# On the determinants of banking efficiency in four new European Union Member States: the impact of structural reforms

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**Abstract**

We employ the stochastic frontier methodology and estimate alternative profit efficiency in the banking industry of four new European Union Member States, namely the Czech Republic, Hungary, Poland and the Slovak Republic, over the period 1999-2003. Our results show that structural reforms in the banking industry improve performance in terms of higher efficiency, whereas the institutional development of the non-bank financial sector hinders banks' profit efficiency.

*JEL Classification:* D24; G21; L25

*Keywords:* structural reforms; alternative profit inefficiency, new EU countries.

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## 1. Introduction

Restructuring the financial systems in Central and Eastern European countries (CEECs) to meet the requirements of a market economy has proved to be a unique challenge. The accession of these countries to the European Union poses additional challenges, especially in terms of accelerating reform efforts towards financial integration. Throughout the transition and the accession path to the EU, strengthening financial markets and, in particular, improving the supervision and the regulation of the banking industry received a strong emphasis in those countries that aimed to cope with market forces and to achieve financial stability. The banking industry has, undoubtedly, played a key role in this process and has been at the forefront of reform efforts.

The process of restructuring the banking industry neither has been an easy task, nor can be considered as being completed. This process primarily had to establish a basic level of operation in the banking system, which was rather a painstaking exercise, as it involved, apart from setting the appropriate legal framework, the transformation of the centrally planned economy into a market based economy. Although most CEE economies faced similar difficulties during this transition period, the progress through the years and across countries, regarding the process of privatization and recapitalization, the restructuring of financial markets, the degree of openness to foreign banks, as well as the management of bad debt problems, are quite diverged. Despite these differences, all Central and Eastern European countries have made enormous progress in reforming their banking systems.

In recent years and due to this ongoing reform process the examination of cost and/or profit efficiency of banks in transition countries and especially in Central and Eastern European countries has received much attention. In particular, the issue of

examining the underlying determinants of banks' efficiency is quite crucial, especially for the transition countries given that the enhancement of efficiency would assist their financial expansion and their ongoing process of real convergence within EU. Most studies in the literature, given the state dominance of the banking industry in the past, focus primarily on the relationship between bank ownership and performance (see Bonin et al. (2005), Hasan and Marton (2003), Rossi et al. (2004)). Although important as they are the financial reforms, and especially the ones referring to the liberalisation and the privatisation of the industry, few studies have actually examined the aggregate impact of these reforms on banks' efficiency. To our knowledge only Fries and Taci (2005) examined the relationship between reforms in the banking sector and cost efficiency using the Stochastic Frontier Approach, while Grigorian and Manole (2002) used the Data Envelopment Analysis (DEA) to investigate a similar relationship.

This paper fills a gap in the literature by departing from the analysis of Grigorian and Manole (2002), as it uses a parametric approach to estimate banking efficiency. Also, in light of the increasing pressure on banks' profitability for those countries due to intensified competition of the enlarged and integrated EU financial markets, an analysis of the impact of structural reforms in banking on banks' profit efficiency seems of particular importance. To this purpose, our paper follows a different methodology than the one proposed by Fries and Taci (2005) as it provides a more flexible theoretical form in terms of an alternative profit function, which incorporates an underlying optimisation that a typical bank faces. In addition, another open issue, which has not been dealt in the literature, is whether non-banking reforms have an impact on the banks' profit efficiency of CEE countries.

In this paper, we address the above issues by employing the stochastic frontier approach, as developed by Aigner et al. (1977), to estimate banks' efficiency. In particular, we estimate alternative profit efficiency and investigate its relationship with both financial banking and non-banking reforms. Our focus is on four Central European countries that have joined the EU since May 2004, namely the Czech Republic, Hungary, Poland, and the Slovak Republic, which are considered to be part of the most advanced group of transition economies, and are featured among the earliest and swiftest economic and banking reformers.

