DEVELOPMENT OF UKRAINIAN BANKING INDUSTRY: STRUCTURE, CONDUCT, PERFORMANCE

by

Tayisiya Shepetko

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Abstract

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by Tayisiya Shepetko

Head of State Examination Committee: Ms. Svitlana Budagovska
Economist, World Bank of Ukraine

The present paper conducts an empirical structure-conduct-performance study of the Ukrainian banking sector with a special focus on the efficiency of its performance. Specifically we examine the industry's development from the origins in 1991 until nowadays and evaluate the performance of Ukrainian banks and the banking system as a whole applying traditional techniques and advanced efficiency analysis methods including aggregation and bootstrap. Investigation of structure and conduct detects the Ukrainian banking as a dynamic and fast growing large and at this stage rather unconcentrated market. Based on data on banks financial indicators for the years 1998-2003, we find the production efficiency of individual banks as well as the aggregate efficiency of the banking industry overall to increase substantially indicating the tendency for within efficiency catching-up and thus revealing the banking industry to improve its performance. We also investigate efficiencies of the sub-groups of banks and find that the group of large and medium banks and the group of small banks has significantly different distributions of efficiencies; we also detect higher aggregate efficiency for the former group comparing to that of the latter. Interestingly, the existing gap between the production efficiencies of the two groups is decreasing over time demonstrating the convergence in performance between the banks of different size.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

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INTRODUCTION

Today the banking sector appears to be one of the essential elements in the market structure. Many of the benefits that banks provide to modern societies originate from their ability to facilitate transaction costs and to ameliorate asymmetric information imperfections. Acting as an intermediary between savers and investors, banks serve as one of the main tools for a healthy economy to operate efficiently. They accommodate savers with additional investment opportunities and borrowers with a greater choice of sources of credit, thereby playing a key role in efficient allocation of resources and thus improving the overall economic efficiency and contributing greatly to economic growth.

The development of a sound banking system becomes fundamentally important when transition economies are concerned. In a recent study of the causal link between the type of financial system and economic growth, Tadesse (2002) found that in countries with underdeveloped financial sectors the degree of bank orientation of the financial system (vs market orientation) is significantly positively related to economic performance. Moreover, according to the recent survey conducted by Ukrainian Institute for Economic Research and Policy Consulting, financing via banks' lending still appears to be the major source of external funds for Ukrainian enterprises: in 2002 bank loans constituted almost 70% of corporations' external financing. Hence, for Ukraine, as a country in transition, the strength, stability and credibility of the banking sector have an extremely strong influence on the macroeconomic stability and economic growth of the country as a whole as well as on the other segments of the national

economy, and thus a high emphasis should be placed on the efficient performance of the Ukrainian banking.

Unfortunately, during the recent years the Ukrainian banking system appeared to be highly unstable and untransparent resulting in the inclusion of Ukraine in year 2001 into the Financial Action Task Force (FATF) "black list"[1] as a result of *"Ukraine's failure to enact anti-money laundering legislation that meets international standards"* (FATF, 2002). The reasons for that stemmed from numerous objective and subjective restraints to the development of the banking system in Ukraine. These include the imperfections in the legislative framework, in particular that concerning the legalisation (laundering) of the crime proceeds, and tax burden, the lack of reliable system of bank deposits insurance. Nevertheless within the last three years Ukrainian banking industry exhibits continuing growth and considered to be one of the most dynamic and fast growing one in the national economy.

The present paper conducts an empirical structure-conduct-performance study of the Ukrainian banking sector examining the industry's development from the origins in 1991 until nowadays. In particular we focus on the performance of groups of banks within the industry and the overall industry performance in terms of its efficiency. We thus investigate the stability of banking performance over period 1998-2003 and test the hypothesis of *convergence* between the performance of sub-groups of Ukrainian banks (large and medium banks and small banks) and within these groups applying traditional techniques and recently advanced efficiency analysis methodologies, such as aggregation and bootstrap.

[1] while this paper was in process, in the beginning of 2004 Ukraine was eventually excluded from the FATF "black list" (see Chapter 3)

The study is of interest for several reasons: the insight on the banking market structure and conduct will explain the current situation (and the historical perspective) in the banking industry with respect to the market extent, ownership, foreign participation, etc., distinguish the major industry peers and their influence on competitiveness of the banking market in Ukraine. At the same time the investigation of the efficiency of sub-groups of banks will explain how the performance of small and large banks in Ukraine differ and whether the gap changes over time, whereas the investigation of the overall industry performance will shed light on the most important question of how successful is the banking system in benefits produced for consumers through the fulfillments of its main functions as a financial intermediary.

The rest of the paper is organized as follows. Chapter 1 discusses the previous research made on structure-conduct-performance analysis of the banking sector as well as on the implementation of the efficiency analysis techniques for the estimation of banks performance in different countries. The methodological framework used for the study and for evaluation of the banking performance in particular is described in Chapter 2. Chapter 3 highlights the main questions regarding the structure and conduct of banking in Ukraine. Chapter 4 specifies the data and the model used and presents empirical results of the research on the banking industry performance. Finally, Chapter 5 concludes on the main findings and results and gives some directions for further research.

Chapter 1

LITERATURE REVIEW

Today there exist a vast amount of literature regarding the market structure, conduct, and performance of banking sectors in different countries and across them. Most part of those studies refers to the microeconomic theory of banking as well as to the empirical research about the relationship between market structure and various aspects of bank conduct and performance.

The conventional structure-conduct-performance (SCP) approach to the industrial organization research was first introduced by Edward S. Mason and his associates in 1931. The main principle of the approach is that industry performance through the firm conduct depends on market structure, which in its turn depends on basic conditions of the market (Carlton and Perloff, 2000). The first empirical SCP studies in the banking date back to the beginning of the 1960's, being driven by the new legal requirement to the Fed regulatory agencies to consider the effect of bank mergers on competition (Gilbert, 1984).

The *basic conditions* for the banking market along with conventional demand and supply conditions include aspects of incomplete information, in particular uncertainty issues and asymmetric information, and transaction costs. The underpinnings for that stem from the microeconomic theory of financial intermediation, which considers banks' special role in minimizing the "costs between borrowers and lenders by monitoring the borrowers at low costs" (Neuberger, 1998; Diamond, 1984).

Another peculiarity in banking market studies arises from special inputs and outputs of banks. There is still a controversy between the three major approaches to the definition of banks inputs and outputs. The *production approach* essentially views banks as producing services for account holders with labor and capital as inputs and processed documents and transactions as outputs. In contrast, the *intermediation approach* sees banks as an intermediary between savers and investors regarding deposits, other funds, labor, and physical capital as inputs while loans and other investments as outputs (Berger and Humphrey, 1997; Wheelock and Wilson, 1995). According to the *value-added approach*, activities which contribute highly to banks' value added (deposits, loans, time and savings deposits) are considered as outputs and labor, physical capital, and purchased funds as inputs (Berger and Humphrey, 1992).

Typically, as stated in Neuberger (1998), banks are considered as multiproduct firms, which produce services through taking deposits and granting loans operating on the three main markets – the deposit market, the loan market and the securities market. The *structure* of the market for banking products is defined with respect to market segmentation, geographical extent, barriers to entry, ownership, costs structure, etc. Most of the studies used concentration in local market areas as a relevant measure of the banking market structure (Gilbert, 1984). During the last years most empirical researches suggest the extinction of geographic limitations due to development of telecommunication industry as well as financial globalisation (ECB, 2003). Thus, for example, most of the European studies examine EU banking market as a whole concerning each specific country market as a local market (Jansen and Haan, 2003; Goldberg and Rai, 1995). In US banking, however, there is still a range of services which are rendered on the local markets primarily to individuals and small businesses, and thus most of US banking studies referred to local markets as opposed to regional (Goldberg and Rai, 1995). As the major barriers to entry the banking industry most of the

authors point out the regulation requirements, economies of scale, advantages of product differentiation, and bank reputation.

Through the *conduct* the market structure influences the overall performance of an industry. The banks' conduct involves their strategies, products promotions, price policies, and sales, in particular the issues of competition (price, quality, etc.), price discrimination, marketing, collusions, and innovations, in general, all that explains the behavior of banks. Empirical studies suggest that the major influence on banks' behavior is exerted by a high degree of asymmetric information between buyers and sellers which is the essential part of a bank activity.

According to Gilbert (1984) survey of 56 studies conducted during the period of 1964-1983, among the main approaches to measure banks' *performance* are the elasticity of loan demand, the interest rates on business loan, on time deposits, on passbook savings, the values of net income per dollar of total assets or capital and others. Along with these conventional measures Neuberger (1998) suggests to use productive (cost and profit) efficiency and allocative efficiency as a bank performance measure.

