Institutional Reforms, EU Accession, and Bank Efficiency in Transition Economies: Evidence from Bulgaria

Kiril Tochkov and Nikolay Nenovsky

ABSTRACT: This paper examines the efficiency of Bulgarian banks and its determinants over the period 1999–2007. The levels of technical, allocative, and cost efficiency are estimated using a nonparametric methodology and then regressed on a number of bank-specific, institutional, and EU-related factors. The findings indicate that foreign banks were more efficient than domestic private banks, although the gap between them narrowed over time. State-owned banks ranked last, but their privatization resulted in efficiency gains. Capitalization, liquidity, and enterprise restructuring enhanced bank efficiency, whereas banking reforms had an adverse effect. The Treaty of Accession and EU membership were associated with significant efficiency improvements.

KEY WORDS: banking, efficiency, EU accession, transition economies.

The transition to a stable, well-regulated, and competitive banking system in Bulgaria has been a long and tortuous process. The legal framework for commercial banking was established soon after the introduction of market reforms in the early 1990s and led to a rapid increase in the number of private banks, the consolidation of numerous state-owned banks, and the entry of foreign banks into the market. However, the sector continued to be dominated by inefficient state-owned banks burdened with nonperforming loans stemming from lending to loss-making state-owned enterprises and relying on financial support from the government. Bad governance, weak regulatory oversight, unsound credit policies, and lack of privatization efforts contributed to the deterioration of the balance sheet of the banking system, culminating in a severe banking crisis and a wave of bank failures in 1996–97.[1] The adoption of a currency board in the aftermath of the crisis signified a fundamental change in the institutional framework of the banking sector, introducing new prudential requirements for commercial banks, eliminating the soft budget constraint, and strengthening the regulatory and supervisory powers of the Bulgarian National Bank (BNB).[2] In the mid-2000s, banking legislation underwent another major revision to comply with EU banking directives in the process of EU accession.[3] Moreover, the government initiated the privatization of state-owned banks, which

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Emerging Markets Finance & Trade / January–February 2011, Vol. 47, No. 1, pp. 113–129.

1540-496X/2011 $9.50 + 0.00.
DOI 10.2753/REE1540-496X470107

attracted strategic foreign investors. As a result, by the time Bulgaria joined the European Union in 2007, over 80 percent of banking assets were controlled by foreign banks, and over 98 percent of banks were privately owned.

The objective of this paper is to examine the efficiency of Bulgarian banks and its determinants in the period between the adoption of the currency board in 1997 and EU membership in 2007, and to examine the impact of ownership, institutional reforms, EU accession, and bank-specific financial factors on efficiency. The issue of bank efficiency in Bulgaria deserves attention for three main reasons. First, as the newest and least developed member state, Bulgaria is in the process of catching up with the rest of the European Union. An inefficient banking system that hampers financial development and is detrimental to economic growth would undermine the process of convergence as well as the eventual adoption of the euro (Rizov 2004). Second, Bulgaria is one of only three EU members (along with Estonia and Lithuania) operating a currency board that restricts the availability of a lender of last resort. This intensifies the danger of bank insolvency and a banking crisis if financial institutions are inefficient or face liquidity problems. Third, the period examined in the paper witnessed numerous institutional reforms of the financial system aimed at dealing with the 1996–97 banking crisis and attaining legal and regulatory harmonization in the wake of EU accession. The assessment of bank efficiency changes over this period can provide valuable feedback to regulators and policymakers about the effectiveness of these reforms in the context of monetary policy (Jimborean 2009).

The empirical analysis is conducted in two stages. First, we employ a nonparametric methodology to estimate technical, allocative, and cost efficiency of Bulgarian banks over the period 1999–2007. Differences in efficiency levels between state-owned, private, and foreign banks, as well as between large and small banks, are explored in the years before and after the Treaty of Accession and EU membership. In the second stage, we use a panel data Tobit regression model to identify the determinants of the previously estimated technical, allocative, and cost-efficiency levels. A set of potential correlates of efficiency are included in the regression, accounting for (1) institutional changes, such as banking reforms, privatization, and enterprise restructuring; (2) accession-related events, such as the Treaty of Accession and EU membership; and (3) bank-specific factors related to profitability, credit risk, liquidity, and capitalization.