The rest of the paper is organized as follows. Section 2 presents a brief overview of financial reform process in the four countries, while section 3 presents our methodology. Our dataset and the empirical results are presented in sections 4 and 5, respectively, whilst some conclusions are offered in section 6.

## 2. Financial Sector Reform - the EBRD Index

The reform process of the financial sector from a centrally planned to a market based economy has raised many controversies. Thus, it should come as no surprise that efforts to reform the financial sector along the principles of a market economy have met more resistance than other transition reforms (Wihlborg, 2004). In particular, the progress of financial sector development has been associated with specific reforms implement by all CEE countries, though at a different pace, such as privatization, recapitalization, absence of strong government guarantees of bail-outs, and the implementation of effective bankruptcy laws.

One of the most severe difficulties that CEE countries had to deal with, was the burden of bad loans they inherited from the past regime. Recapitalisation of banks and work out of bad debts followed different patterns among countries. Strategies

ranged from repeated interventions to one off initiatives and from a complete reliance on "work-out bank" to strong attention to individual banks' incentives to solve portfolio problems. All countries have managed to reduce the ratio of non-performing loans in their balance sheet and to improve the quality of their portfolios through recapitalization programmes. As we can see from table 1, the ratio of non-performing loans has declined significantly during the period 1999-2003 in all countries but Poland, where decreased asset quality reflects the impact of macroeconomic factors, including the overall slowdown of the Polish economy, the growth of unemployment, and structural problems in certain industries currently being restructured.

*(Insert table 1 about here)*

Despite the problems experienced in the early years of transition, the CEE governments appeared determined to develop competitive and efficient financial systems based on market forces. Thus, they initiated large-scale privatization programs that substantially diminished the state ownership in banking during the late 1990s. The main motive behind privatization of state-owned banks was the desire to enhance competition and efficiency in the banking sector through increased foreign and domestic participation. Indeed, by increasing competition, foreign ownership led to a remarkable improvement in services and to a compression of the spreads between deposit and lending rates, while it has also helped to improve the monetary transmission process.

Banking crises that affected the region during this period have basically accelerated the privatization process. The decline in state ownership of banks is remarkable in all countries, as we can see from table 1. However, it is more profound in the case of Slovakia, where state-ownership was reduced from about 50% in 1999 to 1.5 percent in 2003, and in the Czech Republic, where the ratio declined from about

41% in 1999 to 3% in 2003. The assets share of state-owned banks in Hungary has changed very little since 1999, due to the fact that Hungarian banks were almost fully privatized in the mid-1990s. By the end of 2003, the average share of state-owned banks was below 8% in all countries, but Poland, where the state still has direct or indirect control on about 25.7 percent of total banking assets.

Another measure of financial development is the ratio of credit to the private sector as a percentage of GDP. Even after one decade of transition and successful bank restructuring, the level of financial intermediation in CEE countries remains stunted. This is reflected in a low penetration banking assets in the economy. Although banks are by far the most important pillar in the financial sectors of accession countries, the degree of financial penetration through assets and loans is much lower than in other emerging markets and the euro area. Several factors account for the low level of credit in all CEE-4 countries. First of all, the multinational companies, which dominate the economies of these countries, tend to borrow from their mother companies or from their banks abroad, bypassing the domestic banking system. Moreover, lending to households has been constrained by the low level of incomes, while the access to bank credit by domestic private firms has been impeded by the lack of sufficiently long track record that would make them acceptable credit risks for banks. As we can see from table 1, the most rapid expansion in bank credit to the private sector has taken place in Hungary. On the other hand, the Czech Republic and Slovakia show a sharp decrease in credit.

Finally, a general indicator of the progress in financial reforms is provided by the European Bank for Reconstruction and Development (EBRD). The EBRD indexes of banking and non-banking reforms provide a ranking of progress in liberalisation and institutional reform of the banking and non-banking sectors respectively, on a

scale of 1 to 4[1]. A score of 1 represents little change from a socialist banking system apart from the separation of the central bank and commercial banks, while a score of 4+ represents a level of reform that approximates the institutional standards and norms of an industrialised market economy, as represented, for example, by the Basle Committee's Core Principles on Effective Banking Supervision and Regulation.

