COMPETITION AND EFFICIENCY IN THE CZECH BANKING SECTOR

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This article offers empirical evidence on the evolution of competition in the banking sector and its relationship to the cost efficiency of banks in the Czech Republic between 1994 and 2005. First, we measured the level and evolution of competition and cost efficiency. Competition was measured with the Lerner index on the loan market, using quarterly data on loan prices. Then we investigated the relationship and causality between competition and efficiency using the Granger-causality test. This supported a negative causality running from competition to efficiency (the "banking specificities" hypothesis). By contrast, our results reject the "quiet life" hypothesis for the Czech banking sector, according to which competition should positively influence efficiency.

1. INTRODUCTION

Banking competition is expected to provide welfare gains by reducing monopoly rents and cost inefficiencies. A higher degree of banking competition should result in a lower monopoly power of banks, and therefore a decrease in banking prices. Since investment is particularly sensitive to a decrease in commercial interest rates, a reduction of monopoly rents should consequently impact positively on investment and economic growth. These expected gains are a particularly major issue for countries in which bank credit represents the largest source of external finance for companies, as is the case in the Czech Republic (Reininger et al., 2002). Heightened competition should also encourage banks to reduce their operating costs, i.e. their cost inefficiencies. This latter channel is particularly promising in terms of welfare gains, as the order of magnitude of the banking sector cost inefficiencies has been estimated in the past to average between 30% and 50% in European transition countries (e.g. Hasan and Marton, 2001; Fries and Taci, 2005) and 40% in the Czech Republic (Podpiera and Podpiera, 2005).[136] However, some studies emphasise some potential negative effects of growing banking competition through excessive risk-taking by banks, which may hamper financial stability (Allen and Gale, 2004; Carletti and Hartmann, 2002).

The aim of this research is twofold. First, we provide empirical evidence on the level and evolution of competition in the Czech banking sector between 1994 and 2005. In previous studies for the Czech banking sector, competition has been measured using concentration indices such as the Herfindahl index, with higher concentration signalling lower competition and vice versa. This approach is based on the traditional Industrial Organisation (IO) literature, which uses structural tests to assess banking competition based on the SCP model derived in Bain (1951). The SCP hypothesis argues that greater concentration causes less competitive bank conduct and leads to greater profitability (meaning lower performance in terms of national welfare). According to this theory, competition can be measured by concentration indices such as the market share of the five largest banks, or by the Herfindahl index. These tools were applied until the 1990s. However, they suffer from the fact that they infer the degree of competition from indirect proxies such as market structure or market shares.

The new empirical IO approach is based on non-structural tests to circumvent the problems of measuring competition by the traditional IO approach. The new empirical IO theory determines banks' conduct directly. Furthermore, it allows us to consider the actual behaviour of banks by taking contestability into account. Indeed, as observed by Claessens and Laeven (2004), the actual behaviour of a bank is related not only to market structure, but also to barriers to entry, influencing the likelihood of the entry of new competitors and therefore the behaviour of incumbents.

In this study we measure competition with the Lerner index, using data on output prices.[137] The Lerner index has been computed in several empirical studies on banking competition (e.g. Angelini and Cetorelli, 2003; Fernandez

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136 The numerical data describe the excess costs of the average bank relative the most efficient bank for producing the same bundle of outputs.

137 The most commonly applied tool for assessing competition emanating from the new empirical IO approach is the Rosse-Panzar model. This non-structural test is based upon the estimation of the H-statistic, which aggregates the elasticities of total revenues to input prices. It has been applied in Western European countries by several authors (Bikker and Haaf, 2002; Weill, 2004; Gelos and Roldos, 2004). Gelos and Roldos (2004) includes three transition countries (the Czech Republic, Hungary and Poland) and concludes in favour of monopolistic competition in these three countries' banking markets and also of the absence of a significant change in banking competition between 1994 and 1999.

de Guevara et al., 2005). In this study we focus exclusively on the loan market, which represents by far the greatest share of assets for the Czech banking sector. We are therefore able to measure the degree of monopoly power for each bank in the loan market and the evolution of competition over the period 1994–2005.