There exists a bulk of studies examining the performance of the banking sectors in terms of their efficiency in different countries and across them. Vast amount of that literature (Berger and Humphrey, 1997; Berger and Mester, 1997; Bauer et al., 1997; Lozano-Vivas et al., 2002) concerns the efficiency frontier analysis of financial institutions. Thus, for example, Berger and Humphrey (1997) survey 130 studies regarding the efficiency of financial institutions including banks and their branches, savings and loans associations, credit unions, and insurance companies using data from 21 countries; Bauer et al. (1997) evaluate and compare the US bank efficiency estimates using variants of frontier approaches.

Among the various frontier efficiency methods authors distinguish parametric and nonparametric ones. Berger and Humphrey (1997) consider stochastic frontier approach (SFA) and thick frontier approach (TFA) as two major parametric approaches. The main advantage of these approaches is that they isolate inefficiency from random error; however this is done by imposing a particular structure on a functional form for the frontier and the assumptions on distributions for error and inefficiency term which may affect the conclusions and thus are considered as the main drawbacks of the approach. Data envelopment analysis (DEA) and Free Disposal Hull (FDH) are referred to as nonparametric approaches. On the one hand, they do not need to specify the functional form of the frontier and make no assumptions on distributions of inefficiency term, inputs and outputs, in addition they are easy to estimate the multiple output – multiple input models which are considered as their main advantages. On the other hand, the nonparametric approaches may be sensitive to outliers, and do not model the possibility of a measurement error or statistical noise unless the two stage approach is applied with regression analysis on the second stage.

However, in general it is impossible to distinguish which of the two mentioned above approaches is better for estimation since both of them have advantages and disadvantages while the true efficiency scores are not observed. In the banking studies researchers most frequently use either nonparametric DEA (Jackson et al., 1998; Canhoto and Dermine, 2000), or parametric SFA (Bos and Schmiedel, 2003), or both and then compare the results (Styrin, 2003; Lozano-Vivas et al., 2002).

Recent studies concentrates not only on the efficiency of financial institutions within one country (Cebenoyan et al., 1993; Jackson et al., 1998; Canhoto and Dermine, 2000; Rime and Stiroh, 2002), but many of them conduct international surveys among the countries with similar regulation, economic environment,

geographical market, etc. (Lozano-Vivas et al., 2002; Yildirim and Philippatos, 2001; Bos and Schmiedel, 2003) this trend became especially popular with the European financial market integration.

Unfortunately, the studies on the efficiency of banking in transition country are not that numerous. Yildirim and Philippatos (2001) examine the cost and profit efficiency of banking sectors in 12 Central and Eastern European transition countries (including Baltic countries and Russian Federation) applying two different parametric techniques to the data set of 1993-2000. They suggest that higher efficiency levels are associated with higher profitability and equity and find positive relationship between and the level of competition and economic growth and negative relationship between the efficiency and concentration in the banking efficiency in CEE countries. In addition foreign banks appeared to be more cost efficient while domestic banks proved to be more profit efficient. However, Styrin (2003) in his study on efficiency across Russian banks found opposite results on foreign banks in Russia – banks with foreign capital appeared to be less cost efficient; he also found that risky loan portfolio and Moscow location of a bank increase the bank's efficiency while state ownership decrease it.

So far we have come across only a few researches concerned with the efficiency of Ukrainian banking. Thus, Grigorian and Manole (2002) determining the performance of commercial banks in transition used a small sample of Ukrainian banks in an international study. According to results Ukraine was among the countries exhibited the smallest efficiency scores in the sample of transition countries. The study conducted by Mertents and Urga (2001) used data on 79 commercial banks in 1998. The major findings was that small Ukrainian banks operated more efficiently in terms of cost efficiency but appeared to be less profit efficient. The authors thus concluded on the existence of monopoly power in Ukrainian banking where large banks can earn more profits while having greater

costs. The research thesis by Rabtsun (2003) evaluates the current situation in the banking sector of Ukraine testing the hypothesis of high competitiveness in the banking industry using the DEA efficiency analysis. The main finding of the paper is that most banks disregarding their size, ownership, or region where the head office is located appeared to be quite efficient thus supporting the hypothesis of a highly competitive banking sector in Ukraine.

There are amounts of directions for further research. Among them Berger and Humphrey (1997) include those concerning the similarity of scores derived using different frontier approaches, the sensitivity of the results to model specification and choice of inputs and outputs, the examination of scores over time, the building of confidence intervals for the efficiency estimates in order to make an inference on validity of the scores in statistical sense.

Incidentally, there have recently been developed some new theoretical framework for further investigation of DEA efficiency score estimates. Thus, Färe and Zelenyuk (2003) establish the conditions for aggregation of the DEA efficiency scores which enable to receive the aggregate efficiency estimates from the firms' individual efficiency scores. Using weighted average with weights derived from economic optimization, the proposed aggregation method could be used to evaluate the aggregate score of a subgroup of banks, or the aggregate efficiency score of the whole Ukrainian banking industry. In addition, in the recent paper of Simar and Zelenyuk (2003) authors proposed an algorithm of the "g*roup-wise heterogeneous sub-sampling bootstrap of aggregates of DEA efficiency scores*" which enables to build confidence intervals and obtain bias-corrected estimates of the aggregate estimates of DEA scores.

There are still debates around scale economies in banking. On the one hand, the scale issues are considered to be the natural assumption regarding banking

industry since according to the financial market theory banks are assumed to take advantage of economies of scale. However, Berger and Humphrey (1994) in their US banking study found the scale and scope economies in banking to be not important, except for the smallest banks, and mergers have no significant effect on efficiency. The explanations for that stem from the fact that banks of different size produce different ranges of products. The same reasoning is used by Neuberger (1998) which suggests that banks of different size execute different task and therefore there exists no optimal size of a bank.

However, assuming that there really exist different groups of banks that perform different tasks, it would be an important issue to test whether those groups are different in their performance, in their efficiency specifically, and whether those differences disappear with time. In other words, the issue of convergence or catching up between the banks is one of the interests.

The question of convergence between some groups of economic agents is a very popular subject to study. Most of the researches on convergence concern the issue of economic growth and catching up between the world's economies (developed and developing countries). In recent studies (Henderson and Russell, 2001, Kumar and Russell, 2002) authors employed standard DEA approach analysing efficiency levels of developed and developing countries, thus making conclusions on convergence between them. The paper of Henderson and Zelenyuk (2004) uses advanced DEA techniques to extend the question of world's economies convergence.

Taking into account all the recent trends, this paper conducts an empirical structure-conduct-performance study of the Ukrainian banking with a special focus on the efficiency of its performance. In particular, the study investigates the market structure with respect to ownership, foreign participation, concentration,

and the behavior of banks examining the industry's development from the origins in 1991 until nowadays. At the same time it evaluates the performance of Ukrainian banks and the banking system as a whole and tests the hypothesis of *convergence* between the performance of sub-groups of banks applying traditional techniques and advanced efficiency analysis including aggregation and bootstrap.

Chapter 2

METHODOLOGY

The SCP analysis of Ukrainian banking industry comprises two stages. First, we investigate the market structure, and the behavior of banks in Ukraine, thus making the industry overview from its origins in 1991 until nowadays. On the second stage, we evaluate the performance of Ukrainian banking system with a special focus on the efficiency of its functioning and test the hypothesis of *convergence* between the performances of two sub-groups of Ukrainian banks.

Following Neuberger (1998), the productive (cost and profit) efficiency and allocative efficiency can be used as the banks' performance measure. Hence in this paper we use the traditional techniques of the DEA approach and the recently advanced efficiency analysis methodologies, in particular those for DEA efficiency scores, to evaluate the performance of Ukrainian banks.

Data Envelopment Analysis (DEA) is a nonparametric approach to measure the efficiency of a decision making unit (DMU) as the deviation from the efficient frontier which is constructed as a polyhedral surface over the data using linear programming technique. Envisioned first by Farrell (1957), the method received its name and popularity with a seminal paper of Charnes, Cooper and Rhoads (1978), and now is a very popular one and is widely used to asses the efficiency of DMUs in different studies (Jackson et al., 1998; Canhoto and Dermine, 2000; Lozano-Vivas et al., 2002). The main advantage of the approach is that it does not need to specify a functional form of the frontier, makes no assumptions on distributions of the inefficiency term, inputs and outputs, and allows for multi-

output framework without additional assumptions on relationship between the outputs. As a nonparametric approach the DEA may be sensitive to outliers, and does not model the possibility of a measurement error or statistical noise explicitly. However, recently developed methodologies showed that all these drawbacks have reasonable solutions such as tests for outliers, separation of error term with second stage regression analysis, bootstrapping and others.

