

# **Efficiency, Scale and Scope Economies in the Ukrainian Banking Sector in 1998**

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## **Abstract:**

This paper evaluates the current development of the Ukrainian banking system. The research was concentrated on the evaluation of cost and profit efficiency and scale and scope economies for 79 from 168 Ukrainian commercial banks in 1998. There is evidence that small banks operate more efficiently in cost terms but are less efficient in profit terms and further there is a substantial difference in scale economies between small and large banks. Large banks show significant diseconomies of scale while small ones show significant scale economies. This result could suggest that current technology in the financial sector does not allow efficient growth and concentration of the financial sector in Ukraine.

**Keywords: Ukrainian Banking Sector, X-Inefficiencies, Economies of Scale and Scope,  
Cost Functions.**

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## **1. Introduction**

Rapid changes in the structure of the financial system worldwide have attracted a great deal of attention in academic and policy circles. Berger and Humphrey (1998) survey 130 papers analyzing efficiency for 21 countries. However, most of the existing studies are devoted to the financial sector of developed economies, the only exception being a recent special issue of the *Journal of Banking and Finance* (2000) that provides an overview of issues related to the development of the financial system in transition economies. This paper complements these latter studies, concentrating on the evaluation of the banking system in Ukraine and sheds some light on the impact on this country of dramatic changes in financial structure, the role of financial institutions in the process of reform and economic development.

The banking system is a key element of the modern market economy. The availability of finance for enterprises, and the potential to restructure and improve competitiveness in transition economies critically depends on the efficiency of the banking system. In this research we focus on the evaluation of the operational efficiency of commercial banks in Ukraine. The methodology used in this study to test for efficiency is the “efficiency frontier analysis” consisting of estimating the efficient level of cost (or profit) for a given volume of operations of a commercial bank and comparing those figures with the efficient level. This methodology (Berger and Humphrey, 1998) is particularly suitable first of all to draw conclusions about the influence of changes in the structure of the financial system and assessment of the effects of government policy on efficiency; second, to evaluate the efficiency of an industry and to propose a methodology for ranking firms according to their efficiency of operation; third, to improve managerial performance primarily on the basis of the identification of the best-performing firms and best practices in the industry.

The research is based on a unique data set containing broad information on 79 Ukrainian banks. We test for alternative dimensions of efficiency, in particular cost and profit

efficiency, scale and scope economies, and the determinants of the interest margins enjoyed by commercial banks.

The paper is structured as follows. Section 2 shortly introduces the concepts of efficiency and the functional form used in the empirical implementations. The empirical results are reported in Section 3. After a brief description of the current situation in the Ukrainian banking sector (Section 3.1) and a description of the data set used for estimation (Section 3.2), we present the estimation results for cost and profit (Section 3.3) and other determinants (Section 3.4) of efficiency and, finally, the estimates of scale and scope economies (Section 3.5). Section 4 concludes.

## 2. Efficiency and functional form

The analysis of the efficiency of the operations of commercial banks is often based on the estimation of the cost or profit function of commercial bank. In general, a cost function could be expressed as

$$(1) \quad C = C(p, y, z, u, \varepsilon),$$

where  $C$  is bank cost,  $y$  is the vector of outputs (interbank loan, clients' loans, investment in securities, etc.),  $p$  the vector of input prices (prices of deposits, purchased funds, labor),  $z$  the vector of fixed bank parameters (bank capital, fixed assets, off-balance sheet items, etc.),  $u$  represents the inefficiency term that captures the difference between the efficient level of cost for given output levels and input prices and the actual level of cost; finally  $\varepsilon$  is the random error term. Alternatively, we may use a profit function such as

$$(2) \quad P = P(p, \pi, z, u, \varepsilon)$$

where, in addition to the variables described above,  $\pi$  is the vector of output prices. To simplify the estimation of the inefficiency term, multiplicative separability of the random error and the inefficiency term is usually assumed. In this case (1) can be re-written in the logarithmic form as

$$(3) \quad \ln C = \varphi(p, y, z) + \ln u + \ln \varepsilon.$$

Following Berger and Mester (1997), we define the *cost efficiency* of a bank as the estimated cost needed to produce the bank's output vector if the bank was as efficient as the best-practice bank in the sample. This condition is usually expressed as

$$(4) \quad \frac{\hat{u}_{\min}}{\hat{u}},$$

where  $\hat{u}$  is the estimation for the inefficiency term for a given bank,  $\hat{u}_{\min}$  is the minimum across all banks. Otherwise, *profit efficiency* is defined as the actual profit level of a bank divided by the profit level which could be obtained if the bank was as efficient as the best-practice bank.