The second aim is to investigate the relationship and causality between competition and efficiency. Indeed, in spite of the commonly accepted view favouring a positive relationship, there does exist empirical literature supporting a negative link (Berger, 1995; Goldberg and Rai, 1996; Weill, 2004). The theoretical literature provides arguments for both directions of the causality. The intuitive "quiet life" concept (Hicks, 1935) suggests that competition positively influences efficiency. In other words, this concept suggests that monopoly power allows a relaxing of efficiency efforts.[138] By contrast, the "efficient-structure" hypothesis, proposed by Demsetz (1973), predicts a negative impact of efficiency on competition, as the most efficient banks would benefit from lower costs and therefore higher market shares.

On the other hand, the specificities of banking competition may give rise to a negative impact of competition on efficiency. The theoretical literature in banking suggests that imperfect competition in banking markets may result from the information asymmetries between bank and borrower in credit activity. As a consequence, banks have to implement some mechanisms to resolve the resulting problems such as adverse selection and moral hazard. One way out is the implementation by the bank of a customer relationship, meaning a long-term repeated relationship, to gain better information on the borrower and reduce the information asymmetries. According to Diamond (1984), banks have a comparative advantage in the ex post monitoring of borrowers, in comparison to investors, because of the existence of economies of scale resulting from their role of delegated monitor. In this case, competition may make it impossible to realise such economies of scale. As a consequence, competition may increase monitoring costs and potentially reduce the length of the customer relationship, further decreasing the cost efficiency of banks. In other words, the specificities of the banking industry provide some additional arguments in favour of a negative relationship between competition and cost efficiency. This assumption will be called the "banking specificities" hypothesis in the following text. This hypothesis may be more relevant in transition economies than in developed market economies. Indeed, banks suffer more from information asymmetries in transition countries, because of uncertainties of accounting information and the relative lack of credit risk analysis know-how of bank employees, owing to the short history of the market economy.

We perform Granger-causality-type estimations in order to get information on the sense of the causality between competition and efficiency in banking. An analysis of this type will enrich the debate on the conflicting hypotheses described above. Such an analysis is also important to provide the normative implications of competition policy in the banking industry. Specifically, a negative relationship between competition and efficiency would mean a trade-off between these two objectives.

2. METHODOLOGY

Measurement of Competition

The Lerner index is defined as the difference between the price of output (loans) and marginal cost divided by price. The price of loans is computed as "Total interest revenues" divided by "Total net loans". "Total net loans" represents "Total loans" from which non-performing loans have been subtracted.[139] The marginal cost is based on the estimation of the cost function. We estimate a cost function with one output and three input prices. One cost function is estimated for each year by introducing fixed effects for individual banks. We impose the restriction of linear homogeneity in input prices by normalising total costs and input prices by one chosen input price. The cost function is specified as follows:

138 This argument is summarised in the famous sentence from Hicks: "The best of all monopoly profits is a quiet life".

139 Revenues are not likely to come from non-performing loans, so the inclusion of non-performing loans in the Lerner index calculation would understate the price for banks having significant proportions of non-performing loans.

$$\ln\left(\frac{TC}{w_3}\right) = \alpha_0 + \alpha_1 \ln y + \frac{1}{2}\alpha_2 (\ln y)^2 + \alpha_3 \ln\left(\frac{w_1}{w_3}\right) + \alpha_4 \ln\left(\frac{w_2}{w_3}\right) + \alpha_5 \ln\left(\frac{w_1}{w_3}\right)\ln\left(\frac{w_2}{w_3}\right) +$$
$$\frac{1}{2}\alpha_6\left(\ln\left(\frac{w_1}{w_3}\right)\right)^2 + \frac{1}{2}\alpha_7\left(\ln\left(\frac{w_2}{w_3}\right)\right)^2 + \alpha_8 \ln y \ln\left(\frac{w_1}{w_3}\right) + \alpha_9 \ln y \ln\left(\frac{w_2}{w_3}\right) + \varepsilon \qquad (1)$$

where TC denotes total costs, y loans, w_1 the price of labour, w_2 the price of physical capital, and w_3 the price of borrowed funds. The indices for each bank have been dropped from the presentation for the sake of simplicity.

The estimated coefficients of the cost function are then used to compute the marginal cost.

