Eurasian Journal of Business and Economics 2010, 3 (5), 1-25.

Bank Performance and Efficiency in Uzbekistan

Asror NIGMONOV *

Abstract

The development of financial system in Uzbekistan over the last decade puts lots of challenging tasks for the managers of this financial institutions and regulatory bodies. These tasks on its turn demand application of new innovative approaches into the banking system. As a reflection from these issues this paper seeks to apply relatively new method of performance measurement for this country called Data Envelopment Analysis (DEA).

For measuring the efficiency it uses two basic DEA models under the assumptions of constant and variable returns to scale. By using these analyses it seeks to measure and break down the efficiency levels of Uzbek banks during 2004-2006. The results have shown that the overall efficiency levels of banks on average decreased during this period. Additionally, it breaks down overall efficiency level of the banks into that originating from the technical efficiency and scale efficiency. The study found that the main source of inefficiency was due to the technical efficiency. By going further the DEA analysis was able to investigate the reasons for inefficiency for each individual bank.

It then compared the relative performance between the private, joint-stock and foreign banks for which no significant divergence were found. The investigation of differences between the small, medium and large banks lead to the observation of significant difference between the small and medium sized banks.

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

JEL Classification Codes*: C67, G21*

* Westminster International University, Tashkent, Uzbekistan, 100053, Tel.: + 99871 2387402, Fax.: + 99871 2363599,E-mail: anigmonov@wiut.uz

1. Introduction

During the last decade, the Uzbek financial system has been the focus of a series of transformation processes aiming at liberalizing, modernizing and improving the performance of financial markets and institutions. Today the system can be characterized by high concentration of small number of banks and increased size of assets. The affects of such changes into the bank's efficient operation are becoming an up-to-date issue in this sphere. But assessment of previous literature shows the lack of appropriate analysis for these issues. Therefore, more sophisticated performance evaluation measures are needed in order to better understand the functioning of banks and their performance in the whole system.

The nonparametric frontier approach which is called Data Envelopment Analysis is used in this paper for exploring the following research question:

On which extend do the efficiency of banks in Uzbekistan diverge and which factors determine their effectiveness?

In order to deeper explore the research question we subdivide our analysis into several objectives.

1. Assess the structure and overall performance of the Uzbek banking sector: it allows the author to investigate the background information and build the foundations of hypothesis and methodology to be used.
2. Determine the efficiency levels according the predetermined DEA method: in methodology part of the paper the reasoning for choosing particular type of DEA model is explained. Using this model efficiency level of each bank under consideration will be calculated.
3. Investigate whether the ownership structure and size of a bank affect its effectiveness: at this stage obtained results on DEA efficiency will be analyzed.

2. Literature Review

The term "efficiency" is one of the key concepts for financial institutions. It has been extensively studied due to its importance. Mainly, the studies making typical comparisons of bank performance can be divided into two categories: (1) those which use simple aggregate bank ratios relating cost to revenues or assets, and (2) frontier technique which measures a bank's efficiency by its distance to the efficient frontier (Laeven 1999). In this paper we will use the particular frontier technique of Data Envelopment Analysis (DEA) to analyze the efficiency of the Uzbek banking system.

Originally, DEA was first introduced in the work of Farrell (1957) and then developed in the work of Charnes et al. (1978) where they described it as

"mathematical programming model applied to observational data [that] provides a new way of obtaining empirical estimates of relations – such as the production

functions and/or efficient production possibility surfaces – that are cornerstones of modern economics" (cited in Cooper et.al. 2004, page 2).

Since, this model extensively used in different sectors of economy starting from the evaluation of fast-food restaurant chains (KonSi Ltd. 2006) up to the assessment of the performance of large banks in the Japanese financial sector (Harada 2005). However, DEA focuses primarily on the technological aspects of production correspondences, it can be used to estimate technical and scale efficiency without requiring estimates of input and output prices. Thus, this approach has been used extensively in the regulated sector (e.g., Banker et.al. 1986) and the non-profit sector (Lewin, Morey and Cook, 1982). Whereas, the first application of this technique into the banking context can be observed in a work of Sherman and Gold (1985); they used it to explore some operating aspects of bank branches. The paper of Berger and Humphrey (1997) provides thorough results of 130 researches conducted in more than 21 countries. They compared the results for four types of financial institutions — banks, S&Ls, credit unions, and insurance firms. Overall, the mean efficiency scores for these institutions were around 77% (median 82%).

At the same time we should mention some of the literature discussing the usefulness and correctness of DEA models compared with other frontier and econometric approaches. One of the most distinguishable papers belong to Berger and Humphrey (1997) who found that the efficiency estimates from nonparametric (DEA and FDH) studies are similar to those from parametric frontier models (SFA, DFA, and TFA). Ondrich and Ruggiero (2001) argue that both produce similar rankings, and conclude that there is no advantage in using parametric frontiers. But, there are also the opponents of DEA who base their argument on the fact that it fails to account for a random error term and assumes that there is no measurement error in constructing the frontier (Harada 2005). Therefore, it is usually stated that the Data Envelopment Analysis will understate the true efficiency level (Schmidt 1986,).

On overall, the divergence between different approaches is diversified across the studies and the use of a particular model should be usually based on environmental factors and specific features of an industry. Banker et al. (1986) stated that the Data Envelopment models are very useful for the cases when the firm managers have several objectives because of the special feature of DEA to deal with multiple inputs and outputs. By applying DEA to Missouri Banks, Yue (1992) concluded that the main advantage of these analyses is the capability of efficiency scores to be independent from the units in which inputs and outputs are measured. Papers as Rangan et al. (1988), Vassiloglou and Giokas (1990), Hassan et al. (1990), Camanho and Dyson (1999) were one of the significant ones which by explicitly considering the mix of resources used and services provided by individual banks, succeeded not only in identifying inefficient branches, but also in locating specific areas of inefficiency at each branch.

Despite of the huge amount of literature which applied DEA into the banking sector, most of them assessed the performance of banks in the advanced economies. Most bank efficiency studies look at the US or other developed countries; while we can mention few studies considering the emerging markets. The paper by Bhattacharyya et al. (1997) probably was the first study using data of a developing country; they applied DEA to Indian banks. Gilbert and Wilson (1998) used linear programming techniques to investigate the effects of privatization and deregulation on the productivity of Korean banks over the years 1980-94. They find that Korean banks responded to privatization and deregulation by altering their mix of inputs and outputs, yielding large changes in productivity. Mahadzir Ismail (2004) by analyzing the performance of Malaysian banks during 1994 and 2000 (total number of observations was 194) found that the main source of inefficiency of these banks was due to scale problems. Than he went further and tried to explore the characteristics of efficient banks according the ownership structure and different bank specific indicators. On its turn, Quey-Jen Yeh (1996) made an attempt to incorporate DEA scores with the widely used bank financial ratios. By examining the performance of 6 large banks of Taiwan during 1980s he concluded that such integration of two methods is very useful for understanding the main inefficiency sources of banks.