Review of the Literature

The literature on bank efficiency in transition economies can be divided into two categories. One group of studies has focused on bank efficiency within a given transition economy, including Hungary (Hasan and Marton 2003), the Czech Republic (Matousek and Taci 2004; Weill 2003), Croatia (Jemric and Vujcic 2002; Kraft and Tirtiroglu 1998), Poland (Kasman 2005; Nikiel and Opiela 2002), and Romania (Asaftei and Kumbhakar 2008).[4] All of these studies suggest that foreign-owned banks were more efficient than domestic banks, although the issue seems to be more nuanced. For instance, foreign greenfield banks scored higher than domestic banks acquired by foreign owners (Havrylchyk 2004, 2006). Moreover, foreign banks servicing foreign and business customers achieved higher cost efficiency relative to foreign banks with domestic customers that were at par with private domestic banks (Nikiel and Opiela 2002). In contrast to privatization, the tightening of prudential requirements with respect to capital adequacy and required reserves seems to have had a negative effect on efficiency because it imposed higher costs

on banks (Asaftei and Kumbhakar 2008). As for the effect of bank size on efficiency, the evidence from most studies suggests that large banks had an advantage over small banks, although in a few cases this difference was found not to be statistically significant (Havrylchyk 2006; Matousek and Taci 2004).

A second group of studies is comparative in nature and has estimated bank efficiency within a group of transition economies. Their results also show that private banks, especially those with a majority foreign ownership, were more cost efficient than state-owned banks (Bonin et al. 2005; Brissimis et al. 2008; Fries and Taci 2005).[5] However, although foreign-owned banks were more cost efficient, they were found to be less profit efficient relative to state-owned and private domestic banks (Yildirim and Philippatos 2007). Furthermore, consolidation in the banking sector and the privatization to foreign owners had a positive effect on efficiency (Grigorian and Manole 2006).

Methodology

According to Farrell's (1957) seminal work, the concept of efficiency encompasses two aspects of firm performance. To achieve technical efficiency, firms seek to minimize the quantities of inputs used in producing a given level of output. In addition, firms pursue allocative efficiency by evaluating input prices and choosing a combination of inputs that minimizes the cost of production. Combined, technical and allocative efficiency provide an overall efficiency measure, often referred to in the literature as cost efficiency. In practice, the efficiency of a firm is evaluated relative to a reference point on a benchmark production frontier. The efficiency measure is a radial measure of the distance between the firm and the best-practice frontier calculated as the ratio of actual to potential firm performance. Accordingly, a firm is considered efficient if its performance corresponds to a point on the best-practice frontier.

The radial measure of efficiency relies on the existence of a benchmark production frontier, which is not observed in practice. Two main approaches have been developed in the literature to deal with this issue. Parametric methods, such as the stochastic frontier approach (SFA), use econometric techniques to estimate a frontier and decompose the stochastic term of the regression model into an inefficiency component and random error. Nonparametric methods, such as data envelopment analysis (DEA), use mathematical programming to construct a piecewise linear production frontier that envelops the observed data points and treats all deviations from the frontier as inefficiency. In this study, we adopt the DEA methodology because the nonparametric approach allows the data to determine the form of the frontier without imposing any restriction that might misspecify the production technology. In contrast, SFA requires a priori specification of the functional form of the frontier and makes assumptions about the distributional properties of the components of the stochastic term, which are often violated (Greene 1999). The major drawback of the DEA approach is the sensitivity of efficiency measures to outliers and sampling variation. The advantage of SFA over DEA in this regard is that it takes into account stochastic noise. For this reason, we use the bootstrapping method by Simar and Wilson (1998) to test the robustness of our DEA estimates. The bootstrapping produces bias estimates that are then used to correct for the bias of the original DEA estimates; however, this also introduces additional noise into the procedure (Simar and Wilson 2008).[6]

At first, we estimated the technical efficiency of Bulgarian banks by solving the following input-oriented linear programming model developed by Banker, Charnes, and Cooper (1984):

$$\theta^* = \min_{\theta,\lambda} \theta$$

$$\text{such that } \theta x_{io} \geq \sum_{j=1}^{n} \lambda_j x_{ij} \quad i = 1,...,m$$

$$y_{ro} \leq \sum_{j=1}^{n} \lambda_j y_{rj} \quad r = 1,...,s \tag{1}$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0, \ \forall j,$$

where x_{ij} and y_{rj} denote the levels of the ith input and rth output of the jth bank, $j = 1, ..., n$. The first two constraints require that the performance of a given bank o in terms of its inputs x_{io} and outputs y_{ro} be located within a production possibility set defined by the envelopment of all data points. The last two constraints, where λ is an $\boldsymbol{N} \times \mathbf{1}$ vector, allow for variable returns to scale by imposing a convexity restriction that generates a frontier in the form of a convex hull of intersecting planes. The scalar θ^*, which is the optimal solution of the minimization problem in Equation 1, represents the efficiency score of a given bank. If $\theta^* = 1$, the bank is located on the best-practice frontier and is thus efficient, whereas $0 < \theta^* < 1$ indicates inefficiency.