The marginal cost can be expressed as follows:

$$MC = \frac{TC}{y} \cdot \frac{d \ln TC}{d \ln y} \qquad (2)$$

The derivative of the logarithm of the total cost with respect to the logarithm of output is computed using the cost function specified in equation (1):

$$\frac{d \ln TC}{d \ln y} = \alpha_1 + \alpha_2 \cdot \ln y + \alpha_8 \cdot \ln(\frac{w_1}{w_3}) + \alpha_9 \cdot \ln(\frac{w_2}{w_3}) \qquad (3)$$

Measurement of Efficiency

We measure efficiency on the basis of cost efficiency, meaning that we measure how close a bank's cost is to what the most cost-efficient bank's cost would be for producing the same bundle of outputs. It then provides information on losses in the production process and on the optimality of the chosen mix of inputs. Several techniques have been proposed in the literature to measure efficiency with frontier approaches. In this study, we adopt a distribution-free approach (DFA), in this way circumventing the main critique attached to the widely used stochastic frontier approach, namely its reliance on distributional assumptions. The DFA assumes the cost function $TC = f(Y,P) + \varepsilon$ where TC represents total cost, Y denotes output, P is the vector of input prices and ε is the error term. According to this cost function the efficiency of each bank is constant over time and the random error for each bank tends to cancel out over time. Bauer et al. (1998) distinguish three different techniques through which DFA could be implemented in practice. In this study, we focus on DFA-P WITHIN, which is a fixed-effects model that estimates inefficiency from the value of a bank-specific dummy variable; each bank's efficiency is then computed as the deviation from the most efficient bank's intercept term. We estimate the translog cost function presented in equation (1) for each year (four quarters), where we assume that the random error cancels out over the four quarters.

Testing the Relationship between Competition and Efficiency

We analyse the link between competition and efficiency in the Czech banking industry in a Granger-causality framework, formally specified in equations (4) and (5) as follows:

$$y_{it} = \alpha_0 + \sum_{l=1}^{m} \alpha_l^y y_{it-l} + \sum_{l=1}^{m} \delta_l^y x_{it-l} + f_i^y + u_{it}^y \qquad (4)$$

$$x_{it} = \beta_0 + \sum_{l=1}^{m} \alpha_l^x y_{it-l} + \sum_{l=1}^{m} \delta_l^x x_{it-l} + f_i^x + u_{it}^x \qquad (5)$$

where y represents *"Efficiency"* and x the *"Lerner index"*. f_i represents the bank's "individual effect".

Efficiency and *Lerner index* are the yearly averages of the cost efficiency score and the Lerner index respectively. i and t represent the indices for the bank and the time (year) respectively. Each dependent variable is regressed on its lags and on those of the other variable. We use yearly averages in order to be able to capture the genuine effect, if any, of competition on efficiency and vice versa. In other words, we believe that it takes time for the effect of competition on efficiency and vice versa to become apparent, hence such an effect could be revealed by analysing yearly data rather than quarterly data, which are obviously more volatile. Following Berger and De Young (1997) we adopt a maximum lag of four years.

Having at our disposal a panel, we do not employ a standard Granger-causality analysis but resort to panel-specific methodology to estimate the dynamic equations (4) and (5). To estimate the dynamic equations represented in (4) and (5) we employ the Generalised Method of Moments (GMM) as designed by Arellano and Bond (1991).[140]

3. DATA AND VARIABLES

In the analysis we used monthly data reported to the Czech National Bank (CNB) for all Czech commercial banks[141] during the period 1994–2005, and transformed them into quarterly data.[142] Two approaches are proposed in the banking literature for the definition of inputs and outputs. The *intermediation approach* assumes that the bank collects deposits to transform them, using labour and capital, into loans. The *production approach* views the bank as a production unit using labour and capital to produce deposits and loans. As our focus is on lending activity, we adopted the *intermediation approach*.

Table 1 – Descriptive statistics

	Median	Mean	Standard Deviation
Output			
Loans (CZK billions)	14.4	53.9	92.8
Input prices			
Price of labour (CZK thousands)	85.9	116.3	93.7
Price of physical capital	0.09	0.137	0.122
Price of borrowed funds	0.012	0.015	0.011
Other characteristics			
Assets (CZK billions)	20.12	81.09	146.3
Total costs (CZK millions)	305.4	981.8	1 727.8
Price of loans	0.021	0.023	0.0122

N=1110 observations.

