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Efficiency of the Bulgarian Banking System: Traditional Approach and Data Envelopment Analysis

Nikolay Nenovsky[1], Petar Chobanov[2], Gergana Mihaylova[3], Darina Koleva[4]

Abstract

The paper traces the trends in the development of the Bulgarian banking system focusing on the dynamics of bank efficiency. Although the financial crisis in 1996-1997 and the following shift in monetary regime (introduction of Currency Board Arrangement) exerted significant influence on the development of banking sector characteristics, the study covers only the period of 1999-2006 because of the lack of consistent available data prior 1999.

During the analysed period the impact on the bank efficiency of the following factors is studied: change in property, penetration of the foreign commercial banks on the local banking market, competition, structure of bank assets and liabilities, central bank policy in respect to credit activity, etc. The limits of the traditional accounting approaches to bank efficiency evaluation are discussed, as well as the implementation of non-parametric methods, in particular Data Envelopment Analysis (DEA). Different specifications of DEA like intermediation and operating approaches were applied to separate groups and sub-groups. The results show that: firstly, the foreign banks perform better than domestic and state-owned banks because of the technological and managerial improvements; and secondly, the large banks are more efficient than the small banks due to decreasing operating costs and scale economies.

Key words: DEA, bank efficiency, Bulgarian banking system, foreign banks

JEL Classification: O16, G21, C61

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Contents

I. Introduction

Bank efficiency is very important and crucial issue especially in transition economies, where the banking sector faced a considerable change in ownership structure as a result of privatization, foreign banks entry and competition, liberalization, change in legislative environment and institutional rules. All these factors exerted some influence on the bank performance and efficiency. In addition, the technological changes and knowledge, transferred normally with the increase in foreign ownership in the transition economies, altered significantly the operational environment for the banking institutions and the technology of banks production, which in its turn changed the bank efficiency.

There are numerous studies on the banking system efficiency, most of which provide an analysis of the banking systems in the transition economies. During the last years the research has been focused on the bank efficiency comparison between the EU members, the new EU members and the candidate countries for full EU membership. The issue of the banking systems' efficiency of the new and future EU members is gaining importance in view of the fact that the more efficient the banking systems are, the more the country will have the capacity to converge to the EU because of the provided conditions through financial intermediation for higher economic growth.

The efficiency of the Bulgarian banking system had been subject to several studies during the last years. Most of them are comparative studies focusing on transition economies in order to measure the effect of privatization 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)). The operational efficiency of the Bulgarian banking system has been studied in a pool of transition countries, using modern approaches like deterministic and non-parametric Data Envelopment Analysis (Grigorian and Manole (2002) Tomova, Nenovsky and Naneva, (2004) Tomova (2005)) or stochastic and parametric Stochastic Frontier Approach (Yildirim and Philippatos (2002)). Those analyses provide an estimation of different types of banking inefficiency (average X-inefficiency, average profit-inefficiency or average technological inefficiency), covering the period until 2002. Only Nenkova and Tomova (2003) try to estimate the technical efficiency of the Bulgarian banking system itself but their data covers only the period December 1999 - June 2001.

We test two hypotheses on the efficiency of the Bulgarian banking system: hypothesis 1: the foreign-owned banks are more efficient than domestic-owned banks, and hypothesis 2: the large banks in the Bulgarian economy are more efficient than the small ones.

The hypotheses are tested by using two estimation methods of bank efficiency. In addition to traditional accounting indicators, we use an alternative approach - Data Envelopment Analysis (DEA). We take advantage of using the both methods because they reveal not only the bank efficiency of the separate banking units, but also the relative efficiency of the banking units with respect to the other

units in the system, and because this approach allows us to check the robustness of the obtained results.

The current paper contributes to the existing analysis of the Bulgarian banking system in two ways. Firstly, the applied methodology has been used for the first time for such a long period of time. Secondly, unlike the previous country and comparative multi-country studies, focusing on the bank efficiency of the entire system, this paper provides analysis at more disaggregated level like groups and sub-groups.

The paper is organized as follows: Section II gives an overview of the history of the Bulgarian banking system and the major reforms of the banking institutions during the transition period. Section III presents in details the methodology used in bank efficiency estimations and analyses, and discusses the results, obtained by using the traditional and DEA approaches. Section IV concludes.

II. History of the Bulgarian banking system

Major institutional reforms in the banking system took place at the end of 1989. The financial sector reform started with the reestablishment of the commercial banks. At that time, the Bulgarian National Bank (BNB) performed almost all of the functions of the banking system. It was transformed from one-tier into a two-tier banking system with the BNB on the first and the commercial banks on the second tier. The sector-specific banks became universal banks (Miller, Petranov (2001)) collecting deposits and offering credits to different economic sectors. The banking sector reform was backed up by the adoption of new legislation supporting the functioning of the recently established two-tier banking system. With the 1991 Law on the BNB the authority defined the objectives and functions of the Central Bank and granted its independence from the government. A year later the Law on banks and credit activity came into force, where the different activities the banks could perform were defined according to the type of the granted license[1]. Following the transformation of 59 branches of the BNB into commercial banks in 1990, the number of banks reached 70. After 1992 it started to decrease as a result of their consolidation[2].

Many state-owned commercial banks turned out to be inefficient since they were forced by the government to provide credits to loss-making state enterprises. The commercial banks inefficiency was the reason for the establishment of the Bulgarian Consolidation Company (BCC) in 1992 (Miller, Petranov (2001)). The core objectives of the BCC were to consolidate, restructure and privatize state-owned commercial banks. The BNB also tried to encourage the process of consolidation by raising the minimum required capital. Since the beginning of the banking system reforms the authorities have decided not to permit foreign banks to enter the local market because of the fear that they could put pressure on domestic commercial banks[3]. Although the banking supervision regulations were developed according to the international standards, their enforcement was poor and the licensing policy of BNB was rather loose (Balyozov (1999)). The delayed privatization and the lack of financial discipline deepened the transfer of state-owned enterprises' losses to the banking system, which together with poor lending practices, led to the decapitalization of several banks. Deposit runs started in late

[1] The banks with full license could operate in the country and abroad, while the banks with restricted license could operate only in the country.

[2] In 1992 United Bulgarian Bank was created from 22 small banks, in 1993 Express bank and Hebros bank emerged, and in 1995 Biochim took over Sofia bank (see Berlemann, Nenovsky, Hristov, 2002).

[3] The restriction of foreign banks entry was pursued until 1995 and their number at the end of 1995 was only 4 (Berlemann, Hristov and Nenovsky 2002).

1995 with the BNB performing as a lender of first instead of a lender of last resort (Berlemann, Hristov and Nenovsky (2002))[4].

The banking crisis aggravated in 1996 and turned into a large-scaled financial crisis, which was resolved by the introduction of the currency board arrangement in the middle of 1997. A new stage of banking sector reform started: entirely new laws on BNB and commercial banks were adopted, entry of foreign banks was liberalized, supervision policies were strictly applied, and privatization and competition were encouraged. Regardless of the broad improvement in the environment, the commercial banks started to optimize their behaviour providing new products and improving their efficiency only several years ago when the international interest rates fell to extremely low levels thus pushing the banks to the very natural way of performing banking activities[5].

[4] Several studies provide a detailed analysis on the Bulgarian banking system and the main corner stones in its development. See for example those of Millller and Petranov (1996, 2001), Trifonova (2002), Vucheva (2001), Caporale et al. (2002), etc.

[5] On the issues of financial repression, credit rationing, credit activity and credit capacity see Nenovsky and Hristov (1998), Hristov and Mihaylov (2002), etc.

III. Efficiency of the Bulgarian banking system

We test the hypotheses by using two methods of bank efficiency measurement. Before going into details on the specific methodologies and analysis of the obtained results we should present some basic classifications, which are used in the estimation procedure. We use a three groups' classification of the banks[6]. The first ten banks form the first group, the remaining banks are in the second group, and the last group comprises the foreign banks branches[7]. For the purposes of the study and to ensure the comparison for the analysed period we reclassified the banking institutions for the period until 2003 in compliance with the three groups' classification.

In order to test the first hypothesis we produced an alternative classification of the bank units. Applying the criterion of the ownership of the banks' capital we obtained three groups: foreign banks with the majority of the shares held by foreigners, domestic banks with the majority of shares held by domestic owners, and state-owned banks with a government institution as a major shareholder.

By intuition we expect that the bank efficiency depends on the activity of the banking system, legislation, administrative measures imposed by the central bank and some external factors. The dynamics of the bank efficiency indicators doesn't reveal any specified trend, because they depend on several factors simultaneously. By more detailed analysis we will try to identify the main factors, driving the bank efficiency in Bulgaria.