Moreover, the choice of DEA estimator for the analysis is also stipulated for its statistical properties which reveal (Berger and Humphrey, 1997; Simar and Zelenyuk, 2003) that given certain assumptions[2]:

a) The estimated DEA efficiencies provide consistent estimators for "true" real efficiencies of DMUs;
b) The DEA estimators are the maximum likelihood estimators of "true" efficiencies;
c) The empirical distribution of DEA estimates is asymptotically equal to the true distribution of efficiencies.

All these properties give foundations for further analysis, in particular, the bootstrapping to obtain bias corrected estimates of aggregate technical efficiencies, estimate the efficiency scores' standard errors, and build the bootstrap confidence intervals for the estimates, thus obtaining an approximation to the sampling distribution of DEA efficiency estimates which is afterward used for statistical inference.

[2] The list of assumptions adopted to methodologies used in the present paper can be found in Simar and Zelenyuk (2003)

Let's consider a banking industry with k $(k=1,\ldots n)$ banks, where each taken separately bank uses N banking inputs $x^k=(x^k_1,\ldots,x^k_N)$ and produce M banking outputs $y^k=(y^k_1,\ldots,y^k_M)$, and the whole sector uses the same technology

$$T^k \equiv \{(x^k,y^k): x^k \text{ can produce } y^k\}, \tag{2.1}$$

which can equivalently be characterized by the output set

$$P^k(x^k) \equiv \{(y^k): x^k \text{ can produce } y^k\}, \quad x^k \in \mathbb{R}_+^N \tag{2.2}$$

Assuming the technology to satisfy the regularity axioms of production theory fully discussed in Zelenyuk (2004), we define the efficiency of a bank k with the output-oriented Farrell technical efficiency measure as

$$TE(x^k,y^k) \equiv \max\{\theta: \theta y^k \in P^k(x^k)\} \tag{2.3}$$

The choice of the Farrel efficiency measure is determined by its desirable mathematical properties, intuitive interpretation, and relative simplicity to compute (Zelenyuk, 2004).

If further we define the frontier as an upper boundary of $P^k(x^k)$ by

$$\partial P^k(x^k) = \{y \in \mathbb{R}_+^M: y \in P^k(x^k), \ \lambda y \notin P^k(x^k), \ \forall \lambda \in (1;\infty)\}, \tag{2.4}$$

then a bank k is called technically efficient having the efficiency score of 1 – the best-practice bank – if $y^k \in \partial P^k(x^k)$, which we call best practice band. For a technically inefficient bank the efficiency score belongs to the interval $(1;\infty)$ and is given by (2.3); then, the bank inefficiency score can be obtained as $(1 - \frac{1}{TE})\%$.

However, as it was stated before the "true" frontier as well as "true" efficiency scores defined by (2.4) and (2.3) respectively are not observed. Thus, to estimate them we use the DEA estimator which has proved to be consistent. Applying the output oriented variable returns to scale (VRS) model, we estimate the best practice frontier as

$$\partial \hat{P}(x) = \{y \in \mathbb{R}_+^M: y \in \hat{P}(x), \ \lambda y \notin \hat{P}(x), \ \forall \lambda \in (1;\infty)\}, \tag{2.5}$$

where

$$\hat{P}(x) = \{ y \in \Re_+^M : \sum_{k=1}^{n} z_k y_m^k \geq y_m,\ m = 1, \ldots, M;\ \sum_{k=1}^{n} \lambda_k x_i^k \leq x_i;\ i = 1, \ldots, N;$$

$$z_k \geq 0,\ k = 1, \ldots, n,\ \sum_{k=1}^{n} z_k = 1 \} \qquad (2.6)$$

Then the DEA estimator of the technical efficiency[3] of a bank $\hat{TE}(x, y)$ is obtained as follows.

$$\hat{TE}(x, y) \equiv \max_{\theta, z_1, \ldots, z_k} \{\theta : \theta y \in \hat{P}(x)\} \qquad (2.7)$$

Recall that in our study we want to examine the performance of sub-groups of banks within the industry and the overall industry performance; thus, we need to find an aggregate efficiency score (for a group or a sub-group of banks) from the estimated individual efficiencies. One way to do that is to use a simple average of banks' individual efficiency scores in a group. However this approach ignores the relative economic importance of a bank within the group treating all banks as equally important. Another way is to use a weighted average. In the recent work by Färe and Zelenyuk (2002) the authors discovered conditions for aggregation of efficiency scores based on economic optimization principles and proposed the aggregated efficiency measure of a group of firms (banks) as a weighted average which uses the revenue shares as weights. Further, Simar and Zelenyuk (2003) have adopted the above mentioned methodology making the weights price independent (for the case if information on prices is unavailable).

According to their results, the aggregate efficiency of a subgroup l ($l = 1, \ldots, L$) of firms (banks in our case) where each taken separately firm uses N inputs and

[3] It should be mentioned that within the framework of the present study, the estimated efficiency is not purely technical since the model uses inputs and outputs in monetary units rather than in physical values. Thus, the estimated efficiency could be considered as sub-cost efficiency as named in Färe, Grosskopf and Zelenyuk (2002). Within the present study we would call it *production efficiency*.

produces M outputs, in the industry consisting of L non-intersecting and exhaustive sub-groups, using price independent weights is estimated as follows.

$$\overline{TE}^{l} \equiv \sum_{k=1}^{k_l} TE^{l,k}(x^{l,k}, y^{l,k}) \cdot S^{l,k}, \tag{2.8}$$

where

$\overline{TE}^{l}$ - the aggregate technical efficiency of l sub-group of firms, *(l = 1, …, L)*;

$TE^{l,k}$ - the technical efficiency score of k firm in l sub-group, estimated by (2.7);

$x^{l,k}, y^{l,k}$ - inputs and outputs, respectively, of k firm in l sub-group, $x^{k}=(x^{k}_{1},\ldots,x^{k}_{N})$ and $y^{k}=(y^{k}_{1},\ldots,y^{k}_{M})$;

$S^{l,k}$ - the price independent weight for aggregating technical efficiencies, estimated as

$$S^{k} = \frac{1}{M}\sum_{m=1}^{M} \varpi_{m}^{k}, \tag{2.9}$$

where $\varpi_{m}^{k} = y_{m}^{k} / \overline{Y}_{m}$ - the firm's k share in the group in terms of m-output, $m=1,\ldots M$, and M – number of outputs.

Thus, for our study, the aggregate efficiency score for a sub-group of banks can be obtained by taking weighted average of the efficiency scores of each bank individually with weights being the output shares of the bank within its sub-group.

Similarly, the overall aggregate efficiency of a sector is estimated as:

$$\overline{TE} = \sum_{l=1}^{L} \overline{TE}^{l} \cdot S^{l}, \tag{2.10}$$

where

$\overline{TE}$ - the aggregate technical efficiency of a whole sector of firms;

$\overline{TE}^{l}$ - the aggregate technical efficiency of l sub-group of firms, estimated by (2.8), l= *(1,…L)* ;

S^l - the price independent "between sub-groups" weight, estimated as

$$S^l = \frac{1}{M}\sum_{m=1}^{M} W_m^l , \tag{2.11}$$

where $W_m^l = \overline{Y}_m^l / \overline{Y}_m$ - the sub-group's *l* share in the sector in terms of *m*-output, *m=1,…M.*

Again, the equation (2.10) tells that the aggregate efficiency score of the industry is obtained by taking weighted average of the efficiency scores of each sub-group with weights being the output shares of the sub-group within the industry.

However, it should again be stressed that obtained in the preceding way individual and aggregate efficiency scores are just the estimates of the "true" efficiencies which are unknown. Hence, to provide a statistical foundation for DEA a re-sampling technique can be used (due to statistical properties of DEA estimator mentioned above). Simar and Zelenyuk (2003) in their paper provide an algorithm of the "*group-wise heterogeneous sub-sampling bootstrap of aggregates of DEA efficiency scores*", which allows to obtain bias corrected estimates of aggregate technical efficiencies, estimate the efficiency scores' standard errors, and build the bootstrap confidence intervals for the estimates. It is shown that if the bootstrap is consistent, then the relationship between the bootstrap estimate and the empirical estimate reproduces (asymptotically) the relationship between the empirical estimate and the "true" unobservable value that is

$$\overline{T\hat{E}}^{*} - \overline{T\hat{E}} \mid \hat{\wp} \quad \overset{asy.}{\sim} \quad \overline{T\hat{E}} - \overline{TE} \mid \wp , \tag{2.12}$$

where

$\overline{T\hat{E}}^{*}$ - the bootstrap estimate of the aggregate efficiency score;

$\overline{T\hat{E}}$ - the empirical estimate of the aggregate efficiency score;

$\overline{TE}$ - "true" aggregate efficiency score, which is unknown;

$\wp, \hat{\wp}$ - characterizations of the true population and the *pseudo*-population, respectively, derived from a given data set[4].