Small amount of studies can be found which looked into the financial system of the countries in transition; among them can be mentioned the research conducted by Mertensa and Urga (2001) who evaluated the efficiency level of 79 Ukrainian banks in 1998 and the paper by Hasan and Marton (2003) for the Hungarian banking sector. But, the most significant paper among this literature is probably the IMF Working Paper by Grigorya and Manole (2002) which explored the efficiencies of 17 countries in transition (6 CIS counries). Additionally, they applied censored Tobit regression model to investigate the affect of different independent variables (market share, bank capitalization, foreign ownership, government regulation, etc.) on the efficiency of a bank. The 4th International Symposium of DEA held in Aston Business School was substantial in revealing some analysis related with the application of frontier approaches into the financial sectors of countries in transition. For example, Pavlyuk and Balash (2004) presented the paper where the stochastic econometric frontier approach was used to investigate the efficiency of Russian banks. Also can be mentioned the papers by Lacaite et al. (2004) and Guzowska et al. (2004) presented during this Symposium. These two papers tried to find out how the efficiency level is related with the bank ownership structure and size. At this point, I want to mention the increased interest of Russian scholars in recent years to the nonparametric frontier approaches. The papers by Koshelyuk (2006), Golovan (2006), Golovan et al. (2007, 2008) analyzed the efficiency levels of Russian banks in details during the years of transition; however they were only restricted with an investigation of divergences in efficiency scores across the ownership and size.

So far no research has been conducted assessing the performance of Uzbek banks using Data Envelopment Analysis or any other frontier approaches. Usually, the papers in the literature are restricted by the qualitative assessment of aggregate bank ratios or relating these ratios to cost, revenue and asset structures of banks using regression analysis. For example, some yearly reports provided by investment companies such as Ansher Capital (2006) and East Orient Capital Management (2008) analyzed the overall performance of the system over each year. These analytic papers are comprehensive source which investigated the development of Uzbek banking sector and provide detailed analysis of individual banks using traditional methods of bank performance evaluation. Yet none of these studies used a predetermined frontier approach which eliminated the possibility to deeper analyze the reasons for inefficiencies in the operation of banking sector1.

3. Methodology

3.1 Research approach

In order to reach the objectives of this research the deductive approach was used, in view of the fact that there is much literature and theoretical framework on this topic. Additionally, this research is directed into the explanation of casual relationship between different variables such as the impact of bank size on efficiency. The construction of the research objectives itself insist on the utilization of the deductive approach. The first objective builds the fundamentals of hypothesis and choice of the DEA model. When the hypothesis and model is determined all of the collected data will be analyzed accordingly. There are several contrasting theories on this subject which complicates our analysis. Therefore, the quality of results will largely depend on correct determination of DEA model which is applicable for our case.

3.2 Data

Secondary data is our main research instrument, as we need comprehensive and full data about the performance of the Uzbek banks which is obtained from the newspaper “Bank Akhborotnomasi”. The financial statements of individual banks gave almost all of the relevant information for the analysis of efficiency

The main problem with access was the unavailability of internal data which could enrich our analysis. Moreover, even the basic financial statements were not available, especially for the small private banks which lead to the incomplete analysis of data. Therefore, during the analysis these issues are considered and the possibility of making a certain level of error is defined and mentioned by the author in the results section of the paper.

[1] For example, these analysis could not divide the efficiency into scale and technical efficiency which DEA can offer

3.3 The choice of a model

Since the research approach is deductive the choice of relevant model is the main factor determining the success of the project. Therefore, the theory according which the efficiency is calculated was determined cautiously considering all pros and cons related to it. As a consequence Data Envelopment Analysis was chosen as a base for the project behind the following advantages:

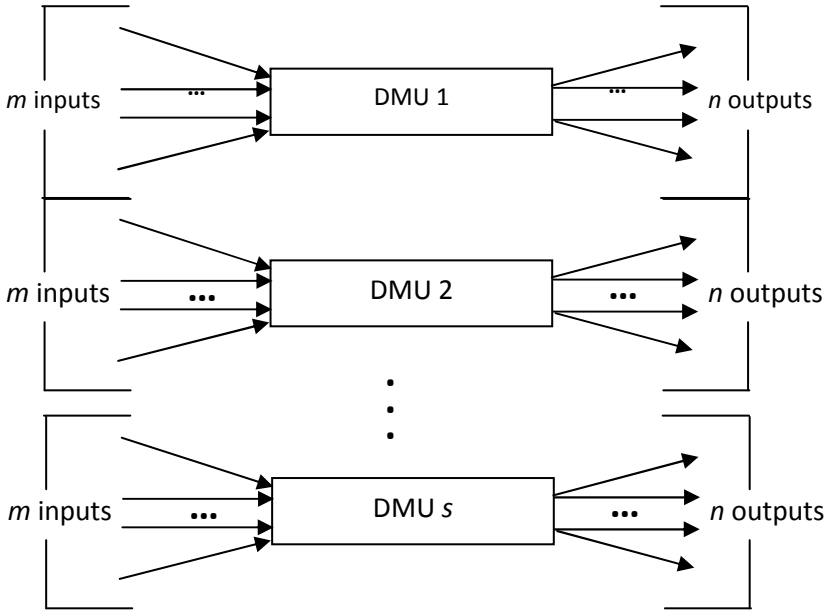
- It easily accommodates both multiple inputs and multiple outputs which is the usual case for banking sector;
- it can be used to estimate technical and scale efficiency;
- easily fits to the regulated and non-profit sectors of economy;
- it can vary over time and all outputs and inputs are handled simultaneously;
- it produces a true frontier from which relative efficiencies can be derived and no functional form is imposed on the data.

These arguments confirm that the chosen model represents reality and can be used in the real life which increases the validity of the obtained results. The mathematical description of a model is given below.

3.4 Explanation of the model

Basically, DEA is concerned with the efficiency of the individual unit, defined as the Decision Making Unit (DMU) in the work of Charnes et al (1978); while this DMU deals with the issues related with converting inputs into the outputs both through the daily operations and decisions accepted at the strategic level.

When we consider s number of DMUs (in our case Uzbek banks) which use a particular group of measurable positive inputs (e.g. Labor hours, buildings, deposits, etc.) for transforming them into a particular types of measurable positive outputs (e.g.: loans, interest income, etc.). Then, the input and output data as it is represented in Figure 1 can be expressed by matrices X and Y, where xij refers to the ith input data of DMU j, whereas yij is the ith output of DMU j.



$$X = \begin{pmatrix} x_{11} & x_{12} & \cdots x_{1s} \\ x_{21} & x_{22} & \cdots x_{2s} \\ \vdots & & \\ x_{m1} & x_{m2} & \cdots x_{ms} \end{pmatrix} \quad (1)$$

$$Y = \begin{pmatrix} y_{11} & y_{12} & \cdots y_{1s} \\ y_{21} & y_{22} & \cdots y_{2s} \\ \vdots & & \\ y_{n1} & y_{n2} & \cdots y_{ns} \end{pmatrix} \quad (2)$$

Figure 1. The Input and Output Data

Whereas, the purpose of DEA is to measure the relative productivity of each DMU by comparing it with every DMU used in the model. For each input and output of every DMU weights are assigned and through the analysis will be selected the input and output weights that maximize its efficiency score. While efficiency is considered to be as:

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

Accordingly, the efficiency score will be obtained relative to some maximum possible unit and will lie between the values of 0 and 1. In our case, for each inefficient bank DEA explores an efficiency reference set which is the set of

relatively efficient branches to which the inefficient bank has been most directly compared in calculating its efficiency rating. This facilitates the examination of the nature of inefficiencies at a bank, by indicating those relatively efficient ones against which performance comparisons can be drawn.

