DETERIORATING COST EFFICIENCY IN A BANK SIGNALS THE RISK OF FAILURE[208]

The banking sector is a dominant component of the financial system in the Czech Republic. The stability of the banking system is of key importance as regards the financial stability of the economy as a whole. Any turbulence in the banking system can, moreover, generate a need for additional fiscal expenses in this area. For these reasons it is important to analyse banking sector developments in more detail and to attempt to enhance the early warning system toolkit – bank ratings, in order to prevent bank failures more effectively.[209]

The transition from a centrally planned economy to a market oriented system has been a complex and challenging process entailing a series of social and economic changes. The impacts of the economic transition in Central and Eastern Europe have affected the region's banking systems, which have been through turbulent times marked by frequent bank failures. The Czech banking market also experienced such turbulence, especially in the 1990s. During 1993–2003, a total of 21 banks closed down, which represents almost half of the banks then registered in the Czech banking system. As the bank failures were distributed gradually over time and new banks kept on entering the market, the stability of the overall banking sector remained largely unaffected. The total assets of the banking sector were little affected by the impact of the failing banks,[210] since the exits from the system mainly concerned the segment of small banks. Table 1 provides an overview of the developments in the banking sector.

TAB. 1 – Banking sector developments

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Entries*	–	1	3	–	2	–	–	–	–	–
Exits – official year of failure**	1	2	3	5	3	3	2	–	–	2
Mergers	–	–	–	–	2	–	1	1	1	–
Banks in system at start of year	48	47	46	46	41	38	35	32	31	30
Banks excluded (incomplete data)	5	1	3	4	2	1	–	1	–	2
Of which: due to entry/exit during year	–	–	1	4	2	–	–	–	–	2
No. of banks in analysis	42	45	43	37	36	34	32	30	30	28
Banking sector assets (109, 1994 prices)	1.27	1.38	1.45	1.44	1.15	1.36	1.22	1.35	1.46	1.57

Note: * GE Capital Bank's entry in 1998 was effected by its purchase of part of Agrobanka
** licence withdrawal, conservatorship or liquidation.

In the literature, bank management is assigned particular significance for the successful functioning of banks. In current practice, the assessment of a bank's management is a result of *ad hoc* processing of information available to the analyst and hence shows considerable subjectivity. Consequently, this element remains largely neglected in the current rating systems (CAMELS, ORAP, etc.).[211] This article sets out to describe a potentially usable concept of cost efficiency for more objective measurement of banks' management quality and demonstrates that this indicator is a good indicator of bank failure.

Bank cost efficiency measures the efficiency of banks relative to the most efficient bank determined on the basis of a model. This concept focuses on the management of operating costs (wages, physical capital and borrowed funds) of producing the same output (of loans and deposits). However, it also includes allocative efficiency, i.e. it also assesses the optimum mix of inputs and outputs.[212]

The data used were taken from the bank report filing system. Deposits and total loans net of loss loans were considered as the outputs. Deposits are represented by the quarterly average of the Czech koruna value of client deposits denominated in all currencies at 1994 constant prices. Total loans net of loss loans comprise the quarterly average of the Czech koruna value of loans at 1994 constant prices denominated in all currencies granted to both resident and non-resident clients, loans to government, loans to and deposits with the central bank and loans to and deposits with other financial institutions. Total loans were adjusted for loss loans.

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209 For the purposes of this paper, the terms "collapse" and "failure" denote a bank's exit from the system.

210 The development of banking sector assets is additionally influenced by numerous other factors, such as the business cycle, methodological changes etc.

211 CAMELS is a composite rating consisting of C-capital, A-asset quality, M-management, E-earnings, L-liquidity and S-market risk. ORAP stands for the Organization and Reinforcement of Preventive Action. For more information on the systems, see, for example, Sahajwala and Bergh (2000).

212 For more details on the measurement of cost efficiency in banks, see, for example, Berger and Humphrey (1997).

The prices of labour, physical capital and borrowed capital were considered as the input prices. The price of labour was calculated as the unit price of labour, i.e. the quarterly average of the total expenses for employees divided by the end-of-quarter number of employees. The price of physical capital was calculated as the quarterly average of expenses for rents, leases, amortisation and materials divided by fixed assets. And finally, the price of borrowed capital is the quarterly average of interest expenses on capital borrowed from the government, central bank, other banks and clients and on securities issued per unit of such capital.

The study focuses on the hypothesis of whether banks that show the lowest cost efficiency (i.e. the worst cost management) fail. In order to assess relative cost efficiency (to estimate the cost frontier function) we use three stochastic parametric methods: the Stochastic Frontier Approach (SFA), the Fixed Effects Model (FEM) and the Random Effects Model (REM).[213]

The cost frontier function is estimated using the translog function. The function is the most commonly estimated one in the literature due to its sufficiently flexible functional form (Taylor expansion around the mean), which has proven an effective tool for empirical analysis of cost efficiency:

$$ln TC_i = \alpha_0 + \sum_{j}^{l} \beta_j \ln Y_j + \frac{1}{2}\sum_{j}^{2}\sum_{k}^{2} \beta_{jk} \ln Y_j Y_k + \sum_{m}^{3} \gamma_m \ln w_m + \frac{1}{2}\sum_{m}^{3}\sum_{n}^{3} \gamma_{mn} \ln w_m w_n + \sum_{j}^{2}\sum_{m}^{3} \rho_{jm} \ln Y_j \ln w_m + v_i \quad (1)$$

where v_i represents composite noise and TC denotes total operating costs, i.e. the sum of expenditures incurred for labour, physical capital and borrowed funds. The vector of input prices, i.e. wages, price of physical capital and price of borrowed funds, is denoted by w. Y is the vector of outputs, comprising deposits and total loans net of bad loans.