Thus, having corrected aggregated scores of sub-groups for bias, the DEA corrected efficiencies are used as consistent estimates of true banks' efficiency scores which could be considered as a measure of banks groups' performance. Applying these techniques for several periods of time reveals a possibility to analyze the banking performance, in particular the performance of two sub-groups of banks and the banking sector as a whole, over time and look at their dynamics; and thus to test the hypothesis of convergence (catching-up) in performance between the groups of banks and within them.

In addition we may be interested how the obtained aggregate scores for the sub-groups are different from each other – in order to find that we use a test provided in Simar and Zelenyuk (2003). Following the methodology, for two sub-groups A and B we postulate

$$H_0 : \overline{TE}^{A} = \overline{TE}^{B} \text{ against } H_1 : \overline{TE}^{A} \neq \overline{TE}^{B}$$

If the relative difference $RD_{A,B}=\overline{TE}^{A}/\overline{TE}^{B}$ in statistical sense is different from unity we reject the H_0. Since true $RD_{A,B}$ is not observed, it is estimated by $\hat{RD}_{A,B}=\overline{\hat{TE}}^{A}/\overline{\hat{TE}}^{B}$. To make the inference about the equality of two aggregate scores, we find the confidence interval for the $RD_{A,B}$ statistics employing the bootstrap technique and "*reject the null if the bootstrap confidence interval does not cover unity*" (Simar and Zelenyuk, 2003). Moreover, further we use the bias corrected estimate of RD statistics to measure the extent of catching-up between the groups (the closer RD to unity, the higher is catching up) and its estimated standard error to measure the extent of convergence between the groups.

[4] For details and the algorithm of bootstrapping see Simar and Zelenyuk (2003)

Finally, it should be mentioned that to justify the choice of the sub-groups, in our case these are the group of large and medium banks versus the group of small banks, we test the hypothesis of difference in the efficiency scores distribution for banks which belong to different sub-groups employing the nonparametric kernel density estimation. The densities for each subgroup are estimated from the individual bias corrected efficiency estimates (obtained through application of the group-wise smooth heterogeneous bootstrap using Simar and Wilson (1998) approach[5]) with Gaussian kernel and Silverman (1986) bandwidth selection rule[6]. According to Simar and Zelenyuk (2004), estimating the densities we should account for the bounded support of the efficiencies - the estimated efficiency scores belong to the interval [1; ∞) (we do so by using Silverman reflection rule) and the consistency of the estimates (we use bias corrected scores for the density estimation). Further we employ the adapted to the DEA context Li-test for equality of two densities (Simar and Zelenyuk, 2004) to examine the differences between the distributions of the efficiencies of the two sub-groups.

[5] In particular, its group-wise heterogeneous version. See Henderson and Zelenyuk (2004)

[6] For details see Zelenyuk (2004)

Chapter 3

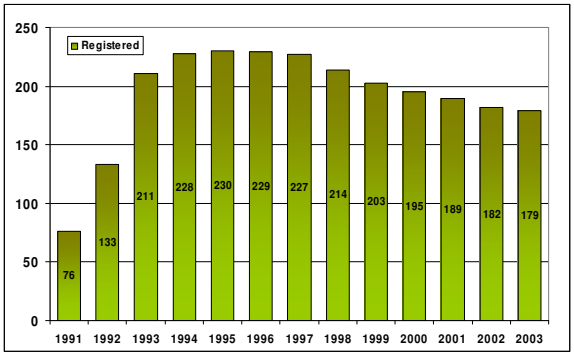
UKRAINIAN BANKING: STRUCTURE AND CONDUCT

The new stage of the national banking system in Ukraine started in March 1991, after the Law of Ukraine "On Banks and Banking" was adopted by the Ukrainian parliament. According to the law, by its structure the Ukrainian banking is a two-tier system with the National Bank of Ukraine on the first level which acts as a Central bank executing financial and credit policy, controlling the monetary supply, ensuring the stability of the national currency, as well as standardising and supervising the performance of the commercial banks of various types and forms of ownership which constitute the second tier of the system.

Nature of the Product. Banks are considered as multiproduct firms, which operate on the three main markets – the deposit market, the loan market and the securities market, and produce services providing liquidity, information and transformation of risks through taking deposits and granting loans. Specifically, banks are making profits through the asset transformation: "*by selling liabilities with one set of characteristics (a particular combination of liquidity, risk and return) and using the proceeds to buy assets with a different set of characteristics*" (Mishkin, 2001).

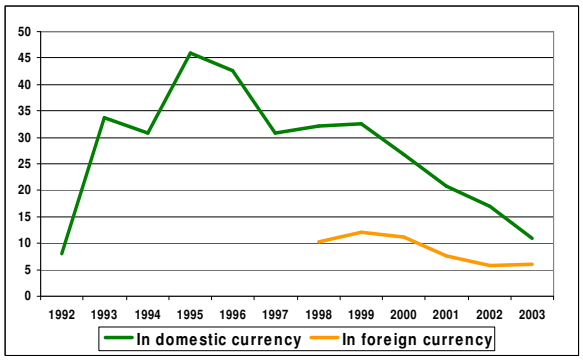
Extent of the Market. During the first years of independence the number of banks in Ukraine increased rapidly (Figure 1). The reasons for such an enormous growth were twofold. On the one hand, the interest rate spread was very high in domestic currency as well as in foreign currencies which allows the banks to make

Figure 1 Number of commercial banks



Source: National Bank of Ukraine (NBU)

Figure 2 Nominal interest rate spread



Source: NBU

huge profits acting as an intermediary between the savers and the borrowers. As we can see from the Figure 2 during the 1992-1995 the spread climbed reaching the maximum of 46 percentage points in 1995. On the other hand, the barriers to entry the industry was very low which encouraged the substantial entry of new banks into the industry: the established level of capital required to set up a bank in 1992 was only 5 mln of roubles (in 1992 this amount was increased up to 500 mln of Ukrainian karbovanec) while the level of inflation during the 1991-1993 soared and reached the peak of 10,155 percent in 1993.

During the last years, however, the number of banks decreased. The reasons for that stemmed partly from the crisis of 1998 and the increased capital requirements; other explanations include not recovered public trust in commercial banks, unstable macroeconomic environment, imperfections in the legislative framework, and tax burden which all result in the failure of banks to meet their obligations. Hence, the banking sector still appears to be quite risky. During 1996-2002, 78 banks exited from the market. At the beginning of 2004 there were 20 banks under liquidation in Ukraine which constitutes 13% of all the

working banks (comparing to 4 banks (19%) in Slovakia, 7 banks (16%) in Croatia, 15 banks (43%) in Czech Republic, and 330 banks (25%) in Russia)[7].

With respect to the customer groups banking market is segmented into (Neuberger, 1998) the wholesale banking (includes big corporate clients) and the retail banking (works with small corporations and households). In Ukraine most of the banks are universal working on the both markets. However up until the recent times almost all the foreign banks were working exclusively on the wholesale market; recently there is a tendency for them to enter the retail market as well. Following the IMF Report (2003) the segmentation of Ukrainian market may also be due to the status of many small banks as "pocket banks" of enterprise groups as a source of cheap financing and equity investing.

Geographically the banking market is considered to be a nationwide in Ukraine. However, according to a survey conducted by SigmaBleyzer foundation (2001), banks are irregularly located throughout the country due to diverse development of Ukrainian's regions. Thus, the majority of banking institutions, consisting of branches, divisions, non-balance departments and outlets around the country, are located in the largest industrial centers and cities, and highly populated regions of the country with near 50% of all banks being registered in Kyiv.

Barriers to entry. One of the most important entry barriers to banking is the minimum level of capital requirement. As it was stated above, in 1992 the established level of capital required to set up a bank was very low amounted to 5 mln of roubles resulting in banking boom in 1992-1993. Dramatically low levels of banks' statutory capitals by the end 1994 resulted in increase of the minimum capital requirements during the further few years – from ECU 100 ths in the beginning of 1996 to ECU 1000 ths in 1998. Such an increase in the capital

[7] According to data from countries National Banks' official sites

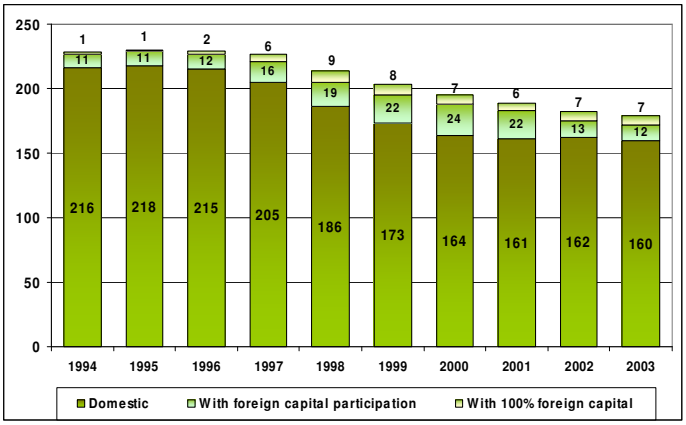
requirements curbed the number on newly registered banks as well as decreased the number of the functioning ones which did not meet the capital requirement and were revoked a licence. In the year 2001 the new law on banking set up EUR 1mln as a minimum capital requirement for a local cooperative bank, EUR 3 mln for a bank operating in one administrative region of Ukraine, and EUR 5 mln for a bank operating throughout the country. It is expected that the new capital requirements will result in small and medium banks mergers to consolidate the assets and capital and further use them more effectively.