Usually in the scientific literature the mathematical representation of a model is used which was developed by Charnes, Coopers and Rhodes (1978). This model was named as CCR model and can be represented as follows:

$$Max \qquad \theta = \frac{u_1 y_{1o} + u_2 y_{2o} + \cdots + u_n y_{no}}{v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo}} \tag{3}$$

subject to

$$\frac{u_1 y_{1j} + u_2 y_{2j} + \cdots + u_n y_{nj}}{v_1 x_{1j} + v_2 x_{2j} + \cdots + v_m x_{mj}} \le 1 \qquad (j = 1, \cdots, s)$$

$$v_1, v_2, \cdots, v_m \ge 0$$

$$u_1, u_2, \cdots, u_n \ge 0 \tag{4}$$

Given the data X and Y in (1) and (2) (Figure-1), the CCR model measures the maximum efficiency of each DMU by solving the fractional programming problem in (3) where the input weights v1, v2, …vm and output weights u1, u2, …un are variables to be obtained. o in (3) varies from 1 to s which means s optimizations for all s DMUs. Constraint (4) reveals that the ratio of 'virtual output' ($u_1 y_{1o} + u_2 y_{2o} + \cdots + u_n y_{no}$) to 'virtual input' ($v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo}$) cannot exceed 1 for each DMU, which conforms to the economic assumption that the output cannot be more than the input in production.

One of the crucial shortcomings of CCR model is that it assumes DMUs to be operating at an optimal scale (Flat portion of LRAC function). Later the basic DEA model was extended in order to account for the returns to scale by Banker, Charnes and Coopers (1984) and usually called as BCC. Under this model the overall efficiency score will be divided between the "scale" and "pure technical" efficiencies. The discussion of this model is out of the scope of this literature and the reader may refer to the previous literature for exploration of this model.

Despite of its advantages the DEA models have some shortcomings. The biggest shortcoming of these models is that they fail to account for error term or white noise. Therefore, it is very important to put a great cautious during the comparisons between DMUs by putting a great attention for the input-output choice and the consideration of the environment where the DMUs operate; while the next section will be devoted for the observation of these issues.

3.5 Discussion of Input-Output selection for DEA analysis

Basically, literature distinguishes two fundamental types of bank performance treatment and there is considerable amount of disagreement among the supporters of each approach. First approach is usually called as the production approach and treats banks as a firm which uses capital and labor for production of different types of banking services (Heffernan 1996, page 474). According to Freixas and Rochet (1997, page 79-82) this way of evaluation is mainly applicable for the case of local branch which is "financially transparent" while the money collected directly transferred to the main branch. The second type of literature defines activities of a bank as intermediation. This approach is mainly applicable for the performance evaluation of main branch which deals with "transferring" money borrowed from depositors into the money lent to borrowers (Freixas and Rochet 1997).

We should also consider the previous researches which applied DEA for the financial institutions in order to arrive into the correct choice of inputs and outputs. In Appendix A we provided the summary of previous researches and in our project these researches will be definitely considered but before we should take a look into the banking industry of Uzbekistan.

Banking sector of Uzbek economy is characterized by high concentration level and specialization of banks around the particular spheres and sectors of economy. The ultimate leader among the banks according their asset size is the National Bank of Uzbekistan (NBU) holding 51.4 % assets of the industry; at the same time the seven large banks posses 81 % of the total assets (Ansher Capital 2006). The second largest bank of Uzbekistan (according the asset size), Asaka bank is mainly services the organizations and companies from the automobile industry; while Galla bank and Pakhta bank are specialized on the agricultural sector. Such a narrow specialization of activities can also be observed for other banks such as People's bank, Aloka bank, Khamkor bank. Therefore, today the management of the banks was left with the limited range of clients which prevented them to offer competitive interest rates and make sound decisions to attract new clients. Instead, their role became the mediation between depositors and borrowers, while striving to earn higher income by making correct loan decisions. Additionally, high concentration of the banking system around the large state owned banks[2] made other banks as price takers. Finally, the government of Uzbekistan provides several tax exemptions for the funds raised through the different types of deposits[3] which make the interest rates for deposits higher than for loans in Uzbekistan. These specific features of Uzbek banking sector lead us to use intermediation approach for our analysis while using the deposits as inputs. Additionally, the target group of

[2] According the data provided by East Capital Invest (2008) 61 % of the total asset of banking system is owned by 3 state banks (National Bank of Uzbekistan, Asakabank and People's bank)

[3] «Regulation on the order of calculation and payment of taxes by commercial banks, credit unions and microcredit organizations»

this research is not the separate branches, but the performance of the whole bank in 2006 which following from Freixas and Rochet (1997) confirms the use of intermediation approach.

We also should consider the current literature on DEA for which the summary is given in the Appendix A. So, after a survey of the inputs and outputs used in the literature and some unstructured interviews with the bank representatives the following inputs and outputs were selected considering the intermediation approach for measuring bank performance.

3 inputs and 3 outputs:

Input A: Operational expenses
Input B: Fixed assets
Input C: Total Deposits
Output 1: Total credits - Reserve for possible loan losses
Output 2: Total non-interest income
Output 3: Other non-interest income (excluding commission income)

Operational expenses and fixed assets were chosen in order to reflect both fixed and variable costs incurred by banks. Whereas, outputs were selected in view of the fact that banks today are becoming more diversified and earning different incomes from differentiated services. At the same time, reserve for possible loan losses were deducted from the total credits with a purpose of reflecting the difference in the risk levels among banks. Other non-interest income excludes commission income and covers diversified range of services offered by banks (eg. Dividends, Forex operations, etc.).

3.6 Sampling

As it was mentioned earlier, DEA does not account for the random error term and is being used for the performance evaluation of identical units. Oral and Yololan (1990) suggest to use DEA models for firms employing similar resources and providing the same services. Quey-Jen Yeh (1996) states that it is important to take into account the homogeneity condition during the choice of DMUs for the model. For that reason we should exclude from the model the large Uzbek state banks (NBU, Asaka bank, People's bank). The reason for this is that the asset size of these banks is not comparable (they possess too large level of assets) with other banks from the system and their inclusion into our analysis will largely distort our findings. On the other hand, these three banks control more than 60% of all banks' assets in Uzbekistan; it prevents us to generalize paper's results to the entire banking sector of a country.

The data is obtained from the weekly magazine "Bank Akhborotnomasi" which provides audited financial reports of almost all banks in Uzbekistan. Additionally, any further detailed information is found from the annual reports of banks or during the unstructured interviews with bank representatives.

Then, the model was solved using the two softwares of DeaFrontier and DEAOS (online) which give detailed and advanced results. The use of two different softwares is explained by the fact that both models present the results in a different format. Therefore, the results for the banking system are presented using DeaFrontier, while for the analysis of individual banks are presented using the online software of DEAOS.

4. Results

For our analysis we firstly employed the input-oriented CCR model which do not account for scale efficiencies and the efficiency scores from the analysis are represented in the Table 1 below.

Table 1. Efficiency under the Input-Oriented CCR model

DMU No.	DMU Name	2004	2005	2006	Mean value
1	ABN-AMRO	0,55	0,6	0,81	0,65
2	Alokabank	0,84	0,67	0,61	0,71
3	Alp Jamol bank	1	0,76	0,85	0,87
4	CreditStandard	0,87	1	1	0,96
5	Gallabank	1	1	1	1
6	Ipak Yuli bank	0,82	0,74	0,67	0,74
7	Ipotekabank	1	0,72	0,61	0,78
8	Kapitalbank	1	0,64	0,62	0,75
9	Khamkorbank	-	0,9	0,96	0,93
10	Pakhtabank	0,9	1	1	0,97
11	Parvinabank	1	0,85	0,68	0,84
12	Soderat (Iran)	-	0,92	1	0,96
13	Trustbank	0,75	0,68	0,59	0,67
14	Turkiston	0,92	1	1	0,97
15	Turonbank	0,68	0,72	1	0,8
16	Uktambank	-	1	0,68	0,84
17	Universalbank	1	1	0,95	0,98
18	U-T bank	0,77	0,68	0,88	0,78
19	UzKDB	1	1	1	1
20	Uzpromstroybank	1	1	0,64	0,88
21	Samarkandbank	0,48	0,56	0,6	0,55
22	Ravnakbank	0,87	0,64	0,75	0,75
23	Savdogar	0,83	1	0,87	0,9
	Mean Value	0,87	0,83	0,82	

