 87% of inputs are efficiently used.

It should be noted that the data for 2008 are extrapolated from the 2008 Q3 balance sheet data.

As it could be seen form Table 1 and Graph. 2, there is large heterogeneity among the banks concerning their levels of efficiency. There is a distinctive trend for increasing the
average efficiency of the banking system. Some of the causes for this are the new technologies, knowhow and better administrative cost management implemented by the foreign banks, which further put pressure on the domestic banks and stimulated them to optimise their activities. The temporary reversion of the trend around 2005 and 2006 is a result of the adoption of measures by the Bulgarian National Bank for slowing the credit boom and of the rise in the interest and related costs of the foreign banks, relying on external financing. From Table 1 and Graph.2 could be seen also that the variation of the efficiency scores is decreasing (measured by the standard deviation and the difference between the min and max scores) which is a result form the homogenisation of the market. Regarding the latter years form 2004 towards 2008 we see that the average efficiency is shifting upwards in the variation band, which could be clearly noted in 2006, 2007 and 2008. This means that the bigger banks are improving their efficiency relatively faster than the others.

In order to assess the reliability of the results we compare the calculated DEA trend for the Bulgarian banking system with selected accounting ratios showing the efficiency and profitability of the banking system. We use the Cost Income Ratio (Operational Expenses / Gross Income) and the Operational Profit Margin (Operational Profit / Gross Income).
From *Graph.3* and *Table 2* we see that the DEA score is negatively correlated with the Cost Income Ratio. This ratio is one of the most analyzed accounting indicators for financial and cost efficiency. It shows the change in the operating costs, driven by the change in the volume of production (gross income). The decrease means that banks are improving their technical efficiency over the years as the operating costs are decreasing relatively in relation to the gross income. This could be an effect of improvement of the cost efficiency by eliminating excessive staff expenses and optimising other costs, or increase of the income while the costs remain unchanged.

We also see that the DEA score is negatively correlated with the Operational Profit Margin (*Graph.4* and *Table 2*). This could question the reliability of our results. But we must not forget that the higher interest rate margins are considered to be an indicator for a not well developed banking system. Given that the Cost Income Ratio and the Operational Profit Margin are both decreasing, means that while the cost efficiency is improving, interest rate margin is shrinking and the gross income in growing rapidly than the operational profit. This is due to the increasing market competition and higher financing costs. This shows that for maintaining their profit growth rates the banks could no longer rely on the higher interest margins because of the market saturation and are expanding their portfolios relying on its scale, which leads to higher interest costs.

<table>
<thead>
<tr>
<th>DEA trend</th>
<th>DEA trend</th>
<th>Cost Income Ratio (op. ex/gross income)</th>
<th>Operational Profit Margin (op/profit/gross.income)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
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<td>Pearson Correlation</td>
<td>Pearson Correlation</td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>Sig. (2-tailed)</td>
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<td>Sig. (2-tailed)</td>
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<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>-7.07*</td>
<td>-.022</td>
<td>-8.55*</td>
</tr>
<tr>
<td>0.05</td>
<td>0.022</td>
<td>0.002</td>
<td>0.002</td>
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<tr>
<td>Cost Income Ratio (op. ex/gross.income)</td>
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<td>N</td>
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<tr>
<td>-7.07*</td>
<td>-.022</td>
<td>1</td>
<td>6.09</td>
</tr>
<tr>
<td>0.05</td>
<td>0.062</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Operational Profit Margin (op/profit/gross.income)</td>
<td>Operational Profit Margin (op/profit/gross.income)</td>
<td>Operational Profit Margin (op/profit/gross.income)</td>
<td>Operational Profit Margin (op/profit/gross.income)</td>
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<td>Pearson Correlation</td>
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<td>N</td>
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<tr>
<td>-8.55*</td>
<td>-.002</td>
<td>.069</td>
<td>1</td>
</tr>
<tr>
<td>0.05</td>
<td>0.062</td>
<td>10</td>
<td>10</td>
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</table>

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
V. The Bulgarian Banking market: is it getting closer to the European?