The essence of the stochastic frontier approach to cost efficiency is the hypothesis that banks incur cost shocks that may be both positive and negative, hence are symmetrically distributed. However, in addition to such fluctuations in costs, banks show differences in cost management efficiency. These systematic differences represent a measure of cost management inefficiency relative to the most efficient bank. The different methods of identification of this systematic difference in costs have some conceptual differences, so the analysis uses all three methods, including a comparison of their results. The methods are applied to yearly panels of quarterly data for all banks operating in each year of the banking system transformation period 1994–2003.

Estimates of the mean cost efficiencies in three-year periods in the Czech banking sector are set out in Table 2 below. The data in the table express the percentage of expenses that the most efficient bank would need to achieve the output of the average bank. An increase (decline) in the average over time indicates improving (deteriorating) cost management in the banking sector, as it means the average bank has reduced (increased) its lag behind the bank with the highest quality cost management.

Tab. 2 – Statistics of estimates of cost efficiency

		1994–1996	1997–1999	2000–2002
Stochastic frontier approach	Avg.	0.47	0.43	0.56
	S.D.	0.14	0.18	0.14
	Min	0.18	0.21	0.32
Random effects model	Avg.	0.61	0.47	0.57
	S.D.	0.13	0.17	0.14
	Min	0.29	0.24	0.34
Fixed effects model	Avg.	0.39	0.37	0.44
	S.D.	0.15	0.19	0.18
	Min	0.15	0.09	0.19
Sample of banks	Number	45	37	32

213 These methods are described in detail in Bauer *et al.* (1998).

As the table shows, all three methods indicate a decline in the mean cost efficiency of the banking system over the period 1997–1999 and a renewed increase in the following years. The improved cost management was partly due to the collapse of inefficient banks and partly to other factors (consolidation of the banking sector, privatisation of state-owned banks, new managements in many banks introducing international know-how leading to improved efficiency, the introduction and refinement of automated control systems, etc.).[214]

An analysis of failing banks in the cost efficiency rank-order reveals that two years prior to failure, 56% of these banks were in the bottom cost efficiency quartile and 23% of them were in the second worst quartile. One year prior to failure, however, 83% of the banks that went on to fail were located in the bottom cost efficiency quartile. The observation supports the idea that cost efficiency may be an important indicator of bank failure.[215] In order to test the statistical significance of the relationship between cost efficiency and failure risk, the Cox proportional hazards model was used.

The data structure allows us to study jointly the risk of failure and the time to failure. The Cox proportional hazards model, applied to describe the process of joint assessment of the risk of failure and the time to failure, is defined as follows:

$$\lambda(t|z)=\lambda_0(t)e^{z\delta}, \tag{2}$$

where $\lambda(t|z)$ is the hazard rate, which represents the probability of failure in a given (short) time interval. $\lambda_0(t)$ is the baseline hazard faced by a specific bank at zero cost efficiency, z is a vector of the measured explanatory variables (relative cost efficiencies) and δ is a vector of relevant parameters.

The estimated hazard rate, the probability of failure in a given (short) time interval, is conditional on the bank surviving until time *t* without failing. It is based on empirical observations of continuous operation of the bank until time *t* (the dependent variable takes the value zero – the empirical probability of failure equals zero) and the occurrence of failure at time *t+1* (the dependent variable takes the value one – the empirical probability of failure is certainty). We test whether the hazard rate is determined by cost efficiencies in alternative efficiency estimation specifications. Table 3 summarises the results of the estimates.

TAB. 3 – Cox proportional hazards model (coefficients)

	EFF	Log-likelihood	ps-R2
HR=f(SFA)	-4.96(1.42)***	-78.79	0.10
HR=f(REM)	-7.71(1.88)***	-75.91	0.14
HR=f(FEM)	-3.97(1.58) **	-82.27	0.06

Note: HR stands for hazard rate; EFF denotes cost efficiency; standard deviations are in parentheses; number of observations: 326; failures: 19. Asterisks denote significance level: **5% and *** 1%. The significance level represents the probability that the estimated coefficient is in fact zero. The lower the significance level, the higher the probability that the estimated coefficient is different from zero.

The results of the estimates suggest that increasing relative cost efficiency proportionately reduces the baseline hazard (in this case the maximum risk of bank failure). The pseudo-variance explained by the model relative to the total variance of the data is as high as 14% for efficiency as measured by the REM. The results therefore confirm that cost efficiency significantly explains the risk of failure of banks regardless of the method used for estimating cost efficiency, i.e. the SFA, FEM or REM. The coefficients on the variable EFF (cost efficiency) are negative and significant, implying that a decrease in relative cost efficiency (worse cost management) increases the risk of bank failure.[216]

In conclusion, we can say that relative cost efficiency proved to be a relevant indicator of the risk of bank failure. One year prior to failure the vast majority of failing banks ranked among the worst performing banks in terms of cost management. Relative cost efficiency scores can therefore be used in early warning systems to warn of the failure of individual banks.

214 Bank failure can also be influenced, among other things, by the macroeconomic environment and its effect on the rate of default on loans provided. The issue of credit risk in relation to macroeconomic parameters is the subject of the separate article *Macroeconomic Credit Risk Model* in this Report.

215 The analysis also includes foreign branches of banks in the Czech Republic. Such institutions do not necessarily pursue profit maximisation or cost minimisation directly, as they primarily fulfil objectives set by their foreign parent and draw on its funds. The inclusion of these institutions may therefore "dilute" the results of the model somewhat.

216 The sign of the correlation between cost efficiency and risk of failure is of primary importance, as the contribution to the hazard rate will depend on the magnitude of the cost efficiency score.

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