Inputs	**Outputs**
Fixed assets	Total credits - Reserve for possible loan losses
Operational expenses	Net non interest income
Total Deposits	Other non-interest income (Dividends, Forex operations, etc)

The banks with the scores lower than 1 have a potential to increase their output. For example, an efficiency score for ABN-AMRO bank was assigned at a rate of 0,81

which means that this bank can increase its outputs by 19% (1-0,81) using the same amount of inputs as it is using now. The table shows that 7 banks out of the 23 were found to be fully efficient in 2006. Whereas, the average efficiency level slightly decreased from 0,87 to 0,82 during 2004 and 2006. Only two banks (UzKDB and Gallabank) remained to be fully efficient during the last three years; while Samarkand bank was the most inefficient bank among the observations having the mean efficiency score of 0,55; the managers of this bank are able to increase the outputs upto 45% by using the available resources of this bank more efficiently.

The DEA analysis allows us to go further and acquire more detailed information for increasing the efficiency of production. We illustrate the use of DEA analysis using the data for Trustbank. The results for this bank are summarized at the Table 2.

Table 2. DEA results for Trustbank

Efficiency score	0.59[4]		
Benchmarks	**Turkiston**	**Uktambank**	**Credit Standard**
Lambdas	0,372	0,059	0,064

Improvements	**Fixed assets**	**Operational expenses**	**Total deposits**	**Total credits**	**Net non interest income**	**Other non-interest income**
Actual	959 039	2 959 505	75 564 012	11 303 365	2 809 221	179 627
Target	567 241	1 750 451	40 423 996	11 303 365	2 809 221	715 493
% [5]	-41	-41	-47	0	0	298
Weights	0,000000326	0,000000326	0	0,000000002	0,000000174	0

Efficiency score for this bank is 0.59 which means that this bank is able to increase its output by 41 % using the current amount of inputs but more efficiently. The reference banks which make up the benchmarks to which Trustbank is compared to and a measure of the relative importance of each reference bank called “lambda,” are also given in the same table. As it can be seen, three banks are considered to be the important benchmarks, Turkistonbank being the most important among them. Under the heading of improvements come the actual and the targeted values of inputs and outputs for this bank in order to become relatively efficient. This bank should decrease each input by around 40%; while increase non interest income 3 times. In other words, diversification of activities will lead to the full relative efficiency of this bank. The last row of the table represents the weights assigned for each variable. Following from the formula for efficiency calculation these weights show the tradeoff of increments or decrements in inputs or outputs to DEA efficiency. The weights do not differ from each other but the relatively large weights for operational expenses and net non interest income suggest that the biggest efficiency gains can be obtained by changing these figures. A similar

[4] This efficiency represents pure technical efficiency obtained from BCC model while later on the paper we will refer to the pure technical efficiency unless otherwise mentioned

[5] Percentage difference between the targeted and actual value

analysis can be conducted for each inefficient DMU in a similar manner and the detailed results from the analysis are given in Appendix E, F and G. So, the reader can refer to the Appendices to determine reference banks and the way in which each DMU can become DEA efficient.

As it was mentioned in the methodology part of the paper the extension of the basic DEA model which is called as a BCC model takes into account various scales of production. We also used this model in our observations for the year 2006 and the efficiency scores with their corresponding scales are represented on the Table 3.

Table 3. Efficiency under the Input-Oriented BCC model

DMU No.	DMU Name	VRS Efficiency for 2006	Returns to Scale
1	ABN-AMRO	1,00	Decreasing
2	Alokabank	0,70	Decreasing
3	Alp Jamol bank	0,85	Increasing
4	CreditStandard	1,00	Decreasing
5	Gallabank	1,00	Decreasing
6	Ipak Yuli bank	0,70	Decreasing
7	Ipotekabank	1,00	Decreasing
8	Kapitalbank	0,65	Decreasing
9	Khamkorbank	1,00	Decreasing
10	Pakhtabank	1,00	Decreasing
11	Parvinabank	1,00	Decreasing
12	Soderat (Iran)	1,00	Decreasing
13	Trastbank	0,59	Increasing
14	Turkiston	1,00	Increasing
15	Turonbank	0,87	Decreasing
16	Uktambank	1,00	Increasing
17	Universalbank	0,95	Decreasing
18	U-T bank	0,91	Increasing
19	UzKDB	1,00	Decreasing
20	Uzpromstroybank	1,00	Decreasing
21	Samarkandbank	0,57	Increasing
22	Ravnakbank	0,58	Decreasing
23	Savdogar	0,82	Decreasing

The efficiency scores for both models are presented in order to make clear comparisons. Although the overall results are similar across the two models, there are minor differences in the individual efficiency scores that may provide information about the relative efficiency of these banks. In the methodology part we were pointing out that the two models differ fundamentally in their definition of the efficiency frontier. In particular, the CCR model assumes constant returns to scale, while the BCC model allows for the possibility of constant, increasing or decreasing returns to scale; whereas the overall efficiency score is composed of “pure” technical and “scale” efficiencies. In the CCR model, it is assumed that a firm

which is technologically efficient also uses the most efficient scale of operation. In the BCC model, however, the score represents only "pure" technical efficiency. So, by comparing the results of the CCR and BCC models, we can state that 3 banks (ABN AMRO, Ipotekabank, Uzpromstroybank) were technically efficient but were not operating at the most efficient scale of operation in 2006. It appears that these banks have chosen incorrect scale of operation and simply used too many inputs or produced too few outputs. On overall, from the 23 banks under the observation 17 were experiencing decreasing returns to scale, while only 6 banks were under the increasing returns to scale and no bank was at the point of constant returns to scale.

After interpreting the results obtained from the DEA analysis we can move into the discussion of the factors affecting the efficiency score. First of all, we try to analyze whether there is any relationship between the ownership type of a bank and its efficiency level. For this we use dummy variable regression models (ANOVA), while for classification of banks according their asset structure we use the sorting applied by Ansher Capital (2006). This report divides banks into 4 groups as it is shown in the Appendix B. Since, we have excluded state banks from our analysis, 3 types will be used and 2 dummy variables can be introduced. The model to be estimated is as follows:

$$Y_i = \beta_1 + \beta_2 D_{2i} + \beta_3 D_{3i}$$

$\boldsymbol{Y_i}$ – efficiency score
$\boldsymbol{D_{2i}}$ ***–Dummy variable, takes the value of 1*** if the bank is the Joint-Stock bank
$\boldsymbol{D_{3i}}$ – ***Dummy variable, takes the value of 1*** if the bank is with the foreign capital
Solving this model using E-views software gives us the following results 6:

$$\begin{array}{lccc} Y_i = & 0.92 & -0.05\, D_{2i} & +0.06\, D_{3i} \\ se & 0.087 & 0.070 & 0.053 \\ t\text{-}stat & 17.537 & -0.663 & 0.64 \\ p & 0.000 & 0.516 & 0.5337 \end{array} \qquad (5)$$

$$R^2 = 0.083$$

The mean efficiency level for private banks is 0.92, whereas this number decreases by 0.05 for Joint-Stock banks and increases by 0.06 for foreign banks. But, the low levels of p values put the significance of these coefficients under the question. Therefore, we can not state that there is a significant difference between the relative efficiencies of banks under different proprietary type. The low level of R2 also reduces the reliability of this model and serves as a sign that the sample regression line does not fit the data. It can be explained by the low number of observations used in the regression model. As it is known the number of banks in Uzbekistan is very small, while there are few foreign banks among them. The reliability of the regression findings can be increased by using longer time series panel data. At the time being non-availability of such a data restricts the author to further develop the above given model.