For revealing the level of integration of the Bulgarian Banking Market towards the European we will compare the efficiency trends and test for beta and sigma convergence. We are using an output oriented VRS (variable return to scale) DEA model, with input and output data matching the “intermediary approach”. For ensuring data compatibility we will use the following parameters as inputs: Total Fixed Assets, Total Liabilities, Administrative Costs and for outputs: Total Net Loans (Total Gross Loans deducted by the Loan Loss Provisions) and Other Earning Assets (securities). The analysis will be conducted with data for 23 Bulgarian banks (around 90% of the total banking assets in the Bulgarian banking system) for the period 1999 to 2008 and 19 of the largest European banking groups (over 50% of the total EU banking market) for the period 2003 - 2008. The used data are on consolidated level. The initial idea was to cover around 90% of the EU market and to use data on solo level. This could have allowed us to compare the average efficiency levels of the different countries in EU and to search also for regional convergence. However due to some data constraints the scope was lowered to 50% of the EU banking total assets and data on consolidated level. This is still enabling us to demonstrate the concept without getting into much detail about the efficiency structure of the EU market, assuming it as a peer financial market for the purpose of the comparison.

For examining simultaneously the presence of beta and sigma convergence we will use data for the BG and EU banks together. So a benchmark will be the best performing bank in certain year from the given period. Thus we will analyze the development in the efficiency trends, which will help us to search for presence of beta convergence (the output of the relatively underdeveloped banking systems tends to grow faster than the developed one) and also will help us to see whether the (cross-sectional) dispersion between the performances of the two groups is diminishing, which is a sign for sigma convergence.

<table>
<thead>
<tr>
<th></th>
<th>2003 - 2008</th>
<th>BG Banks</th>
<th>EU Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of banks</td>
<td></td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>Average efficiency by groups</td>
<td></td>
<td>0.77</td>
<td>0.94</td>
</tr>
<tr>
<td>St.Dev.</td>
<td></td>
<td>0.10</td>
<td>0.05</td>
</tr>
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</table>

Table 3
The results show (Graph. 5) clearly that the efficiency of the Bulgarian banks is improving at a higher rate than the EU banks. Also the dispersion is diminishing over time. This confirms the presence of the two types of convergence.

Nevertheless we can see that the average efficiency (Table 3) of the Bulgarian market is considerably lower than the average EU efficiency. The hypothesis testing confirms these results (see Annex 3). This can be explained by the fact that for maintaining their profitability for long time the banks on the Bulgarian market could afford maintaining greater margins due to the relatively underdeveloped market and lower saturation. This gave them less stimulus for striving for further optimization of their processes. But because of the growing competition on the local market in the recent years, the banks are improving their performance and in terms of technical efficiency they are catching up to the levels of the European market.

VI. Does the privatisation play a role in the process of integration towards the European Financial Market?

In many researches the privatisation of foreign state banks is regarded as a form convergence towards some foreign markets from which the foreign players come from. We will try to analyse whether in the case of Bulgaria there is a significant improvement of the banking efficiency due to the entry of the foreign financial institutions, which reorganize and improve the bank processes. For analyzing the effect of the privatization processes we are
constructing an output oriented DEA model, with input and output data matching the “intermediary approach”. This time the efficiency estimation will be made for each year separately (on cross-sectional basis).

By this we want to eliminate the dependence of a bank performance from its performance in the other years and so to compare clearly the different banks in each period. This also means that we won’t have much change in the scale (the total assets of the banking system), so we will use CRS (constant return to scale) model.

The results (Graph.6 and Table 4) are confirming our finding that the heterogeneity in the market is diminishing (i.e. the efficiency scores of the different banks are getting closer – Standard deviation dropping rapidly) and also that the bigger banks are becoming more efficient than the small and mid-sized (the shift in the trend towards the upper side of the band).

By using the DEA model separately for each year we are eliminating the efficiency growth trend in the period and can clearly compare the banks relative positions.

