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Abhandlungen

Linking Managerial Behaviour to Cost and Profit Efficiency in the Banking Sectors of Central and Eastern European Countries

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I. Introduction

This paper investigates the state and evolution of banking efficiency in Central and Eastern European countries (CEECs) with a focus on countries that have recently acceded the European Union. The swift changes in the financial system following the collapse of the centrally planned economies, its catching up with EU levels and the overall transition towards a market economy make the banking systems of these countries a distinct field of research.

The analysis of banks' efficiency levels continues to be important from both a macroeconomic and a microeconomic point of view as documented by its long tradition in literature (see *Berger/Mester* (1997) or *Berger/Humphrey* (1997) for an overview). From the micro perspective, the issue of banking efficiency is crucial, especially for the transition economies of Central and Eastern Europe (CEE), given increasing competition and the strong presence of foreign banks in these countries, which render the issue of reducing the underperformance of the banking sector a main priority for the financial sector. From the macro perspective, the efficiency of the banking sector influences the costs of financial intermediation and the overall stability of the financial markets. For CEECs improvements in bank efficiency can have a significant impact on the allocation of financial resources since this sector remains still the most

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important source of financing private investment of firms, given the underdevelopment of the financial markets (see *Caviglia* et al. (2002)).

In line with the voluminous literature on banking efficiency in OECD countries, a fairly large number of studies deals with banking efficiency in transition economies in CEE.[1] The application of cost efficiency frontier techniques in the empirical literature for the transition countries of CEE has been largely focused on analyses based on a single country, such as *Kraft/Tirtiroglu* (1998) on Croatia, *Opiela* (2000), and *Nikiel/Opiela* (2002) on Poland, or *Taci/Zampieri* (1998) on the Czech Republic, as well as *Hasan/Marton* (2003) on the Hungarian experience. Recently empirical contributions have dealt with cross-country comparisons for CEECs. *Bonin* et al. (2005), *Green* et al. (2004), and *Weill* (2003) for example analyze the effect of bank privatization on efficiency in selected CEE transition countries (the Czech Republic and Poland), while *Fries/Taci* (2005), and *Fries* et al. (2002) investigate the efficiency/performance of a sample of banks in transition economies. *Zajc* (2004) focuses on differences between foreign and domestic banks relying on the methodology of *Claessens* et al. (2001). *Berglöf/Bolton* (2002) as well as *Fries/Taci* (2002) deal with the effect of macroeconomic stabilization and institutional reforms on the banking system. *Buch* (2000) compares interest rate spreads across three CEE countries (Hungary, Poland and the Czech Republic). *Weill* (2004) contrasts efficiency of banks from Western countries with those from CEECs testing different hypotheses to explain the performance gap between them.

One focus of these recent contributions has been to explain variation in efficiency across CEECs banks in terms of their ownership yielding often mixed or inconclusive results. The reason why a different ownership form can lead to a different efficiency level of banks mainly relates to the principal-agent framework: managers in foreign owned or privatized institutions are supposed to be more constrained by capital market discipline. On the contrary, a lack of owners' control makes management more free to pursue its own agenda and provides few incentives to be efficient (see *Altunbas* et al. (2001)) for an extensive discussion on the issue). Empirically the influence of ownership remains debated. *Hasan/Marton* (2003) provide evidence that increased foreign ownership is associated with higher efficiency in the Hungarian banking sector; *Weill*

[1] See the IMF report (2000); *Thimann* (2002); *ECB* (2005). Furthermore, a well-structured overview of recent developments in CEE banking markets can be found in *Balling* et al. (2004).

(2003) comes to a similar conclusion for the Czech Republic and Poland by demonstrating that foreign owned banks are more efficient than domestic-owned banks. In contrast to these results, *Bonin* et al. (2005) show that privatization by itself is not sufficient to increase bank efficiency on a sample of banks from eleven transition countries. *Fries/Taci* (2005) find, for a sample of banks in fifteen transition economies, that there is no significant evidence that privatization or major foreign ownership has a direct effect in boosting cost efficiency.

One reason for these inconsistent results may be that the gap in the efficiency levels of CEECs banks and Western banks could be due more to the poor management behaviour than to the ownership structure (see *Weill* (2004)). Similarly, as pointed out in *Williams* (2004) the target of the bank ownership literature is to prove that financial institutions organized under one ownership model are more/less efficient than banks organized in a different way. While the ownership approach could therefore provide useful suggestions for policy and bank regulation, it does not help in understanding how managerial behaviour could affect efficiency. In other words, the link between ownership and efficiency implicitly assumes a different behaviour of management but does not say how managerial behaviour directly affects the performance and efficiency of banks.

The literature on the link between managerial behaviour and efficiency is still limited (see *Berger* (1995); *Mester* (1996); *Berger/DeYoung* (1997); *Berger/Hannan* (1998); *DeYoung* et al. (2001); *Williams* (2004)) and to the best of our knowledge has not been applied to the case of CEECs.

By using data on the risk and asset quality of CEECs banks we provide evidence on this issue by examining the link between managerial behaviour and the efficiency of banks in the period prior to EU membership from 1995 to 2002, as negotiations on the enlargement of the EU were officially concluded in December 2002.

Our paper contributes to the existing literature in two ways therefore:

a) Firstly, by extensively analyzing the evolution of and the differences in cost and profit scores across nine CEECs, we examine whether and how the management of the asset quality and the risk of the bank can explain the performance in terms of cost and profit efficiency. We thereby model the inefficiency/efficiency term as an explicit function of variables, which may influence the firm's efficiency. Our investigation is based on a stochastic frontier model, in which the cost and profit func-

tion are specified according to the flexible Fourier function (FF), which has been proved to give a better fit of the data than the well used Translog function (TL).

b) Secondly, based on the results obtained from the static econometric analysis, we test whether differences in management behaviour could be the cause for the CEECs bank inefficiency. In order to do so, we use the approach proposed by *Berger/DeYoung* (1997) based on a Granger Causality test, which assumes inter-temporal relationships between efficiency (cost and/or profit), capitalization and loan loss provisions of the bank. By means of these relationships, four hypotheses on management behaviour can be derived:

(i) The *bad management hypothesis* (low cost/profit efficiency Granger causes high loan loss provisions), (ii) the *skimping hypothesis* (high cost/profit efficiency Granger causes high loan loss provisions), (iii) the *bad luck hypothesis* (exogenous shocks in the level of loan loss provisions Granger cause changes in cost/profit efficiency levels) and (iv) the *moral hazard hypothesis* (thinly capitalized banks are more prone to risk taking).

The remainder of the paper is organized as follows. Section II provides a description of the data and some stylized facts about the CEECs banking systems. Section III describes the methodologies used in the analysis: the efficiency analysis is presented in section III.1; in section III.2 we describe the specification of cost and profit functions; in III.3 we present a model for analyzing the possible determinants of cost and profit (in)efficiency; finally in III.4 we review the econometric model of management behaviour. Results are presented in section IV. Section V concludes.

II. Data

Our dataset is composed of single-bank records for CEECs, consisting of annual accounting data derived from the financial statements of banks made available through the BankScope database of Bureau van Dijk and Fitch/Ibca. We use data for the years 1995 to 2002 for the eight CEECs that joined the EU in the first wave of accession: the Czech Republic (CZ), Hungary (HU), Poland (PL), Slovakia (SK), Slovenia (SI), the three Baltic countries Estonia (EE), Latvia (LV) and Lithuania (LT) as well as for the Romania (RO) which joined in the second wave. As reliable data on each bank is not available for every year, we obtained an unbalanced panel dataset consisting of 1170 observations, which refers to a sample

of 278 banks belonging to the nine selected CEECs.[2] The distribution of banks across countries is given in the first column of Table 1. Our sample includes banks that taken together hold more than 80 per cent of total banking assets in the respective countries and therefore can be considered highly representative of the CEECs banking sectors.

The period 1995 to 2002 is one of transition for the countries under study culminating in the conclusion of membership negotiations with the EU in 2002, except for Romania of course which joined in 2007. The run up period to EU membership was marked by wide ranging structural reforms in the financial and real sector in CEECs. Following a period of macroeconomic instability especially inflationary, which combined with unsolved structural and institutional problems to generate latent or open banking crisis in a number of countries, the economic environment in CEE stabilized at the turn of the millennium. Banking activities entered a path of sustained expansion, boosted by surging FDI flows in the financial sector, the resumption of economic growth and the anchor of EU integration.

Before turning to the efficiency analysis, it is appropriate to review the main characteristics of CEE banking markets during our observation period. From Table 1 it is interesting to see that despite the rapid speed of financial deepening in the region, the CEE banking market today maintains a number of features present at the end of our observation period. Although CEE banking markets have grown significantly in size, they still account for only a tiny fraction of EU-25 total banking assets (1.5 % at the end of 2005).

At the same time, the CEE banking sector has conserved an enormous potential for growth. Although the process of financial deepening has been ongoing for the last several years already, this is mainly due to the fact that the intermediation depth, measured as banking assets over GDP, still stands at a level well below MU-12 figures.

As a consequence of the intense process of restructuring and growth, the CEE banking sector had by 2002 experienced an unprecedented level

[2] The raw data required substantial editing to obtain a reliable database for the analysis. In a thorough review process we concentrated on choosing the most appropriate accounting standards (we preferred financial statements using IAS over those using national standards and used consolidated balance sheets whenever they were available), on avoiding double counting of institutions and on converting all the values into a single currency (i.e. USD). Furthermore, we conducted several plausibility checks regarding the completeness and consistency of the individual profit and loss accounts and balance sheets.