3.1. Traditional accounting approach

First we focus on the analysis of the standard bank efficiency indicators like return on assets (ROA) and return on equity (ROE). In addition several ratios to total banks' assets are analysed – those are operating profit, net interest income, non-interest expenditures and exchange rate revaluations.

The return on assets indicator shows a relatively high efficiency of the Bulgarian banking system[8], because of the high profits realised in the sector (figure 1). Starting from very high level (4.98 at the end of 1997) it decreased for a year and then started to step up reaching 2.89 in 2000. The high values of ROA in 1997 might be explained by the profits realized by the banks from the exchange rate

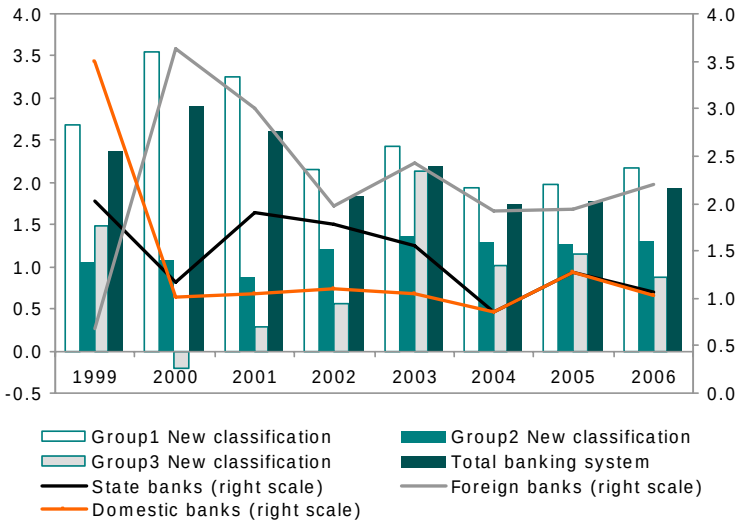
[6] Until 2003 the bank groups were five. The classification was made on the basis of the amount of the banking assets. The first group included the banks with total assets of more than BGN 800 mln. (before 2000 – BGN 500 mln.), the second group included banks with total assets of more than BGN 300 mln., the third group included the banks with total assets of more than BGN 100 mln., the forth group included the banks with total assets of less than BGN 100 mln., and the fifth group included the branches of the foreign banks.

[7] Since June 2007 BNB modified the existing classification. As before the groups are three with the first group including the top 5 banking institutions in terms of realized assets instead of the top 10.

[8] For the purpose of comparison the three EU countries with the highest ROA are Romania (1.79), Estonia (1.67) and Latvia (1.66) (ECB (2007)).

movements as a result of the national currency depreciation, especially in the first half of the year. After the deep financial crisis, in July 1997 the Bulgarian currency was pegged to the Deutsche Mark (DEM), later to the Euro and the banking system lost this opportunity. As a result the growth rates of the banks net profits started to decelerate and the ROA slowed down. After 2000 the decrease in the indicator was driven by the decline in the interest rates on the international markets[9], and by the depreciation of the USD against the Euro (Bulgarian lev respectively) in 2002. During the following years the ROA remained relatively stable, with the exception of 2003, when a considerable credit growth in the banking system was observed[10] (figure 3).

Figure 1: Return on Assets (net profit in % of total assets)



Source: BNB, own calculations

The ROA developments of the different banks groups reveal that ROA of the first group has the same dynamics as the ROA of the total banking system. Actually, the first group determines the dynamics of the ROA in the banking system because it comprises more than 75% of the total assets in the banking system (79.5% in 1999). The ROA of the second group is moving relatively steady with the exception of the 2001 fall and the jump in 2003, when the interest rates dropped and the credit growth surged respectively.

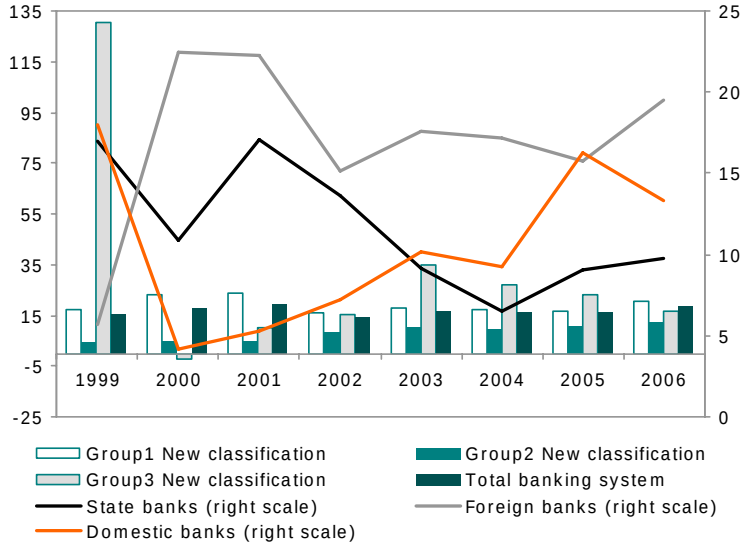
According to the ownership classification, a considerable change in the ROA of the foreign banks and domestic banks is observed. In 2000 Bulbank was sold to a strategic foreign bank and this contributed to the significant increase in the ROA of the foreign banks group. As the ROA of the Bulbank increased more

[9] In 2001 the main part of the banks assets was claims on financial institutions or banks assets invested abroad. The share of claims on financial institutions was 33.1% of the total banks assets, whereas the share of claims on non-financial assets was 33.9% of the total assets in 2001.

[10] The credit growth in 2003 was 49.4%, while in 2001 and 2002 it was 37.2% and 45.5% respectively.

than sixty percent it could be claimed that the privatisation has some effect on the bank efficiency. In 2003 there was again a new spike in the ROA of foreign banks when bank DSK was privatised, which confirms the stated thesis. After this period there were no more new foreign entries and the ROA stabilised. At the end of 2006 again there was an increase, this time due to the better performance of the foreign banks and probably decreased non-interest expenditures as a result of technological improvements. It should be pointed out that after 2000 the foreign banks have the highest profitability, measured by the ROA indicator, which could be explained with the transfer of technological advance, experience and knowledge of the foreign banks in the bank management of the privatised domestic banks.

Figure 2: Return on Equity Capital (equity capital in % of total assets)



Source: BNB, own calculations

Since 2002 the state-owned and the domestic banks have the same ROA, which could be explained with the high competition in the sector (see the Annex I)[11].

The bank efficiency, measured by the return on equity (ROE), is also relatively high[12]. In 1999 it decreased to 15.2% in comparison with 1997, when it was 40.5%. The Currency board adoption, the strong monetary rules and the new capital requirements have contributed to this slow-down. In 2000 and 2001 it stepped up for a while and in 2002 again registered a decrease mainly due to the exchange rates revaluations. For the next years the indicator remained relatively stable with the exception of 2006, when it went up because of the deceleration of the capital augmentation.

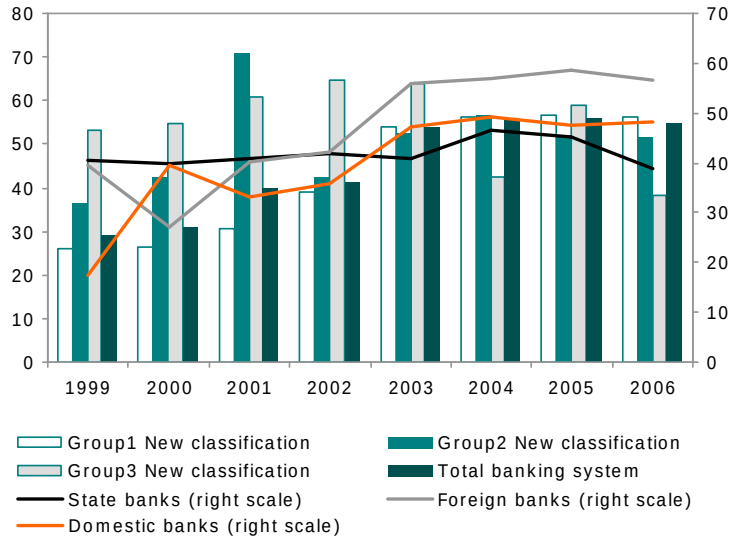
[11] We measure the competition with Herfindahl index and the concentration coefficient in respect to bank assets, claims on non-financial institutions and other clients and deposits of non-financial institutions and other clients.

[12] For the purpose of comparison the three EU countries with the highest ROE are Latvia (26.4), Estonia (24.4) and Czech Republic (23.5) (ECB (2007)).

The ROE is different for the separate banking groups. The third group has the largest volatility with the indicator moving in the range of -1.96 to 130.5%. The second banking group had moderate increase in the ROE, especially after the spike in 2002. The data shows that the indicator for the entire banking system is determined by the dynamics of the indicator for the first and third group.