The main estimation problem that a practitioner has to face is to distinguish the inefficiency term ( $\ln u$ ) from the random error term ( $\ln \varepsilon$ ). There are alternative methods that may be used to solve this problem involving both parametric and non-parametric techniques. Following best practice, we prefer parametric techniques mainly because they concentrate on the evaluation of not only technological but also of economic factors. We apply the stochastic frontier approach (SFA) and thick frontier approach (TFA). In SFA one has to make clear assumptions about the distributions of the regression residuals  $\ln u$  and  $\ln \varepsilon$ <sup>1</sup>. On the other hand TFA assumes that deviations from the predicted values of cost or profit within the highest and lowest quartiles is a random error but inefficiency is represented by deviations between quartiles. We report empirical results from both SFA and TFA approaches that, as the discussion above suggests, may give different results.

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<sup>1</sup> Usually  $\eta = \ln \varepsilon$  is assumed to be normally distributed, while the distribution of  $\ln u$  is asymmetric: half-normal, log-normal, or other. A consistent (but not efficient) estimation of regression (3) could be obtained using least squares. If  $\ln u = |\xi|$  is half-normally distributed, then,

$$E[\eta + |\xi|] = \mu_{\eta} + \mu_{\xi} + \sigma_{\xi} \sqrt{\frac{2}{\pi}} = 0, \quad E[\xi] \equiv \mu_{\xi} = 0, \quad E[\eta] \equiv \mu_{\eta} = -\sigma_{\xi} \sqrt{\frac{2}{\pi}},$$

The estimation (consistent but again not efficient) of the parameters  $\sigma_{\eta}$  and  $\sigma_{\xi}$  could be obtained using the method of moments. Having parameters of distribution of  $\ln u$  and  $\ln \varepsilon$ , the inefficiency term for a given bank is estimated as  $\ln \hat{u} = E[\ln u | \ln u + \ln \varepsilon]$ .

In the study we adopt the transcendental logarithmic (or translog) functional form for cost or profit, widely used in the literature. The full specification of the translog cost function (one of the input prices  $p_{i^*}$  and one of the inputs  $z_{k^*}$  are used as a numeraire') is:

$$\begin{aligned}
(5) \quad \ln \frac{C}{p_{i^*} z_{k^*}} = & \beta_0 + \sum_{i \neq i^*} \beta_i \ln \frac{p_i}{p_{i^*}} + \sum_j \gamma_j \ln \frac{y_j}{z_{k^*}} + \sum_{k \neq k^*} \lambda_k \ln \frac{z_k}{z_{k^*}} \\
& + \frac{1}{2} \sum_{i \neq i^*} \sum_{l \neq i^*} \beta_{il} \ln \frac{p_i}{p_{i^*}} \ln \frac{p_l}{p_{i^*}} + \frac{1}{2} \sum_j \sum_l \gamma_{jl} \ln \frac{y_j}{z_{k^*}} \ln \frac{y_l}{z_{k^*}} + \frac{1}{2} \sum_{k \neq k^*} \sum_{l \neq k^*} \lambda_{kl} \ln \frac{z_k}{z_{k^*}} \ln \frac{z_l}{z_{k^*}} \\
& + \sum_{i \neq i^*} \sum_{k \neq k^*} \delta_{ik} \ln \frac{p_i}{p_{i^*}} \ln \frac{z_k}{z_{k^*}} + \sum_{i \neq i^*} \sum_j \rho_{ij} \ln \frac{p_i}{p_{i^*}} \ln \frac{y_j}{z_{k^*}} + \sum_j \sum_{k \neq k^*} \nu_{jk} \ln \frac{y_j}{z_{k^*}} \ln \frac{z_k}{z_{k^*}} + \xi
\end{aligned}$$

If we assume the allocative efficiency of production, then, according to Shepard's lemma, the levels of inputs we get is

$$(6) \quad s_i = \frac{\partial \ln C}{\partial \ln p_i}, \quad \text{where } s_i \text{ is input shares in cost.}$$

For the profit function, Hotelling's lemma could be applied: if profit is maximized, then

$$(7) \quad s_j = \frac{\partial \ln P}{\partial \ln \pi_j}, \quad \text{where } s_j \text{ is a share of } j\text{-th output in profit.}$$

In the following section, we provide a brief description of the Ukrainian banking sector in 1998 and of the data set used; then we report various empirical results of efficiency for Ukrainian banks, using the framework introduced above.