[6] For complete output refer to Appendix D

But, how our findings are consistent with the previous literature? As it is stated in the literature review the relationship between the ownership and the efficiency level is one of the frequently analyzed issues among the papers under the frontier approaches. Basically, the findings of previous papers are diversified. For example, Sathe (2001) who studied the performance of Australian banks in 1996 found that the foreign banks are less efficient than the local banks; while Yildirim and Philippatos (2002) investigated that the state-owned banks are more efficient than the foreign and private banks. If we look to the papers using the observations in the countries with transitional economies (Grigorian and Manole 2002, Hasan and Marton 2003, Golovan et al. 2006) we can observe the dominance of a view that the foreign ownership enhances the efficiency level of banks. Unfortunately, low level of significance of our findings does not allow us to state the consistency of our finding with the previous literature.

Now we move into the analysis of relationship between the size and the efficiency score for which we will also use Dummy variables.

$$Y_i = \beta_1 + \beta_2 D_{2i} + \beta_3 D_{3i}$$

$\boldsymbol{Y_i}$ – efficiency score
D_{2i} – *Dummy variable, takes the value of 1* if the bank is large sized bank
D_{3i} – *Dummy variable, takes the value of 1* if the bank is medium sized bank

Here for the determination of the size of a bank we used the classification under the Ansher Capital (2007) according the total asset of each bank. Estimation output was as follows:

$$\begin{array}{lcccc} Y_i = & 0.98 & - 0.02\, D_{2i} & + 0.14\, D_{3i} & \\ se & 0.049 & 0.078 & 0.062 & \\ t\text{-}stat & 19.885 & 0.300 & -2.246 & \\ p & 0.000 & 0.7672 & 0.0383 & \end{array} \qquad (6)$$

$$R^2 = 0.31$$

The model shows significant deference between the mean efficiency scores of small and medium sized banks. This is confirmed by the low value of p for coefficient β3 which means that the null hypothesis of β3 = 0 was rejected under the 5 % significance level. So, the medium sized banks are inclined to be more efficient than the small sized banks. This finding partially incorporates with the previous findings. Several papers (Guzovska et al. 2004, Ismail 2003, Grigorya and Manole 2002, Fadzlan 2004, etc.) which investigated the relationship between the size of a bank and DEA efficiency concluded that there is a positive relationship between these variables. However, large-sized banks are not more efficient than either small banks or medium-sized banks. Investigation of this contradiction involves deep analysis of insights of the banking system with employing another model which is out of the scope of this project's objectives.

5. Conclusion and directions for future research

When we have analyzed the efficiency level of Uzbek banks and how they diverge across different ownership structure and size, we can draw some conclusions following from these analyses.

- We found that some 60% of the analyzed banks are relatively efficient which can be explained by the fact that such a high number of efficient banks is usually obtained when the DMUs under the DEA analysis are few (Alirezaee et al. 1998).
- Following from the finding that the majority of the banks are operating at a point of decreasing returns to scale, we may expect that by increased competition these banks will be faced with the problem of decreasing their output level or even the takeover by more scale efficient banks.
- Falling average efficiency levels of a banking sector over the last three years should be a serious concern for government regulators and bank management. But more thorough analysis are needed to understand the causes of such a fall in efficiency level.
- Detailed investigation of the results of DEA may provide with the detailed information needed for further improvement of a financial institution's performance. Particularly, the Trustbank was advised to decrease operational expenses and diversify their activities away from the interest earning assets.
- The researcher also found that the ownership structure of a bank does not affect the relative efficiency, while medium sized banks tend to be more efficient than the small banks. These findings lead us to conclude that the entry of foreign banks should not substantially affect the performance of the banking sector in Uzbekistan. While the better performance of medium sized banks probably resulted from the better management of the available resources.

At this place, it is worth mentioning that the lack of relevant literature on Uzbekistan relating to this issue made our analysis very difficult. The author tried to solve this problem by looking into the studies on other countries, at the same time, followed the suggestions of bank representatives with whom the interviews were made. Problems related with the amount of available data further complicated our task. So, the efficiency levels are calculated for only three periods because of the non availability of reliable time series data for Uzbek banks.

According these shortcomings some suggestions for further research can be proposed. First of all, the time horizon of the research may be extended in order to better understand the transformation process after the independence of a country. Secondly, the analysis may go further by looking into the relationship between the various bank specific and country specific indicators. At this stage, emphasis should be made on consideration of the recent government policies directed towards the developing the banking sector and looking forward on how these policies are going to affect the banking system in the future, in line with giving some

recommendations for the policymakers. Following from the research papers of Grigorian and Manole (2002), Thanassoulis (1993), Ferrier and Lovell (1990) it is highly advised to use Tobit regression models for these analyses.

As a last point, the author states that this research opens a broad area for further researches and hopes that it will be the starting point for the development of frontier approaches in Uzbekistan.

References

Howland A. and Van De Panne, 1998. Sampling Size and Efficiency Bias in Data Envelopment Analysis. Journal of Applied Mathematics Decision Sciences 2 (1), 51- 64

Ansher Capital 2006. Uzbekistan Banking Sector: Emerging opportunities. [Online] Available from: <https://www.anshercap.com> Last accessed: 01.05.2008

Banker R., Conrad R. and Strauss R., 1986, A comparative application of data envelopment analysis and translog methods: An illustrative study of hospital production, Management Science 32(1), pp.30-44, January.

Banker R., Gadh M., and Gorr W., 1993 A Monte Carlo comparison of two production frontier estimation methods: Corrected ordinary least squares and data envelopment analysis. European Journal of Operational Research. 67, 332-343.

Berger A., Humphrey D., 1997. Efficiency of Financial Institutions: International Survey and Directions for Future Research, European Journal of Operational Research, Vol. 98. –pp. 175 – 212.

Berger A., Hancock D. and Humphrey D., 1993, Bank efficiency derived from the profit function, Journal of Banking and Finance 17, pp 317-347.

Bhattacharyya A., Lovell C. and Sahay P. 1997. The Impact of Liberalization on the Productive Efficiency of Indian Commercial Banks, European Journal of Operational Research 98: 332-345.

Camanho A., Dyson R., 1999. Efficiency, Size, Benchmarks and Targets for Bank Branches: An Application of Data Envelopment Analysis. The Journal of the Operational Research Society. Vol. 50, No. 9., pp. 903-915.

Chaparro P., Jimenez S., and Smith P. 1999. On the quality of the Data Envelopment Analysis model. Journal of the Operational Research Society, 50, 636-645.

Charnes, A., W.W. Cooper, and E. Rhodes, 1978, Measuring the efficiency of decision making units, European Journal of Operational Research 2, 429-444.

Cooper W., Seiford L., Zhu J. (ed.) 2004. Handbook on Data Envelopment Analysis. Boston: Kluwer Academic Publishers.

Cooper W., Seiford L., and Tone K., 2000, Data Development Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software, Kluwer Academic Publishers,.

Development and efficiency of the banking sector in a transitional economy: Hungarian experience Journal of Banking & Finance, Volume 27, Issue 12, December 2003, Pages 2249-2271 Iftekhar Hasan and Katherin Marton

Drake L., Hall M. (2000). Efficiency in Japanese Banking an Empirical Analysis. Centre for International, Financial and Economics Research. Economic Research Paper No. 00/25. [Online] Available from: http://econpapers.repec.org> Last Accessed: 30 December 2007.