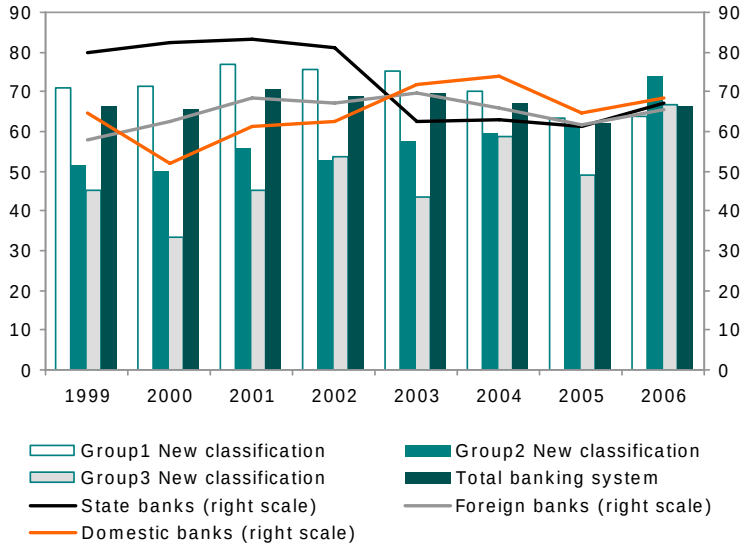
Concerning the ownership structure, the foreign banks have the highest efficiency due to the reasons stated above. The dynamics of ROE follows the dynamics of ROA. However, the efficiency of the domestic banks followed an upward trend after the privatisation of Bulbank in 2000. In 2006 there was a slight decrease of the indicator due to the restrained opportunities for net profits of the domestic banks as a result of the central bank measures for curbing bank credit activities (figure 3). Additional factors are the price increase of the financial resources attracted by the domestic banks (in 2006 interest rates on term deposits in BGN increased by 0.23 percentage points to 3.47%) and the competition in the bank sector mainly in respect to deposits collection (figure 4). At the same time the state-owned banks are characterised with decreasing bank efficiency, reaching its lowest level among the banking system during the last four years.

Figure 3: Credit to Non-financial Institutions and Other Clients
(% of total assets)



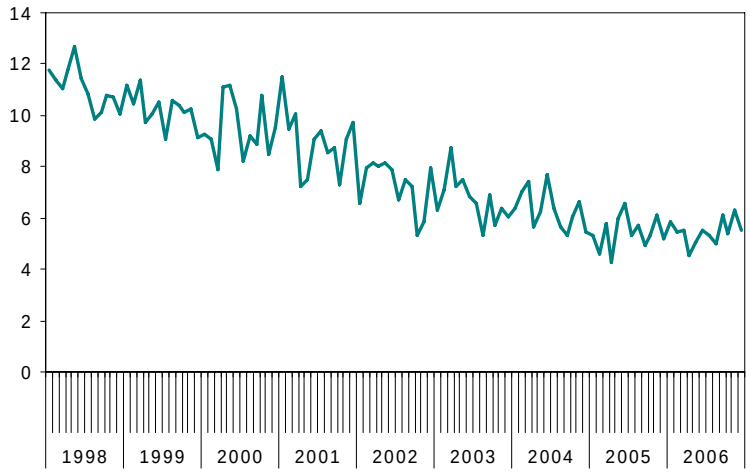
Source: BNB, own calculations

Figure 4: Deposits to Non-financial Institutions and Other Clients
(% of total assets)



Source: BNB, own calculations

Figure 5: Interest Rate Spread (percentage points)



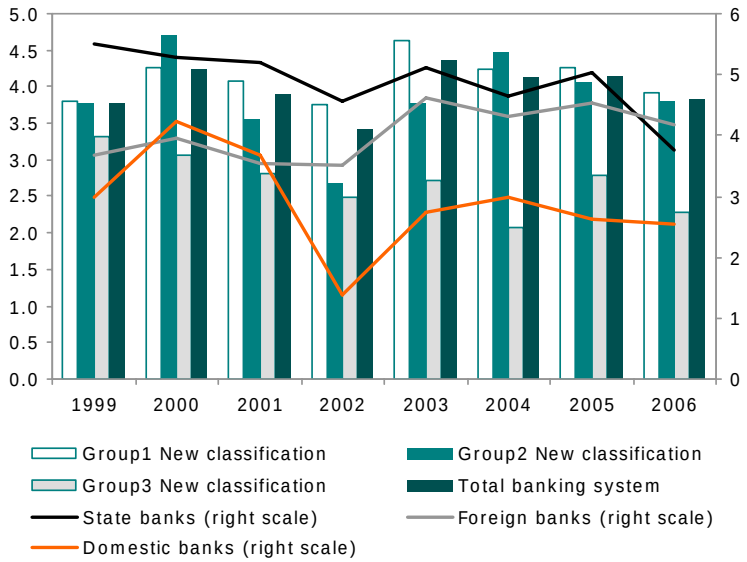
Source: BNB, own calculations

The declining interest spread[13] in the country lowers cost of credit and encourages investment projects implementation, thus stimulating the economic growth. Although the interest spread in Bulgaria is about 3-3.5 percentage points higher than its average level in the EU, it follows a stable downward path with the financial integration and continued process of intermediation deepening (figure 5).

[13] The interest spread is the difference between the interest rates on short-term loans and interest rates on term deposits.

Although the net non-interest income contribution to total income generation is steadily increasing, the net interest income remains the most important source of income for the Bulgarian banking system, mainly because of the high interest spread (figure 6). However, since 2004 there is a slight decrease in the net interest income (more pronounced for the second group of small and medium-sized banks), which reflects the higher costs of financing and the slow-down of credit activity.

Figure 6: Net Interest Income (% of total assets)

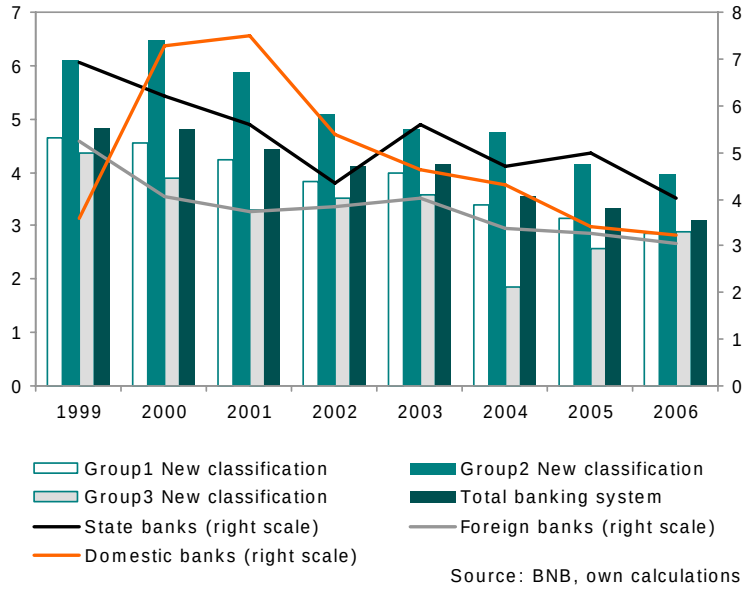


Source: BNB, own calculations

Another positive impact on the bank efficiency comes from the non-interest expenditures of the banks (figure 7). Since 2000 the administrative costs follow a downward trend, driven by the improvement of banking institutions management all over the system. The most significant drop is observed in domestic banks group, as their administrative costs converge rapidly towards those of the foreign banks.

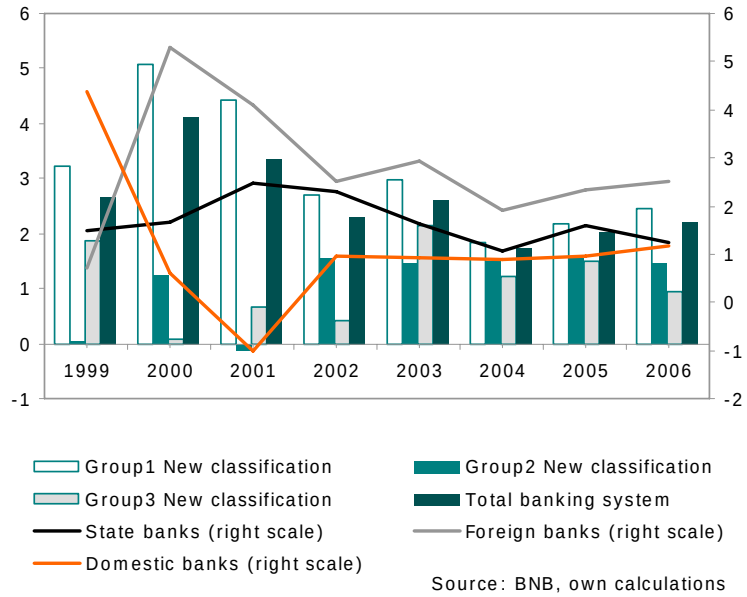
The observed tendencies are reflected in the dynamics of operating profit to total assets ratio which after a significant drop in the period 2000-2003 stabilized and started to grow again. Together with the declining interest spread and decreasing non-interest expenditures, this reflects the improved efficiency of the banking institutions. The most efficient is the group of large banks due to the economies of scale, and in respect to the second classification – the group of foreign banks due to the flexibility of financing and better access to managerial and technology improvements. The stabilization of operating profit observed in the group of domestic banks proves that as a whole this group is improving its potential to operate under increased competition pressure, thus contributing to the process of transformation of the banking system into more efficient one.