One output – loans – is adopted in the cost function and the cost efficiency frontier. The inputs include labour, physical capital and borrowed funds. The price of labour is measured by the ratio of personnel expenses to the number of employees. The price of physical capital is defined as the ratio of expenses for physical capital to total fixed assets. The price of borrowed funds is measured by the ratio of expenses for borrowed funds to borrowed funds. Total costs are the sum of expenses for personnel, physical capital and borrowed funds. The price of loans is computed using the ratio of interest received on loans to net loans. Summary statistics for the period 1994–2005 are reported in Table 1.

140 Attanasio et al. (2000) mention that most studies seeking Granger-causality type estimation with fixed effects use estimators such as those proposed by Holtz-Eakin, Newey and Rosen (1988) and Arrelano and Bond (1991) (hereinafter "AB").

141 Mortgage banks are not included, as their production function most likely differs from that of commercial banks.

142 We performed a careful investigation of the data to find and drop outliers. For the failed banks, the observations for the year of failure were dropped, as the data for the quarters preceding the failures were mostly chaotic. Furthermore, for each bank and for each year, we tried to have complete data for all four quarters. The result is an unbalanced panel.

4. RESULTS

The Evolution of Banking Competition

The results of the computation of the Lerner index for each year are displayed in Table 2. The Lerner index is an inverse measure of competition, i.e., a greater Lerner index means lower competition. Table 2 also shows the Herfindahl indices[143] to allow comparison of our measure of competition with one used routinely in practice.

Table 2 – Lerner indices and Herfindahl indices

	Lerner indices				Herfindahl
	No. of observations	Median	Mean	Standard Deviation	indices
1994	87	60.13	59.01	30.97	1381.78
1995	110	16.94	13.6	49.48	1233.47
1996	99	14.73	2.46	71.12	1204.91
1997	106	-14.38	-26.88	83.67	1150.33
1998	86	8.77	10.94	24.26	1045.26
1999	99	32.16	30.76	31.73	1002.98
2000	100	30.37	31.11	23.96	951.89
2001	92	24.4	29.12	24.79	1071.03
2002	92	17.1	17.03	27.7	1321.18
2003	88	50.95	43.44	30.93	1285.35
2004	75	55.11	45.74	27.66	1250.70
2005	76	44.8	42.09	26.67	1232.43

All indices are in per cent.
Note: The negative figure for the year 1997 probably comes from the fact that on average the MC was higher than the price of loans that year. This was due to the high interbank rates triggered by the financial turmoil in 1997.

The fact that the results show a negative figure for the Lerner index in 1997 make interpretation of the trend difficult for the period 1995–1998. The drastic increase in the Lerner index from 1998 to 1999 was to some extent triggered by a decrease in banks' marginal costs related to a decline in interest rates on the interbank market after 1998. The obvious increase in competition during the period 1999–2002 can be attributed to the entry of foreign banks into the Czech banking industry, which considerably increased from 1999 onwards with the launch of the privatisation of major banks. The subsequent (2003–2005) decrease in our measure of competition contradicts the common belief of rising competition in banking. This might actually have been a result of a temporary absence of the acute threat of a new competitor entering the Czech banking market. As all the big banks were now privatised, and as there was already a relatively high number of branches of foreign banks active in the market, the threat of entry of a new bank seemed very low. Consequently, the competitive pressures on banks were limited. At the same time, we have to recall that our measure of competition does not account for the riskiness of banks' products. The price of output is the average for all types of loans regardless of their riskiness. The rise in the Lerner index during the period 2002–2005 may have been due to some extent to the fact that after 2002 banks offered a wider spectrum of products, some of them relatively riskier and pricier.

According to the Herfindahl index, concentration fell continuously from 1994 to 2000 and then strongly increased from 2000 until 2002, followed by a slight decrease between 2003 and 2005. Our measure of competition and the Herfindahl index display common turning points: minimum competition in 2000 and maximum competition in 2002. Also, the period 2003–2005 is characterised by decreasing competition on both scales, although the decline is rather smaller in the case of the Herfindahl index.

143 The Herfindahl index is the sum of the squares of the market shares of the individual market participants. It ranges from 0 to 10 000, with a higher index signalling higher concentration.

The results of the GMM estimation of the dynamic equations represented in (4) and (5) are displayed in Table 3. The Sargan test and the first- and second-order auto-correlations in the differenced residuals (AR1 and AR2) satisfy the necessary conditions specified in Arellano and Bond (1991). The table reports the coefficients of the lags of the dependent and independent variables. Of primary interest for our hypothesis are the coefficients of the lag of the independent variable. For both equations (4) and (5), we test the hypothesis that $\delta_1 = \delta_2 = ... = \delta_m$ are equal to zero, which signals whether the independent variable Granger-causes the dependent variable. The sum of these coefficients, which gives an overall measure of the effect on the dependent variable, is also presented for an assessment of the sign of the relationship.