In addition to capital requirements, an extensive branch network, a bank's reputation (probability to failure), information costs on customers are considered to be complementary barriers to entry the industry.

Ownership structure. Regarding the ownership structure of Ukrainian banks, it is necessary to say that since 1994 there are only two state-owned banks: Ukreximbank and Oshchadbank. However, their share in the total assets is quite stable making up around 12% of the total assets during 1998-2003.

The presence of foreign financial institutions in the Ukrainian banking system is thought to increase the competition in the industry and provide a positive effect on the sector development introducing new Western-style standards of service and management into the banking system and bringing in new investments. Since 1994 the number of banks with foreign capital participation in Ukraine increased from 14 to 31 in 2000 (Figure 3). However, during the last three years this number has dropped to 19 in 2003 (7 of that banks are with 100% foreign capital participation: Raiffeisenbank Ukraine (Austria), Citibank (USA), Bank Credit Suisse First Boston (Switzerland), Credit Lynnais Ukraine (France), Bank PEKAO (Poland), ING Bank Ukraine (Holland), HVB Bank Ukraine

Figure 3 Foreign participation in Ukrainian banking sector: number of banks (end of period)



Source: NBU

(Germany)). Despite the drop, the capital of the banks with foreign capital makes up about one fifth of the total capital of Ukrainian banks in 2003, whereas their assets make up one sixth of the total assets. Moreover, the participation of foreign capital in the industry is supposed to increase with the adoption by NBU a law permitting the foreign banks to set up in Ukraine their affiliates.

Industry concentration. Industry concentration is thought to be related to the degree of competitiveness in the industry. Bain (1951) stated that fewer and larger firms are more likely to engage in anticompetitive conduct; thus, higher concentration ratios in the industry are considered to be an indicator of uncompetitive market. The assets concentration of Ukrainian banking sector is not very high with the eight largest banks dominating in the sector (Table 1).

Thus, we can see that the four largest banks account for about 33% of total assets, while the eight largest banks (including 2 state-owned banks) occupy near the half of all the assets of working banks (comparing to four major banks

Table 1. Market concentration indices (for all working banks, end of period)

	Number of working banks	HHI	CR4	CR8
1998	179	476.6809	0.3663	0.5568
1999	164	409.8802	0.3290	0.5234
2000	154	400.6182	0.3252	0.5159
2001	152	425.4129	0.3511	0.5039
2002	157	405.2901	0.3420	0.4969
2003	157	394.4697	0.3293	0.4863

Notes: HHI - Herfindahl-Hirschman Index, defined as the sum of the squares of the firm's market shares; CR4 and CR8 – four-firm and eight-firm concentration ratios, respectively, defined as the sum of the four or eight largest firms in the industry, respectively.

making up 69% and 60% of total assets in China and Azerbaijan respectively, and five largest banks making up 58% and 65% in Croatia and Czech Republic respectively). According to the Horizontal Merger Guidelines (The U.S. Department of Justice and Federal Trade Commission, 1992) markets with the spectrum of market concentration as measured by the Herfindahl-Hirschman Index (HHI) are divided into "*three regions that can be broadly characterized as unconcentrated (HHI below 1000), moderately concentrated (HHI between 1000 and 1800), and highly concentrated (HHI above 1800)*". Following the above classification we regard Ukrainian banking is an unconcentrated industry with no adverse effect on competition. Moreover, we can mention a tendency for decrease in the concentration indices which serves as an indicator of increased competition in banking.

At the end of 2003 among the 8 largest banks were"Aval", the "Privat" Bank, Prominvestbank, Oshchadbank (the Savings Bank of Ukraine), Ukrsotsbank, Ukreximbank (the Export-Import Bank), Ukrsibbank, and Raiffeisenbank Ukraine (Table 2). Two of which are the state-owned banks (Oshchadbank, Ukreximbank) and one is a bank with 100% foreign participation (Raiffeisenbank).

Table 2. Total assets of eight largest Ukrainian banks (01.01.2004)

Rating	Bank	Total assets, mln UAH	Asset share
	Banking system	**100234.36**	**100**
	8 largest	**48739.966**	**48.63**
1	"Aval"	9929.038	9.91
2	Privatbank	9842.534	9.82
3	Prominvestbank	7625.622	7.61
4	Oshchadbank	5608.094	5.59
5	Ukrsotsbank	5157.914	5.15
6	Ukreximbank	3876.928	3.87
7	Ukrsibbank	3792.328	3.78
8	Raiffeisenbank Ukraine	2907.508	2.90

Source: NBU with calculations by author, UAH – Ukrainian national currency Hryvnia

activities and innovations based on use of telecommunications and Internet such as mobile-banking, internet-banking, e-cards, e-shops, etc. have started to develop (now primarily within the large banks). By the year 2003 Ukrainian commercial banks have issued more that 1 mln of credit and debit cards and this market has huge growth potential. Unfortunately, such issues as derivatives trading, foreign operations, trading on own-account in market instruments are still of minor concern (IMF Report, 2003).

Overall, during the last three years Ukrainian banking sector exhibits continuing growth. The activity of the banks was positively influenced by favorable macroeconomic changes of the last years. According to NBU monitoring (Press-service of NBU, 2004), in 2003 banks active transactions, crediting of the real sector of economy, as well as capitalization level of Ukraine banking sector increased comparing to their 2002 levels. In the beginning of 2004 there were 158 working banks in Ukraine with the total assets of more than 100 billion UAH. As a positive tendency can be considered the increase in population who trust the banking system (at the end of 2003 year the amount of household deposits totals to 77.4 % of all the deposits and to more than one third of all the banks liabilities)

as well as the advanced rates of growth of revenues of banks comparing to the expenditures growth providing growth in industries profits during the last three years (in 2003 revenues of banks have increased 32.9 % comparing to 2002 and have reached UAH 13.92 bln, while the profits increased 41.3% and amounted for UAH 0.97 bln). Moreover in the beginning of 2004 Ukraine was eventually excluded from the FATF "black list". However, the bank's lending ability is still very low resulting in the value of money multiplier (M2/M0) amounted to 2.85 only in 2003 comparing 9.7 and 8.4 in 1999 in the United States and Germany respectively. Thus, among the main targets postulated by NBU for near-term outlook was "*to take measures to raise capitalization level, to form required reserves on active transactions, to improve the quality of assets and liabilities and to provide for their balanced growth*".

Chapter 4

UKRAINIAN BANKING: PERFORMANCE

As we mentioned before, today the banking system of Ukraine exhibits continuing growth having an enormous growth potential, and it is thought to be one of the most dynamic one in the national economy. The investigation of the market performance answer the most important question of how successful is the banking system in benefits produced for consumers through the fulfillments of its main functions as a financial intermediary.

To evaluate the performance of Ukrainian banks in this paper we use the DEA approach. All the estimation procedures are conducted using the MatLab program with the codes kindly provided by professor Zelenyuk and slightly adapted to the framework of the present study.

4.1 Data and Model Specification

Data. Taking into account data availability, the empirical research on the Ukrainian banks performance covers the period of April 1998 to January 2004. In our study we use cross sectional data on all the Ukrainian banks quarterly for periods of 1998-2003. The data set includes main financial indexes on the financial and physical assets and liabilities which characterize the Ukrainian banks performance (Loans, Deposits, Physical capital, etc). All the data is taken from the annual balance sheets and income statements of banks that were found published in the official editions of NBU (Visnyk NBU).

The study is supposed to examine the performance of groups of banks within the industry, in particular the group of large and medium banks and the group of small banks, and the overall industry performance in terms of its efficiency. The division of the sample into two groups of large and medium banks and small banks was made according to the NBU criterion which takes into account the asset size (and capital size for marginal banks in the group). Thus the first group of large and medium banks contains those with assets greater than 50 mln UAH for the period up to 01.01.2001 and with assets greater than 70 mln UAH since 01.04.2001 (the criteria changed due to increase in general level of total assets), the group of small banks includes all the remaining banks[8].