Figure 7: Non-Interest Expenditures (% of total assets)



Source: BNB, own calculations

Figure 8: Operating Profit (% of total assets)



Source: BNB, own calculations

On the ground of the analysis of the traditional indicators for bank efficiency we come to the following conclusions:

First, the efficiency of the entire banking system is determined by the efficiency of the largest banks in the banking system, which comprises the first banking group. The largest banks are more efficient than the small ones because of the opportunities to take advantage of the economies of scale.

Second, the most efficient banks in terms of ROA and ROE are the foreign ones because of the transfer of technological knowledge and experience in the management of the privatized domestic banks. The foreign banks increase the competition in the banking system, which in its turn pushes the domestic banks to start a process of transformation in order to operate more efficiently. Thus, domestic banks underwent significant drop in their administrative costs by management improvements.

Finally, the net interest income remains the most important source of income for the Bulgarian banking system because of the relatively high interest spread in the country. Thus, the whole banking system has relatively higher efficiency as compared with the rest of the EU banking systems due to the relatively high profits realized in the sector.

3.2. Data Envelopment Analysis

DEA is a specific methodology for analysis of the relative efficiency for multiple inputs and outputs by evaluation of all decision-making units (DMUs)[14] and measurement of their performance in respect to the best practice banks, which determine the so-called efficient frontier (See Annex II). The most important advantage of DEA is that it does not require in advance assumptions about the production function's analytical form. At the same time like the rest of the models, DEA also has some disadvantages. First, it is sensitive to extreme observations, and second, it does not decompose the banks deviation from the efficient production frontier into inefficiency and random error components.

We use both the traditional approach and the DEA approach to bank efficiency in order to obtain more complete and clear picture of the bank performance and efficiency. Both methods have important advantages. The traditional accounting approach provides opportunities for better comparison of the tendencies and measures the performance of the bank in terms of profitability. In its turn, the DEA approach enables for the determination of multiple outputs and multiple inputs in efficiency score calculation, and measures the technical efficiency of the banking institutions. At the same time, the DEA treats the bank as an enterprise with specific production process, taking into account the particular production factors and allowing for optimal decision making.

The DEA is more complex and sophisticated method than the traditional ones, because it is a deterministic non-parametric approach, using multiple inputs and outputs. At the same time, unlike the parametric approaches (Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and Thick Frontier Approach (TFA)) it doesn't need too long time series.

There are various models of DEA. We choose to apply the most frequently used ones – CCR-model and BCC-model. CCR-model was developed by Charnes, Cooper and Rhodes (Charnes et al. (1978)). Its specific assumption is that the DMU operates under constant returns to scale (CRS). BCC-model was defined by

[14] In our study the DMUs are the commercial banks.

Banker, Charnes and Cooper (Banker et al. (1984)). It estimates the efficiency under the assumption of variable returns to scale (VES). The efficiency scores calculated by BCC-model are higher than the efficiency scores estimated by CCR-model. BCC-model compares DMUs with the DMUs, operating in the same region of returns to scale, while CCR-model compares DMUs in the whole sample. To perform the efficiency scores calculation we use the software DEAFrontier, developed by Joe Zhu.

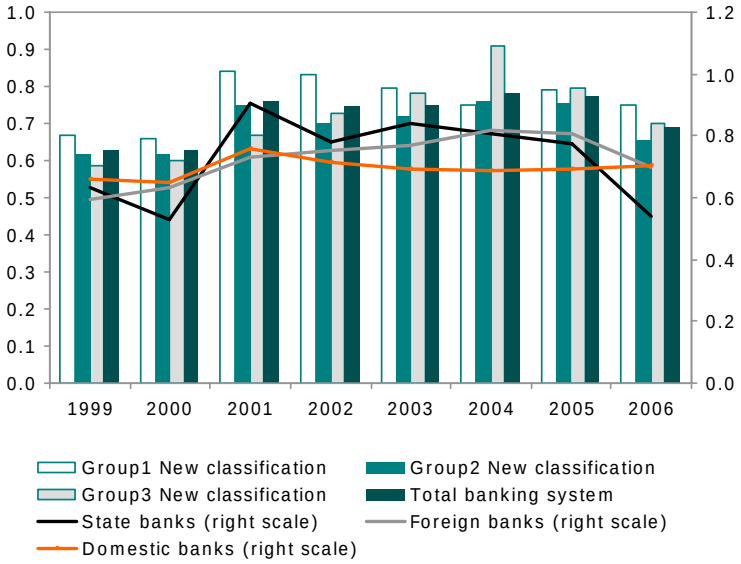
In addition to the specification of the used DEA-model it is necessary to determine the factors, which will be used as measures of inputs and outputs. Depending on the data availability and the economic treatment of banking institutions as producers of financial services or mediators of funds between savers and investors, several approaches to DEA have been used. In the literature the following approaches could be identified: operating approach, intermediation approach, production approach, value-added approach, user cost approach and asset approach (Jemric and Vujcic (2002), Pawlowska (2005), Grigorian and Manole (2002)). In fact, there is no consensus which of the available approaches to DEA should be used for the efficiency scores estimation. We decided to use the operating approach and intermediation approach, as they are in line with the specific treatment of Bulgarian banks behaviour and fit very well to the available individual banks data.

The operating approach estimates the efficiency from the cost/revenues perspective, while the intermediation approach treats the banks as units, which transform a set of production factors into final banking products. For the operating approach we use two variables for inputs: interest and related costs and non-interest costs, while for the outputs we take the interest and related revenues and the non-interest revenues. For the intermediation approach the production factors used are the fixed assets, the number of employed and the deposits, while the final products are covered by loans and securities.

Before presenting the efficiency results according to the operating approach specification of DEA, it is necessary to explain how the scores should be interpreted. In 1999 the average efficiency score of the total banking system is 0.63, which means that the average bank uses efficiently only 63% of its inputs to produce its current outputs. For comparison, in 2006 the average efficiency of the banks is 0.69, which means that 69% of inputs are efficiently used.

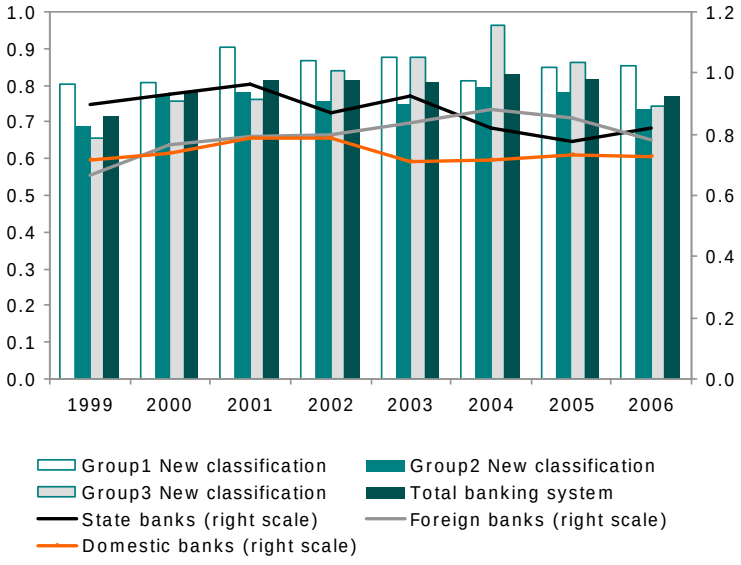
The calculations obtained when using the CRS-model show that there is relatively large asymmetry among banks (see Figure 9 and the detailed results in Annex III). There is a tendency of increase in average efficiency of the total banking system until 2005, when it has been reversed as a result of the credit measures adopted by the central bank. The drop in efficiency in 2006 is due to the rise in interest and related costs of the foreign banks as a result of their policy to attract financial resources from abroad under the circumstances of faster increasing international liquidity costs compared to those at the local market. At the same time, the domestic banks maintain relatively stable efficiency levels with equalisation in terms of average efficiency into the group. It has been measured by the standard deviation, which over the time falls dramatically.