Table 1

The Banking Sector in Selected CEECs

	Number of banks	Total assets in bn EUR		Total assets as a % of GDP		Market share of the 5 largest banks (%)		Foreign-owned bank assets (%)(1)		Return on Equity (ROE) (%)		Capital Adequacy Ratio (CAR) (%)	
		2005	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005	2002
CZ	39	105.0	79.5	106.6	101.1	65.5	65.8	84.2	83.7	24.1	24.8	11.6	14.1
EE	14	11.8	5.2	112.2	69.9	98.1	99.0	89.4	90.0	24.6	13.6	10.7	15.0
HU	33	74.7	46.3	84.9	62.6	53.2	54.5	58.8	56.6	24.8	14.1	12	13.3
LT	12	13.1	5.0	63.6	33.4	80.6	84.5	74.8	51.0	17.2	12.1	9.8	14.7
LV	28	15.6	7.1	121.7	73.2	67.3	64.3	53.2	38.6	27.3	17.5	10.0	12.0
PL	72	152.1	116.0	62.5	55.4	48.6	53.4	66.2	68.0	20.1	5.8	14.6	13.8
RO	34	35.4	14.4	n.a.	n.a.	70.6	69.8	59.2	52.9	14.9	n.a.	21.1	n.a.
SI	19	30.0	19.8	109.8	84.4	63	69.5	20.8	16.0	13.4	11	9.9	11.9
SK	27	36.4	21.5	95.4	91.2	67.7	66.9	75.2	81.5	17.5	18.9	14.7	21.3
Total	278												
MU-12		22,660	18,069	284.3	249.3	43.0	39.3	12.2	9.8	n.a.	8.8**	n.a.	12**
EU-25		32,882	25,261	304.0	257.4	42.3	38.3	12.9	9.7	12.2*	n.a.	11.9*	n.a.

(1) Total assets of subsidiaries of credit institutions from EU and third countries over total assets of credit institutions in the respective country.

* Data 2004

** EU-15

Source: ECB (2004, 2005, 2006), IMF, OeNB and Bankscope.

of consolidation through merger and acquisitions by Western financial institutions. In contrast to MU-12 data, the CEE banking market is thus characterized by a relatively high degree of both concentration and foreign ownership (see also *ECB* (2004)).

The structural reforms in the run up to EU enlargement have had effects in terms of strong profits for CEECs banking sectors well above MU-12 averages, and a satisfactory equity endowment. As competition tightens, profitability levels can be expected to decrease in the future, as for example the onset of a decrease in the comparatively high interest rate margins in the CEECs already indicates (see also *Walko/Reininger* (2004)).[3]

III. Methodology

1. Efficiency Measurement

From a theoretical viewpoint a production plan is called efficient if it is not possible to produce more with the same input or to reduce these inputs leaving the output unchanged.[4] It is often observed however that firms are away from the optimum production frontier. This is due to the fact that production plans and cost/profit levels are not the result of perfectly rational and efficient decisions: factors such as errors, bad management, lags between the choice of plan and its implementation, inertia in human behaviour and distorted communication may cause what is called *X*-inefficiency. Two classes of models have been proposed for isolating the efficient frontier, the deterministic and parametric models. While deterministic models (*Aigner/Chu* (1968); *Afriat* (1972); *Richmond* (1974)) use the residuals of the production function as a measure for inefficiency without controlling for random noise, parametric models, such as the stochastic frontier approach (SFA), the distribution free approach (DFA), and the thick frontier approach (TFA), disentangle the error term in to two components (see e. g. *Bauer* et al. (1998) for an overview). The

[3] A number of factors in CEECs have contributed to increasing competition among financial institutions, such as the institutional upgrading in all economic sectors after the collapse of the socialist regimes, the preparation of the new Member States for joining Economic and Monetary Union, and the privatization and concentration process outlined above.

[4] Duality theory (see e. g. *Beattie/Taylor* (1985) and *Shephard* (1970)) has shown that under given conditions (exogenous prices and optimal behavior of the producer) the properties of the production function can be studied indirectly through cost or profit functions.

first one, *V,* corresponds to random fluctuations. The second one, *U,* accounts for the firm's inefficiency – e. g. the factors that affect technical or allocative efficiency, which could be controlled by banks.

In our analysis we apply the stochastic frontier approach which assumes that *V* is normally distributed, whereas *U,* is distributed half-normally (truncated at zero).[5] According to the SFA, the total costs/profits (*TC* and *TP*) for the *s*-th firm at time *t* assume the following specification:[6]

$$H_{st} = H(Y_{st}, P_{st}) + V_{st} + U_{st} \tag{1}$$

where *H* is either *TC* or *TP, Y* is a vector of outputs of the firm and *P* is a vector of input prices. In the case of the profit function (*TP*) the disturbance term is specified as $V_{st} - U_{st}$. Following the *Battese/Coelli* (1988 and 1992) model, the predictions of individual bank's cost/profit efficiency (*EFF_H*) may then be written as:

$$EFF\_H_{st} = \mathrm{E}(H_{st}|U_{st}, \varphi_{st}) / \mathrm{E}(H_{st}|U_{st} = 0, \varphi_{st}) \tag{2}$$

where φ_{st} are the regression parameters.

A major reason for preferring the SFA over other parametric models is that it allows us to analyze the evolution of efficiency over time. However, several researchers have stressed the importance of checking for the consistency of results across different parametric models (see e. g. *Berger/Mester* (1997), *Bauer* et al. (1998), *Maudos* et al. (2002) and *Lozano-Vivas* et al. (2002)). Following the procedure laid down in Bauer et al. (1998), we check whether our efficiency estimates based on the SFA are consistent in their ranking with the results obtained from the distribution free approach (DFA) and the thick frontier approach (TFA). The main difference between the DFA and SFA approaches is that the DFA avoids the distributional assumptions of the SFA and assumes that there is a core efficiency or average efficiency for each firm, which is persistent over time. In addition, the DFA assumes that random errors tend to aver-

[5] See on this issue *Aigner* et al. (1977), *Meeusen/van den Broeck* (1977), *Stevenson* (1980), *Jondrow* et al. (1982), *Battese/Coelli* (1988 and 1992), *Coelli* et al. (1998), and *Kumbhakar/Lovell* (2000).

[6] A distinction between cost and profit efficiency arises when markets are not perfect. It is reasonable to assume in the case of the CEEC that, given our observation period (1995–2002), competitive markets did not occur in these banking industries. Therefore a profit efficiency analysis brings additional insights into the analysis.

age out in the course of time. The TFA and SFA are modelled in a similar manner, but the TFA employs in the estimations only the quartile of the best performing firms in the data set. Inefficiency is measured as the distance from the estimated frontier using the sample of these best performing banks.[7]

2. *Cost and Profit Function Specifications*

In modelling banks' cost or profit function, one of the most debated questions in literature is the definition of the *inputs* and *outputs* of multi-product financial firms. The discussion particularly concentrates on the role of deposits, considering that they have both input and output characteristics. The empirical literature on banking suggests different approaches to this issue: the most commonly used approaches are the *production approach* (or value added approach or user cost approach) and the *intermediation approach* (or asset approach). The first underlines the role of financial institutions as providers of services for account holders. This approach argues that deposits should be considered as an output because they involve the creation of value added associated with liquidity, safekeeping and payment services provided to depositors. The *intermediation approach* however considers financial institutions mainly as mediators of funds between savers and investors. Under this approach the funds raised (deposits) and their cost should be included as inputs in the analysis, since they constitute the raw material to be transformed into loans and investible funds.

Berger/Humphrey (1991) and *Bauer* et al. (1993) proposed a so called *modified production approach,* which allows both the input and output characteristics of deposits to be considered in the cost/profit functions. According to this approach the interest paid on deposits should be counted as an input, while the volume of deposits should be considered an output.

In our cost/profit specifications for CEE banks, we employ the *modified production approach,* which provides a better fit for our dataset.[8] We therefore shape both the cost and profit functions using loans, depos-

[7] For both DFA and TFA a brief overview can be found in *Berger/Humphrey* (1997).

[8] This choice is supported by an *F*-test procedure, which leads us to prefer this specification versus the production and the intermediation cost and profit specifications.

its and other earning assets as outputs, and the price of labour, capital and deposits as inputs.[9] A detailed description of the variables used in the cost and profit functions is presented in Table 2.

As discussed above, we employ a profit function which uses the same exogenous variables as the cost function. This specification is known in the literature as the *alternative* profit specification (see e. g. *Humphrey/Pulley* (1997); *Berger/Mester* (1997)). In contrast to the standard profit function, this alternative specification employs output levels instead of output prices. Following the arguments of *Berger/Mester* (1997) the analysis based on the alternative profit function seems to be preferable when the assumption of perfectly competitive markets is doubtful and when there are differences in the quality of banks' products and services. Consequently, the estimation of the alternative profit function seems to be more appropriate for making cross-country comparisons (see also *Maudos* et al. (2002) and *Bos/Kool* (2006)). Our choice of using the alternative profit function for the CEE banking markets is furthermore supported by the following arguments:

(i) The intense concentration of banks and the comparably high returns earned in these markets suggest that output markets are far from being perfectly competitive so that CEE banks may have some market power over the prices they charge (see *Berger/Mester* (1997) and also *Maudos* et al. (2002)).

(ii) As shown in Table 1, the banking sector in CEECs is fairly heterogeneous; this emerges quite clearly when we look at the differences in the depth of financial intermediation, proxied by the ratio of total assets to GDP. We may thus assume that there are substantial unmeasured differences in the quality of banking services which can be better controlled when we use the alternative profit efficiency function (see *Berger/Mester* (1997)).