### 3. Empirical results

#### 3.1 The Ukrainian banking system in 1998

Like Russia (see Ogluzdin and Urga, (1999) and Dmitriyev *et al.* (1998)) and other CIS countries, Ukraine has a two-level banking system with a Central bank (National Bank of Ukraine, henceforth NBU) and more than 200 commercial banks, only about 170 of which

actively operate now<sup>2</sup>. The main law, introduced in 1992, is “On banks and banking activity”. All new regulation is provided by the NBU. Ukrainian banks are much more closely regulated than in Russia – for example, in order to police reserve and liquidity requirements the NBU requires detailed balance sheets every day from Ukrainian banks. Ukraine’s electronic payment system is much more efficient than Russia’s: payments are executed in few minutes.

Commercial banks can be divided into several groups (see Table 1). First, state-owned and former state-owned banks: Prominvestbank (largest Ukrainian commercial bank), Bank “Ukraine” (former “Agroindustrial” bank), Ukreximbank (former Ukrainian part of Soviet Eximbank), Oshchadbank (the analog of Russian Sberbank) and Ukrspotsbank. Second, foreign banks: ING Barings Ukraine, CS First Boston Ukraine, Societe Generale Ukraine, Raiffaisen Ukraine, Kreditanshaldt Ukraine, Inkombank Ukraine (Russia). Third, group of new private banks that now are large enough to be very important for the whole financial system. Largest in that group are Privatbank (eastern industrial region, but it has subsidiaries everywhere in Ukraine) and Aval (so-called “post and pension bank”). Fourth, middle-size and small-size new commercial bank.

**Table 1. Commercial banks in Ukraine (end of 1998)**

Total number of banks	214
State	2 (Oshchadbank and Ukreximbank)
Private	212
With foreign capital	28
With 100% foreign capital	6
Banks with license for currency exchange operations	161
Statutory funds, UAH bn	2.097

Source: NBU

1998 was one of the most difficult years for the Ukrainian banking system. The Russian crisis and its combination with very similar domestic problems produced a number of difficulties for all banks in Ukraine. First, the Ukrainian government didn’t default on internal debt in the true sense, but all commercial banks were compelled to “convert” T-bills into obligations with much longer maturity. Second, to eliminate the consequences of the crisis, the NBU was

<sup>2</sup> According to *Groshi ta Svit* information agency, which specializes on Ukrainian banking statistic.

compelled to introduce several restrictions on the operations of commercial banks (primarily on the currency market) and increased reserve requirements in September from 15% to 16.5% of the total sum of deposits (reserve requirements had already risen in November 1997 from 11% to 15%). As a result, in September 1998 80 banks could not meet their reserve requirements mainly because of the forced conversion of T-Bills. In addition, some of the largest banks also faced major difficulties in performing regular operations: the most important example is Bank Ukraine that had a large portfolio of T-Bills and a large amount of non-performing loans. Finally, it is worth mentioning that it was also required for commercial banks to have at least 1 million Euro of equity.

In sum, the Association of Ukrainian Banks has estimated the total losses of the banking sector caused by the crisis at about 30% of bank capital. However, the consequences of the crisis for the economy as a whole and the banking sector in particular were much less severe than in Russia. Most importantly, banks didn't default on clients' deposits, the amount of deposits in the banking system didn't decrease and the credibility of the banking system was saved. The crisis in the second half of 1998 produced huge (but less than in Russia) devaluation of the domestic currency (about 70%) and an increase in interest rates already at high level. To prevent the destabilization of the currency market, the NBU, as already noted above, was compelled to tighten bank liquidity by increasing reserve requirements and the refinancing rate. Some nominal growth of credit to the private sector was mainly caused by the devaluation (because credits were partly denominated in hard currency) and it doesn't represent a real improvement in banking system operations. In Appendix 1, Table A1 provides some general information about the development of the Ukrainian banking system in 1998, while Table A2 presents some key macroeconomic parameters describing the environment in which Ukrainian banks operate

Generally, we may conclude that the Ukrainian banking system is still underdeveloped. Ukrainian banks are very small from an international point of view: the largest Ukrainian bank

has less than USD 2 billions of gross total assets. The volume of loans to enterprises is extremely low. The main reason is in the high level of interest rates due to an extremely restrictive monetary policy and the poor quality of borrowers, but also in the poor quality of banking services themselves and the inefficiency of the management.

For all those reasons a study of the efficiency of the banking sector could be very useful if it can help to discover sources of inefficiency and formulate policy recommendations in this field. Another important question is the evaluation of the consequences of changes in the structure of the banking industry. Current capital requirements may cause the closure of small banks and a wave of mergers and acquisitions.