Figure 9: Efficiency Score by Operating Approach (CRS)



Source: own calculations

Figure 10: Efficiency Score by Operating Approach (VRS)

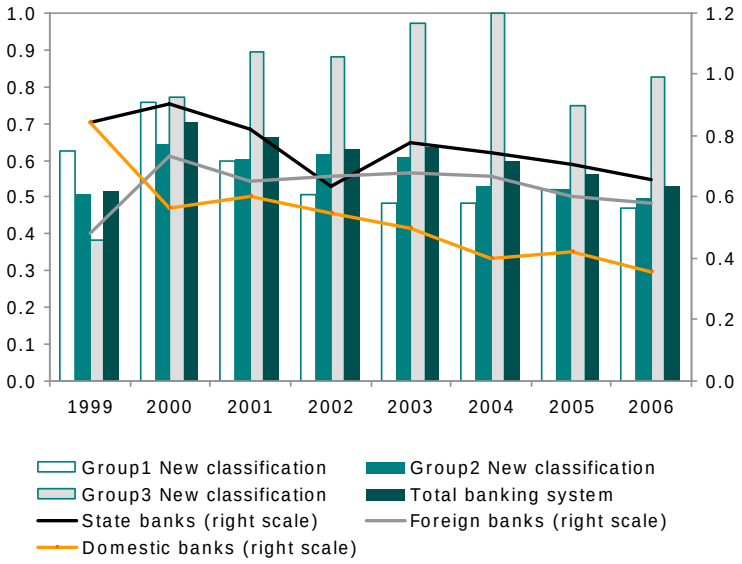


Source: own calculations

According to the VRS-model (see Figure 10), we observe less dramatic changes in the technical efficiency and higher number of efficient banks. The average efficiency of the total banking system declined again in 2005 and 2006, but the drop is less pronounced due to the rising efficiency of the top 10 banks. The share of administrative costs in total costs has been substantially cut down as a consequence of the changed ownership structure in the large banks group. The foreign participation influenced the transfer of knowledge and better management

practices, including administrative costs optimisation, which led to higher efficiency in the group.

Figure 11: Efficiency Score by Intermediation Approach (CRS)



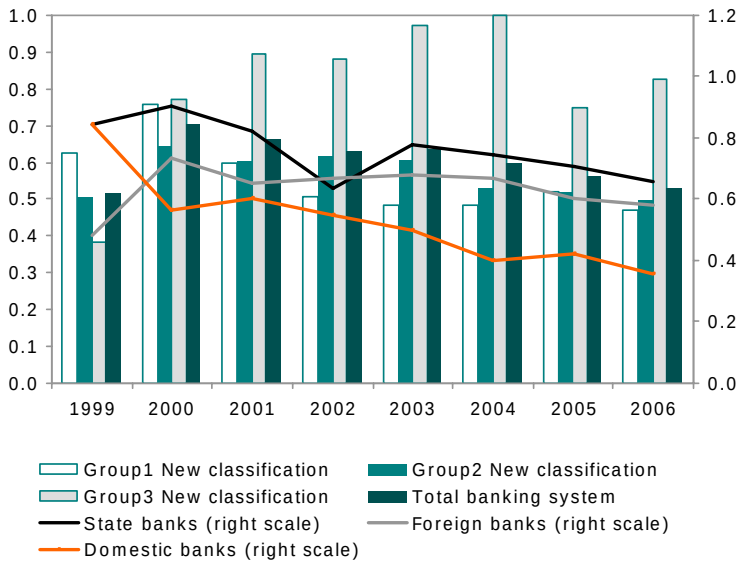
Source: own calculations

The intermediation approach provides another perspective of what happens to the bank efficiency, when actual production process is regarded as a "black" box. In that case the efficiency is simply estimated upon the amount of output produced from certain amount of inputs.

Using CRS intermediation approach (see Figure 11 and Annex IV), we obtain much lower average efficiency score for the total banking system as compared with the operating approach models. This is due to much lower average efficiency scores of the large banks. As the intermediation approach does not account for the transaction costs per unit of output, which are much higher for the smaller banks, the CRS assumption is the only one appropriate for them.

The VRS-model is more appropriate when calculating the average banking efficiency, because the large banks in Bulgaria account for about 75% of the total assets in the banking system. This assumption is further supported by the presence of factors like increasing competition, changes in regulation and technology improvement, which might prevent the banks from operating at the optimal scale or change substantially the production frontiers. In addition, this statement is supported by the results obtained when using the software solver. The estimations show that during the analysed period there are only few banks, which operate on the optimal scale. When we drop the strict assumption for constant returns to scale and allow for variable returns to scale, the solver shows that most of the banks are operating under decreasing or increasing returns to scale.

Figure 12: Efficiency Score by Intermediation Approach (VRS)



Source: own calculations

Under the VRS-model of intermediation approach we observe much higher average banks efficiency than under the already presented models (see Figure 12). According to the detailed results it has been driven by the top 10 banks, where a huge improvement in technological process took place through two channels. First, there was a substantial shift in capital to labour ratio (fixed assets per employee), which grew about 3 times during the analysed period. And second, the labour productivity increased seven times (loans and securities per employee).

Using the ownership classification, we find that the high bank efficiency of the total system reflects the efficiency-net effects of foreign banks presence at the local market. They are the main providers of new technologies and better administrative cost management implementation. The presence of the foreign banks stimulated the competition in the financial sector and put a lot of pressure on domestic banks. As a result they went through a process of optimisation of their activities, which led to improvement in their efficiency scores, more visible during the last two years. At the same time, the general trend of equalisation of efficiency in their group was observed.

Regarding the state-owned banks we should point out that the sample is small and diminishing so we could not rely on the estimated efficiency scores. During the first years of the analysed period most of the privatization deals were closed, while currently some mergers lead to further consolidation of the banking system.

On the ground of the analysis of the estimated efficiency scores for the different groups and sub-groups we come to the following conclusions:

First, under the operating approach to DEA we observe a tendency of increase in average efficiency of the banking system, which was interrupted in the last year of the analysed period. This might be a consequence of the imposed credit measures by the central bank. Under the CRS intermediation approach we find

that the average efficiency of the banking system is lower as compared with the operating approach results because of the efficiency scores of the largest banks. This is due to the fact that the intermediation approach does not account for the transaction costs per unit of labour.

Second, the applied intermediation and operating approaches to DEA show that there is an equalisation in the Bulgarian banking system during the analysed period.

Third, the foreign banks have relatively higher efficiency as compared with the domestic and state-owned banks, as a result of the transfer of knowledge, better management practice, including administrative cost optimisation.

Finally, the VRS-model is more appropriate when calculating the large banks and the total banking system's average efficiency, because the increasing competition, technology improvement and regulatory changes affect the banks' behaviour and impede some of them from operating at their optimal level.

IV. Conclusion

In the paper we estimate and analyse the efficiency of the Bulgarian banking system by splitting it into several major groups, according to the ownership structure and banks assets. We use standard indicators for bank efficiency, namely return on assets, return on capital, operating profit, net interest income, non-interest expenditures and exchange rate revaluations. In order to check the robustness of the obtained results we use the DEA approach to bank efficiency scores' measurement. The lack of data concerning particular banks prior to 1999 prevents us from providing a consistent analysis for the period preceding the Currency board establishment. However, using the official data we make some conclusions for the current state of the banking system profitability and confirm the initial hypotheses.

On the ground of the analysis we come to the conclusion that during the analysed period the foreign banks perform better than domestic and state-owned banks. Their efficiency is higher than that of other banks because of the technological improvements and better managerial knowledge and experience. Actually, the privatization of the state-owned banks had a positive impact not only on the privatised banks efficiency but also on the entire system.

In addition, the large banks turned out to be more efficient in comparison with the small ones. The reasons behind are the decreasing operating costs and the advantage of scale economies realisation. The accumulation of large financial resources, the need for better management and the increased competition in the banking system put pressure on domestic banks, which inevitably led to increase in their non-interest expenditures. Although such investments have higher burden for the small banks, they are expected to augment the banks' capacity to further improve their efficiency in the future. In fact, the competition also led to equalisation in average efficiency not only in the separate groups, but also all over the system.

Taking into account the importance of the efficiency development of the banking system, especially in highly competitive and dynamic environment as the one where the Bulgarian banking intermediaries operate, requires further research on the topic. In order to decompose efficiency change into technical and scale efficiency and to provide better time comparisons we intend to use the so-called Malmquist index. With the accumulation of longer time series we plan as well to apply some parametric approaches to bank efficiency measurement in order to account for institutional, other financial and macroeconomic factors, which have impact not only on technical, but also on economic efficiency of the banks.