Dyson R. and Thanassoulis E., 1988. Reducing weight flexibility in data envelopment analysis. Journal of Operational Research Society. 39. 563-576.

East Capital Invest, 2007. Report on Uzbek Banking System 2007.

Emrouznejad A 2001. An Extensive Bibliography of Data Envelopment Analysis (DEA), Volume I – V Coventry: University of Warwick, [Online] Available from: <http://www.warwick.ac.uk/~bsrlu> Last accessed: February 14, 2008.

Fadzlan S., 2004. The Efficiency Effects of Bank Mergers and Acquisitions in a Developing Economy: Evidence from Malaysia. International Journal of Applied Econometrics and Quantitative Studies. Vol.1-4, pp. 53-74.

Farrell, M. J. (1957). "The Measurement of Productive Efficiency of Production." Journal of the Royal Statistical Society, Series A, 120(III), 253–281.

Ferrier, G. and Lovell K. (1990), Measuring Cost Efficiency in Banking: Econometric and Linear Programming Evidence, Journal of Econometrics 46: 229-245.

Field K. 1990. Production Efficiency of British Building Societies. Applied Economics, 22(3). 415–426.

Freixas, X., Rochet J., 1997. Microeconomics of Banking. The MIT Press, Cambridge.

Gilbert, R.A. and P.W. Wilson (1998), Effects of Deregulation on the Productivity of Korean Banks, Journal of Economics and Business 50: 133-155.

Golvan C. 2006. Факторы, влияющие на эффективность российских банков (Factors affecting the efficiency of Russian Banks). Прикладная эконометрика (Applied Econometrics). №2, pp. 3-17.

Golovan C., Kostyurina O., Pastukhova Y., Karminskiy A., Perestskiy A. 2007. Эффективность российских банков с точки зрения минимизации издержек (Efficiency of Russian banks on the Basis of Cost Minimization). Препринт РЭШ, WP/2007/071

Grigorian D. and Manole V. 2002. Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis. IMF Working Paper. WP/02/146. International Monetary Fund.

Guzowska M., Isielewska M., Nellis J. and Zarzecki D. 2004. Efficiency of the Polish Banking Sector – Assessing the Impact of Transformation. In Emrouznejad A. and Podinovski V. 2004. Data Envelopment Analysis and Performance Management, Coventry: Warwick print.

Harada K., 2005. Did Efficiency Improve? Megamergers in the Japanese Banking Sector. Korea Institute for International Economic Policy (KIEP). CNAEC Research Series 05-02

Hassan Y., Grabowski R., Pasurka C, Rangan N., 1990. Technical, Scale, and Allocative Efficiencies in U.S. Banking: An Empirical Investigation. The Review of Economics and Statistics. Vol. 72, No. 2., pp. 211-218.

Hasan I. and Marton K. 2003. Development and efficiency of the banking sector in a transitional economy: Hungarian experience. Journal of Banking & Finance, Volume 27, Issue 12, December 2003, 2249-2271.

Heffernan S. (1996) Modern Money and Banking. Wiley: West Sussex.

Ismail M., 2004. A Dea Analysis of Bank Performance in Malaysia. In Emrouznejad A. and Podinovski V. 2004. Data Envelopment Analysis and Performance Management, Coventry: Warwick print.

KonSi Ltd. 2006. Benchmarking Process and Konsi Dea Software. [Online] Available from: <http://www.dea-analysis.com/data-envelopment-analysis-benchmarking/data-envelopment-analysis.html> Last accessed: February 2, 2008.

Koshelyuk Y. 2007. Граничный анализ эффективности (Frontier Analysis of efficiency). Paper presented during the seminar: Экспертные оценки и анализ данных [Online] Available from: http://www.ipu.ru/ . Last accessed: May 12, 2008.

Kraft E., Hofler R., Payne J. 2002. Privatization, Foreign Bank Entry and Bank Efficiency in Croatia: A Fourier-Flexible Function Stochastic Cost Frontier Analysis. Croatian National Bank, Zagreb, CNB working papers, 9.

Laeven L. 1999, Risk and Efficiency in East Asian Banks. World Bank Policy Research Working Paper No. 2255. [Online] Available from: <http://ssrn.com/abstract=629192> Last accessed: February 20, 2008

Lašaite D., Kuodas S., Boguševicius J. and Pranculis A. 2004. Efficiency of Czech Insurance Companies. In Emrouznejad A. and Podinovski V. 2004. Data Envelopment Analysis and Performance Management, Coventry: Warwick print.

Leigh D. and Howcroft B. 1994. Relative efficiency in the branch network of a UK bank: An empirical study, Omega, International Journal of Management Science 22(1), pp 83-90.

Lewin A., Morey R. and Cook T., 1982, Evaluating the administrative efficiency of courts, International Journal of Management Science 10(4), pp. 401-411.

Pastor J., and Lovell C. 1997. Target setting in a bank branch network, European Journal of Operational Research, 98, 290-299.

Mertensa A. and Urga G. 2001. Efficiency, scale and scope economies in the Ukrainian banking sector in 1998. Emerging Markets Review Volume 2, Issue 3, 1 September 2001, 292-308

Ondrich. J. and Ruggiero J., 2001. Efficiency measurement in the stochastic frontier model. European Journal of Operational Research, 129, 434-442.

Oral M., Keffanaind O. Yolalan R. (1992) An empirical study on analyzing the productivity of bank branches. IIE Trans. 24, 166-176.

Paradi J., Vela S. and Yang Z. Assessing Bank and Bank Branch Performance: Modeling Considerations and Approaches. In: Cooper W., Seiford L., Zhu J. (ed.) 2004. Handbook on Data Envelopment Analysis. Boston: Kluwer Academic Publishers.

Pavlyuk D.and Balash V. 2004. An Efficiency Analysis of Russian Banks. In Emrouznejad A. and Podinovski V. 2004. Data Envelopment Analysis and Performance Management, Coventry: Warwick print.

Quey-Jen Yeh, 1996. The Application of Data Envelopment Analysis in Conjunction with Financial Ratios for Bank Performance Evaluation. The Journal of the Operational Research Society, Vol. 47, No. 8., pp. 980-988.

Rangan, N., Grabowski R., Aly H. and Pasurka C., 1988. The technical efficiency of US banks. Economics Letters 28, pp 169-175.

Regulation on the order of calculation and payment of taxes by commercial banks, credit unions and microcredit organizations. Approved by the Resolution of the Ministry of Finance (N 68), State Tax Committee (N 2007-38) and Central Bank (N 291-B) of the Republic of Uzbekistan from 25.06.2007.

Schmidt P., 1986. Frontier Production Functions, Econometric Reviews 4: 289-328.

Sherman H. and Gold F., 1985. Bank branch operating efficiency-evaluation with data envelopment analysis. Journal of Banking and Finance. 9, 297-315.

Thanassoulis E., 1993. A comparison of regression analysis and data envelopment analysis as alternative methods for performance assessments. Journal of Operational Research Society. 44, 1129-1144.

Vassiloglou M., Giokas D., 1990. A Study of the Relative Efficiency of Bank Branches: An Application of Data Envelopment Analysis. The Journal of the Operational Research Society. Vol. 41, No. 7., pp. 591-597.