### **3.2 Data**

We acknowledge that this research was made possible by close cooperation with the Ukrainian Interbank Currency Exchange (UICE). The data set used includes aggregated balance sheets and income statements calculated at UICE from the original detailed balance sheets of commercial banks using UICE's own methodology of aggregation. In addition, the data includes all the financial parameters needed for the estimations from the banks' financial reports for 1998. The sample contains information about 79 Ukrainian banks including 2 state banks (Oshchadbank and Ukreximbank), large former state banks (except Ukrainian largest Prominvestbank which doesn't provide its reports to UICE), Ukrainian banks with 100% foreign capital, large, average and small private banks. The sample could be viewed as representative because it includes 79 banks from 170 operating banks<sup>3</sup> and it covers 76% of the gross total assets of the whole banking system<sup>4</sup>.

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<sup>3</sup> From 214 banks which were in the NBU register at the end of 1998 some banks do not perform operations because of insolvency or other problems.

<sup>4</sup> Note that the largest bank, Prominvest (not included in the sample because this bank didn't provide its information to UICE), in 1998 had about 19% of the total assets of the Ukrainian banking system.



A detailed description of the variables used for the estimations is reported in Table A3 in Appendix 1. For the balance sheet items we used period averages. One of the main problems with the data was the non-financial information about the banks, in particular the number of employees. Official information about the number of employees was available only for 24 banks in the sample, for the remaining banks we used estimates from private sources. We used total assets to proxy the price of labor, given that total assets are highly correlated with the number of employees. Another problem in calculating the price of labor is that the reported figures of wage and salary expenses often doesn't represent actual expenses for labor: salaries and benefits are often paid in hidden or even illegal form.

### **3.3 Estimation of (in)efficiency of commercial banks**

In this section we present the results of estimating (3) for cost efficiency and its equivalent for profit efficiency. The cost/profit functions include as outputs interbank loans (*ibc*), clients' loans (*loans*) and investment in securities and other investment (*sec*); as prices of inputs we use labor (*labor*) and deposits (*dep*), including clients' deposits and purchased funds (14 coefficients to be estimated in total). In other specifications different sets of inputs and bank-specific variables were included (bank specific and environmental variables could be included as additional parameters in the cost function (5)): inputs variables are bank capital (*cap*) and fixed assets (*fix*), while a bank-specific variable is the share of non-performing loans in the total volume of loans (*bad*).

The estimates of cost and profit efficiency parameters for the whole sample and different groups of banks are reported in Table 2<sup>5</sup>. According to the stochastic frontier approach, about one third of banks' cost are used inefficiently, and only one fifth for the thick frontier approach. However, both methods show that large banks are substantially less efficient in cost

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<sup>5</sup> The estimates reported in Table 2 are derived by estimating the cost and profit functions using the least-squares estimator. The full set of parameters of cost and profit functions are reported in Table A4 and Table A5 respectively.

efficiency terms compared to small ones. There are many possible explanations for this result. The first is related to the possible differences between reported figures and actual cost if we assume that small banks have more possibilities for hiding some expenditures (e.g. for tax or regulatory purposes). Another possible explanation is the large amount of non-performing loans concentrated mainly in large (mainly state-owned) banks.

**Table 2. Cost and profit efficiency of Ukrainian banks (standard errors in parentheses)**

Group of banks	Stochastic frontier approach	Thick frontier approach
<i>Cost efficiency:</i>		
All sample (79 banks)	.672 (.0218)	.805 (.0165)
Large and medium banks (more than UAH 100 m of assets, 22 banks)	.631 (.0418)	.775 (.0304)
Small banks ( less than UAH 100 m of assets, 57 banks)	.688 (.0254)	.816 (.0195)
Very small banks ( less than UAH 40 m of assets, 31 banks)	.732 (.0291)	.845 (.0242)
<i>Profit efficiency:</i>		
All sample (79 banks)	.7199 (.0081)	.6577 (.0305)
Large and medium banks (more than UAH 100 m of assets, 22 banks)	.7316 (.0194)	.6719 (.0602)
Small banks ( less than UAH 100 m of assets, 57 banks)	.7154 (.0084)	.6522 (.0357)
Very small banks ( less than UAH 40 m of assets, 31 banks)	.7025 (.0107)	.5849 (.0466)

Further, it is worth noticing that there is a substantial difference between the cost and profit efficiency estimates. Large banks are more efficient in profit terms than small ones. The possible explanation is monopoly power exercised by the large banks which allows them to receive more profit despite having relatively high costs.