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Annexes

Annex I

Table 1: Measures of Concentration in the Banking Sector

	XII.1999	XII2000	XII.2001	XII.2002	XII.2003	XII.2004	XII.2005	XII.2006
Banks assets								
Herfindahl Index	0.12	0.11	0.09	0.08	0.08	0.07	0.07	0.07
Concentration Coefficient (%)	57	55.2	51.4	49.9	47	44.2	42.19	41.18
Claims on non-financial institutions and other clients								
Herfindahl Index	0.08	0.07	0.07	0.07	0.07	0.08	0.08	0.08
Concentration Coefficient (%)	43.6	42	41.1	41.85	43.15	45.36	44.98	44.19
Deposits of non-financial institutions and other clients								
Herfindahl Index	0.13	0.13	0.11	0.1	0.09	0.08	0.08	0.07
Concentration Coefficient (%)	61.7	62.2	58.2	55.8	53.07	50.32	46.79	43.79

Source: Miller and Petranov (1996), BNB, AEAF, own calculations.

Annex II

The efficiency score[15] in the presence of multiple input and output factors is defined as:

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

The optimal weights are obtained by solving the following mathematical programming problem:

$$\max_{u,v}(u' y_i / v' x_i) \qquad \text{(AII.1)}$$

$$\text{Subject to} \quad u' y_j / v' x_j \le 1 \quad j = 1,2,....,I$$

$$u, v \ge 0$$

For each of I firms there are N inputs and M outputs. In that case the column vectors x_i and y_i represent the set of inputs and outputs respectively for the i-th firm, while the data for all I firms is represented by the NxI input matrix, X, and the MxI output matrix, Y.

The following *multiplier form* avoids the problem of obtaining an infinite number of solutions by imposing a new constraint:

$$\max_{u,v}(u' y_I) \qquad \text{(AII.2)}$$

$$\text{Subject to} \quad v' x_I = 1$$

$$u' y_j - v' x_j \le 0 \quad j = 1,2,..., j_0,..., I$$

$$u, v \ge 0$$

The equivalent *envelopment form* of this linear programming problem is the preferred one to solve, as it involves fewer constrains than the multiplier form (AII.2):

$$\min_{\theta,\lambda} \theta \qquad \text{(AII.3)}$$

$$\text{Subject to} \quad -y_I + \mathrm{Y}\lambda \ge 0$$

$$\theta x_I - \mathrm{X}\lambda \ge 0$$

$$\lambda \ge 0$$

Here θ is a scalar, and λ is an Ix1 vector of constants (i.e. weights). The value of θ obtained is the efficiency score of the i-th firm and it satisfies $\theta \le 1$, where a value

[15] The presented specifications of the DEA models are based on the book "An Introduction to Efficiency and Productivity Analysis", by Coelli et al. (2005), Springer Science and Business Media Inc., 2nd Ed., where more detailed information on efficiency measurement models might be found.

of 1 indicates a point on the frontier, i.e. a technically efficient firm. To obtain the value of θ for each firm, the linear programming model must be solved I times.

The presented approach to the linear programming problem (AII.2) assumes constant returns to scale (CRS). The CRS problem can be easily modified to account for VRS by adding a convexity constraint, which allows to envelope the data points more tightly than under the CRS specification and thus provides technical efficiency scores that are greater than or equal to those obtained using CRS model (see AII.5). The VRS linear programming problem is:

$$\begin{aligned} & \min_{\theta,\lambda} \theta \\ \text{Subject to} \quad & -y_I + \mathrm{Y}\lambda \geq 0 \\ & \theta x_I - \mathrm{X}\lambda \geq 0 \\ & \mathrm{I1}^1 = 1 \\ & \lambda \geq 0 \end{aligned} \tag{AII.4}$$

Where I1 is an Ix1 vector of ones.

The technical efficiency scores (TE) under CRS and VRS specifications are related by the scale efficiency effect (SE), which is netted when calculating technical efficiency under VRS. The relation is:

$$TE_{CRS} = TE_{vrs} \times SE \tag{AII.5}$$

Annex III

Operating approach								
	1999	2000	2001	2002	2003	2004	2005	2006
Total banking system								
	Constant returns to scale							
Number of DMUs	34	35	35	34	35	35	34	32
Number of efficient DMUs	5	5	7	6	7	8	7	5
Average efficiency	0.62521	0.62656	0.75886	0.74366	0.75189	0.78059	0.77358	0.69179
Average inefficiency ((1-M)/M)	0.599468	0.596012	0.317767	0.344702	0.329977	0.281084	0.29270	0.44552
Median efficiency level	0.599569	0.589527	0.75452	0.744566	0.725317	0.802422	0.74633	0.656706
Minimal efficiency level	0.193809	0.191409	0.300053	0.44169	0.347347	0.42749	0.48328	0.30577
Maximal efficiency level	1	1	1	1	1	1	1.00000	1
Standard deviation	0.219436	0.228723	0.187176	0.170559	0.182134	0.175708	0.15694	0.192454
	Variable returns to scale							
Number of DMUs	34	35	35	33	35	35	34	32
Number of efficient DMUs	7	11	13	8	9	11	11	8
Average efficiency	0.716155	0.778436	0.810752	0.811301	0.806991	0.828409	0.815609	0.771595
Average inefficiency ((1-M)/M)	0.396345	0.284627	0.233422	0.232588	0.239171	0.207133	0.226078	0.296017
Median efficiency level	0.725399	0.795413	0.819341	0.841807	0.846098	0.858396	0.798569	0.737339
Minimal efficiency level	0.267167	0.423542	0.50156	0.477995	0.417855	0.428046	0.498267	0.5292
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.219588	0.191869	0.178885	0.16315	0.187659	0.170501	0.16184	0.17156
Group1 New classification								
	Constant returns to scale							
Number of DMUs	10	10	10	10	10	10	10	10
Number of efficient DMUs	2	1	1	3	2	2	2	1
Average efficiency	0.66605	0.65847	0.84052	0.83268	0.79496	0.74856	0.79309	0.75197
Average inefficiency ((1-M)/M)	0.501385	0.518661	0.18974	0.200946	0.257927	0.335904	0.260896	0.329839
Median efficiency level	0.625301	0.597747	0.852255	0.793301	0.802465	0.782777	0.746328	0.718653
Minimal efficiency level	0.428059	0.325125	0.61238	0.680747	0.541371	0.42749	0.568586	0.595192
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.203318	0.198526	0.124088	0.124516	0.156598	0.194692	0.149758	0.118751
	Variable returns to scale							
Number of DMUs	10	10	10	10	10	10	10	10
Number of efficient DMUs	3	4	5	4	3	3	4	3

Average efficiency	0.80439	0.80873	0.902937	0.86849	0.877555	0.810071	0.848324	0.851218
Average inefficiency ((1-M)/M)	0.243177	0.236507	0.107497	0.151423	0.13953	0.234459	0.178794	0.174788
Median efficiency level	0.82526	0.804584	0.967421	0.861512	0.960248	0.862732	0.911078	0.840182
Minimal efficiency level	0.555205	0.447997	0.66988	0.696046	0.547792	0.428046	0.57063	0.596162
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.173095	0.197142	0.122866	0.12369	0.166491	0.199983	0.169492	0.132844
Group2 New classification								
	Constant returns to scale							
Number of DMUs	17	17	18	18	19	19	18	18
Number of efficient DMUs	3	2	5	2	4	3	3	3
Average efficiency	0.61701	0.61995	0.74827	0.69906	0.71983	0.75726	0.75517	0.65654
Average inefficiency ((1-M)/M)	0.620709	0.613038	0.336417	0.430484	0.389212	0.320546	0.324211	0.523141
Median efficiency level	0.586936	0.571133	0.741547	0.667464	0.678585	0.720622	0.751076	0.627909
Minimal efficiency level	0.193809	0.243918	0.300053	0.44169	0.347347	0.526243	0.483282	0.30577
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.251288	0.225486	0.210152	0.178802	0.207888	0.169749	0.163524	0.215593
	Variable returns to scale							
Number of DMUs	17	17	18	18	19	19	18	18
Number of efficient DMUs	4	4	6	2	4	4	4	4
Average efficiency	0.689291	0.770547	0.778557	0.75494	0.748631	0.795696	0.782079	0.733903
Average inefficiency ((1-M)/M)	0.450765	0.297779	0.284428	0.324609	0.335771	0.256762	0.278643	0.362577
Median efficiency level	0.716472	0.760676	0.764158	0.756778	0.727149	0.838266	0.793436	0.649676
Minimal efficiency level	0.267167	0.484996	0.50156	0.477995	0.417855	0.550285	0.498267	0.5292
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.250554	0.172554	0.189516	0.178558	0.199886	0.162894	0.161686	0.181303
Group3 New classification								
	Constant returns to scale							
Number of DMUs	7	8	7	6	6	6	6	4
Number of efficient DMUs	0	2	1	1	1	3	2	1
Average efficiency	0.58676	0.60072	0.66943	0.72908	0.78164	0.90784	0.79629	0.69999
Average inefficiency ((1-M)/M)	0.704276	0.664657	0.493797	0.371588	0.279359	0.10151	0.255828	0.428586
Median efficiency level	0.608489	0.576593	0.601013	0.70329	0.741628	0.947422	0.743712	0.687722
Minimal efficiency level	0.368239	0.191409	0.517595	0.526036	0.64465	0.699426	0.578889	0.424528
Maximal efficiency level	0.797327	1	1	1	1	1	1	1
Standard deviation	0.17247	0.291353	0.171823	0.179237	0.13105	0.120096	0.16933	0.239629