Model specification. In Chapter 2 we mentioned that there are still debates between the approaches to the definition of banks inputs and outputs. According to the *value-added approach*, activities which contribute highly to banks' value added (deposits, loans, time and savings deposits) are considered as outputs and labor, physical capital, and purchased funds as inputs (Berger and Humphrey, 1992). Berger and Humphrey (1997) suggest to follow the *production approach*, which essentially views banks as producing services for account holders with labor and capital as inputs and processed documents and transactions as outputs, for evaluating the performance of branches of financial institutions. In contrast, when the whole banking system is evaluated the *intermediation approach*, which sees banks as an intermediary between savers and investors and regards financial assets as outputs while financial liabilities and physical factors as inputs, is suggested as more appropriate for use.

The choice of deposits either as an input or an output (Berger and Humphrey, 1997) is another controversial point, since they have input characteristics (the

[8] Sample sizes for each of the periods under investigation and number of banks fall in each group can be found in the Appendix 1.

funds raised provide a source for bank's assets) as well as output characteristics (they are associated with liquidity and payments services provided to depositors). However it was found that models where both deposits and loans are interpreted as outputs showed to lead to biased results, specifically to biased scale and scope measures since larger banks employ a higher proportion of interbanking deposits (Lang and Welzel, 1996).

Taking the arguments into consideration, to evaluate the performance of Ukrainian banking system we apply the intermediation approach and define the basic model (Model 1) with financial assets, particularly loans, securities and other earning assets, as outputs while financial liabilities and physical factors, particularly labor, purchased funds and deposits, as inputs (Table 3).

Table 3. Basic model specification (Model 1)

	Variable	Explanation
Inputs	**Labor**	Personnel expenses
	Purchased funds	NBU credit + budget funds + interbank credit + other credits
	Deposits	Deposits held by households and business entities
Outputs	**Loans**	Credit portfolio
	Securities & Other earning assets	Securities + Current assets+ Other assets

Yet we encountered difficulties with the labor variable: as far as the number of employees is unavailable we can take the personnel expenses as an approximation for the amount of labor used; however, for a country in transition with high economic instability and untransparancy of payments, these expenses are considered to be unreliable and not to reflect the real costs of labor. In addition for the earlier years the data on personnel expenses is unavailable. To eliminate the problem, we can follow Rabtsun (2003) and take the value of total assets as a proxy for labor or we can try other specification choosing the best fitting one.

Table 4. Models specification

Model	Inputs	Outputs
Model 1	Personnel Expenses Deposits Purchased funds	Loans Securities & Other earning assets
Model 2	Physical Capital Deposits Purchased funds	Loans Securities & Other earning assets
Model 3	Total assets Deposits Purchased funds	Loans Securities & Other earning assets

Table 5. Correlation between the scores

	Model 1	**Model 2**	**Model 3**
Model 1	1		
Model 2	**0.8465**	1	
Model 3	0.6470	0.7527	1

Table 6. Spearman Rank Order correlation between the scores

	Model 1	**Model 2**	**Model 3**
Model 1	1		
Model 2	**0.7635**	1	
Model 3	0.7426	0.8599	1

Thus, for a period with available personnel expenses data (III quarter 2003) we try several model specifications in order to find the model highly correlated with the basic model which will further be used for investigation. The specification of the models and the resulted correlation coefficients are given in Tables 4 and 5-6 respectively. As we can see, Model 2 which uses physical capital (monetary value of physical capital stock) instead of labor is highly correlated with the Model 1. Our choice is not surprising: in principle physical capital is supposed to be correlated with the labor since the more people are working in a bank the more computers and other equipments, bank buildings, etc. are employed. In addition, the data on physical capital is considered to be more reliable than the labor costs. Based on the obtained correlation coefficients and data availability considerations, for further investigation we choose the Model 2 with physical capital, deposits,

and purchased funds as inputs and loans, securities and other earning assets as outputs[9].

The orientation of the model usually depends on the specifics of an industry being under consideration. The value of technical inefficiency of a firm obtained from input oriented model means by how much inputs of the firm could be proportionally reduced without changes in output for the firm to become an efficient one. Similarly for output oriented model the technical inefficiency shows by how much outputs could be increased without changes on input side. Some of the efficiency papers in banking use output oriented models (Berger et al., 1993; English et al., 1993), while others use input oriented models (Bauer et al., 1997, Lozano-Vivas et al., 2002, Rabtsun, 2003). In her thesis Rabtsun (2003) justifies the choice of input orientation by the fact that in banking "*outputs are not completely variable and in reality bank can not achieve any output scale, at least in the short run*" (Rabtsun, 2003). In contrast, we could argue that rather the banking inputs (physical capital, deposits, and other financial liabilities) are fixed in short run, while the outputs (loans, securities, and other financial assets) are easier to manage (change) since the bank itself makes a decision on their amount. Following the reasons mentioned above, we'd prefer output orientation.

Another issue of model specification is the choice between constant returns to scale (CRS) and variable returns to scale (VRS) specifications. In many studies VRS is considered as the natural assumption regarding banking industry since according to the financial market theory banks are assumed to take advantage of economies of scale. In addition, it is less sensitive to model specification. We use the VRS assumption in the study.

[9] Descriptive statistics for each variable used in the analysis can be found in the Appendix 1

Let us remind the reader that within the framework of the present study the estimated efficiency is a so called *production efficiency* (equivalent to the sub-cost efficiency as named in Färe, Grosskopf and Zelenyuk (2002)) rather than technical efficiency, since the model uses inputs and outputs in monetary units rather than in physical values.

The further analysis supposes to run the model for each quarter during the analyzed period and obtain the individual efficiency scores and the efficiency scores for each of the sub-groups of banks and the banking sector as a whole. Having corrected the estimates for bias applying bootstrapping, we can treat the obtained scores as a consistent measure of banks' performance to reveal the stability of performance over time and to test the hypothesis of convergence between the sub-groups of banks and within them.

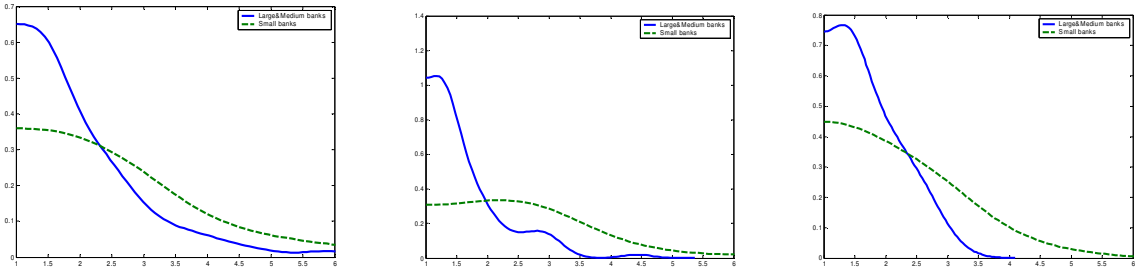
4.2 Empirical Results

4.2.1 Analysis of the Efficiency Scores Distributions

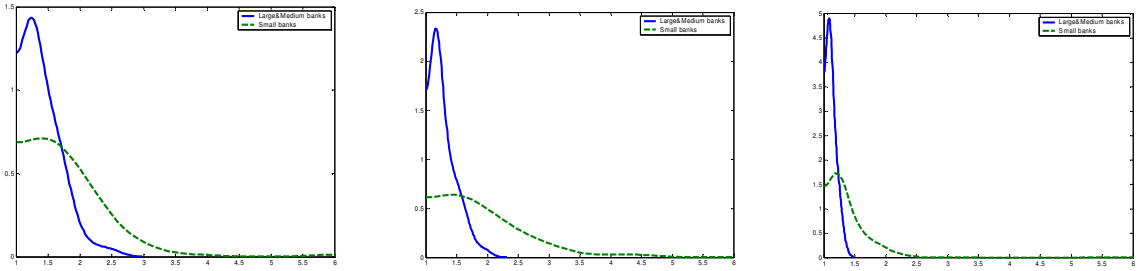
To justify the choice of sub-groups, in particular we analyze the performance of large and medium banks group versus that of the group of small banks, we employ the nonparametric kernel density estimation and analyze the densities of the efficiency scores for two sub-groups in each yearly period. We estimated the densities for the groups using Gaussian kernel, the reflection method, and Silverman (1986) bandwidth selection rule. Having estimated the densities for each sub-group from the individual bias corrected efficiency estimates (obtained via smooth group-wise heterogeneous bootstrap), we obtain consistent estimate of the true unknown distributions. The results are presented in Figure 4 (a-f).