(iii) The CEE market was experiencing an intense process of restructuring and growth during the sample period, with banks being very different in terms of their size. As the alternative profit efficiency function measures a bank's ability to generate profit for the same level of output, it helps reduce a potential scale bias (see *Berger/Mester* (1997) and also *Bos/Kool* (2006)).

[9] We do not account for interbank market activities (which mainly refer to the different sorts of deposits from and with banks), since interbank market conditions should be approximately the same for all banks.

Table 2

Variables Used in the Cost and Profit Functions for CEE banks

Variables	Name	Description
Exogenous variables		
Outputs		
Y_1	Loans	Loans (performing and non-performing) to customers
Y_2	Deposits	Deposits from customers
Y_3	Other earning assets	Banks' investments in various types of securities (e.g. government securities, bonds, equity investments, CDS, T-bills, equity investment) not including deposits with banks
Input prices		
W	Price of labour	Staff expenses/total assets
K	Price of capital	Cost of capital (operative costs associated with capital expenses/adjusted value of fixed assets net of depreciation)
D	Price of deposits	Total interest expenses/volume of customer deposits
Endogenous variables		
TC	Total costs	Operating expenses
TP	Total profits	Operating profit minus loan loss provisions[10]

Some authors (see e.g. *Berger/Mester* (1997); *Maudos* et al. (2002); *Bos/Schmiedel* (2006)) have argued that the cost and profit specifications should also account for financial capital as a measure of risk. In our analysis we do not use any asset quality and risk variables as arguments in the cost and profit functions, since we want to follow the approach of *Berger/deYoung* (1997) and analyze the interrelationships between bank's capitalization, asset quality, risk and cost and profit efficiency in

[10] More explicitly, total profits is defined as total operating income (including net interest, net commission and fees, trading, and other operating income) minus total operating expenses (including personnel, administrative, and other operating expenses (the last also including other provisions) minus loan loss provisions. This definition is consistent with the definition used in the IBCA/Bankscope database.

a second stage.[11] Nevertheless, in order to verify whether our cost and profit efficiency results remain stable in their ranking when controlling for banks' equity capital, we run a second specification which includes this variable as an argument in the cost and profit functions.

To analyze the CEE banks' efficiencies we built a common efficient frontier for all banks in our sample. The use of one common frontier allows for a comparison of the performance of banks across countries. The existing literature has pointed out (see e. g. *Lozano-Vivas* et al. (2002); *Bos/Schmiedel* (2006)) that cross-country differences in environmental conditions, which are beyond the control of bank managers, have to be adequately accounted for. To this end, various different methods have been proposed in literature. One approach followed by *DeYoung* (1998) and *Lozano-Vivas* et al. (2002) suggests incorporating the country environmental factors together with the banking variables directly in the cost and profit functions. Another approach suggests the use of so-called meta-frontiers by enveloping country or regional-specific frontiers (*Bos/Schmiedel* (2006)). In our paper we follow a third approach based on a two-stage procedure (see *Maudos* et al. (2002) and *Bos/Kool* (2006)). Firstly, we estimate a single efficient cost and profit frontier for all banks. Secondly, the marginal impact of environmental conditions together with banks' characteristics and other possible determinants of inefficiencies are considered. Through this approach, we gain explicit insights into the underlying determinants of differences in efficient scores across countries and we can analyze the marginal impact of each of the environmental factors on cost and profit efficiency. Furthermore, we avoid the problem of specifying *ex-ante* for which groups of banks one would need to estimate separate frontiers (see *Bos/Kool* (2006)).

For our cost and profit functions we use the Fourier flexible form (FF), which is a semi-nonparametric form that combines the standard translog (TL) specification (nested in the FF), with the non-parametric Fourier form, i. e. trigonometric terms. The FF has the well-known advantages of being a flexible form and of including, as a particular case, the Cobb-Douglas specification. This theoretical improvement, which is able to represent a broad range of functions, has been proven to give a better fit to the data than the TL, which, does not necessarily approximate the unknown true function of an industry, as pointed out in the literature (see

[11] More specifically we make use of equity capital, loan loss provisions, and loans over total assets as explanatory variables in our static and dynamic analysis carried out in sections III.3 and III.4.

White (1980); *Gallant* (1981); *McAllister/McManus* (1993); *Mitchell/Onvural* (1996); *Berger/Mester* (1997)).

The FF representation of our base specifications gives:

$$
\begin{aligned}
\ln H_{st} = & \left[\alpha_0 + \sum_{i=1}^{3} \alpha_i \cdot \ln y_{is} + \sum_{k=1}^{3} \beta_k \cdot \ln p_{ks} + \frac{1}{2} \sum_{i=1}^{3} \sum_{j=1}^{3} \alpha_{ij} \cdot \ln y_{is} \cdot \ln y_{js} \right. \\
& \left. + \frac{1}{2} \sum_{k=1}^{3} \sum_{h=1}^{3} \beta_{kh} \cdot \ln p_{ks} \cdot \ln p_{hs} + \sum_{i=1}^{3} \sum_{k=1}^{3} \delta_{ik} \cdot \ln y_{is} \cdot \ln p_{ks} \right] \\
& + \sum_{i} a_i \cos(y_i) + \sum_{i} b_i \sin(y_i) + \sum_{k} c_k \cos(p_k) + \sum_{k} d_k \sin(p_k) \\
& + \sum_{ij} e_{ij} [\cos(y_j) + \cos(y_j)] \sum_{ij} f_{ij} [\sin(y_i) + \sin(y_j)] \\
& + \sum_{ij} g_{ij} [\cos(y_j) - \cos(y_j)] + \sum_{ij} h_{ij} [\sin(y_i) - \sin(y_j)] \\
& + \sum_{kl} i_{kl} [\cos(p_k) + \cos(p_l)] + \sum_{kl} l_{kl} [\sin(p_k) + \sin(p_l)] \\
& + \sum_{kl} m_{kl} [\cos(p_k)] - \cos(p_l) + \sum_{kl} n_{kl} [\sin(p_k) - \sin(p_l)] \\
& V_{st} + U_{st}
\end{aligned}
\tag{3}
$$

where H is again either total cost TC or total profits TP[12], y_i is the i-th output and p_k is the price of the k-th input. V_{st} is the error term accounting for random noise in the data, and U_{st} refers to technical inefficiency.

The restrictions in the form of the linear homogeneity conditions and cost exhaustion are obtained by normalizing total costs/profits, the price of labour and the price of deposits by the price of capital. The symmetry conditions state that:

$$
\begin{aligned}
\alpha_{ij} &= \alpha_{ji} \quad \forall \quad i,j (i,j = 1,...,n) \quad \text{and} \\
\beta_{ij} &= \beta_{ji} \quad \forall \quad i,j (i,j = 1,...,m).
\end{aligned}
$$

The linear homogeneity restrictions demand that:

$$
\sum_{k=1}^{3} \beta_k = 1; \quad \sum_{k=1}^{3} \beta_{kh} = 0, \quad \text{for all } h; \qquad \sum_{k=1}^{3} \delta_{ik} = 0, \quad \text{for all } i.
$$

[12] As it is common in literature (see e.g. *Hasan/Morton* (2003)), in the estimate of the profit function we include a constant term (which is equal to 1 plus the absolute value of the minimum profit value in the sample) into the total profit variable (TP), which avoids taking the log of a negative number.

In the FF specification, the trigonometric addends have been rescaled coherently with our sample size.[13]

The FF cost and profit regressions (3) are estimated using the stochastic frontier approach with the time-varying panel model (*Battese/Coelli* (1992)) which allows the inefficiency term of each bank to vary over time.

The model provides maximum likelihood estimates of the following parameters:

(a) The inefficiency term, which varies over time according to the following behaviour

$$U_{st} = U_s^{(\eta-(t-T))}$$

where U_{st} is the inefficiency term of bank s at time T (which is the last period considered) and η is a parameter to be estimated. When η is positive, the inefficiency term, U_{st}, is decreasing over time; when η is negative, U_{st} is increasing over time; when $\eta = 0$ U_{st} stays steady.

(b) The mean, μ of the truncation at zero of a normal density distribution; μ indicates how far firms operate from the efficient frontier. Econometrically this means that if μ is significantly different from zero we reject the hypothesis that the distribution is half normal and therefore efficiency is not the prevalent behaviour of our bank sample.

(c) The parameter $\gamma = \sigma_u^2/\sigma^2$; γ is the ratio between the variance associated to the inefficiency of the bank and total variance: it varies between 0 and 1.

3. Possible Determinants of Efficiency

Failing banks and banks with a high level of problem loans tend to be far from the efficiency frontier (see e.g. *Berger/DeYoung* (1997), who provide a good survey on the issue). Moreover, one of the implications of the recent empirical literature on CEECs is that poor managerial per-

[13] Special attention must be paid to the choice of the rescaling form for the trigonometric terms in order to fix their argument in the $0 - 2\pi$ range. The truncation point here has been chosen according to the rule of thumb expounded in *Mitchell/Onvural* (1996) that the number of parameters should be set equal to the number of observations raised to the power of two-thirds in order to obtain consistent and asymptotically normal estimates. However, as suggested by *Gallant* (1981), the effective number of the coefficients is corrected by reducing the number of the regressors to cope with possible multicollinearity.

formance could be one reason behind low efficiency levels in these banking systems.

As a first step, we therefore look at a static model in which the cost and profit *X*-efficiency values (*XEFF*) obtained by estimation of eq. (3) for each bank s at time t are expressed as an explicit function of a vector of variables, which may influence the firm's efficiency. As the causality link between loan loss provisions and bank efficiency is a core issue in investigating management behaviour we concentrate on the question of whether the management of the asset quality, proxied by problem loans (*LLP*) affects efficiency in the static analysis.