	Variable returns to scale							
Number of DMUs	7	8	7	6	6	6	6	4
Number of efficient DMUs	0	3	2	2	2	4	3	1
Average efficiency	0.655346	0.757333	0.76185	0.837506	0.874191	0.962564	0.861671	0.742148
Average inefficiency ((1-M)/M)	0.525911	0.320424	0.312595	0.194021	0.143915	0.038892	0.160536	0.34744
Median efficiency level	0.712704	0.800159	0.716705	0.854946	0.899708	1	0.881715	0.690909
Minimal efficiency level	0.407401	0.423542	0.521482	0.619108	0.660575	0.853456	0.687759	0.586775
Maximal efficiency level	0.896265	1	1	1	1	1	1	1
Standard deviation	0.183086	0.242514	0.191994	0.17861	0.13197	0.061906	0.153429	0.184699
State banks (right scale)								
	Constant returns to scale							
Number of DMUs	5	4	4	3	2	2	2	2
Number of efficient DMUs	1	0	1	0	1	1	1	0
Average efficiency	0.63343	0.52925	0.90425	0.78113	0.83929	0.80506	0.77351	0.53839
Average inefficiency ((1-M)/M)	0.578702	0.889463	0.105884	0.280193	0.19148	0.242137	0.292805	0.857398
Median efficiency level	0.586936	0.583733	0.886906	0.783472	0.839292	0.805064	0.773512	0.538388
Minimal efficiency level	0.360939	0.350377	0.843205	0.732091	0.678585	0.610129	0.547024	0.4628
Maximal efficiency level	1	0.599161	1	0.827835	1	1	1	0.613976
Standard deviation	0.255179	0.119913	0.074126	0.047915	0.227275	0.275681	0.320303	0.106898
	Variable returns to scale							
Number of DMUs	5	4	4	3	2	2	2	2
Number of efficient DMUs	3	2	3	1	1	1	1	1
Average efficiency	0.896155	0.931468	0.964592	0.868015	0.923049	0.817444	0.775303	0.822223
Average inefficiency ((1-M)/M)	0.115878	0.073574	0.036708	0.152054	0.083366	0.223326	0.289818	0.216215
Median efficiency level	1	0.961068	1	0.858312	0.923049	0.817444	0.775303	0.822223
Minimal efficiency level	0.644195	0.803737	0.858367	0.745732	0.846098	0.634887	0.550606	0.644446
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.157626	0.092728	0.070817	0.127412	0.108825	0.258174	0.317769	0.251415
Foreign banks (right scale)								
	Constant returns to scale							
Number of DMUs	17	21	22	21	23	23	23	22
Number of efficient DMUs	1	4	4	5	5	7	6	5
Average efficiency	0.59641	0.63357	0.73348	0.75334	0.77050	0.81947	0.80457	0.70051
Average inefficiency ((1-M)/M)	0.676708	0.578359	0.363364	0.327416	0.297862	0.220306	0.242907	0.427534
Median efficiency level	0.608489	0.589527	0.732765	0.74744	0.729406	0.811494	0.757332	0.688298

Minimal efficiency level	0.193809	0.191409	0.300053	0.44169	0.415808	0.529875	0.578889	0.30577
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.199266	0.243535	0.200112	0.182101	0.166723	0.161748	0.142216	0.21704
	Variable returns to scale							
Number of DMUs	17	21	22	21	23	23	23	22
Number of efficient DMUs	1	7	7	6	7	9	9	7
Average efficiency	0.665469	0.76785	0.791323	0.800721	0.838393	0.878357	0.851158	0.783235
Average inefficiency ((1-M)/M)	0.502699	0.302337	0.263706	0.248875	0.192758	0.13849	0.17487	0.276756
Median efficiency level	0.712704	0.795019	0.817989	0.820791	0.916483	0.92193	0.827626	0.761673
Minimal efficiency level	0.270949	0.423542	0.50156	0.477995	0.425016	0.550285	0.629236	0.5292
Maximal efficiency level	1	1	1	1	1	1	1	1
Standard deviation	0.19572	0.19972	0.185347	0.177236	0.176278	0.140935	0.135318	0.182077
Domestic banks (right scale)								
	Constant returns to scale							
Number of DMUs	12	10	9	10	10	10	9	8
Number of efficient DMUs	3	1	2	1	1	0	0	0
Average efficiency	0.66258	0.65077	0.75628	0.71208	0.69162	0.68628	0.69440	0.70618
Average inefficiency ((1-M)/M)	0.509245	0.536641	0.322262	0.404334	0.445877	0.457139	0.440099	0.416079
Median efficiency level	0.599569	0.607843	0.728573	0.670851	0.635345	0.644195	0.688139	0.656145
Minimal efficiency level	0.265369	0.325125	0.537406	0.511846	0.347347	0.42749	0.483282	0.595192
Maximal efficiency level	1	1	1	1	1	0.948271	0.965563	0.916183
Standard deviation	0.245327	0.236783	0.171382	0.175123	0.212166	0.17423	0.152779	0.117805
	Variable returns to scale							
Number of DMUs	12	10	9	10	10	10	9	8
Number of efficient DMUs	3	2	3	1	1	1	1	0
Average efficiency	0.712961	0.73945	0.789873	0.787968	0.711554	0.715723	0.733717	0.726927
Average inefficiency ((1-M)/M)	0.402602	0.35235	0.266027	0.269086	0.405374	0.397189	0.362923	0.375655
Median efficiency level	0.726663	0.73833	0.761007	0.768927	0.679558	0.694486	0.691533	0.65748
Minimal efficiency level	0.267167	0.44800	0.538008	0.525918	0.417855	0.428046	0.498267	0.596162
Maximal efficiency level	1	1.00000	1	1	1	1	1	0.966638
Standard deviation	0.247375	0.18764	0.174867	0.168342	0.200324	0.182626	0.18298	0.135719

Annex IV

Intermediation approach								
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Total banking system								
	Constant returns to scale							
Number of DMUs	34	35	35	34	35	35	34	32
Number of efficient DMUs	6	10	10	5	9	9	7	6
Average efficiency	0.5159	0.7055	0.6599	0.6312	0.6340	0.5970	0.5608	0.5305
Average inefficiency ((1-M)/M)	0.9383	0.4175	0.5154	0.5843	0.5772	0.6751	0.7832	0.8851
Median efficiency level	0.4676	0.7360	0.6525	0.5950	0.5583	0.5265	0.4753	0.4669
Minimal efficiency level	0.0068	0.0214	0.1659	0.2395	0.2147	0.1452	0.0000	0.1539
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.3252	0.3019	0.3005	0.2417	0.2814	0.3003	0.2875	0.2705
	Variable returns to scale							
Number of DMUs	34	35	35	34	35	35	34	32
Number of efficient DMUs	12	18	15	18	17	16	15	14
Average efficiency	0.6883	0.7888	0.8120	0.8390	0.8068	0.7694	0.7622	0.7988
Average inefficiency ((1-M)/M)	0.4529	0.2678	0.2315	0.1919	0.2395	0.2997	0.3120	0.2519
Median efficiency level	0.7329	1.0000	0.9708	1.0000	0.9242	0.9288	0.8428	0.9502
Minimal efficiency level	0.0929	0.1617	0.2354	0.2930	0.2411	0.2085	0.1305	0.3010
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.2971	0.2627	0.2531	0.2173	0.2510	0.2641	0.2631	0.2491
Group1 New classification								
	Constant returns to scale							
Number of DMUs	10	10	10	10	10	10	10	10
Number of efficient DMUs	2	3	1	0	0	1	0	0
Average efficiency	0.6246	0.7599	0.5974	0.5078	0.4835	0.4842	0.5195	0.4708
Average inefficiency ((1-M)/M)	0.6010	0.3160	0.6740	0.9693	1.0684	1.0651	0.9249	1.1240
Median efficiency level	0.6045	0.8140	0.6440	0.4978	0.4141	0.3889	0.4357	0.4857
Minimal efficiency level	0.1986	0.2586	0.2208	0.2395	0.3267	0.2996	0.3105	0.2776
Maximal efficiency level	1.0000	1.0000	1.0000	0.7898	0.8924	1.0000	0.9436	0.6339
Standard deviation	0.2846	0.2629	0.2362	0.1808	0.1929	0.2285	0.1945	0.1176
	Variable returns to scale							
Number of DMUs	10	10	10	10	10	10	10	10
Number of efficient DMUs	4	7	4	5	6	5	6	7