In sum, the results above address an interesting and hot policy issue regarding the restructuring of Ukrainian banks concerning the necessity to accelerate the concentration of the industry. Small banks that do not meet capital requirements are supposed to be liquidated or taken over. Our results suggest that such a concentration, in the current economic environment, could produce undesirable consequences with greater inefficiency and greater monopoly power in the sector. It is absolutely true that most of the Ukrainian banks are extremely small from the point of view of international comparisons and one of the general long-term direction of changes in the industry structure is integration and mergers of banks. But in the current environment the acceleration of such industrial concentration could produce only negative results for the economy.

### **3.4 Determinants of efficiency**

The main conclusion from the previous paragraph is that the size of the bank does influence the efficiency of the banking system. Moreover, this does not exclude the possibility that other bank-specific factors may be important for efficiency. Thus we performed further experiments. Table 3 reports the results from estimating alternative bank-specific variables such as total assets, bank capital, non-performing loans. Further, following Berger and Mester (1997) we also tested the significance of raw data measures of efficiency, such as bank's cost to total assets, ROA and ROE.

The first interesting feature of the estimated regressions is the absence of interdependence between the size of a bank and efficiency parameters. Earlier we concluded that *on average* large banks are less efficient in cost terms and more efficient in profit terms, but for a particular bank there is no such a correlation. There is also evidence of the importance of bad loans for cost efficiency: as expected, there is significant negative dependence of the cost efficiency term on the proportion of bad loans in the bank's loan portfolio.

The significant correlation between cost and profit efficiency and raw efficiency parameters (costs to total assets, ROA, ROE) could be viewed as further evidence of the robustness of the estimated efficiency parameters.

**Table 3. Efficiency parameters of some bank-specific variables  
(regression coefficients, t-statistics in parentheses)**

Variable	Cost efficiency (SFA)		Profit efficiency (SFA)	
Total assets	-.00003	(-.775)	.0000028	(.203)
Bank capital	.00001	(.036)	.00024	(1.846)
Non-performing loans (in % to total volume of loans)	-.351	(-3.263)	-.00784	(-.183)
Bank's costs in % to total assets	-.0231	(-.083)	-.288	(-2.921)
ROA	.933	(3.126)	.388	(3.542)
ROE	.315	(2.499)	.181	(4.091)

### 3.5 Estimation of economies of scale and scope

Another dimension of efficiency is the evaluation of economies of scale and scope. Firms in an industry realize economies of scale when output rises proportionately faster than costs - **global economies of scale**. **Product-specific economies of scale** arise when an increase in production of a *specific* output rises proportionately faster than costs. Finally, we will also evaluate **economies of scope** arising when a firm produces two or more products jointly at a lower cost than if they are produced independently (in Appendix 2 we briefly present the definitions).

Table 4 presents statistically significant economy of scale<sup>6</sup> for the whole sample and small banks, but diseconomy of scale for the group of large banks<sup>7</sup>. The results for product-specific scale economy and scope economy are reported in Table 5: we observe diseconomies of scale for interbank loans (somewhat more significant for large banks). There is evidence of small

**Table 4. Global economy of scale estimates**

	Estimate	St. Dev.	St.error of estimate	t-stat. for Ho: scale=0	t-stat for Ho: scale=1
All sample (79 banks)	.8856	.3355	.0377	23.46	-3.031
Large and medium (22 banks)	1.2331	.2001	.0427	28.88	5.465
Small (57 banks)	.7515	.2757	.0365	20.59	-6.807

**Table 5. Product-specific economy of scale estimates**

	Estimate	St. Dev.	St.error of estimate	t-stat. for H0: scale=0
<i>INTERBANK LOANS</i>				
All sample (79 banks)	-1.618	5.545	.628	-2.576
Large and medium (22 banks)	-5.651	9.018	1.968	-2.871
Small (57 banks)	-.1318	2.212	.293	-.45
<i>SECURITIES</i>				
All sample (80 banks)	.5928	7.936	.8985	.660
Large and medium (22 banks)	1.705	.2389	.0509	33.47
Small (57 banks)	.1561	9.352	1.250	.125
<i>LOANS</i>				
All sample (80 banks)	1.134	1.437	.1627	6.97
Large and medium (22 banks)	1.173	.0991	.0211	55.51
Small (57 banks)	1.119	1.699	.227	4.93

<sup>6</sup> The coefficient are statistically smaller than 1 (t-test=-3.031 and t-test=-6.807) for the whole sample of banks and small banks, respectively.