Moreover we include an additional set of exogenous variables along the lines of the arguments given in the previous section to control for further bank specifics and cross-country differences in environmental conditions (see *Maudos* et al. (2002) and *Bos/Kool* (2006)). We thereby divide the independent variables used in our regressions into four groups: other bank characteristics, size variables, specialisation variables, and general market and economic characteristics of the respective country (see *Maudos* et al. (2002)).

(i) To account for banks' risk levels we use three additional *bank characteristics* to capture the extent of risk taking by banks. We include bank capitalization (*CAP*), the standard deviation of each bank's return on assets (*STDEVROA*), and the ratio of loans to assets (*LTA*) covering a bank's specific composition of assets.

(ii) To measure *size* and *market power* we use two variables. Firstly, we create dummy variables (*SMALLBANK*, and *LARGEBANK*; *MEDIUMBANK* is omitted) based on total assets. Secondly, we use each bank's market share (*MARKETSHARE*) computed as the ratio of the total assets of each bank to the total assets of the banking industry in the respective country.

(iii) To capture the *specialisation* of the banks we use dummy variables based on the classification of banks given in the BankScope database that distinguishes between bank holding companies (*S1*), commercial banks (*S2*), co-operative banks (*S3*), investment banks (*S4*), medium- and long-term credit banks (S5), real estate/mortgage banks (*S6*), savings banks (*S7*), and specialised governmental credit institutions (omitted dummy).

(iv) To control for the particular features of each country's banking industry and to explicitly account for cross-country differences regarding

general economic conditions and characteristics of the banking market we include four additional environmental variables. Firstly, income per capita (*GDPCAP*) defined as the ratio of the Gross Domestic Product to the number of inhabitants is intended to measure demand and supply for banking services (see also *Lozano-Vivas* et al. (2002)). Secondly, the degree of market concentration (*CONCENTRATION*) captures potential cross-country differences in the degree of competition and is calculated as the ratio of the assets of the largest five banks to the total assets of the banking industry in each country. Thirdly, in order to obtain additional insights into the potential relationship between efficiency and foreign ownership and to examine whether foreign ownership affects the way that banks are managed and therefore bank efficiency (see e. g. *Hasan/Marton* (2003); *Weill* (2003)) we include a variable *OWNERSHIP,* defined as the percentage of foreign owned assets out of total bank assets.[14] Finally, *TREND,* accounts for any other exogenous changes in environmental conditions over time.

The representation of our static model is thus:

$$
\begin{aligned}
XEFF_{st} = {} & \alpha + \beta_1 LLP_{st} + \beta_2 CAP_{st} + \beta_3 LTA_{st} + \beta_4 STDEVROA_s \\
& + \beta_5 SMALLBANK_{st} + \beta_6 LARGEBANK_{st} + \beta_7 MARKETSHARE_{st} \\
& + \beta_8 S1_s + \beta_9 S2_2 + \beta_{10} S3_s + \beta_{11} S4_s + \beta_{12} S5_s + \beta_{13} S6_s + \beta_{14} S7_s \\
& + \beta_{15} GDPCAP_t + \beta_{16} CONCENTRATION_t + \beta_{17} OWNERSHIP_t \\
& + \beta_{18} TREND_t \\
& + \varepsilon_{st}
\end{aligned} \tag{4}
$$

where ε_{st} stands for the error term and all the other variables are defined above.

4. Modelling the Management Behaviour

If the static analysis reveals a negative correlation between loan loss provisions and efficiency levels, it will be premature to conclude that this will be a sign of bad management in properly managing bank's risk exposure. Alternatively, the bad luck hypothesis could hide behind a correlation between efficiency scores and loan loss provisions, as problem loans may increase due to the presence of exogenous factors outside the control of the bank's management. A regional economic recession could affect the quality of customer loans and as a consequence entail higher

[14] Some other contributions find no statistical evidence to support a positive influence of foreign ownership on efficiency, see e. g. *Fries/Taci* (2005).

monitoring costs and extra expenses. The increase in operating cost would in turn dampen cost and profit efficiency levels.

In order to clarify the causality governing the relationship between problem loans, capitalization and efficiency, we therefore investigate the link between managerial behaviour and bank efficiency. Following *Berger/DeYoung* (1997) and *Williams* (2004) we address the question by linking managerial behaviour to bank efficiency levels. The causality in the relationship between management behaviour and efficiency can be analyzed by studying the inter-temporal relationships between the quality of banks' loan portfolios, their capitalization and their efficiency using a Granger causality approach.

Following the approach of *Berger/DeYoung* (1997), four different hypotheses concerning different kinds of management behaviour can be formulated:

a) The *bad management hypothesis* implies that bad managers do not adequately control for operating expenses and poorly manage their loan portfolio: low efficiency should cause an increase in problem loans.

b) The *skimping hypothesis* suggests that the quality of a bank's loan portfolio is determined by the costs associated with the monitoring of lending activities: higher levels of cost efficiency therefore cause higher levels of problem loans.

c) The *bad luck hypothesis* suggests that external factors increase problem loans which in turn cause a decline in cost efficiency as monitoring costs are increased in response.

d) The *moral hazard hypothesis* suggests that managers of weakly capitalized banks are less risk adverse and engage in risk taking behaviour. Therefore, low bank capitalization causes an increase in problem loans.

Each of these four hypotheses would of course also entail a different set of regulatory implications. Whereas the bad luck hypothesis would highlight the need for regulators to put an effort into insulating the banking system from external shocks, the bad management hypothesis as well as the skimping hypothesis would indicate that supervisors should focus their attention towards bank-internal credit-risk management systems. The moral hazard hypothesis would alternatively suggest a close monitoring of banks with comparatively low capitalization levels.

These hypotheses are captured in the following equations:

$$LLP_{st} = f_1(LLP_{s\,lag}, XEFF_{s\,lag}, CAP_{s\,lag}, LTA_{s\,lag}, Trend_t) + \varepsilon_{1st} \quad (5)$$

$$XEFf_{st} = f_2(LLP_{s\,lag}, XEFF_{s\,lag}, CAP_{s\,lag}, LTA_{s\,lag}, Trend_t) + \varepsilon_{2st} \quad (6)$$

$$CAP_{st} = f_3(LLp_{s\,lag}, XEFF_{s\,lag}, CAP_{s\,lag}, LTA_{s\,lag}, Trend_t) + \varepsilon_{3st} \quad (7)$$

The variables included in equations (5–7) have been all defined above. Following *Berger/DeYoung* (1997) and *Williams* (2004) we use the ratio of loan to total assets (*LTA)* to account for the banks' risk and a time trend (*Trend*) to capture changes in the macroeconomic environment, such as falling interest rates or regulatory changes emanating from European integration and financial deregulation in the CEE countries. Each dependent variable is regressed on its own lagged value and the lagged values of the independent variables.

Equation (5) tests the *bad management hypothesis* (we would expect a negative sign of the lagged *X*-efficiency variables), as well as the skimping hypothesis (we would expect a positive sign of the lagged *X*-efficiency variables). Equation (5) also tests the *moral hazard hypothesis* when only a sub-sample of low capitalized banks are used. In this case, a negative sign is expected between the bad loan and the lagged value of the capitalization variables (CAP).

Equation (6) tests the *bad luck hypothesis*: a negative relationship is expected between *X*-efficiency and the lagged values of problem loans.

As in *Berger/DeYoung* (1997) and *Williams* (2004) equation (7) is included to complete the model and to allow us to obtain further information on managerial behaviour.

IV. Empirical Findings and Discussion

The presentation of our empirical findings is split into three parts. First we present cost and profit efficiency estimates for our sample and we test whether efficiency levels significantly differ by country and over time. Secondly, we present our findings on possible determinants of efficiency. Finally, we report our results on the management behaviour of CEE-banks.

1. Cost and Profit Estimates

The FF stochastic cost and profit frontier estimates, on the overall sample are presented in the Appendix. As far as the cost function is concerned, all the output and input price coefficients are strongly signifi-

cant. The elasticity of production costs to the price of labour ($\beta_1 = 0.68$) is larger than the elasticity to the price of deposits ($\beta_2 = 0.15$) and to the price of capital ($1 - \beta_1 - \beta_2 = 0.17$, due to the linear homogeneity conditions imposed). This means that our sample of CEE banks can more easily control capital and deposit expenses than labour expenses when prices rise. Looking at the output coefficients, all the variables present the expected positive sign.

Concerning the profit function, again all the output and input price coefficients have the correct sign and the expected magnitude. The positive and significant coefficient for deposits means that more deposits imply more capital that can be transformed into loans (which raise profits); in particular deposits stemming from customers are usually cheaper than capital borrowed in interbank markets.

Before turning to a further analysis of bank (in)efficiencies, we first check the robustness of the results obtained from our cost and profit function SFA. As described in III.1, following the procedure laid down in *Bauer* et al. (1998) we compare the results based on SFA (eq. 3) to the results from the thick frontier approach (TFA) and the distribution free approach (DFA) by means of the Spearman rank correlation. Furthermore, we verify whether controlling for equity in the specification of our cost and profit functions alters our efficiency results (see Table 3).