As we can see from table 1, from the four countries under investigation, only Hungary has achieved the highest score of 4 for the banking reform index, while no country has achieved a score of 4 for the EBRD Index for non-banking reform. Hungary's banking market has always been one of the most developed and liberal in Central and Eastern Europe mainly due to the early privatization of state-owned banks and the involvement of foreign investors, which has put the banking sector on a sound footing well above the other transition countries. Overall, in all countries, but Poland, reforms of the non-bank sector still lag behind those of the banking sector, which is not surprising given that banks dominate the financial system and have been at the centre of reforms, while capital markets have remained relatively underdeveloped. On the whole, we observe an increase in both EBRD indexes for the majority of the countries during the period 1999-2003.

## 3. A parametric methodological approach: the alternative profit function

In light of this ongoing reform process it would be interesting to investigate whether these changes in the regulatory and financial environment have implications, among other things, for the efficiency of banking institutions. To this purpose, we employ the stochastic frontier approach (SFA) as developed by Aigner et al. (1977), to estimate profit efficiency. The SFA specifies a particular form for the profit

[1] See the EBRD Transition Report (2004) for a detailed definition and classification.

function and allows for random errors. It assumes that these errors consist of inefficiencies, which follow an asymmetric distribution, usually a truncated or half-normal distribution, and random errors that follow a symmetric distribution, usually the standard normal distribution. The reason for this particular structure of the composite error term is that, by definition, inefficiencies cannot be negative. Both the inefficiencies and random errors are assumed to be orthogonal to the input prices, outputs and country-level variables specified in the estimating equation.

In particular, according to the SFA the estimation of banks' relative efficiency using panel data is performed by estimating a profit function of the general form:

$$y_{cst} = \alpha + \mathrm{X}'_{cst}\beta + \varepsilon_{cst} - u_{cst} \qquad (1)$$

where $y_{cst}$ is total profit in logarithm form of bank *s* in country c in period *t*, $X'_{cst}$ is a matrix of outputs, input prices and explanatory variables in logarithm form, $\varepsilon_{cst}$ is a random error term that follows a symmetric normal distribution ($\varepsilon_s$~idd $N(0,\sigma^2_\varepsilon)$) and $u_{cst} > 0$ is the technical inefficiency term that follows a half-normally distributed, ($u_s$~iid $N^+(\mu,\sigma^2_u)$).

Regarding the definition of efficiency, we follow the approach of Pulley and Humphrey (1993) and Berger and Mester (1997) that allows estimating an alternative profit efficiency given that banks hold some degree of market power on output. This widely-used alternative profit approach departs from the restrictions imposed by assuming a perfectly competitive output markets. Thus, instead of counting deviations from optimal output as inefficiency, as in the standard profit function, variable output is held constant, while output prices are free to vary and affect profits. Hence, profits are a function of both input prices and output quantities, while the bank chooses input quantities and output prices.

As it is common practice in the efficiency literature, in this paper we employ the translog[2] specification of the underlying profit function in (1), with the standard underlying symmetry and homogeneity assumptions, which takes the following form:

$$\ln(\pi_{st}+\theta+1) = \alpha_0 + \sum_i \alpha_i \ln P_{ist} + \sum_i \beta_i \ln Y_{ist} + 1/2\sum_i\sum_j \alpha_{ij} \ln P_{ist} \ln P_{jst} + 1/2\sum_i\sum_j \beta_{ij} \ln Y_{ist} \ln Y_{jst}$$
$$+ \sum_i\sum_j \delta_{ij} \ln P_{ist} \ln Y_{jst} + \sum_i \phi_i \ln N_{ist} + 1/2\sum_i\sum_j \phi_{ij} \ln N_{ist} \ln N_{jst} + \sum_i\sum_j \eta_{ij} \ln N_{ist} \ln Y_{jst} +$$
$$+ \sum_i \lambda_{ij} \ln N_{ist} \ln P_{jst} + \kappa T + 1/2\kappa_1 T^2 + \sum_i \gamma_i T \ln P_{ist} + \sum_i \mu_i T \ln Y_{ist} + \sum_i \nu_i T \ln N_{ist} +$$
$$+ \varepsilon_{ist} - u_{ist} \qquad (2)$$