<sup>7</sup> The coefficient is statistically bigger than 1 (t-test=5.465)

even though not statistically significant economies of scale for investment in securities. In this case the results are very different for small and large banks (large banks demonstrate significant economies of scope for this type of output). There are also significant economies of scale for loans that we like to interpret as evidence of the existence of potential for expanding this type of operations. Finally, Table 6 provides unequivocal evidence of significant scope economies. It is interesting to note that once more small banks as against large ones demonstrate substantial economies when combining different kinds of operations.

**Table 6. Estimate of scope economies**

	Estimate	St. Dev.	St.error of estimate	t-stat. for H0: scope=0
All sample (80 banks)	2.0964	3.380	.2677	7.831
Large and medium (22 banks)	.2626	.9001	.1919	1.368
Small (57 banks)	2.8042	2.398	.3177	8.828

#### **4. Conclusions and policy implications**

The main goal of this paper was the evaluation of the current development of the Ukrainian banking system. The research concentrated on cost and profit efficiency and scale and scope economies for 79 Ukrainian commercial banks.

One of the main findings of the research is that small banks operate more efficiently in terms of cost but less efficiently in terms of profit. This difference could suggest the existence of

monopoly power in the Ukrainian financial sector where large banks can realize greater profits having at the same time greater costs.

Another important piece of evidence is the substantial difference in the scale economies between small and large banks. Large banks (large only for Ukraine but small when compared to international standard) present significant diseconomies of scale, while small ones show significant scale economies. This result could suggest that current technology in the financial sector (technology in wide sense, including economic environmental factors) does not allow efficient growth and concentration of the financial sector in Ukraine (except may be the possible efficiency of concentration for small banks). This result is even more interesting if we compare it with estimations of scale economies for Russian banks (see Ogluzdin and Urga, 1999), where no significant differences between small and large banks are found.

Although statistically robust and economically interesting, the results reported in this paper cannot be considered conclusive for policy purposes, given that they are based on data for 1998 only. It is necessary to extend the data set in terms of both number of banks in the sample and time periods. This will allow us to formulate more precise and reliable policy implications. Unfortunately, at the moment it is extremely difficult to update the current sample due to the lack of disclosure of available data. However, we remain confident to expand this study in a future work.

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## References

- Berger, A.N., Humphrey, D.B., 1998. Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research* 98, 175-212.
- Berger, A.N., Mester, L.J., 1997. Inside the black box: what explains differences in the efficiencies of financial institutions?. *Journal of Banking and Finance* 21, 895-947.
- Clark J.A., 1988. Economies of scale and scope at depository financial institutions: a review of the literature. *Economic Review*, Sep/Oct, 16-33.
- Dmitriyev, M., Matovnikov, M., Mikhailov, L., Sycheva, L., 1999. Russian stabilization policy and the banking sector of Moscow banks in 1995-1997. Working Paper, Institute for Economies in Transition, Bank of Finland.
- Fries, S., Neven, D., Seabright, P., 1998. Bank performance in transition economies: market structure, ownership and country effects, mimeo, EBRD.
- Journal of Banking and Finance, 2000. Financial system development in transition economies. Special issue, April, North-Holland.
- Mitchell, K., Onvural, N.M., 1996. Economies of scale and scope at large commercial banks: Evidence from the Fourier flexible functional form. *Journal of Money, Credit and Banking* 28, 178-199.
- Ogluzdin S., Urga, G., 1999. Scale and scope economies in the Russian Banking sector in 1997, mimeo, Department of Investment, Risk Management and Insurance, City University Business School.



## Appendix 1: TABLES

Table 1. **Ukrainian Banking System in 1998 (UAH bn)**

	Q1	Q2	Q3	Q4
Reserves (Cash and deposits in NBU)	.805	.857	1.168	1.454
Foreign assets	1.649	1.953	2.808	3.107
Claims to General Government	2.106	2.274	1.923	1.528
Claims to non-financial government institutions	1.441	1.372	1.563	1.447
Claims to private sector	6.004	6.425	7.892	7.731
Claims to non-banking financial institutions	.111	.117	.128	.129
Demand deposits	2.842	2.827	2.744	3.143
Term deposits	3.666	4.103	5.165	5.209
Foreign liabilities	1.578	1.706	2.140	1.738
Deposits on general government	.820	.807	.898	.544
NBU credits	.653	.645	.829	.809
Deposits of non-banking financial institutions	.051	.51	.51	.59
Capital accounts	4.195	4.428	4.825	4.843
Other items net	-1.686	-1.565	-1.167	-.948