Table 3: **Robustness Checks on Efficiency Results**

Cost Efficiency: Spearman Rank Correlations

	Efficiency estimates based on SFA, controlling for equity	Efficiency estimates based on DFA	Efficiency estimates based on TFA
Efficiency estimates based on SFA (eq. 3)	0.89*	0.93*	0.85*

Profit Efficiency: Spearman Rank Correlations

	Efficiency estimates based on SFA, controlling for equity	Efficiency estimates based on DFA	Efficiency estimates based on TFA
Efficiency estimates based on SFA (eq. 3)	0.83*	0.92*	0.92*

* indicates significance at the 1 percent level.

The consistency checks show that the efficiency results based on the SFA are robust. Both, DFA and TFA present highly significant positive rank correlations with the SFA results. Furthermore, the alternative specification, which includes equity capital in the cost and profit functions, shows high and significant rank correlations (0.89 for the cost efficiency and 0.83 for the profit efficiency) with our baseline specification (eq. 3), suggesting that this alternative specification would have a small impact on the ranking of efficiency scores. After having checked for robustness of our SFA cost and profit estimates, we compare the bank inefficiency scores across countries, as displayed in Table 4. In order to check whether the differences in the efficiency across countries are statistically significant we perform a test on the mean differences.

The evidence emerging from Table 4 can be summarized as follows:

(a) The banking systems of CEECs present, as expected, significant levels of cost and profit inefficiency, indicating that on average banks operate far above (below) the cost (profit) efficient frontiers.[15] Compared to studies available for banks in Western European countries and the U.S. (*Berger/Humphrey* (1997)), banks in CEECs display higher variation as well as comparably lower levels of efficiency (see *Weill* (2004)).

(b) Efficiency levels vary considerably across countries, as is revealed by inspecting the average efficiency scores by country. These differences in cost and profit efficiency levels are significant in almost all cases. As far as cost efficiency is concerned, values range from 0.58 (the Czech Republic) to 0.89 (Slovenia). For profit efficiency, values range from 0.29 (Romania) to 0.57 (the Czech Republic).

(c) Overall, the profit efficiency levels of the CEE banks are well below cost efficiency levels. This result is consistent with most other empirical papers estimating both cost and profit functions for the Western banking sectors (*Berger/Humphrey* (1997); *Maudos* et al. (2002)). The evidence suggests that the investigation of profit efficiencies provides important additional information on the banks' management which is not captured by cost efficiency analysis alone. The maximization of profit is reached not only by minimizing cost but also by maximizing revenues, and our results suggest that CEE banks seem to deal much better on the cost than on the revenue side. Their expertise in generating profits seems to be less developed than their ability to supply services in a cost-saving

[15] This evidence is obviously consistent with the positive value of the parameter μ in the FF cost and profit estimates presented in the Appendix.

Table 4: **Cost and Profit Efficiency Levels and Differences in Mean Scores by Country**

	CZ	EE	HU	LT	LV	PL	RO	SK	SI
Cost Efficiency 1995–2002	0.58 (0.19)	0.79 (0.10)	0.75 (0.17)	0.78 (0.09)	0.71 (0.15)	0.79 (0.16)	0.75 (0.14)	0.67 (0.19)	0.89 (0.07)
Profit Efficiency 1995–2002	0.57 (0.17)	0.41 (0.08)	0.33 (0.08)	0.38 (0.08)	0.45 (0.13)	0.38 (0.08)	0.29 (0.13)	0.47 (0.12)	0.37 (0.12)
					Cost efficiency				
CZ		–0.21* (–10.46)	–0.17* (–7.76)	–0.20* (–10.38)	–0.13* (–6.82)	–0.21* (–11.84)	–0.17* (–7.90)	–0.097* (–3.54)	–0.316* (–18.24)
EE			0.036*** (1.76)	0.010 (0.62)	0.074* (4.12)	–0.007 (–0.44)	0.041*** (2.14)	0.11* (4.45)	–0.10* (–7.18)
HU				–0.020 (–1.30)	0.038*** (1.88)	–0.04*** (–2.30)	0.005 (0.24)	0.078** (2.83)	–0.14* (–7.95)
LT					0.064* (3.83)	–0.017 (–1.20)	0.030*** (1.67)	0.010* (4.14)	–0.11* (–8.64)
LV						–0.08* (–5.20)	–0.033*** (–1.73)	0.039 (1.55)	–0.17* (–12.53)
PL							0.048** (2.77)	0.12* (4.99)	–0.097* (–8.13)
RO								0.073** (2.73)	–0.14* (–8.95)
SK									–0.21* (–9.31)

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Table 4: Continued

	CZ	EE	HU	LT	LV	PL	RO	SK	SI
					Profit efficiency				
CZ		0.16* (8.77)	0.23* (13.77)	0.18* (10.45)	0.11* (6.09)	0.18* (11.66)	0.27* (14.33)	0.095* (5.07)	0.20* (12.08)
EE			0.076* (5.72)	0.024*** (1.71)	–0.047* (–3.12)	0.023*** (2.04)	0.11* (7.24)	–0.066* (4.38)	0.039* (3.13)
HU				–0.052* (–4.22)	–0.12* (–8.98)	–0.005* (–5.55)	0.039** (2.65)	–0.14* (10.37)	–0.037* (–3.48)
LT					–0.071* (–4.96)	–0.000 (–0.53)	0.091* (6.03)	–0.09* (6.30)	0.01 (1.31)
LV						0.07* (5.92)	0.16* (10.01)	–0.019 (–1.23)	0.08* (6.69)
PL							0.092* (7.13)	–0.09* (–7.52)	0.015*** (1.89)
RO								–018* (–11.18)	–0.076* (–5.53)
SK									0.10 * (8.17)

In the first two rows of the Table we report the cost and profit efficiency levels by country over the period 1995–2002. Standard deviations are in parenthesis.
The remainder of the Table reports cross country tabulation between the differences in the mean efficiency levels. In parenthesis we report the value of the t-test computed as:

$$t = (\mu_1 - \mu_2)\sqrt{\frac{N_1 N_2 g}{N_1 + N_2}}\Big/\sqrt{(N_1 - 1)\sigma_1^2 + (N_2 - 1)\sigma_2^2}$$

where: $g = N_1 + N_2 - 2$ defines the degrees of freedom, μ_i is the mean of the i-th group, N_i is the number of observations in the i-th group and σ_i^2 is the variance of the i-th group. The null hypothesis is that the mean differences are equal to zero.

*, ** and *** indicate significance at the 1, 5 and 10 percent level respectively.

way. This may be caused inter alia by a decline in interest rates margins (lending minus deposits rates) which has been accelerated by the increasing competition between domestic and foreign owned banks (see also *Walko/Reininger* (2004)). Furthermore, given the potential reward for maintaining/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.

(d) Additionally, Table 4 shows that the profit efficiency ranking across countries is rather different from the cost efficiency ranking: countries that present fairly high cost efficiency scores seem to be performing less well in terms of profit efficiency, and *vice versa.*[16] This *negative correlation* between cost and profit efficiencies is supported by other empirical studies, such as those for US banks (see *Berger/Mester* (1997) and *Rogers* (1998)). As pointed out in *Maudos* et al. (2002) this may reflect the fact that banks with higher revenues have less competitive incentives to reduce cost inefficiency, or that the revenues of these banks benefit from a different output vector composition. If for example a bank produces an output vector of higher quality this could generate higher costs which in turn can result in biased cost efficiency scores. The profit function can capture productive specialization, allowing the higher revenues received by banks that produce different or higher quality outputs to compensate for the higher costs incurred (see *Maudos* et al. (2002)).

Looking at the evolution of efficiency we find a positive and significant increase over time of cost and profit efficiency for the overall sample of banks, equal to 6 per cent and 4 per cent respectively (Table 5).[17]

This trend is also consistent with results of *Weill* (2004) for a smaller sample of countries considering the period 1996–2000. Looking at the evolution of efficiency over time on a country by country basis we find that despite a generally increasing trend only in a small number of countries is the increase in efficiency statistically significant (see Table 6), suggesting that the evolution of bank efficiency was not homogenous across CEECs. Thus the overall increase in cost and profit efficiency is

[16] Support for this result comes from the Spearman and Kendall rank correlation tests which show that cost and profit efficiency are negatively correlated: both Spearman's rho (which is equal to –0.4084 significant at 1%) and Kendall's score (which is equal to –136654, significant at 1%) allow us to reject the *Ho* that the two variables are independent.

[17] A clear indication of this tendency is shown in the value of η, which is positive and significant in the estimate of the stochastic cost and profit functions (see Table in the Appendix).

Table 5

Cost and Profit Efficiency Levels by year

	Overall period	1995	1996	1997	1998	1999	2000	2001	2002	Increase 95–02	Mean test
Cost efficiency	0.75 (0.17)	0.71 (0.18)	0.73 (0.17)	0.73 (0.17)	0.74 (0.17)	0.74 (0.17)	0.75 (0.18)	0.76 (0.17)	0.77 (0.15)	+6%	0.061* $t = 2.59$
Profit efficiency	0.41 (0.13)	0.38 (0.14)	0.40 (0.13)	0.42 (0.13)	0.41 (0.13)	0.40 (0.14)	0.40 (0.13)	0.41 (0.13)	0.42 (0.14)	+4%	0.038** $t = 2.23$

Standard deviation in parenthesis. * and ** indicate significance at the 1 and 5 percent level respectively.