Figure 4 Kernel estimated densities for two groups from the bias corrected efficiency estimates

a) 1998 b) 1999 c) 2000



d) 2001 e) 2002 f) 2003



Notes: we use Gaussian kernel and Silverman (1986) bandwidth selection rule, number of bootstrap iterations is 500

The visual inspection of the densities provides evidence that distributions between the groups are likely to be different. The formal results of the Simar-Zelenyuk adapted Li-test for equality of two densities also substantiate that conclusion: p-values of no more than 2.4% argue against the null hypothesis of the groups' distributions to be equal, and thus we reject the null at 5% level of confidence (Table 7).

Table 7. Results of Simar-Zelenyuk adapted Li-test for equality of efficiency distributions across sub-groups of banks

Null Hypothesis	Bootstrap p-value
f (group A_{1998}) = f (group B_{1998})	0.016
f (group A_{1999}) = f (group B_{1999})	0.000
f (group A_{2000}) = f (group B_{2000})	0.024
f (group A_{2001}) = f (group B_{2001})	0.000
f (group A_{2002}) = f (group B_{2002})	0.000
f (group A_{2003}) = f (group B_{2003})	0.000
f (group A_{2003}) = f (group A_{1998})	0.000
f (group B_{2003}) = f (group B_{1998})	0.000

Notes: group A –Large&Medium banks, group B –Small banks; number of bootstrap iterations is 2000

Hence, the findings so far support the hypothesis that efficiency scores for the groups come from different distributions (this fact is used further when we employ group-wise heterogeneous sub-sampling bootstrap of aggregates of DEA efficiency scores), moreover the results reveal the efficiencies for the group of large and medium banks to be on average higher than those for the group of small banks since the modes for the distribution of the former group is closer to unity than that for the letter group in each period.

In addition, the Figures display huge changes in distribution within the sub-groups during 1998-2003 which is also supported by the Simar-Zelenyuk adapted Li-test. We compare distributions within each group in periods 1998 and 2003 and find the distributions to change significantly during this period: the p-values of 0.00 for each of the group provide evidence against the hypothesis of distributions to remain the same. We can see that the modes for each of the sub-groups have decreased significantly concentrating closer to unity within the last few years comparing to the earlier periods. This result testifies the tendency for improving of the Ukrainian banking performance as long as we observe the increase in efficiency of all the banks within both of the groups. In the next section, we investigate the banks' performance further and look on the aggregate efficiencies of groups of banks testing for convergence between the sub-groups' performances.

4.2.2 Analysis of the Aggregate Efficiency Scores

Table 8 depicts the estimates and the bias corrected estimates[10] of the aggregate efficiency of the banking industry and the aggregate sub-groups efficiency scores obtained using means weighted with price independent weights and corrected for bias applying bootstrap techniques. We find that the estimated DEA efficiencies

[10] Here we present the estimates only on yearly basis, the outputs of the results on quarterly basis are provided in the Appendix 2

have expected downward bias, and the bias correction increases their values (increases their inefficiency) thus making the estimated values closer to the true "unknown" efficiencies.

Table 8. Aggregate estimates and bias corrected estimates efficiency (end of the year)

		1998	1999	2000	2001	2002	2003
Large&Medium banks	**AggEff**	**1.2209**	**1.1226**	**1.172**	**1.0976**	**1.0574**	**1.0286**
	Bias corrected AggEff	**1.3713**	**1.2038**	**1.29**	**1.1495**	**1.0896**	**1.0453**
	Std. Error	0.0626	0.0294	0.0357	0.0274	0.0152	0.0065
	95% CI lower bound	1.2001	1.1238	1.1988	1.0778	1.0506	1.0291
	95% CI upper bound	1.4330	1.2391	1.3331	1.1856	1.1090	1.0544
Small banks	**AggEff**	**2.078**	**1.9387**	**1.8421**	**1.4792**	**1.4326**	**1.1984**
	Bias corrected AggEff	**2.7209**	**2.5953**	**2.4499**	**1.731**	**1.6947**	**1.3059**
	Std. Error	0.2380	0.1422	0.1725	0.0726	0.0783	0.0323
	95% CI lower bound	2.1350	2.2718	1.9609	1.5737	1.5097	1.2340
	95% CI upper bound	3.0414	2.7965	2.6551	1.8517	1.8084	1.3604
Banking industry	**AggEff**	**1.3106**	**1.186**	**1.1993**	**1.1492**	**1.1078**	**1.0492**
	Bias corrected AggEff	**1.5153**	**1.3108**	**1.3342**	**1.2297**	**1.1714**	**1.0778**
	Std. Error	0.0763	0.0369	0.0414	0.0304	0.0222	0.0084
	95% CI lower bound	1.3081	1.2125	1.2261	1.1576	1.1126	1.0580
	95% CI upper bound	1.5986	1.3575	1.3845	1.2738	1.2006	1.0902

Notes: AggEff – aggregate efficiency of a group of banks, 95% CI – 95% confidence interval, number of bootstrap iterations is 2000

Having corrected the DEA scores for bias, we can use them as consistent estimates of true banks' efficiency scores to investigate the stability of banking performance over time. Table 9 presents the results on group and sub-groups efficiency scores of Ukrainian banks comparing the values of estimated weighted and unweighted (simple averages) aggregate efficiencies.

The results are quite interesting; we found that weighted means of efficiencies comparing to unweighted means reveal higher aggregate scores for both the sub-group of large and medium banks and the overall industry efficiency. This can be explained by the fact that weighted scores take into account each firm's share in the group in terms of outputs (loans, securities, etc.) and therefore consider the economic importance of each bank in the group. However for the group of small banks this pattern found to be ambiguous.

Table 9. Group and sub-groups bias corrected efficiency scores of banks (end of the year)

		1998	1999	2000	2001	2002	2003
Large & Medium banks	Unweighted Mean	2.0776	1.6659	1.773	1.3798	1.2634	1.1057
	Aggregate Efficiency (Weighted Mean)	1.3713	1.2038	1.29	1.1495	1.0896	1.0453
Small banks	Unweighted Mean	2.812	2.8646	2.3634	1.9327	2.092	1.4962
	Aggregate Efficiency (Weighted Mean)	2.7209	2.5953	2.4499	1.731	1.6947	1.3059
Banking industry	Unweighted Mean	2.5884	2.3114	1.9614	1.7383	1.8023	1.3553
	Aggregate Efficiency (Weighted Mean)	1.5153	1.3108	1.3342	1.2297	1.1714	1.0778
# of large & medium banks		57	76	104	55	56	58
# of small banks*		122	85	50	97	101	99
# of banks (total)		179	161	154	152	157	157

* Small banks - banks with assets < 50 mln UAH up to 01.01.2001, according to NBU standards as on 01.04.2000
< 70 mln UAH since 01.04.2001, according to NBU standards as on 01.04.2001

The results are quite interesting; we found that weighted means of efficiencies comparing to unweighted means reveal higher aggregate scores for both the sub-group of large and medium banks and the overall industry efficiency. This can be explained by the fact that weighted scores take into account each firm's share in the group in terms of outputs (loans, securities, etc.) and therefore consider the economic importance of each bank in the group. However for the group of small banks this pattern found to be ambiguous.

Moreover, taking into account the economic importance of a bank in the group, we found the large and medium banks to operate more efficiently than the small ones: aggregated efficiency for the group of large and medium banks is closer to unity than that of the group of small banks for each period. The production efficiency of the whole banking industry is found to be very close to the efficiency of the first group since as it was found in Chapter 3 the industry is dominated by eight large banks which results in weak influence of small banks inefficient performance on the overall industry functioning.