For finding the effect of the privatisation we are regrouping the banks in three mutually-excluding groups: Privatized banks, Bulgarian banks, Foreign (green field) banks. Each of these groups has fixed numbers of banks in it. The idea to assess the change in the efficiency levels of the different groups. The “Bulgarian banks”
group consists of banks, which were established by local owners or were bought by Bulgarian investors during the privatisation. In the “Privatized banks” group the banks are former foreign owned banks, which were sold foreign owners mostly during the period 1998 – 2002. Further more in the group of the privatized banks are presented two Bulgarian banks (one of them not-state owned), which were sold in 2006. This exception is made because the main idea is analyse the foreign penetration into the banking sectors. The group of the Foreign (green field) banks comprise banks on the local market which were founded by foreign investors.

The efficiency scores for the three groups can be seen on Graph.7 and Table 5. The average efficiency of the Privatized banks is the highest, followed closely by the foreign (green field) banks. And the local banks are lagging behind. Nevertheless the results are very close. At the beginning of the period least efficient have been the green field foreign banks, as they have had limited expertise for the local market, small scale, limited scope of activities and smaller client base. The Bulgarian banks and Privatised (“to be privatized” at that time) have been more efficient due to their past experience and resources. But as the green field banks acquire experience on the market they get ahead of the other two groups, mainly because of the foreign know how, technologies and image. During the year of privatisation 1999 – 2003 we can see that the group of the privatized banks also definitively gets ahead of the Bulgarian banks. In this period the foreign owners reorganize the activities and finalize the transition processes, so after 2002 they are permanently more efficient than the Bulgarian banks. In the recent years we can witness that the strong competition have stimulated the Bulgarian banks to optimize their activities so to keep in pace with the market. Especially in 2007 and 2008 they are closing the efficiency gap between them and foreign
(privatized and green field) banks. Also the improvement of the foreign (green field) banks efficiency has been more apparent (we should consider that they have also a lower starting base). While the efficiency trend of the Bulgarian banks and the privatized banks is more stable.

For assessing the statistical significance of these results we have conducted a hypothesis testing \( (Annex\ 2) \). The results confirm our conclusion, that privatisation played its role as a form of integration towards the Single European Market. The foreign penetration on the local market has brought new technologies, knowhow and better administrative cost management. Also the access to foreign funds from the parent companies played significant role in the credit boom. All these factors have increased foreign banks efficiency which on the other hand had forced the local banks to optimize their operations and as a result we can see an increased efficiency, strong competition and slight market de-concentration.

\begin{table}
\centering
\begin{tabular}{|l|l|l|l|}
\hline
& BG banks & Privatized & Foreign (green field) \\
\hline
Number of banks & 7 & 9 & 7 \\
\hline
Change in % & 28\% & 32\% & 66\% \\
St.Dev. & 0.06 & 0.07 & 0.14 \\
Average Efficiency by groups & 0.83 & 0.88 & 0.87 \\
\hline
\end{tabular}
\caption{Table 5}
\end{table}

\begin{graph}
\centering
\includegraphics[width=\textwidth]{Total_Assets_BGN_000.png}
\caption{Graph 8}
\end{graph}

VII. Limitations and way for improvement

As we mentioned at the beginning, the DEA does not discriminate between efficiency score and random error component. It is also sensitive to extreme values of the variables. So to confirm the results on which the analysis is based, the application of some parametric frontier approaches, like SFA and others is possible.
Furthermore the scope of the data about the EU banks could be widened. Because of maintaining simplicity and flexibility of the calculations in this paper we decided to use consolidated data for 19 larger EU banking groups which account for over 50% of the total assets on the market. The data availability issue was also a factor in this decision. The use of consolidated data is to some extent mitigating the differences between the efficiency of banks within the group, their activities structure and business models.

So for bringing greater accuracy of the final conclusions we consider as our next task to widen the data scope and to encompass 80% - 90% of the total assets of the European market. Data on solo (non-consolidated) level will be used. And the aggregation of the average efficiency will be done in two stages: Finding the average banking efficiency in each EU member state and then computing the EU wide average efficiency. By this approach it is possible to determine also whether a regional convergence is in place.

We should keep in mind that the currently used “intermediary approach” shows us the technical efficiency of the banks, in other words how efficiently the banks are using their resources to produce loans and (to invest in) other earning assets. From this point of view we are analyzing the efficiency with which the banks are carrying out their function as financial intermediaries in the economy. Furthermore the financial efficiency should be also analyzed and compared. This will allow to reveal how efficient the banks are form the point of view if their managers and shareholders.