Table 6: **Evolution in Cost and Profit Efficiency by Country between 1995 and 2002**

	1995			2002			2002–1995	2002–1995	
	Number of banks	Mean	Standard Deviation	Number of banks	Mean	Standard Deviation	Change in %	Mean test	
Cost efficiency									
CZ	11	0.47	0.17	20	0.64	0.18	+17	0.173*	(2.81)
EE	9	0.78	0.11	6	0.8	0.1	+2	0.025	(–0.47)
HU	14	0.71	0.18	13	0.79	0.15	+8.7	0.087	(1.39)
LV	12	0.64	0.15	17	0.77	0.11	+13	0.134*	(2.63)
LT	4	0.75	0.06	9	0.79	0.09	+4.5	0.045	(1.07)
PL	25	0.78	0.19	30	0.82	0.13	+4	0.04	(0.91)
RO[a]	10	0.76	0.03	22	0.76	0.15	–1	–0.006	(–0.13)
SI	11	0.87	0.09	13	0.92	0.05	+4.4	0.04	(1.47)
SK	5	0.63	0.14	8	0.66	0.25	+3.5	0.035	(0.32)
Profit efficiency									
CZ	12	0.55	0.15	14	0.61	0.21	+5	0.054	(0.77)
EE	7	0.41	0.03	5	0.40	0.06	–1	–0.004	(–0.16)
HU	11	0.31	0.08	9	0.35	0.07	+3.4	0.034	(0.99)
LV	17	0.40	0.13	15	0.48	0.14	+8	0.080***	(1.63)
LT	7	0.33	0.07	9	0.41	0.08	+7.6	0.076**	(2.04)
PL	28	0.34	0.07	30	0.41	0.08	+7	0.066*	(3.25)
RO[a]	12	0.27	0.04	23	0.33	0.13	+5.6	0.056	(1.19)
SI	13	0.34	0.05	12	0.38	0.04	+4	0.04**	(2.26)
SK	9	0.47	0.16	14	0.47	0.11	0	0.00	(-0.06)

[a] Results for Romania are based on observations from the period 1998–2002, due to the limited number of observation for the years 1995, 1996, 1997.
t-statistics are in parenthesis. *, ** and *** indicate significance at the 1, 5 and 10 percent level respectively.

Table 7

Share of Loan Loss Provisions as Percent of Total Loans

	CZ	EE	HU	LT	LV	PL	RO	SI	SK
1995	14.7	2.3	12.1	18.5	19.3	13.7	10.6	12.0	17.2
1996	14.5	2.2	5.6	21.7	16.4	9.0	20.0	12.5	22.4
1997	13.6	2.0	5.9	13.2	8.3	6.0	1.0	9.4	22.7
1998	14.8	5.1	6.9	6.7	6.1	5.3	13.9	8.9	25.6
1999	14.2	3.6	3.9	4.5	5.9	6.7	9.9	8.0	16.7
2000	12.2	3.2	3.9	4.6	3.8	8.9	7.3	9.0	21.4
2001	10.9	2.4	4.3	3.4	2.5	12.6	6.8	11.7	16.4
2002	7.6	1.6	4.5	1.7	2.1	15.9	3.7	10.8	14.8
Average	12.8	2.8	5.9	9.3	8.1	9.8	9.2	10.3	19.7

Data expressed in percent.
Source: Bankscope.

mostly driven by a few countries. From the cost efficiency viewpoint, only the Czech Republic and Latvia present a large and statistically significant increase in efficiency[18]. From the profit side the trend is significant only for Latvia, Lithuania, Poland and Slovakia.

The generally low level of efficiency as well as the significant differences in cost and profit efficiency across countries and over time raises the question of which type of management behaviour could be responsible for bank performance in the emerging market of CEE. A way to look at this is to focus on the quality of a bank's loan portfolio and the role of the loan loss provision in explaining the efficiency scores. Table 7 shows the ratio of loan loss provisions to total loans (proxy for non-performing loans) for our sample of CEE banks. Comparing the average cost efficiency scores in Tables 4 and 5 with the figures in Table 7, we find some results of interest. For instance in all countries the decreasing burden of non-performing loans (Table 7) – which may be signal for improvement in managerial quality – is consistent with the increasing efficiency levels over time. Furthermore the two countries that offered the worst performance in terms of cost efficiency, the Czech Republic and Slovakia, both

[18] This result is consistent with evidence provided by *Weill* (2004), who found a positive and significant increase in cost efficiency for the Czech Republic and Latvia over the period 1996–2000. The results for the Czech Republic, which began the period at the lowest level on the ranking, could be the result of the process of privatization and improvement in governance as also pointed out by *Weill* (2004).

have a high burden of non performing loans affecting the quality of bank's loan portfolios. On the other hand, Slovenia, Estonia and Lithuania, which are the leading countries in terms of cost efficiency, present relatively low levels of loan loss provisions, which may be the result of better management behaviour due to the fact that these banking sectors – with the exception of Slovenia which is characterized by the dominance of state-owned banks and a comparatively low market share of foreign-owned institutions – are highly concentrated and largely in foreign hands (*ECB* (2004)).

2. Possible Determinants of Cost and Profit Efficiency

In exploring the rationale behind the results presented in section IV.1 we first attempt to explain the cost/profit efficiency level for banks in CEECs by using the specification in equation (4). The dependent variable (X-EFF) of the two specifications are respectively the level of cost and profit efficiency, obtained from the cost and profit stochastic Fourier functions. As described above we focus on the potential impact of the management, of the asset quality and of the capitalization of banks on cost and profit bank efficiency. At the same time we control for environmental conditions and general bank characteristics along the lines of the arguments provided in sections III.2 and III.3. The results of our regressions are presented in Table 8.

The estimates provide a first insight into the managerial hypotheses we would like to test later on. Our results show a negative, albeit small, relationship between loan loss provisions *LLP* (as a proxy for problem loans) and the cost efficiency level, indicating that higher problem loans are connected with lower efficiency levels.[19] This may be an indication that bad management or bad luck explain these results. On the profit side we do not find a significant impact of the variable LLP on profit efficiency. In order to clarify the nature of these relationships we perform a test based on the Granger causality analysis in the next section.

The positive correlation between the ratio of equity to total assets (*CAP*) and cost efficiency is also consistent with our expectations, sug-

[19] This evidence is supported by Spearman's and Kendall's correlation tests. Spearman's rho (which is equal to –0.0195 significant at 1%) and Kendall's score (which is equal to –5882, significant at 1%) allow us to reject the H_0 that cost and problem loans are independent, with the negative signs indicating that the two variables are negatively correlated.

Table 8

Determinants of Cost and Profit Inefficiency for CEECs Banks

Variables	Dependent variable: Cost efficiency		Dependent variable: Profit efficiency	
	Coefficient	*p*-Value	Coefficient	*p*-Value
LLP	–0.000026*	0.008	0.0000009	0.181
CAP	0.0141**	0.046	0.0008**	0.054
LTA	0.0076**	0.044	–0.00002	0.955
STDEVROA	–0.0811	0.382	–0.0732	0.224
SMALLBANK	–0.0007	0.724	0.0002	0.110
LARGEBANK	–0.0005	0.817	–0.00003	0.864
MARKETSHARE	0.0300**	0.052	0.0009	0.422
*S*1	0.4041*	0.003	–0.0146	0.885
*S*2	0.3723*	0.000	0.0525	0.440
*S*3	0.2467**	0.043	0.1542***	0.082
*S*4	0.5347*	0.006	0.0842	0.564
*S*5	0.4823*	0.012	0.0398	0.785
*S*6	0.2737	0.157	0.3129*	0.006
*S*7	0.4157*	0.000	–0.0558	0.504
GDPCAP	–0.0005***	0.101	0.00007*	0.010
CONCENTRATION	–0.0106	0.229	–0.0005	0.413
OWNERSHIP	-0.0012*	0.001	0.0015*	0.000
TREND	0.0110*	0.000	0.0043*	0.000
Constant	0.4172*	0.000	0.2127*	0.002
Overall R^2	0.14		0.13	
Obs.	995		1103	
N. of Banks	232		247	

The Table reports the estimates and p-Values of a random effects GLS regression. The dependent variables cost and profit efficiency are derived from the Fourier cost and profit SFA estimations. *, ** and *** indicate significance at the 1, 5 and 10 percent level respectively.

gesting that banks that are well capitalized have more room for absorbing losses originating from their loan exposures. The coefficient on CAP turns out to be positive and significant also in the profit efficiency estimation. Managerial prudence in terms of a higher level of capitalisation is thus positively related to earnings and profit efficiency (see *Berger* (1995) or *Mester* (1996)). This may be a sign of less moral hazard behaviour as banks aim at higher expected returns by increasing their risk appetite only if they have enough of a financial cushion to absorb potential losses (see *Berger/DeYoung* (1997) and *Williams* (2004)).

Considering our additional control variables accounting for banks' different levels of risk we do not find a significant impact of the standard deviation of banks' return on assets (*STDEVROA*) on efficiency. The coefficient of the ratio of loans to totals assets (*LTA*), however, is positive and highly significant in the cost efficiency estimation suggesting that banks with loan-intensive balance sheets are more cost efficient. This result may be explained by relationship lending practices in the respective countries (see also *Williams* (2004)). If banks know their customers very well and if consequently the quality of information about their customers and general market conditions is very high, banks will be able to avoid the additional operating costs for monitoring bad debt, negotiating possible workout arrangements, and seizing and disposing of collateral (see *Berger/DeYoung* (1997)).