*Source: NBU*

Table A2. **Ukraine: some macroeconomic indicators**

	Q1	Q2	Q3	end of 1998
GDP, UAH bn				<b>104</b>
Inflation (CPI), % p.a.				<b>20</b>
M3, UAH bn	12.960	13.458	14.325	<b>15.718</b>
M0 (cash outside banks), UAH bn	6.364	6.39	6.31	<b>7.158</b>
M1, UAH bn	9.23	9.226	9.066	<b>10.331</b>
Reserve rate, %	15	15	16.5	<b>16.5</b>
NBU refinancing rate, % p.a.	40	45	82	<b>74.2</b>
Com. Banks credit rates, % p.a.	48.9	48.0	63.8	<b>60.4</b>
Private sector deposits in commercial banks, UAH bn	6.495	6.897	7.867	<b>8.278</b>
Commercial Banks credits to private sector (UAH bn, end of period)	7.343	7.634	9.182	<b>8.855</b>
Exchange rate UAH/USD, end of period	2.0383	2.0573	3.4	<b>3.427</b>

*Source: NBU, Ministry of Statistics*

**Table A3.Data used for estimation**

Variable	Description	Sample mean	St.dev.
<i>C</i>	Variable cost plus expenses for bank's premises, furniture and equipment, and other administrative expenses, UAH m	39.607	111.136
<i>P</i>	Bank's profit: revenues from loans, securities, fees and charges, trading operations minus total cost, UAH m	15.110	30.434
<i>Output variables (period averages)</i>			
<i>y<sub>ibc</sub></i>	inter-bank loans, UAH m	16.249	39.088
<i>y<sub>loan</sub></i>	consumer loans, UAH m	53.912	123.237
<i>y<sub>sec</sub></i>	other investment, including government and risky securities, and investment in other enterprises, UAH m	21.261	49.536
<i>Input prices</i>			
<i>p<sub>lab</sub></i>	price of labor; here – total sum of expenses for labor divided by period average total assets (see text for explanation), %	2.86	1.94
<i>p<sub>dep</sub></i>	price of deposits: total interest expenses divided by period average total sum of deposits (including clients' deposits and purchased funds), %	18.2	16.1
<i>p<sub>cap</sub></i>	expenses for furniture and premises plus other administrative expenses divided by period average fixed assets (for scale efficiency estimation only), %	78.5	78.6
<i>Output prices</i>			
<i>p<sub>ibc</sub></i>	price of inter-bank credits: interest revenues from interbank loans divided by period average sum of interbank loans, %	12.48	20.71
<i>p<sub>loan</sub></i>	price of consumer loans: interest revenues from consumer loans divided by period average sum of consumer loans, %	39.03	20.77
<i>p<sub>sec</sub></i>	price of securities: revenues from securities and other investments divided by period average sum of securities and other investment, %	39.35	28.33
	Bank's capital, UAH m	35.097	61.618
	Share of non-performing loans in total volume of loans, %	26.7	19.23
<i>Number of observations – 79</i>			

Table A4. Cost function estimation

	Coefficients	Std. Error	t	Sig.	
<i>Constant</i>	9.3274	.301	31.015	.000	
<i>sec</i>	.3644	.188	1.943	.056	
<i>sec_sec</i>	.0081	.098	.083	.934	
<i>ibc</i>	.2848	.135	2.113	.039	
<i>ibc_ibc</i>	.2006	.075	2.666	.010	
<i>ibc_bond</i>	-.0558	.053	-1.053	.297	
<i>loan</i>	.4377	.173	2.537	.014	
<i>loan_loan</i>	.1718	.070	2.470	.016	
<i>loan_bond</i>	-.0146	.057	-.258	.797	
<i>loan_ibc</i>	-.0993	.066	-1.497	.139	
<i>dep</i>	.2324	.148	1.569	.122	
<i>dep_dep</i>	.1611	.057	2.849	.006	
<i>dep_bond</i>	.0505	.054	.937	.352	
<i>dep_ibc</i>	-.0505	.054	-.941	.350	
<i>dep_loan</i>	-.0272	.060	-.457	.649	
R-sq.	.939	Adj. R-sq.	.926	D.-W.	1.901
F-stat.	70.76	Mean of dep.var.	12.94		