Total profit, $\pi_{st}$, is defined as profit before tax of bank *s* at time *t*. Following the literature, we add a constant[3], θ, to profit for all banks to avoid having negative net profits for any bank observation. $P_i$ is a vector of input prices, $Y_i$ is a vector of variable outputs, $N_i$ is a vector of fixed netputs, and T is a time trend capturing technological change over the period[4]. In order to retrieve the inefficiency component from the composite error for each bank from the alternative profit function estimation, the method of Jondrow et al. (1982) is employed to calculate the conditional expectation $u_{ist}$ given $v_{ist}=\varepsilon_{ist}-u_{ist}$.

A variety of approaches have been proposed in the literature for the definition of bank inputs and outputs, i.e. the production, the intermediation, the asset, the value-

[2] We prefer the translog specification compared with the alternative Fourier-flexible functional form, since the latter application requires additional truncations of data (Hasan and Marton, 2003). Moreover, Berger and Mester (1997) report that mean efficiency estimates between the two procedures is very small.

[3] θ indicates the absolute value of the minimum value of profit (π) over all banks in the sample.

[4] In equation (2) we impose linear homogeneity in prices, $\sum_i \alpha_i = 1$, whilst symmetry restrictions in all quadratic terms are also imposed in accordance with economic theory, $\alpha_{ij}=\alpha_{ji}$; $\delta_{ij}=\delta_{ji}$; $\lambda_{ij}=\lambda_{ji}$; $\gamma_{ij}=\gamma_{ji}$.

added and the user-cost approach; yet, there is little agreement among economists, mainly as a result of the nature and functions of financial intermediaries (see Berger and Humphrey (1992) and Maggi and Rossi (2003)).

In this paper, we follow the intermediation approach and specify two outputs: loans, and other earning assets; and two inputs: labor and deposits. The price of deposits is computed by dividing total interest expenses by the total amount of deposits and short term funding, while the price of labor is defined as the ratio of personnel expenses to total assets. The dependent variable is defined as profit before tax. We also specify physical capital and equity as fixed netputs. The treatment of physical capital as a fixed input is relatively standard in efficiency estimation (Berger and Mester, 1997), while the level of equity is included so as to account for different risk preferences of banks and to control for bank's insolvency risk (Hughes and Mester, 1993; Mester, 1996; Berger and Mester, 1997).

The variations of inefficiency measures across banks may be associated with the banking and economic environment in which each bank operates. This is particularly relevant in the context of a cross-country comparison, as it is important to allow not only for variation in relative factor prices across countries but also for country-level variables that could influence the level of efficiency for all banks in the country and the quality of services provided by the banking sector. By ignoring factors in the economic environment that could influence technology efficiency and service quality variations, one would incorrectly assume that efficiency differences across countries are attributed entirely to managerial decisions within banks regarding the scale and mix of inputs and outputs. Country-specific factors, such as the level of economic development, legal and regulatory frameworks, household wealth and incomes and market structures in banking, can have significant effects on the level of

technological efficiency and service quality, and these effects are potentially important in the case of countries in transition.