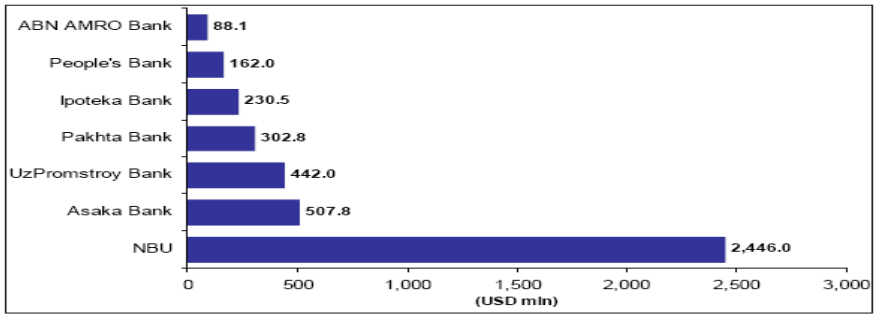
Yildirim S. and Philippatos G. 2002. Efficiency of Banks: Recent Evidence from the Transition Economies of Europe, 1993-2000. Knoxville: University of Tennessee

Yue, P. 1992. Data Envelope Analysis and Commercial Bank Performance: A Primer with Applications to Missouri Banks. Federal Reserve Bank of St. Louis Review, pp. 31-45.

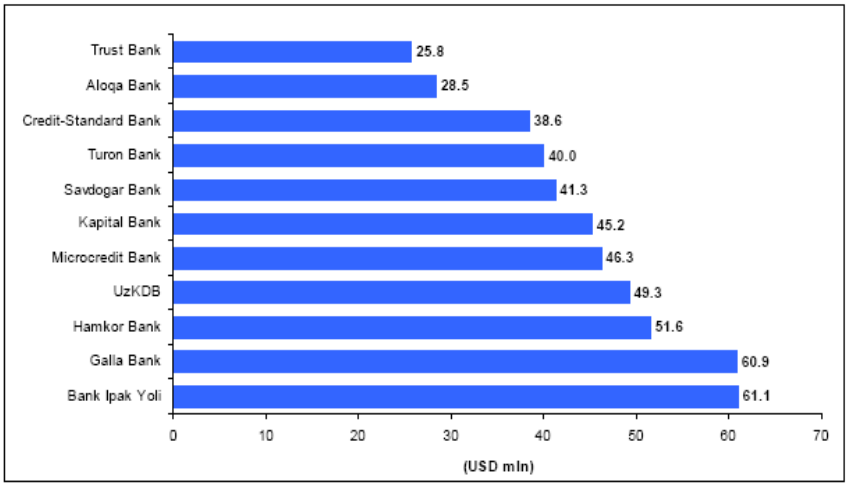
Appendix A. Summary of some literature on DEA (input and output choice)

Authors (Date)	**Method**	**Target country**	**Inputs**	**Outputs**
Berger, Allen , Hancock and Humphrey (1993)	*DEA*	*USA*	*Labor, Capital Deposits, physical capital.*	*Business loans, consumer loans*
Quey-JenYeh (1996)	*DEA*	*Taiwan*	*Interest expense, non-interest expense, total deposits*	*Interest income, non-interest income, total loans*
Guzovska, Kisielevska, Nellis and Zarzecki (2004)	*DEA*	*Poland*	*General expenses, fixed assets*	*Loans to non-financial sector, deposits to non-financial sector*
Koshelyuk (2007)	*DEA*	*Russia*	*Deposit and saving accounts, Equity*	*Working assets, Net Income*

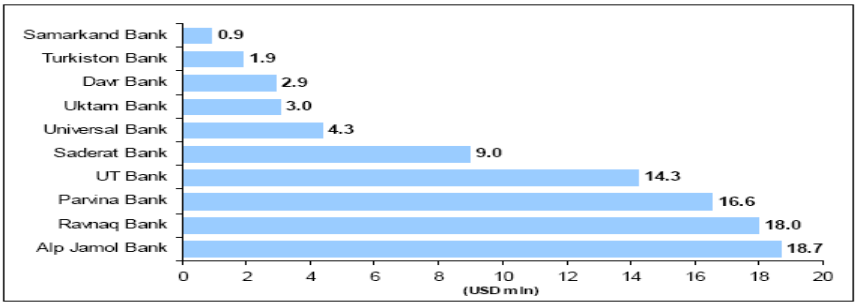
Appendix B. Classification of banks according the asset size (Source: Ansher Capital 2006)



(Large banks)



(Medium banks)



(Small banks)

Appendix C. Classification of banks according the ownership size (Source: Ansher Capital 2006)

#	Commercial Banks of Uzbekistan	Type of Proprietorship
1	Asaka Bank	State Bank
2	People's Bank	State Bank
3	National Bank of Uzbekistan	State Bank
4	Aloqa Bank	Joint-stock Bank
5	Gallabank	Joint-stock Bank
6	Hamkor Bank	Joint-stock Bank
7	Ipak Yuli Bank	Joint-stock Bank
8	Ipotekabank	Joint-stock Bank
9	Pakhtabank	Joint-stock Bank
10	Savdogar Bank	Joint-stock Bank
11	Trastbank	Joint-stock Bank
12	Turonbank	Joint-stock Bank
13	Uzpromstroybank	Joint-stock Bank
14	Microcredit Bank	Joint-stock Bank
15	Creditstandard	Private Bank
16	Alp Jamol Bank	Private Bank
17	Universalbank	Private Bank
18	Uktambank	Private Bank
19	Ravnaq Bank	Private Bank
20	Kapitalbank	Private Bank
21	Parvinabank	Private Bank
22	Samarkand Bank	Private Bank
23	Davr Bank	Private Bank
24	Turkiston	Private Bank
25	Abn-Amro	Bank with Foreign Capital
26	Soderat (Iran)	Bank with Foreign Capital
27	UzKDB	Bank with Foreign Capital
28	U-T Bank	Bank with Foreign Capital

Appendix D. Results of Dummy variable regression analysis (ANOVA)

Dependent Variable: EFFICIENCY under Variable Returns to Scale
Method: Least Squares
Sample: 1 20
Included observations: 20

	Coefficient	Std. Error	t-Statistic	Prob.
FOREIGN	0.055349	0.087124	0.635294	0.5337
JOINT_STOCK	-0.046441	0.070050	-0.662967	0.5162
C	0.921369	0.052538	17.53735	0.0000

R-squared	0.083007	Mean dependent variable	0.911541
Adjusted R-squared	-0.024874	S.D. dependent variable	0.137304
S.E. of regression	0.139001	Akaike info criterion	-0.971187
Sum squared residual	0.328463	Schwarz criterion	-0.821827
Log likelihood	12.71187	Hannan-Quinn criterion	-0.942030
F-statistic	0.769430	Durbin-Watson statistics	2.542416
Prob(F-statistic)	0.478751		

Dependent Variable: EFFICIENCY under Variable Returns to Scale
Method: Least Squares
Sample: 1 20
Included observations: 20

	Coefficient	Std. Error	t-Statistic	Prob.
MEDIUM	-0.139547	0.062125	-2.246223	0.0383
LARGE	0.023357	0.077656	0.300778	0.7672
C	0.976643	0.049114	19.88512	0.0000

R-squared	0.313098	Mean dependent variable	0.911541
Adjusted R-squared	0.232286	S.D. dependent variable	0.137304
S.E. of regression	0.120305	Akaike info criterion	-1.260095
Sum squared residual	0.246045	Schwarz criterion	-1.110735
Log likelihood	15.60095	Hannan-Quinn criterion	-1.230938
F-statistic	3.874401	Durbin-Watson statistics	2.359431
Prob.(F-statistic)	0.041078		

Appendix E. Improvements (Analysis for the year 2006)