Concerning our results for the control variables capturing further bank characteristics we find that a bank's market share (*marketshare*), which is a measure of bank's size, has a positive effect on cost efficiency. This suggests that large banks better control their costs as they can exploit scale economies more easily. For our dichotomous size indicators we observe that all the dummy variables are insignificant as the size effect seems to be fully captured by the market share variable.[20] Regarding the dummies capturing banks' specialisation Table 8 reveals that the coefficients are mostly positive. Furthermore, the variable *specialization* turns out to be significant using a joint *F*-test in the case of cost efficiency, but it does not appear relevant in an analysis of profit efficiency (only S3 is significantly positive). As the coefficients for these dummies show the

[20] In order to check for multicollinearity between marketshare, size and concentration we firstly looked at the correlation matrix for these variables. Secondly, we re-estimated equation (4) leaving out one or some of these variables. The correlation matrix and the robustness checks allow us to exclude the presence of multicollinearity between the variables. Results are available from the authors upon request.

differences in efficiencies relative to specialised governmental credit institutions (for which the dummy was omitted) we may conclude that privatized banks seem to be more efficient than state owned ones (see *Micco* et al. (2007)).

Finally we observe that all our environmental factors except the degree of concentration (*CONCENTRATION)* have a systematic and significant impact on efficiency. First of all, we find a negative relation between cost efficiency and GDP per capita (*GDPCAP*) – which is a proxy for the demand and supply of banking services – and a positive correlation of *GDPCAP* with profit efficiency. This evidence indicates that banks operating in expanding markets present higher level of revenues and ultimately profit efficiency while at the same time feeling less pressure to control their costs (see also *Maudos* et al. (2002), who obtain similar results for Western European banks). Regarding the impact of foreign bank penetration (*OWNERSHIP*) on efficiency we observe a negative correlation between foreign owned bank assets and cost efficiency and a positive and significant correlation with profit efficiency. This evidence could reflect the fact that foreign owned banks may face higher costs, since they provide different and higher quality outputs (see also *Maudos* et al. (2002)) which may require capital and technology intensity, which may in turn lead to a negative impact of foreign owned bank assets on cost efficiency. On the other hand, higher quality outputs may increase market power in pricing thus generating higher profit efficiency for foreign owned banks. Finally the variable trend is positive and strongly significant in both the cost and profit specification. This is in line with the results of the previous section where we found increasing efficiency over time.

To sum up we conclude that the high variation in efficiency we observe can to some extent be explained by bank features, market characteristics and general environmental conditions. The correlation we found between bad loans and cost efficiency doesn't entitle us yet to give any conclusion on the causality between efficiency and managerial behaviour. It only opens up a crucial question: is this negative correlation a sign of bad management or bad luck? In order to address this issue we examine the managerial behaviour hypotheses using Granger causality tests.

3. Management Behaviour Results

In this section we present the results of our tests to verify whether the correlation across cost efficiency, asset quality and capitalization detected in the previous section could be due to management behaviour. We employ the model proposed by *Berger/DeYoung* (1997) and used in *Williams* (2004) based on a Granger causality approach for testing the different management hypotheses (see equations 5–7). The three equations of the model were estimated separately using the Arellano-Bond dynamic panel data model. We chose a specification using three lags for both dependent and explanatory variables which is supported by *F*-tests. In contrast to what we could have expected from the ownership literature, which suggests that a lack of owner control in publicly owned banks may lower the incentive to be efficient, we find no evidence in favour of the bad management hypothesis in CEE-banks. This is true both for the cost efficiency and profit efficiency specification.

Moreover, we also estimate the model on two different sub-samples one containing banks with few foreign owned assets and the other one with many foreign owned assets to verify whether the bad management hypothesis leads to different results for these subgroups: once again, our results do not support any behavioural management hypothesis.

We also find no evidence for the *skimping hypothesis* or for the *moral hazard hypothesis*. The *skimping hypothesis* would have implied a positive association between loan loss provision and *X*-efficiency in equation (5). The *moral hazard* hypothesis is examined by running equation (5) on a sub-sample of well capitalized and a sub-sample of thinly capitalized banks to investigate whether banks with different capitalization react differently to the change in problem loans. In the case of thinly capitalized banks, we would have expected a negative relation between loan loss provision and the lagged value of the variable accounting for the capitalization of the bank (*CAP*) if the moral hazard hypothesis held.

The only hypothesis that is supported by our analysis, both for cost and profit efficiency, is the bad luck hypothesis. This is the case since only equation (6) results in significant coefficients of the expected sign. In Table 9 we present the results of the dynamic Arellano Bond estimates of equation (6)[21]. In the case of the model using profit efficiency as the

[21] For the sake of brevity we chose to present the estimation output only for equation (6) where we find significant results. The remaining estimates of the model are available from the authors upon request.

Table 9

Granger Causality Test for the Cost and Profit Efficiency Equation (6): Bad Luck Hypothesis

	Dependent variable: Cost Efficiency		Dependent variable: Profit Efficiency	
	Coefficient	*p*-Value	Coefficient	*p*-Value
$X\text{-}EFF_{t-1}$	1.936011*	0.000	1.98921900*	0.000
$X\text{-}EFF_{t-2}$	–0.939033*	0.000	–0.98955430*	0.000
$X\text{-}EFF_{t-3}$	Dropped		Dropped	
$X\text{-}EFF_{TOT}$	0.996978*	0.000	0.99966470*	0.000
LLP_{t-1}	–0.000014**	0.044	–0.00000011**	0.025
LLP_{t-2}	–0.000019*	0.001	–0.00000010**	0.031
LLP_{t-3}	–0.000008*	0.014	–0.00000002	0.276
LLP_{TOT}	**–0.000041***	**0.000**	**–0.00000022***	**0.001**
CAP_{t-1}	–0.000011	0.236	–0.00000005	0.552
CAP_{t-2}	0.000001	0.818	–0.00000005	0.429
CAP_{t-3}	–0.000005	0.504	–0.00000008	0.157
CAP_{TOT}	–0.000015	0.267	–0.00000017	0.132
LTA_{t-1}	0.000016***	0.088	0.00000007	0.233
LTA_{t-2}	0.000004	0.436	0.00000000	0.918
LTA_{t-3}	0.000007***	0.067	0.00000000	0.825
LTA_{TOT}	0.000028**	0.017	0.00000008	0.288
trend	0.000012*	0.000	0.00000084*	0.000
N. of obs	365		348	
N. of banks	124		118	

The table reports the Arellano Bond dynamic estimates of equation (6). Estimates are robust to the autocorrelation test conducted on the robust estimator of the variance-covariance matrix of the parameter estimates.

*, ** and *** indicate significance at the 1, 5 and 10 percent level respectively.

The profit efficiency results are obtained cutting at the 1% and 99% quantile in the data because of the presence of outliers.

dependent variable the results presented are obtained after a cut of efficiency at the 1% and 99% quantiles to remove disturbing effects of a couple of outliers. We report the three lagged coefficients of the dependent and independent variables and their respective sum. The fact that the sum of the lagged coefficients of loan loss provisions (*LLP*) turns out to be negative and significant (albeit the effect is small) is an indication for the presence of the bad luck hypothesis: unexpected and external factors increase loan loss provisions, which reduce cost and profit efficiency.

The results also indicate that the lagged values of the dependent variables have a comparatively high impact on efficiency, suggesting that cost and profit efficiency today is affected by efficiency in the past. The remaining coefficients including those for the loan loss provisions take on relatively small values, particularly in the analysis of profit efficiency.

Regarding the coefficients on the other variables, *CAP* and *LTA,* we find that the overall effect of the ratio of loans to total assets (*LTA*) is again positive and significant in the cost efficiency analysis. The influence of *CAP* on efficiency that we found in the static analysis vanishes in the dynamic model. The differences in the significance of *CAP* between the static model and the Granger causality model could hinge upon the autoregressive nature of the efficiency process in the dynamic specification which may to some extent already capture cross section specifics such as capitalization.

Finally, the coefficients on the trend terms are again positive and significant indicating the increase in efficiency over time as already discussed.

As a final robustness check we re-estimate the Granger causality model including all the additional covariates capturing bank specifics and further environmental conditions of equation (4) with the intention of controlling for other external factors that could affect the results. The inclusion of these variables in the model does not change the results: with the results again supporting the bad luck hypothesis.[22]

One reason why our evidence on management behaviour as the cause of the poor performance of CEECs banks is scarce may be due to the sample size, which obviously decreases with the number of lags used in the estimations, as well as other data limitations of the Bankscope database for these countries. For instance we had to use loan loss provisions – instead of bad loans – which retain elements of endogeneity since they

[22] Results of this analysis are available from the authors upon request.

could be controlled by the bank's management (see also *William* (2004)). In this respect, further investigation would be necessary to corroborate our evidence.

In terms of regulatory policy implications the evidence for the bad luck hypothesis is a signal that bank inefficiency and failures in these markets are inter alia associated with external shocks beyond the control of management. Although there is a general trend in terms of improving efficiency scores across the region, regulatory and supervisory rules should therefore focus on reducing banks' exposure to these unforeseen events. This could for instance be done by increasing the diversification of loan portfolios through limits on loan concentration or by promoting mergers with foreign institutions. In this regard macroeconomic-stress testing exercises, assessing the impact of macroeconomic shocks on the quality of banks' loan books (see e. g. *Blaschke* et al. (2001)) could help spot the most vulnerable points in CEE banking systems. Stress testing can for example give insights into the differing size of the impact of exogenous shocks on individual banks and thus provide an indication of priorities for both regulators and bank management. Higher capitalization requirements are another way to increase banks' shock absorption capacity thereby better insulating them from unfavourable external shocks. A special emphasis should be put on the need for CEE banks to keep up in the development of risk management systems as they expand their loan portfolios. Without such responses changes in external market conditions could prove harmful to banks that have merely focused on growth targets and neglected controlling their rising risk exposure. All these efforts to insulate the banking system *vis à vis* external shocks should however not neglect the beneficial effect that comes from reducing slack and increasing banking efficiency levels in these countries. As our results show, banks in CEE, despite the progress made during the observation period, still face a challenge in this regard.