To examine the potential factors that are correlated with bank inefficiencies, we use the conditional mean model of Battese and Coelli (1993, 1995), which permits the simultaneous estimation of the alternative profit function and the identification of the correlates of bank inefficiencies in a single-step estimation. Thus, the estimation procedure allows for bank inefficiencies to have a half-normal distribution that is independently but not identically distributed over different banks. The mean of the inefficiency term is then modelled as a linear function of a set of explanatory variables. As in Battese and Coelli (1995), the mean profit-inefficiency ($m\pi_i$) is a deterministic function of ρ explanatory variables, in other words:

$$m\pi_{ist} = z_{ist}\,\xi, \qquad (3)$$

where ξ is a ρx1 vector of parameters to be estimated. Following Battese and Cora (1977) let $\sigma^2 = \sigma_\varepsilon^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_\varepsilon^2 + \sigma_u^2)$. Then, the inefficiency, $u_{ist}$, can be formulated as:

$$u_{ist} = \xi_i Z_{ist} + w_{ist} \qquad (4)$$

where $w_{ist}$ is assumed to be truncated normally distributed, with zero mean and variance $\sigma^2_u$, ξ is a vector of coefficients to be estimated, and Z is a vector of country-level factors.

We incorporate in our analysis several environmental variables, including: the EBRD Index of banking reform, the EBRD Index of non-banking reform, the Herfindahl Index that captures the degree of concentration in the banking industry, the ratio of credit to the private sector as a percentage of GDP, which measures the level of financial intermediation in each country and can also be considered as an aggregate measure of banking development, the interest rate spread, which is a proxy for

competition for banking services, and two macroeconomic indicators, that is the GDP per capita variable, which serves as a measure of economic activity, and the inflation rate.

Among the explanatory variables, the EBRD Indexes of banking and non-banking reform are of particular interest for our analysis, as the motivation behind this paper is to investigate the relationship between profit efficiency and the banking and financial reforms implemented in Central and Eastern European countries, prior to their accession to the EU.

## 4. Data sources and summary statistics

Our data comprise of banks in four new European Union Member States in the area of Central and Eastern Europe, namely Poland, Hungary, Czech Republic and Slovakia, that are listed in the IBCA-Bankscope database for the period 1999 to 2003. This database reports published financial statements from financial institutions worldwide, homogenized into a global format, which are comparable across countries and therefore suitable for a cross-country study[5]. After reviewing the data for reporting errors and other inconsistencies, an unbalanced panel of 362 observations is used, that included a sample of 90 banks from the four Central and Eastern European countries. Our sample is quite extended and covers most important banks, as defined by their balance sheet aggregates. Table 2 presents the number of banks by year and country.

*(Insert Table 2 about here)*

[5] The underlying hypothesis of the Bankscope is that all countries suffer from the same survival bias.

The sources of the macroeconomic data and measures of banking reform for the countries are the EBRD's Transition Reports and the World Development Indicator Statistics.

Table 3 presents some descriptive statistics for the dataset we use in our analysis. It reports sample means for the overall sample and by country (calculated for bank-year observations), for the dependent and explanatory variables.

*(Insert table 3 about here)*

Comparing the summary statistics across countries, we see significant variations regarding profits, inputs prices and outputs. The mean of return on assets (ROA) is about 1.1% for all countries and ranges from 0.7 percent in the Czech Republic to 1.4 percent in Hungary. Taking outputs as percentages of assets, loans stand at about 46.3 percent for the whole region, ranging from 35.6 percent for the Czech Republic to 54.3 percent for Hungary, while the ratio of other earning assets to the balance sheet total stands at an average of 44.9 percent. Regarding input prices, the price of labour exhibits significantly more variability than the price of deposits across countries. Moreover, the ratio of equity to assets ranges between 9 percent in Hungary to 14.7 percent in Poland, while the ratio of physical capital to total assets exhibits much lower variability.

Regarding the country-level factors, differences in average values of macroeconomic variables are significant, especially in the per capita GDP, which ranges from 4,018 in Slovakia to 5,676 in the Czech Republic. We also observe significant variation in the inflation rate, which ranges from 2.5 percent in the Czech Republic to 8 percent in Slovakia. The average interest rate spread is relatively high in Poland and Slovakia, while Hungary exhibits the highest ratio of domestic credit as a percentage of GDP. Regarding the structure of banking systems, average asset

concentration is relatively high in the Czech Republic and Slovakia, as it is indicated by the Herfindahl index. Finally, the banking sector reform progress as measured by the EBRD transition indicator stands at an average of 3.5 for CEE-4, while the EBRD index for non-banking sector reform is slightly lower and has an average value of 3.2.