Table 3 – Granger-causality tests

	Dependent variable: $Efficiency_t$		Dependent variable: $Lerner_t$	
	Coefficient	Std. err.	Coefficient	Std. err.
Intercept	-0.06***	0,011	0.06***	0.02
$Efficiency_{t-1}$	-0.6***	0,12	0.11	0.15
$Efficiency_{t-2}$	0.05	0,12	0.28*	0.17
$Efficiency_{t-3}$	-0.18**	0,09	-0.11	0.14
$Efficiency_{t-4}$	0.05	0,09	-0.05	0.14
$Efficiency_{t-1}$= $Efficiency_{t-2}$=	chi2(4) = 32.94		chi2(4) = 4.33	
= $Efficiency_{t-3}$= $Efficiency_{t-4}$=0	Prob > chi2 = 0.0000		Prob > chi2 = 0.3629	
$\sum AR$ Efficiency coefficients	-0.69***	0.24	0.24	0.32
$Lerner_{t-1}$	0.2***	0.07	-0.33***	0.11
$Lerner_{t-2}$	0.29***	0.08	-0.17	0.12
$Lerner_{t-3}$	0.29***	0.08	-0.15	0.11
$Lerner_{t-4}$	0.12**	0.06	-0.12	0.10
$Lerner_{t-1}$= $Lerner_{t-2}$= $Lerner_{t-3}$=	chi2(4) = 32.69		chi2(4) = 11.99	
= $Lerner_{t-4}$=0	Prob > chi2 = 0.0000		Prob > chi2 = 0.0175	
$\sum AR$ Lerner coefficients	0.898***	0.16	-0.77***	0.24
p- value AR1/AR2	0.05 / 0.13		0.000 / 0.24	
p- value Sargan	0.003		0.04	
Number of observations	1085		1085	

*, **, *** denote estimates significantly different from zero at the 10%, 5% and 1% levels respectively.
AR means auto-regressive lag.

The results show that the Lerner index positively Granger-causes efficiency – hence competition negatively Granger-causes efficiency – but efficiency does not Granger-cause competition.[144] This result is consistent with the "banking specificities" hypothesis, according to which greater competition should reduce the cost efficiency of banks through increased monitoring costs.

Our work thus supports the literature regarding the trade-off between banking competition and financial stability (Allen and Gale, 2004). Our analysis provides another channel of transmission for the negative effects of competition on financial stability, namely the negative effects of competition on the cost efficiency of banks.

144 In the equation explaining *Efficiency* the coefficients of the lags of the Lerner index are jointly statistically different from zero (Prob > chi2 = 0.0000). In the equation explaining the *Lerner index,* the coefficients and the lags of *Efficiency* are not jointly different from zero (Prob > chi2 = 0.3629).

5. CONCLUSIONS

This research focuses on the relationship between competition and efficiency in the Czech banking sector during the economic transition period. Our measure of competition shows an absence of increased competition in the Czech banking market between 1994 and 2005. Using the Lerner index we find an increase in competition during the privatisation period (1999–2002). This was followed by a decrease in our measure of competition in 2003–2004 and a slight revival in 2005. This may seem a surprising finding, as one may have expected that the massive entry of foreign investors into the Czech banking industry would have contributed to enhancing the degree of banking competition. On the other hand, the decrease in competition or increase in the Lerner index in 2002–2005 might have been due to the fact that after 2002 banks also offered some riskier and pricier products.

Our analysis of the relationship and causality between our measure of competition and estimated cost efficiency suggests that competition has negatively affected cost efficiency in the Czech banking sector. Although it may appear counterintuitive, this finding is in accordance with the part of the literature which supports the existence of a negative link between competition and efficiency. It can be explained by the fact that increased competition leads to greater monitoring costs for banks (economies of scale mean that a higher number of banks leads to higher costs) and a reduction of the length of the customer relationship between the bank and the borrower, which reduces efficiency.

Our findings have potentially important implications, as they reveal that efforts to increase competition might be balanced by a decrease in the cost efficiency of banks, which could result in higher loan rates.

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