**VIII. Conclusion**

We use the Data Envelopment Analysis to analyze the level of integration of the Bulgarian banking market towards the European Single Market, by comparing the technical efficiency levels. DEA has become popular in analysing different national banking industries. Segmentation of the Bulgarian banking market was made by the criteria ownership to assess the role of the foreign capital penetration. We utilised data on Bulgarian banks for the years 1999 through 2008. This is the period for which relatively reliable banks’ data are available. For constructing the European efficiency frontier we used consolidated data for 19 banks for the period 2003 – 2008.

Overall, the analysis leads to the conclusion that the Bulgarian banking system is consequently improving its average technical efficiency which is mainly due to the stable
macroeconomic environment, increased competition and the entering of foreign players on the local market. It is visible that from one side the heterogeneity between the market participants is diminishing but from the other, the bigger banks are gaining speed in terms of higher efficiency coefficients.

The banks with significant foreign participation were and are on average more efficient than the domestic ones. The foreign penetration on the local market contributed to these processes with the establishment of new technologies, knowhow, better administrative and cost management and access to foreign funds from the parent companies. All these factors have increased foreign banks efficiency which on the other hand had stimulated the local banks to optimize their operations and to be able to keep in pace with the market development. The biggest improvement in terms of efficiency in the given period experienced the green-field foreign banks due to their initially limited expertise on the local market, small scale and limited portfolio but because of their foreign know how, technologies and image they become the most effective players on the market. The local (bulgarian and to-be-privatized) banks have been more efficient at the beginning due to their past experience and resources. After the years of privatisisation 1999 – 2003 the group of privatized banks also become more efficient in comparison with Bulgarian banks due to the reorganization of their activities and access to the group resources. In the recent years we are witnessing that the local banks are already closing the efficiency gap.

While comparing the performance of the Bulgarian market with the European one, we can conclude that the difference in the technical efficiency levels remains material which supposes that the locally presented banks are utilizing their resources less optimally than the European ones. However we can note that a clear trend of integration is in place, witnessed by the presence of beta and sigma convergence in the average efficiency levels.

Further evidence of the remaining heterogeneity in the characteristics between the Banking Markets of different EU member-states is the different reaction, in terms of volume and timing, regarding the recent crisis environment. Therefore our future task is to analyse the impact of this crisis environment over the development of the corporate models and the integration processes in the EU.
Annex 1: DEA Methodology

That there are \( n \) DMUs (banks), each producing \( s \) different outputs using \( r \) different inputs. The efficiency ratio is calculated (Ismail, 2004) by the following way:

\[
E_{l} = \frac{\sum_{i=1}^{s} u_{i}y_{il}}{\sum_{j=1}^{r} v_{j}x_{jl}} \quad \text{Equation 1}
\]

where:
- \( E_{l} \) = relative efficiency of the DMU
- \( s \) = number of outputs produced by the DMU
- \( r \) = number of inputs employed by the DMU
- \( y_{i} \) = the \( i \)-th output produced by the DMU
- \( x_{j} \) = the \( j \)-th input employed by the DMU
- \( u = s \times 1 \) vector of output weights and
- \( v = r \times 1 \) vector of input weights.
- \( i \) runs from 1 to \( s \) and \( j \) runs from 1 to \( r \).

Rewritten in the form of fractional programming and then transformed into a linear programming as done by Charnes et al. (1978), we have:

\[
\max E_{l} = \sum_{i=1}^{s} u_{i}y_{il} \quad \text{Equation 2}
\]

subject to:

\[
\sum_{j=1}^{r} v_{j}x_{jl} = 1
\]

\[
\sum_{i=1}^{s} u_{i}y_{im} - \sum_{j=1}^{r} v_{j}x_{jm} \leq 0, m = 1, \ldots, n.
\]

\( u_{i}, v_{j} \geq 0. u \) and \( v \) are small but positive quantities. The first constraint \((v_{j}x_{jl} = 1)\) guarantees that it is possible to move from a linear programming to a fractional programming as well as from a fractional programming to a linear programming (Bowlin, 2002). Equation 2 is constructed under the assumption of constant returns to scale.