Figure 5. Bias corrected unweighted mean efficiencies

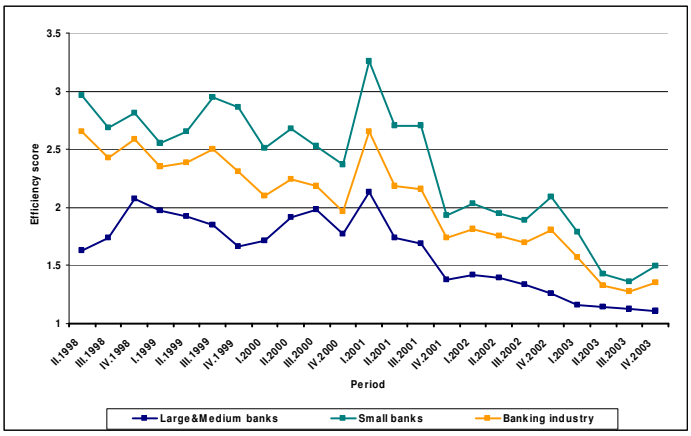
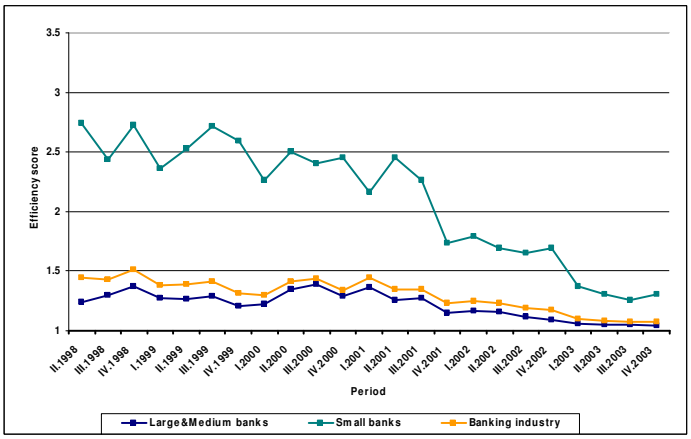


Figure 6. Bias corrected aggregate (weighted mean) efficiencies



Regarding the stability of scores over time, we found that both sub-groups' and industry's efficiencies are not stable but fluctuate over time with the tendency to increase which indicates the improvement of banks' performance during the period. To test the hypothesis of convergence we plot the estimated results for each quarter (Figures 5-6).

As we can see, the figures reflect the tendency for improving performance over time for the groups of banks and the industry overall. However, plotting the unweighted mean efficiencies does not reveal any catching up in performance

between the two sub-groups with the gap fluctuating over its some mean value. In contrast, analyzing the aggregate efficiency scores (weighted) detects the gap between the both group performances to be eliminated with time thus justifying, at least visually, the hypothesis of catching up between the performances of large and small banks.

To test the hypothesis of convergence with more formal methods we refer to the paper of Henderson and Zelenyuk (2004) and define

- efficiency *catching-up within the group* as decrease in mean efficiency of a sub-group over time (e. g. mean efficiency becomes closer to unity);
- efficiency *convergence within the group* as decrease in standard error of a sub-group aggregates over time;
- efficiency *catching up between the group* as eliminating the difference between the means of sub-groups;
- efficiency *convergence between the group* as decrease in a measure of spread (i.g. coefficient of variation,) between the groups.

In our case we use the RD statistics (Table 10), already mentioned in Chapter 2, which assess whether the means of two subgroups are statistically different from each other[11]to measure the extent of catching-up between the groups (the closer RD to unity, the higher is catching up) and its standard error to measure the extent of convergence between the groups. All the treatment we make on the basis of aggregate efficiency scores (weighted statistics).

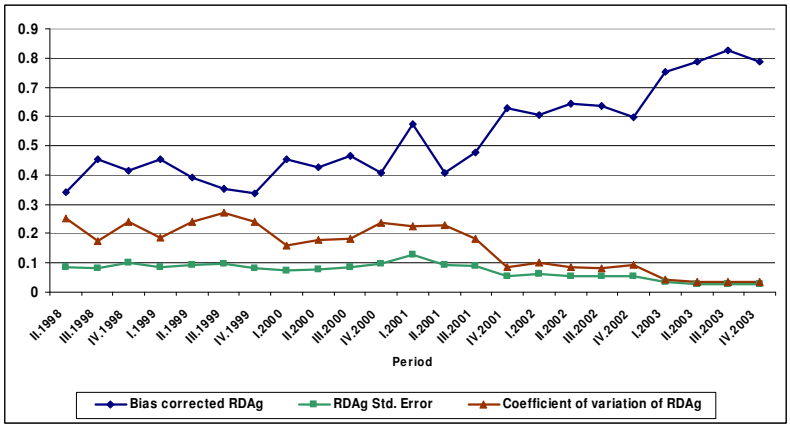
[11] Recall, H_0: Aggregate efficiency scores between the groups are equal, e.g. $\overline{TE}^{L\&M} = \overline{TE}^{S}$ (with L&M stands for the group of Large&Mediumbanks and S – the group of small banks). Decision rule: "Regect Ho if confidence interval for RD does not cover unity".

Table 10. Estimated RD statistics for aggregate efficiency scores

	1998	1999	2000	2001	2002	2003
$\hat{RD}_{Ag}$	0.588	0.579	0.636	0.742	0.738	0.858
Bias corrected $\hat{RD}_{Ag}$	**0.414**	**0.337**	**0.406**	**0.629**	**0.597**	**0.788**
Std. Error	**0.100**	**0.081**	**0.096**	**0.053**	**0.055**	**0.027**
Coefficient of variation	**0.241**	**0.240**	**0.236**	**0.085**	**0.093**	**0.035**
95% CI lower bound	0.244	0.201	0.254	0.528	0.506	0.740
95% CI upper bound	0.625	0.506	0.636	0.736	0.718	0.847

Notes: 95% CI – 95% confidence interval, number of bootstrap iterations is 2000

Figure 7. Dynamics of the estimated RD statistics for aggregate efficiency scores



Thus, according to the defined measures and referring to the results presented in Tables 8 and 10, we claim the efficiencies catching-up and convergence *within* each subgroup of banks and within the banking industry overall as long as the aggregate mean efficiencies for each of the group and for the industry likewise their standard errors are decreasing over time. Regarding the between subgroup measures, the results demonstrate strong evidence for catching up between the two sub-groups since during the period the estimated RD statistics becomes closer to unity (Figure 7). Moreover, the estimated standard error for the RD statistics as well as the coefficient of variation (the value of the standard error normalized by the value of RD statistics) are decreasing over time which reveal the evidence for the *convergence* of the production efficiency *between* the sub-groups of small banks and large and medium banks.

To generalize, in the present study we found the banking industry performance in Ukraine to improve during the last five years. In addition, we discover the group of large and medium banks to reveal higher production efficiency than that of the group of small banks during all the periods. However, the gap between the performance of the groups is found to decrease over time thus revealing the issue of convergence between the group of banks and within the industry overall. Combining the obtained results with the previous findings of decreasing concentration within the industry, we claim for increasing competition in Ukrainian banking. Indeed, as long as an industry develops competition usually spurs firms in it to achieve efficiencies internally enforcing them to operate at the highest possible efficiency in order to stay within the industry.

Chapter 5

CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

The present paper has analyzed the development of the banking sector in Ukraine examining its structure, conduct and performance with a special focus on the industry efficiency. So far, this is the first SCP study regarding the Ukrainian banking. Moreover, within the framework of the study to evaluate the industry performance we apply recently advanced efficiency analysis techniques to DEA scores, including aggregation, bootstrapping, and estimation of efficiency scores densities specifically, and test the hypothesis of *convergence* between the performance of sub-groups of Ukrainian banks (large and medium banks and small banks).

Overall, results detect the Ukrainian banking as a fast growing rather unconcentrated to certain extent large market (with quite high barriers to entry) which is dominated by the eight largest banks (almost 50% of total assets). We also find a positive tendency of increase in population that trusts the banking system and an increasing development of innovations in the banking activities.

Regarding the performance of the industry, we find that during the period of 1998-2003 the production efficiency of individual banks as well as the aggregate efficiency of the banking industry overall increases substantially indicating the tendency for *within* efficiency catching-up and thus revealing the banking industry to improve its performance. In addition, investigation of the efficiencies of the sub-groups of banks finds the group of large and medium banks and the group of small banks to have different distributions and be statistically different from each other. The group of large and medium banks is also found to have higher

aggregate efficiency than that of the group of small banks for all the periods; however the existing gap between the production efficiencies of two groups is decreasing over time demonstrating the *convergence* in performance *between* the banks of different size.

Combining with the previous findings of decreasing concentration within the industry, we explain found issue of convergence by increasing competition in the Ukrainian banking. Indeed, as long as an industry develops, competition usually spurs firms in it to achieve efficiencies internally enforcing them to operate at the highest possible efficiency in order to stay within the industry and thus eliminating the gap between their performances.

Another possible explanation for the findings is the one which coincides with the previous studies' conclusions of no importance of scale economies in banking explained by the product differentiation between the groups of banks of different size (Berger and Humphrey, 1994; Neuberger, 1998) claiming that banks of different size perform different tasks. In fact, this explanation deserves an attention since currently most of Ukrainian small banks have the status of so called "pocket banks" of enterprise groups and serve as a source of their cheap financing and equity investing.

As a natural extension to the present study we would consider the one investigating the possible reasons for the convergence, which may be due to some institutional changes or reforms in the banking sector, or increasing foreign banks participation, or may be simply due to the process of "learning by doing" with banks improving their performance by learning from their past experiences. Further it would also be interesting to test the scale economies in the Ukrainian banking and evaluate on possible mergers between the small banks to improve their performance.

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