Average efficiency	0.8617	0.8768	0.7654	0.8459	0.8567	0.8457	0.9191	0.9239
Average inefficiency ((1-M)/M)	0.1604	0.1406	0.3065	0.1822	0.1673	0.1825	0.0880	0.0823
Median efficiency level	0.8943	1.0000	0.9109	0.9885	1.0000	0.9718	1.0000	1.0000
Minimal efficiency level	0.6118	0.4668	0.2354	0.2930	0.4539	0.3446	0.6282	0.6664
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.1491	0.2068	0.2939	0.2426	0.2016	0.2383	0.1415	0.1274
Group2 New classification								
	Constant returns to scale							
Number of DMUs	17	17	18	18	19	19	18	18
Number of efficient DMUs	3	4	5	2	4	3	3	3
Average efficiency	0.5072	0.6431	0.6039	0.6167	0.6069	0.5297	0.5210	0.4982
Average inefficiency ((1-M)/M)	0.9714	0.5550	0.6558	0.6216	0.6476	0.8880	0.9196	1.0072
Median efficiency level	0.4218	0.7001	0.5945	0.5950	0.5583	0.4953	0.4465	0.3716
Minimal efficiency level	0.0068	0.0214	0.1659	0.2534	0.2147	0.1452	0.1219	0.1539
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.3324	0.3217	0.3343	0.2345	0.2799	0.2806	0.2713	0.2844
	Variable returns to scale							
Number of DMUs	17	17	18	18	19	19	18	18
Number of efficient DMUs	5	6	7	8	5	5	4	4
Average efficiency	0.6094	0.6972	0.7901	0.8006	0.7195	0.6565	0.6237	0.7234
Average inefficiency ((1-M)/M)	0.6410	0.4342	0.2656	0.2491	0.3898	0.5233	0.6032	0.3823
Median efficiency level	0.5756	0.7816	0.9123	0.8403	0.8147	0.6182	0.5937	0.7243
Minimal efficiency level	0.0929	0.1617	0.2483	0.3627	0.2411	0.2085	0.1305	0.3189
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.3078	0.2972	0.2574	0.2221	0.2772	0.2625	0.2611	0.2600
Group3 New classification								
	Constant returns to scale							
Number of DMUs	7	8	7	6	6	6	6	4
Number of efficient DMUs	1	3	4	3	5	5	4	3
Average efficiency	0.3818	0.7700	0.8931	0.8804	0.9709	0.9980	0.7491	0.8248
Average inefficiency ((1-M)/M)	1.6194	0.2987	0.1197	0.1358	0.0300	0.0020	0.3350	0.2124
Median efficiency level	0.2620	0.8279	1.0000	0.9599	1.0000	1.0000	1.0000	1.0000
Minimal efficiency level	0.0113	0.0558	0.5141	0.5292	0.8254	0.9882	0.0000	0.2993
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.3530	0.3146	0.1786	0.1844	0.0713	0.0048	0.4190	0.3504

	Variable returns to scale							
Number of DMUs	7	8	7	6	6	6	6	4
Number of efficient DMUs	3	5	4	5	6	6	5	3
Average efficiency	0.6321	0.8732	0.9350	0.9427	1.0000	1.0000	0.9161	0.8252
Average inefficiency ((1-M)/M)	0.5820	0.1452	0.0695	0.0608	0.0000	0.0000	0.0916	0.2118
Median efficiency level	0.5615	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Minimal efficiency level	0.2704	0.4685	0.5919	0.6560	1.0000	1.0000	0.4963	0.3010
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.3578	0.1966	0.1517	0.1404	0.0000	0.0000	0.2056	0.3495
State banks (right scale)								
	Constant returns to scale							
Number of DMUs	5	4	4	3	2	2	2	2
Number of efficient DMUs	1	2	2	1	1	1	1	1
Average efficiency	0.8459	0.9026	0.8214	0.6359	0.7792	0.7476	0.7089	0.6601
Average inefficiency ((1-M)/M)	0.1822	0.1080	0.2174	0.5726	0.2834	0.3376	0.4107	0.5150
Median efficiency level	0.8667	0.9635	0.8233	0.5145	0.7792	0.7476	0.7089	0.6601
Minimal efficiency level	0.6793	0.6832	0.6389	0.3932	0.5583	0.4953	0.4177	0.3202
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.1261	0.1502	0.2063	0.3211	0.3123	0.3569	0.4117	0.4807
	Variable returns to scale							
Number of DMUs	5	4	4	3	2	2	2	2
Number of efficient DMUs	4	4	3	2	2	2	2	1
Average efficiency	0.9953	1.0000	0.9925	0.9362	1.0000	1.0000	1.0000	0.9992
Average inefficiency ((1-M)/M)	0.0047	0.0000	0.0076	0.0681	0.0000	0.0000	0.0000	0.0008
Median efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9992
Minimal efficiency level	0.9764	1.0000	0.9698	0.8086	1.0000	1.0000	1.0000	0.9984
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.0105	0.0000	0.0151	0.1105	0.0000	0.0000	0.0000	0.0011
Foreign banks (right scale)								
	Constant returns to scale							
Number of DMUs	17	21	22	21	23	23	23	22
Number of efficient DMUs	4	7	7	4	7	7	6	5
Average efficiency	0.4839	0.7355	0.6533	0.6690	0.6807	0.6699	0.6016	0.5822
Average inefficiency ((1-M)/M)	1.0665	0.3596	0.5306	0.4948	0.4691	0.4929	0.6622	0.7178
Median efficiency level	0.3496	0.7735	0.6993	0.6508	0.7153	0.6473	0.5542	0.5024

Minimal efficiency level	0.0113	0.0214	0.1659	0.3122	0.3363	0.2016	0.0000	0.2178
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.3423	0.3179	0.3167	0.2264	0.2691	0.2873	0.2998	0.2733
	Variable returns to scale							
Number of DMUs	17	21	22	21	23	23	23	22
Number of efficient DMUs	6	12	10	11	14	13	12	12
Average efficiency	0.6727	0.8213	0.7969	0.8633	0.8809	0.8775	0.7973	0.8038
Average inefficiency ((1-M)/M)	0.4866	0.2175	0.2548	0.1583	0.1352	0.1395	0.2543	0.2441
Median efficiency level	0.6805	1.0000	0.9766	1.0000	1.0000	1.0000	1.0000	1.0000
Minimal efficiency level	0.2704	0.1617	0.2354	0.4586	0.4274	0.4480	0.3257	0.3010
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.2894	0.2531	0.2584	0.1852	0.1838	0.1771	0.2537	0.2659
Domestic banks (right scale)								
	Constant returns to scale							
Number of DMUs	5	10	9	10	10	10	9	8
Number of efficient DMUs	1	1	1	0	1	1	0	0
Average efficiency	0.8459	0.5635	0.6041	0.5504	0.4978	0.3992	0.4235	0.3559
Average inefficiency ((1-M)/M)	0.1822	0.7745	0.6554	0.8169	1.0090	1.5049	1.3612	1.8094
Median efficiency level	0.8667	0.5499	0.5998	0.5105	0.3829	0.3121	0.4173	0.3319
Minimal efficiency level	0.6793	0.2160	0.1733	0.2395	0.2147	0.1452	0.1219	0.1539
Maximal efficiency level	1.0000	1.0000	1.0000	0.9792	1.0000	1.0000	0.7024	0.6019
Standard deviation	0.1261	0.2656	0.2963	0.2584	0.2835	0.2501	0.2030	0.1378
	Variable returns to scale							
Number of DMUs	12	10	9	10	10	10	9	8
Number of efficient DMUs	2	2	2	5	1	1	1	1
Average efficiency	0.5825	0.6359	0.7688	0.7588	0.5977	0.4746	0.6197	0.7350
Average inefficiency ((1-M)/M)	0.7168	0.5727	0.3008	0.3179	0.6730	1.1069	0.6136	0.3605
Median efficiency level	0.6077	0.5780	0.9097	0.8807	0.5922	0.4564	0.6475	0.7171
Minimal efficiency level	0.0929	0.2181	0.2483	0.2930	0.2411	0.2085	0.1305	0.4346
Maximal efficiency level	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Standard deviation	0.2959	0.2646	0.2791	0.2872	0.2910	0.2204	0.2607	0.2153