DMU	fixed assets			operational expenses			total deposits		
	Actual	Target	%	Actual	Target	%	Actual	Target	%
Abn-Amro	1349120	1349120	0%	10561926	10561926	0%	117000000	117000000	0%
Alokabank	36233910	2088758.93	-94%	3922407	2747572.22	-30%	40467541	28346750.22	-30%
Alp Jamol Bank	2175065	1844543.94	-15%	2597344	2202653.77	-15%	27514023	23333015.03	-15%
Creditstandard	1666062	1666062	0%	2922643	2922643	0%	99303814	99303814	0%
Gallabank	5809428	5809428	0%	10324684	10324684	0%	31274262	31274262	0%
Ipak Yuli Bank	4436876	2905052.21	-35%	6451820	4576396.44	-29%	79164707	56153005.34	-29%
Ipotekabank	19633732	19633732	0%	25121128	25121128	0%	362000000	362000000	0%
Kapitalbank	6584456	3559567.62	-46%	9872263	6402763.37	-35%	109000000	70636520.78	-35%
Khamkorbank	3776096	3776096	0%	6504350	6504350	0%	52969686	52969686	0%
Pakhtabank	33208295	33208295	0%	43820379	43820379	0%	296000000	296000000	0%
Parvinabank	1060567	1060567	0%	1466379	1466379	0%	21663329	21663329	0%
Soderat (Iran)	1308217	1308217	0%	570043	570043	0%	2570877	2570877	0%
Trastbank	959039	567240.54	-41%	2959505	1750451.47	-41%	75564012	40423996.39	-47%
Turkiston	241738	241738	0%	386847	386847	0%	1993103	1993103	0%
Turonbank	5311445	3321198.57	-37%	6222519	5432804.87	-13%	45976189	40141245.61	-13%
Uktambank	1477757	1477757	0%	279506	279506	0%	1989641	1989641	0%
Universalbank	905141	862583.74	-5%	716059	682391.86	-5%	4998565	4763546.12	-5%
U-T Bank	974758	883981.94	-9%	890934	807964.2	-9%	16977188	15396157.47	-9%
Uzkdb	560882	560882	0%	2776932	2776932	0%	65729206	65729206	0%
Uzpromstroybank	27466391	27466391	0%	29581659	29581659	0%	436000000	436000000	0%

DMU	total credits			net non interest income			other non-interest income		
	Actual	Target	%	Actual	Target	%	Actual	Target	%
Abn-Amro	7023360	7023360	0%	6944688	6944688	0%	1810810	1810810	0%
Alokabank	21610051	21610051	0%	3168644	3168644	0%	251952	367589.83	46%
Alp Jamol Bank	12609820	16642187.4	32%	2587419	2587419	0%	217535	302094.21	39%
Creditstandard	2627448	2627448	0%	5350770	5350770	0%	660778	660778	0%
Gallabank	57856511	57856511	0%	5401035	5401035	0%	678428	678428	0%
Ipak Yuli Bank	41901563	41901563	0%	5048451	5048451	0%	988459	988459	0%
Ipotekabank	162000000	162000000	0%	19392898	19392898	0%	4318333	4318333	0%
Kapitalbank	33112513	46451702.49	40%	7226882	7226882	0%	997388	1011796.75	1%
Khamkorbank	46370429	46370429	0%	6945870	6945870	0%	437809	437809	0%
Pakhtabank	318000000	318000000	0%	37802875	37802875	0%	3685338	3685338	0%
Parvinabank	22415582	22415582	0%	1702294	1702294	0%	570313	570313	0%
Soderat (Iran)	303409	303409	0%	280149	280149	0%	72095	72095	0%
Trastbank	11303365	11303365	0%	2809221	2809221	0%	179627	715493.17	298%
Turkiston	982997	982997	0%	327141	327141	0%	52680	52680	0%
Turonbank	39431098	39431098	0%	5200592	5200592	0%	454616	454616	0%
Uktambank	3756508	3756508	0%	351425	351425	0%	32676	32676	0%
Universalbank	3311595	4413209.69	33%	695458	695458	0%	56886	66692.88	17%
U-T Bank	1996711	5512586.58	176%	1190628	1190628	0%	219671	264780.81	21%
Uzkdb	20873001	20873001	0%	4600314	4600314	0%	1289702	1289702	0%
Uzpromstroybank	408000000	408000000	0%	29148908	29148908	0%	3826421	3826421	0%

Appendix F. Lambdas (Analysis for the year 2006)

DMU Name	*Input-Oriented VRS Efficiency*	Optimal Lambdas with Benchmarks							
ABN-AMRO	1,00000	1,000	ABN-AMRO						
Alokabank	0,70048	0,331	Khamkorbank	0,091	Parvinabank	0,458	Uktambank	0,121	UzKDB
Alp Jamol bank	0,84804	0,255	Khamkorbank	0,080	Turkiston	0,534	Uktambank	0,131	UzKDB
CreditStandard	1,00000	1,000	CreditStandard						
Gallabank	1,00000	1,000	Gallabank						
Ipak Yuli bank	0,70932	0,064	Khamkorbank	0,048	Pakhtabank	0,542	Parvinabank	0,335	UzKDB
Ipotekabank	1,00000	1,000	Ipotekabank						
Kapitalbank	0,64856	0,458	Khamkorbank	0,047	Pakhtabank	0,495	UzKDB		
Khamkorbank	1,00000	1,000	Khamkorbank						
Pakhtabank	1,00000	1,000	Pakhtabank						
Parvinabank	1,00000	1,000	Parvinabank						
Soderat (Iran)	1,00000	1,000	Soderat (Iran)						
Trastbank	0,59147	0,064	CreditStandard	0,372	Turkiston	0,059	Uktambank	0,505	UzKDB
Turkiston	1,00000	1,000	Turkiston						
Turonbank	0,87309	0,109	Gallabank	0,602	Khamkorbank	0,002	Pakhtabank	0,186	Parvinabank
Uktambank	1,00000	1,000	Uktambank						
Universalbank	0,95298	0,000	Gallabank	0,054	Khamkorbank	0,599	Turkiston	0,347	Uktambank
U-T bank	0,90687	0,031	CreditStandard	0,364	Turkiston	0,442	Uktambank	0,164	UzKDB
UzKDB	1,00000	1,000	UzKDB						
Uzpromstroybank	1,00000	1,000	Uzpromstroybank						

Appendix G. References (Analysis for the year 2006)

DMU	Peer Group	Frequencies
Abn-Amro	Abn-Amro	1
Alokabank	Khamkorbank , Parvinabank , Uktambank , Uzkdb	0
Alp Jamol Bank	Khamkorbank , Turkiston , Uktambank , Uzkdb	0
Creditstandard	Creditstandard	3
Gallabank	Gallabank	4
Ipak Yuli Bank	Khamkorbank, Pakhtabank, Parvinabank, Uzkdb, Uzpromstroybank	0
Ipotekabank	Ipotekabank	1
Kapitalbank	Khamkorbank , Pakhtabank , Uzkdb	0
Khamkorbank	Khamkorbank	7
Pakhtabank	Gallabank , Pakhtabank , Uzpromstroybank	4
Parvinabank	Parvinabank	4
Soderat (Iran)	Soderat (Iran)	1
Trastbank	Creditstandard , Turkiston , Uktambank , Uzkdb	0
Turkiston	Turkiston	5
Turonbank	Gallabank , Khamkorbank , Pakhtabank , Parvinabank , Uktambank	0
Uktambank	Uktambank	7
Universalbank	Gallabank , Khamkorbank , Turkiston , Uktambank	0
U-T Bank	Creditstandard , Turkiston , Uktambank , Uzkdb	0
Uzkdb	Uzkdb	7
Uzpromstroybank	Uzpromstroybank	3