Next, we make use of the data on input prices and estimate the cost efficiency by solving the following linear programming model based on Farrell (1957):

$$c_{io} x_{io}^* = \min_{x,\lambda} \sum_{i=1}^{m} c_{io} x_{io}$$

$$\text{such that } x_{io} \geq \sum_{j=1}^{n} \lambda_j x_{ij} \quad i = 1,...,m$$

$$y_{ro} \leq \sum_{j=1}^{n} \lambda_j y_{rj} \quad r = 1,...,s \tag{2}$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0,$$

where the constraints, including variable returns to scale, are identical to the model in Equation (1), but the goal is to minimize the production cost represented by the product of the input x_{io} and its corresponding price c_{io}. The optimal solution is the input vector $\boldsymbol{x}^*$, which when multiplied with the input-price vector $\boldsymbol{c}$ determines the minimal cost. The cost efficiency (CE) score for each bank is then obtained by evaluating the minimal cost cx^* relative to the observed cost cx as follows:

$$CE = \frac{cx^*}{cx}, \tag{3}$$

where $0 < CE \leq 1$, and the bank is cost efficient only if $CE = 1$. Given that cost efficiency can be decomposed into technical efficiency (TE) and allocative efficiency (AE) as

$$CE = TE \times AE \tag{4}$$

we are able to estimate *AE* by dividing the estimate from Equation 2 by the estimate from Equation (1). Whereas the TE is concerned with the distance between the bank performance and the best-practice frontier, the AE measures the distance between the reference point on the frontier and the cost line. Full AE, defined as $AE = 1$, is achieved if a bank has an optimal combination of inputs and costs corresponding to a location on the cost line. Consequently, full CE is attained only if a bank has perfect scores in both technical and allocative efficiency and is thus located on both the best-practice frontier and the cost line.

Data

The data set included all commercial banks in Bulgaria over the period 1999–2007. The number of banks in each year varied between 29 and 35. We based our selection of input and output variables on the intermediation approach, which focuses on the traditional role of banks as financial intermediaries that collect deposits and convert them, using labor and capital, into loans and other earnings assets.[7] Accordingly, we defined three inputs and two outputs. The inputs included labor, capital, and borrowed funds. Labor was measured as the number of bank employees, and capital as the value of fixed assets. Borrowed funds were the sum of total deposits and short- and long-term borrowings. The two outputs were total loans and investment assets.

Data on the number of employees were provided by the BNB. All other variables were collected from year-end balance sheets and income statements published by the BNB in the bulletin *Commercial Banks in Bulgaria.* Nominal variables expressed in Bulgarian leva (BGN) were deflated by the consumer price index with 2005 as base year.

In addition to input and output variables, CE analysis required data on input prices for each bank. In line with the literature, we defined the price of borrowed funds as the ratio of interest expenses to borrowed funds, the price of labor as the ratio of personnel expenses to the number of employees, and the price of capital as the ratio of operating expenses (net of interest and personnel expenses) to fixed assets.[8] Interest expenses and operating expenses are available from the BNB bulletin, but personnel expenses are not reported separately for each bank. Instead, since 2003, the BNB has provided aggregate annual data on personnel expenses for three groups of banks arranged according to asset size and ownership. We calculated the personnel expenses as a percentage of noninterest operating expenses for each of the three groups and used these ratios to estimate the annual personnel expenses for each bank over the period 2003–7.[9] The descriptive statistics of the input, output, and price variables are summarized in Table 1.

The sample of banks was subdivided by ownership (state owned, private domestic, and foreign) and by size (large, medium, small).[10] The last state-owned bank of any significance was privatized in 2002, making this category obsolete in subsequent years of the sample period.[11] Banks with foreign ownership of at least 50 percent were treated as foreign. With regard to bank size, the categories of large and small banks were defined as the upper and lower quartiles of the asset distribution in each year.[12]

Results

Efficiency Estimates

The DEA estimates are reported in Table 2 and indicate that the mean efficiency score of Bulgarian banks was 0.83 over the period 1999–2007. From the annual estimates, it is