To conclude, the particularities of the observation period should also be borne in mind when interpreting our results. The period from 1995 to 2002 was by and large a time frame of rapid transition both in terms of privatization as well as in terms of foreign bank entry. Whereas our results give new insights into the management behaviour in CEE-banks during the transition period, new bank management paradigms may emerge as these markets mature. This aspect will certainly merit the attention of future research, as more and more data becomes available.

V. Conclusions

This paper investigates the cost and profit efficiency of banks in CEECs over the period 1995 to 2002 and tests using data on risk and asset quality whether managerial behaviour can help explain banking efficiency levels.

Not surprisingly, our findings, based on the FF stochastic cost and profit functions, show a generally low level of cost and profit efficiency for banks in the CEECs. Conversely, the results also reveal a significant tendency for (both cost and profit) efficiency to increase over time, although this trend is not equally spread across countries. We furthermore found large and significant differences in efficiency levels in different countries. Our results also indicate that banks in the former accession countries seem to be more efficient in controlling costs than in generating profits.

We also provide an insight into the determinants of *X*-efficiency levels in CEE-markets. In explaining cost efficiency we attempt to verify if the management of the asset quality and the risk of the bank can explain the cost and profit performance. The evidence provided by our static analysis suggests a negative correlation between cost efficiency and bad loans. When we look at the managerial behaviour hidden behind this negative correlation, we find no evidence for the bad management hypothesis explaining the relationship between efficiency and loan quality. By using the Granger causality approach we only find evidence for the bad luck hypothesis, i. e. that the exogeneity of bad loans is triggering inefficiency.

The fact that our data support the bad luck hypothesis suggests that high levels of problem loans (generated by external factors, such as environmental conditions, an adverse business cycle, etc.) cause a decrease in the level of cost efficiency, as costs of monitoring and other related expenses (e. g. a more prudent administration of the performing loans) increase with higher provisioning for bad loans. With all the caveats of our empirical investigation, our results indicate that the low level of efficiency recorded in the CEECs could therefore be partially ascribed to external factors beyond managers' control. This conclusion suggests that for these countries the target should be to reduce the exposure of banks to external shocks. Foreign bank penetration and loan diversification may help lower the risk of financial crises by reducing the potential negative effects deriving from the adverse business cycle. Foreign strategic capital may also strengthen the banking system and improve the level of

financial intermediation. Moreover, foreign bank penetration may help increase competition and international integration which may be beneficial by stabilizing the credit base for these countries. The effect of having joined the European Union will be crucial for these countries which can benefit from a more competitive and stable market and a more favourable macroeconomic environment. Given the data restrictions faced in the analysis of CEE-banks as well as our period of investigation which has been marked by a fast process of transition in CEE-banking sectors, a number of aspects could be addressed by future research. Future research on bank managerial behaviour in these countries should be able to take advantage of better data quality on bank risk arising from the introduction of the Basel II accord and common reporting standards (IFRS) for these countries. Furthermore, it should be verified, once a long enough time series exists, whether improvements in banking efficiency were a lasting development and whether the dynamics of banks' managerial behaviour has changed since EU membership.

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Appendix

Cost and Profit Fourier Function Estimates – CEE banks

Variables	Cost function		Profit function	
	Ln(*TC*)		Ln(*TP*)	
	Coefficient	*p*-value	Coefficient	*p*-value
Ln y_1 *(loans)*	0.19*	0.000	0.12**	0.023
Ln y_2 *(deposits)*	0.36*	0.000	0.10**	0.032
Ln y_3 *(other earning assets)*	0.21*	0.000	0.14*	0.000
Ln p_1 *(labour price)*	0.68*	0.000	0.55*	0.000
Ln p_2 *(deposits price)*	0.15*	0.001	0.20*	0.000
Ln y_1^2	0.08*	0.000	0.05*	0.000
Ln y_2^2	0.16*	0.000	0.06*	0.000
Ln y_3^2	0.01*	0.000	0.02**	0.025
Ln p_1^2	0.11*	0.000	0.01	0.473
Ln p_2^2	0.14*	0.000	0.01	0.433
Ln y_1y_2	–0.07*	0.000	–0.06*	0.000
Ln y_1y_3	0.03*	0.004	0.01	0.572
Ln y_2y_3	–0.06*	0.000	–0.02*	0.008
Ln p_1p_2	–0.11*	0.000	0.00	0.551
Ln y_1p_1	0.02	0.161	0.01	0.317
Ln y_2p_1	–0.07*	0.000	–0.04*	0.014
Ln y_3p_1	0.01	0.803	0.04*	0.000
Ln y_1p_2	–0.03**	0.033	0.01	0.989
Ln y_2p_2	0.11***	0.000	0.03**	0.033
Ln y_3p_2	–0.03**	0.051	–0.03*	0.003

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Continued

Variables	Cost function		Profit function	
	Ln(*TC*)		Ln(*TP*)	
	Coefficient	*p*-value	Coefficient	*p*-value
$\sin y_1y_2$	0.01	0.152	0.00	0.801
$\sin y_1y_3$	0.01	0.300	0.01	0.604
$\cos y_1y_3$	0.00	0.723	0.00	0.457
difsin y_1y_2	–0.01	0.449	0.00	0.894
difcos y_1y_2	0.01	0.554	–0.01	0.766
difcos y_1y_3	–0.02***	0.078	0.01	0.666
$\sin p_1p_2$	–0.08	0.164	–0.04	0.360
$\cos p_1p_2$	–0.08	0.123	–0.03	0.692
difsin p_1p_2	–0.08***	0.062	0.02	0.615
difcos p_1p_2	–0.06	0.206	0.04	0.302
Constant	2.35*	0.000	10.38*	0.000
μ	0.84*	0.000	0.92*	0.000
η	0.05*	0.000	0.02*	0.007
γ	0.99	(0.000)	0.75	(0.026)
σ^2	142.48	(0.48)	0.19	(0.017)
σ_u^2	142.42	(0.48)	0.14	(0.017)
σ_y^2	0.05	(0.002)	0.05	(0.002)
Obs.	1070		1105	
Number of banks	250		241	

The Table reports the magnitude and the *p*-values of the Maximum Likelihood estimates (eq. 3) based on the Davidon-Fletcher-Powell Quasi-Newton algorithm, using the *Battese/Coelli* (1992) model.

In parenthesis we report the standard deviation. The prefix "Ln" stands for the natural logarithm; sum and dif, respectively, represent the sum and difference between trigonometric operators. Total cost, price of labour (p_1), and price of deposits (p_2) are normalized to the price of capital. Mixed products and squares of inputs and outputs represent the second order terms of the flexible form.

μ is the mean of the truncation at zero of a normal density function;

$\gamma = \sigma_u^2/\sigma^2$;

*, ** and *** indicate significance at the 1, 5 and 10 percent level respectively.

Summary

Linking Managerial Behaviour to Cost and Profit Efficiency in the Banking Sectors of Central and Eastern European Countries

This paper analyzes cost and profit efficiency as well as the managerial behaviour of banks in nine Central and Eastern European countries, providing cross-country and time-series evidence on the run up period to EU accession from 1995 to 2002. A stochastic frontier analysis based on a Fourier flexible form indicates a generally low level of cost and profit efficiency. We also observe an increasing tendency over time in cost and profit efficiency, with significant differences among countries. Apart from looking at the determinants of cost and profit efficiency (e.g. asset quality, problem loans, risk, and environmental factors), we test several hypotheses on banks' managerial behaviour using a Granger causality approach. Even though a static analysis shows a negative correlation between problem loans and efficiency, we find no evidence supporting the bad management hypothesis according to which inefficiency triggers a decrease in asset quality. On the contrary results provide evidence for the bad luck hypothesis suggesting that the exogeneity of bad loans causes inefficiency. (JEL G21, G28, C14, D21)

Zusammenfassung

Der Zusammenhang zwischen Managementverhalten und Kosten- sowie Gewinneffizienz in den Banksektoren von zentral- und ost-europäischen Ländern

Diese Arbeit untersucht die Kosten- und Gewinneffizienz sowie das Managementverhalten von Banken in neun zentral- und osteuropäischen Ländern. Diesbezüglich wird länderübergreifende empirische Evidenz für die Periode von 1995 bis 2002 im Vorfeld des EU-Beitritts dieser Staaten präsentiert. Eine Analyse basierend auf dem „Stochastic Frontier Approach" unter Verwendung einer „Fourier Flexible Form" deutet auf ein im Allgemeinen niedriges Niveau der Kosten- und Gewinneffizienz hin. Im Zeitverlauf lässt sich ein Anstieg von Kosten- und Gewinneffizienz erkennen, wobei signifikante Unterschiede zwischen den Ländern offenbar werden. Ergänzend zu einer Analyse der Einflussfaktoren auf Kosten- und Gewinneffizienz (z.B. die Qualität der Aktiva, das Volumen von Problemkrediten, die Risikoneigung der Bank sowie allgemeine Umweltfaktoren) werden mehrere Hypothesen in Bezug auf das Managementverhalten der Banken basierend auf einem Granger-Kausalitätsansatz getestet. Obwohl eine statische Analyse eine negative Korrelation zwischen Problemkrediten und Bankeneffizienz offenbart, muss die Hypothese, dass dies auf schlechtes Management zurückzuführen ist, verworfen werden. Vielmehr unterstützen die Ergebnisse die sogenannte „bad-luck"-Hypothese, gemäß der die durch exogene Einflüsse verschlechterte Kreditqualität Ineffizienz verursacht.