## 5. Evidence on the determinants of technical efficiency

Next, we report the empirical findings of bank efficiency based on the Stochastic Frontier Approach. Table 4 presents the stochastic profit function estimates. The use of a common frontier has the advantage of allowing performance comparisons of banks across countries, while inclusion of country-specific variables allows us to control for differences in the environmental conditions in each country, which may affect efficiency. Most output and input price coefficients are significant, while they have the expected from the theory of optimisation signs.

*(Insert table 4 about here)*

Graph 1 presents alternative profit efficiency scores for each country. Overall, the results report substantial levels of inefficiency in the banking industry, suggesting that banks do not operate close to the efficient frontier. In particular, we can observe an average profit efficiency score of 0.56 for the whole period and for all countries under investigation, indicating that the average bank in the sample could increase its profits by 44 per cent to meet the performance of the best-practice bank. The observed high level of profit inefficiency is justified by the fairly low intermediation depth, while the observed high demand for financial services asserts additional pressure on banks. Given the potential reward of expanding market shares in a rapidly growing market, banks have little incentive to maximize profits by means of full utilization of their discretionary pricing power (Rossi et al., 2004). In addition, as interest margins

in these banking systems are relatively high, though declining in recent years, and banks earn substantial profits, they face less pressure to further increase profitability, thus shifting their attention to expanding their market share. However, efficiency is increasing over time for all countries (except for the Slovak Republic).

A cursory look in the graph also reveals substantial differences in the efficiency scores across countries, a finding that highlights the challenges in terms of financial, and in particular banking, integration laying ahead for these new EU member states.

*(Insert graph 1 about here)*

Regarding the impact of reforms on efficiency, Table 4 shows that progress in banking reform, as measured by the EBRD transition indicator, is significantly associated with lower profit inefficiency, implying that efforts to restructure the banking industry has positively contributed to efficiency. This is consistent with the findings of Fries and Taci (2005), who also found a positive (though non-linear) relationship between reform and cost efficiency.

An interesting finding is that progress in non-banking reform, as measured by the EBRD non-banking transition indicator, is associated with higher profit inefficiency. This may be due to fact that as other segments of the financial market, and in particular capital markets, develop further and mature, the prominent role of banks decreases, and therefore the non-banking sector gains importance in the financial industry. For example, an opportunity to raise funds on the stock market would reduce the demand for bank loans by the best borrowers on the market (Grigorian and Manole, 2002). Less credit extended to these clients would then lead to lower returns with the final outcome being lower profit efficiency for banking operations.

Finally, regarding the macroeconomic variables, the interest rate spread is negatively associated with profit inefficiency, reflecting the fact that higher spreads as associated with higher margins and thus higher profits. On the other hand, neither the Herfindahl Index, which measures concentration, nor the ratio of credit to the private sector as a percentage of GDP, has a significant impact on profit inefficiency. Also, there exist a negative and significant relationship between the level of economic development, as measured by GDP per capita, and profit inefficiency, implying that banks in higher per capita income countries are more efficient in terms of generating stronger cash flows and higher profits than banks in low income countries. This should not be surprising as countries with higher per capita income tend to generate more savings, and hence a higher demand for financial services. Our results are in accordance with Grigorian and Manole (2002). Concerning other elements of the macro environment, the inflation rate is found to be negatively correlated with profit inefficiency, suggesting that high inflation is not necessarily associated with large-scale inefficiencies.

## 6. Conclusion

This paper investigates the impact of financial sector reforms on the efficiency of the banking systems in four Central European countries that have recently joined the EU, namely Czech Republic Hungary, Poland and Slovak Republic, over the period prior to their accession to the EU, that is 1999 to 2003, a period characterised by intensive restructuring.