Table A5. Profit function estimation

	Coefficients	Std. Error	t	Sig.	
<i>Constant</i>	3.5384	1.520	2.328	.023	
<i>ibc</i>	.1716	.362	.474	.638	
<i>ibc_2</i>	.2463	.102	2.406	.019	
<i>loan</i>	.0398	.555	.072	.943	
<i>loan_2</i>	.1157	.107	1.083	.283	
<i>pcap</i>	-.3042	.728	-.418	.677	
<i>pcap_2</i>	.3161	.215	1.468	.147	
<i>pcap_ibc</i>	-.0952	.101	-.945	.348	
<i>pcap_loan</i>	.0783	.141	.554	.582	
<i>pcap_sec</i>	-.0294	.132	-.223	.824	
<i>pdep</i>	.5464	.411	1.329	.189	
<i>pdep_2</i>	.3281	.164	2.004	.049	
<i>pdep_ibc</i>	.0529	.106	.497	.621	
<i>pdep_loan</i>	-.2958	.157	-1.886	.064	
<i>pdep_pcap</i>	-.1972	.153	-1.285	.204	
<i>pdep_sec</i>	.1686	.131	1.283	.204	
<i>sec</i>	.2629	.502	.524	.602	
<i>sec_2</i>	-.1208	.140	-.860	.393	
R-sq.	.756	Adj. R-sq.	.688	D.-W.	1.740
F-stat.	11.139	Mean of dep.var.	5.8285		

**Table 9. Cost function estimation (modified specification, three types of inputs, model includes share equations)**

	Coefficients	Std. Error	t	Sig.	
<i>sec</i>	-.5438	.195	-2.79	.006	
<i>sec_sec</i>	.0514	.017	3.07	.002	
<i>sec_loan</i>	.0405	.012	3.28	.001	
<i>CONST</i>	10.6116	1.345	7.89	.000	
<i>ibc</i>	.1736	.111	1.57	.118	
<i>ibc_ibc</i>	.0248	.011	2.36	.019	
<i>ibc_sec</i>	-.0030	.012	-.258	.797	
<i>inc_loan</i>	-.0255	.016	-1.600	.111	
<i>loan</i>	-.4823	.192	-2.513	.013	
<i>loan_loan</i>	.0913	.015	6.089	.000	
<i>dep</i>	.1136	.070	1.615	.108	
<i>dep_dep</i>	.1904	.012	15.854	.000	
<i>dep_sec</i>	.0141	.007	1.905	.058	
<i>dep_ibc</i>	.0031	.004	.825	.410	
<i>dep_loan</i>	.0141	.007	2.077	.039	
<i>capital</i>	.4419	.067	6.628	.000	
<i>capital_capital</i>	.0243	.011	2.139	.034	
<i>capital_sec</i>	-.0100	.007	-1.521	.130	
<i>capital_ibc</i>	-.0027	.003	-.807	.421	
<i>capital_loan</i>	-.0067	.006	-1.125	.262	
<i>capital_dep</i>	-.0592	.009	-6.804	.000	
R-sq.	.997	Adj. R-sq.	.997	D.-W.	2.041
F-stat.	3685.14	Mean of dep.var.	12.835		

## Appendix 2: Scale and scope economies

### Measures for scale and scope economies

Global economy of scale could be measured from the cost function as a sum of output cost elasticities:

$$(A1) \quad \sum_i \varepsilon_i = \sum_i \frac{\partial \ln C}{\partial \ln y_i},$$

where  $\varepsilon_i$  is output cost elasticity for  $i$ -th product. If in the sum (A1) is less than one, we have global economy on scale, otherwise we have diseconomy on scale.

Product-specific economies arise if increasing in production of particular product lower costs, or if the value of

$$(A2) \quad \frac{1}{\varepsilon_i} \cdot \frac{C(y_1, \dots, y_n) - C(y_1, \dots, y_{i-1}, 0, y_{i+1}, \dots, y_n)}{C(y_1, \dots, y_n)}$$

is positive (negative number indicates product-specific diseconomies on scale).

The measure of global economy on scope could be calculated from the cost function as follows,

$$(A3) \quad \frac{C(y_1, 0, \dots, 0) + C(0, y_2, 0, \dots, 0) \dots + C(0, \dots, 0, y_n)}{C(y_1, \dots, y_n)}$$

Positive values indicate existence of the overall scope economy, while negative tells us about diseconomy on scale.

*Scale and scope economies estimation*

For the estimation of scale and scope economies modified specification of the cost function was used: one additional input (capital) was added. Price of capital is defined as expenditures on bank premises, furniture and fixtures divided by bank's fixed asset. Share equations specified according to Shephard's lemma was added into the model. Iterative feasible least squares procedure (IFLS) was used for estimation of parameters.