However, the CCR model shown by Equation 2 is only appropriate when all decision making units (DMUs) are running at an optimal scale, and this requires the DMUs to operate at the flat portion of the long run average cost (LRAC) curve. In practice, some factors may
prevent a DMU from operating at optimal scale, such as financial and legal constraints, imperfect information etc. Coelli (1996) highlighted that the use of the CRS specification when some of the DMUs are not running at optimal scale will result in measures of technical efficiency which are mixed up with scale efficiency. To overcome this problem, Banker et al (1984) suggested their model (known as the BCR model). It improved the CCR model by introducing a variable that represents the returns to scale. The BCR model allows a calculation of technical efficiency that is free from the scale efficiency effects.

In the BCR model, the problem formulation is written as:

$$\max E_l = \sum_{i=1}^{s} u_i y_{il} - c_l$$

Equation 3

subject to:

$$\sum_{j=1}^{r} v_j x_{jl} = 1$$

$$\sum_{i=1}^{s} u_i y_{im} - \sum_{j=1}^{r} v_j x_{jm} - c_l < 0, m = 1, ..., N$$

The parameter $c_l$ is unconstrained in sign. It indicates the various possibilities of returns to scale. $c_l > 0$ means increasing returns to scale and $c_l = 0$ implies constant returns to scale. Finally, $c_l < 0$ implies decreasing returns to scale. This model forms a convex hull of intersecting planes which envelop the data points more tightly than the CRS model. Therefore, it enables technical efficiency scores to be greater than or equal to those obtained under the CRS model.
Annex 2: Hypothesis testing – does privatisation count?

From the K-S test we find that distributions are normal and we can use parametric test for hypothesis testing. Because of the small sample size we will use T-test.

We will test two sets of hypotheses:

H0: privatized banks efficiency = BG banks efficiency (there is no significant difference between the efficiency of the local banks and the privatized banks)

H0: privatized banks & Green field banks efficiency = BG banks efficiency (there is no significant difference between the efficiency of the local banks and the banks with foreign capital).

### Paired Samples Test

<table>
<thead>
<tr>
<th>Pair</th>
<th>Paired Differences</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BG banks - Privatized</td>
<td>.02324</td>
<td>-.10043 -- .00469</td>
<td>-2.060</td>
<td>9</td>
<td>.069</td>
</tr>
<tr>
<td>2</td>
<td>BG banks - Priv_Green</td>
<td>.02532</td>
<td>-.10807 -- .00647</td>
<td>-2.007</td>
<td>9</td>
<td>.076</td>
</tr>
</tbody>
</table>

We can reject the two zero hypothesis (Sig. < 0.10).
Annex 3: Hypothesis testing – Integration towards the European Financial Market

From the K-S test we find that distributions are normal and we can use parametric approach for hypothesis testing. Because of the small sample size T-test is used.

The H0 states that: there is no significant difference between the average efficiency levels of the Bulgarian and European banking markets. (BG DEA scores = EU DEA scores).

<table>
<thead>
<tr>
<th>BG_DEA_score</th>
<th>EU_DEA_score</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Mean</td>
<td>.7737</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.10020</td>
</tr>
<tr>
<td>Absolute</td>
<td>.169</td>
</tr>
<tr>
<td>Positive</td>
<td>.169</td>
</tr>
<tr>
<td>Negative</td>
<td>-.160</td>
</tr>
<tr>
<td>Kolmogorov-Smirnov Z</td>
<td>.413</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.996</td>
</tr>
</tbody>
</table>

a. Test distribution is Normal.
b. Calculated from data.

Paired Samples Test

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BG_DEA_score - EU_DEA_core</td>
<td>-.16914</td>
<td>.06223</td>
<td>.02540</td>
<td>-.2344 - .10384</td>
<td>-6.658</td>
<td>5</td>
<td>.001</td>
</tr>
</tbody>
</table>

Given the results we can reject the zero hypothesis (Sig. < 0.05).
References


Ismail, M., A DEA analysis of bank performance in Malaysia, 4-th International Symposium of DEA, Aston Business School, Aston University, 2004

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