Our findings, based on the stochastic alternative profit stochastic frontier, show a low level of profit efficiency that necessitates the continuation of restructuring in these countries so as to accelerate the process of financial integration. When

decomposing the efficiency scores by country, significant differences are reported, while a year-by-year analysis reveals an improvement in the efficiency scores over time.

Regarding the importance of reforms in banking industry, they assert a positive impact on profit efficiency, implying that the restructuring of the banking sector has improved banks' profitability. On the other hand, progress in non-banking reforms, as measured by the EBRD non-banking transition indicator, is found to be associated with lower profit efficiency. Finally, regarding the macroeconomic variables, we observe a negative relationship between profit inefficiency and both the level of economic development, as measured by GDP per capita, and the inflation rate.

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## Table 1: Financial Reform Indicators

| | EBRD Index banking | | EBRD Index non-banking | | Domestic Credit to the private sector (% of GDP) | | Non-performing loans / Loans | | Asset share of state owned banks (in per cent) | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Country** | 1999 | 2003 | 1999 | 2003 | 1999 | 2003 | 1999 | 2003 | 1999 | 2003 |
| Czech Republic | 3.3 | 3.7 | 3.0 | 3.0 | 39.4 | 17.9 | 24.5 | 5.0 | 41.2 | 3.0 |
| Hungary | 4.0 | 4.0 | 3.3 | 3.7 | 25.8 | 42.3 | 4.4 | 3.8 | 7.8 | 7.4 |
| Poland | 3.3 | 3.3 | 3.3 | 3.7 | 18.7 | 17.8 | 14.9 | 25.1 | 24.9 | 25.7 |
| Slovak Republic | 2.7 | 3.3 | 2.3 | 2.7 | 39.1 | 25.0 | 32.9 | 9.1 | 50.7 | 1.5 |

Source: EBRD Transition Report (2004)

**Table 2: Number of banks in the sample**

| | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| Czech Republic | 16 | 17 | 20 | 21 | 19 |
| Hungary | 11 | 13 | 14 | 17 | 16 |
| Poland | 25 | 26 | 26 | 29 | 28 |
| Slovak Republic | 10 | 11 | 14 | 15 | 14 |
| **CEE-4** | **62** | **67** | **74** | **82** | **77** |

Source: Bankscope database

**Table 3: Summary Statistics**

| Variable | Czech Republic | Hungary | Poland | Slovakia | CEE-4 |
|---|---|---|---|---|---|
| ***Total profits, outputs and input prices*** | | | | | |
| Ratio of total profit before tax to assets (in %) | 0.7 | 1.4 | 1.3 | 0.8 | **1.1** |
| Ratio of total loans to assets (in %) | 35.6 | 54.3 | 51.6 | 41.7 | **46.3** |
| Ratio of other earning assets to assets (in %) | 56.6 | 36.5 | 39.0 | 49.7 | **44.9** |
| Price of deposits (in %) | 6.0 | 6.5 | 7.2 | 5.5 | **6.4** |
| Price of labour (in %) | 0.9 | 1.6 | 1.8 | 1.1 | **1.4** |
| ***Fixed netputs*** | | | | | |
| Ratio of equity to assets (in %) | 11.2 | 9.0 | 14.7 | 9.2 | **11.2** |
| Ratio of fixed assets to assets (in %) | 2.5 | 2.8 | 2.3 | 3.8 | **2.5** |
| ***Zs*** | | | | | |
| EBRD Index of banking reform | 3.6 | 4.0 | 3.3 | 3.2 | **3.5** |
| EBRD Index of non-banking reform | 3.0 | 3.6 | 3.6 | 2.4 | **3.2** |
| Domestic Credit (in % of GDP) | 24.9 | 33.5 | 18.0 | 29.2 | **24.8** |
| Interest rate spread | 4.3 | 3.2 | 5.5 | 4.7 | **4.6** |
| Herfindahl Index | 1,904 | 1,371 | 1,166 | 1,796 | **1,507** |
| Inflation rate | 2.5 | 7.5 | 5.0 | 8.0 | **5.4** |
| GDP per capita | 5,676 | 4,878 | 4,461 | 4,018 | **4,777** |

Source: Bankscope database

**Table 4: Panel estimation of stochastic profit efficiency frontier and correlates of bank inefficiencies**

| | **Coefficient** | **St. Err.** | **P>\|z\|** |
|---|---|---|---|
| $Ln(Y_1)$ | -0.334 | 0.238 | 0.160 |
| $Ln(Y_2)$ | -0.140* | 0.081 | 0.083 |
| $Ln(P_1)$ | 1.354*** | 0.382 | 0.000 |
| $Ln(P_2)$ | -0.354 | 0.382 | 0.355 |
| $Ln(Y_1^2)$ | 0.116 | 0.082 | 0.157 |
| $Ln(Y_2^2)$ | 0.059** | 0.024 | 0.013 |
| $Ln(Y_1)ln(Y_2)$ | -0.032 | 0.023 | 0.169 |
| $Ln(P_1^2)$ | -0.070 | 0.056 | 0.218 |
| $Ln(Y_1)ln(P_1)$ | -0.096*** | 0.031 | 0.002 |
| $Ln(Y_2)ln(P_1)$ | 0.044* | 0.024 | 0.066 |
| Ln(EQ) | -0.268*** | 0.096 | 0.005 |
| Ln(PC) | 0.587*** | 0.194 | 0.002 |
| $Ln(EQ^2)$ | -0.077*** | 0.011 | 0.000 |
| $Ln(PC^2)$ | -0.079*** | 0.015 | 0.000 |
| Ln(EQ)ln(PC) | 0.025 | 0.043 | 0.560 |
| $Ln(EQ)ln(Y_1)$ | 0.076* | 0.043 | 0.078 |
| $Ln(EQ)ln(Y_2)$ | -0.009 | 0.029 | 0.753 |
| $Ln(PC)ln(Y_1)$ | -0.078*** | 0.026 | 0.003 |
| $Ln(PC)ln(Y_2)$ | 0.014 | 0.024 | 0.563 |
| $Ln(EQ)ln(P_1)$ | -0.095*** | 0.032 | 0.003 |
| $Ln(PC)ln(P_1)$ | 0.063*** | 0.021 | 0.003 |
| lnT | 0.346 | 0.594 | 0.560 |
| $lnT^2$ | 1.099*** | 0.125 | 0.000 |
| $Ln(T)ln(P_1)$ | 0.083 | 0.081 | 0.304 |
| $Ln(T)ln(Y_1)$ | -0.360*** | 0.083 | 0.000 |
| $Ln(T)ln(Y_2)$ | 0.035 | 0.036 | 0.332 |
| Ln(T)ln(EQ) | 0.031 | 0.069 | 0.653 |
| Ln(T)ln(PC) | 0.212*** | 0.079 | 0.007 |
| constant | 12.019*** | 0.992 | 0.000 |
| ***Zs** (Factors affecting inefficiency)* | | | |
| EBRD banking | -1.151*** | 0.438 | 0.009 |
| EBRD non-banking | 1.712*** | 0.318 | 0.000 |
| HHI | 0.411 | 0.734 | 0.575 |
| Credit/GDP | -0.021 | 0.016 | 0.167 |
| GDP per capita | -2.249*** | 0.606 | 0.000 |
| Inflation | -0.188* | 0.111 | 0.091 |
| Interest spread | -1.209** | 0.500 | 0.016 |
| Number of obs | 362 | | |
| Log likelihood | -192.120 | | |

**Note:** *** indicates significance at the 1% significance level, ** indicates significance at the 5% significance level, * indicates significance at the 10% level.

**Graph 1: Profit efficiency scores**