Table 1. Descriptive statistics of the input, output, and price variables, 1999–2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of banks	34	34	35	34	35	35	33	32	29
Outputs									
Loans									
Mean	215	266	285	324	375	523	714	894	1,369
Standard deviation	354	470	427	415	450	624	826	1,025	1,645
Investment assets									
Mean	26	17	18	38	55	54	82	91	80
Standard deviation	98	64	72	138	180	159	182	179	146
Inputs									
Employees									
Mean	641	638	636	638	612	642	737	826	1,054
Standard deviation	1,158	1,105	1,068	975	802	766	782	831	1,145
Fixed assets									
Mean	14	16	16	21	19	20	24	27	33
Standard deviation	23	22	23	36	31	31	33	38	49
Borrowed funds									
Mean	271	292	334	397	463	572	848	1,051	1,502
Standard deviation	456	471	528	550	601	677	977	1,192	1,774
Input prices									
Labor									
Mean					17.2	18.5	19.0	18.8	18.7
Standard deviation					9.6	10.0	11.8	11.1	11.0
Capital									
Mean					2.4	2.7	2.3	3.5	3.5
Standard deviation					3.2	3.7	3.3	6.9	7.7
Borrowed funds									
Mean					2.1	2.2	2.3	2.4	2.6
Standard deviation					1.1	1.3	1.1	0.9	0.6

Notes: All input and output variables are measured in millions of constant 2005 BGN with the exception of the number of bank employees. The price of labor is the ratio of personnel expenses to the number of employees and is expressed in thousands of constant 2005 BGN. The price of capital is the ratio of operating expenses (net of interest and personnel expenses) to fixed assets and is measured in percentage. The price of borrowed funds is the ratio of interest expenses to borrowed funds and is measured in percentage.

Table 2. Technical efficiency by ownership and size, 1999–2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007	1999–2007	EU
Sample											
N	34	34	35	34	35	35	33	32	29		
Mean	0.81	0.84	0.80	0.69	0.82	0.75	0.93	0.91	0.90	0.83	0.08***
Standard deviation	0.20	0.18	0.20	0.30	0.19	0.21	0.10	0.13	0.14	0.18	
Minimum	0.06	0.50	0.41	0.11	0.41	0.41	0.70	0.56	0.45	0.40	
State owned											
N	7	4	4	3							
Mean	0.87	0.65	0.74	0.48						0.69	
Standard deviation	0.17	0.24	0.20	0.36						0.24	
Minimum	0.64	0.50	0.53	0.14						0.45	
Private domestic											
N	8	9	10	10	10	10	9	7	6		
Mean	0.72	0.77	0.65	0.52	0.70	0.59	0.89	0.90	0.92	0.74	0.20***
Standard deviation	0.11	0.19	0.17	0.24	0.17	0.16	0.11	0.09	0.10	0.15	
Minimum	0.57	0.59	0.38	0.11	0.44	0.41	0.75	0.79	0.75	0.53	
Foreign											
N	19	21	21	21	23	23	22	23	21		
Mean	0.82	0.90	0.89	0.79	0.89	0.84	0.95	0.93	0.91	0.88	0.03
Standard deviation	0.23	0.13	0.17	0.27	0.16	0.20	0.07	0.13	0.15	0.17	
Minimum	0.06	0.60	0.42	0.12	0.44	0.42	0.74	0.56	0.45	0.42	
Large											
N	8	9	9	8	7	7	6	7	7		
Mean	0.88	0.83	0.90	0.95	1.00	0.92	1.00	1.00	1.00	0.94	0.06***
Standard deviation	0.13	0.17	0.13	0.07	0.00	0.12	0.02	0.00	0.00	0.07	
Minimum	0.67	0.52	0.64	0.82	1.00	0.71	0.96	1.00	1.00	0.81	
Small											
N	7	9	9	7	8	8	8	7	7		
Mean	0.80	0.98	0.83	0.46	0.83	0.77	0.98	0.92	0.82	0.82	0.00
Standard deviation	0.36	0.04	0.22	0.39	0.23	0.19	0.02	0.12	0.19	0.20	
Minimum	0.06	0.90	0.42	0.11	0.47	0.47	1.00	0.07	0.45	0.33	

Notes: EU = difference between the technical efficiency level in 2007 and the average technical efficiency level in 1999–2006. *** 1 percent significance level.

evident that there is a significant difference between the periods 1999–2004 and 2005–7. Whereas in the first six years of the sample period efficiency fluctuated between 0.69 and 0.84 without a clear pattern, it soared above 0.90 in 2005. The reason for the lower efficiency in the late 1990s and early 2000s is that most banks were reluctant to lend because they were still haunted by the aftermath of the 1996 crisis. This changed in 2004 when foreign banks, lured by higher rates of return and the prospect of Bulgaria's EU accession, poured resources into the financial system through their Bulgarian subsidiaries, creating a credit boom reflected in the jump in efficiency scores. BNB reacted by raising the reserve requirements and imposing restrictions on lending, which were most likely responsible for the moderate decline in efficiency after 2005.

Foreign banks were more efficient than private domestic banks, and their score mirrored the overall pattern of change of the sample average. By contrast, private domestic banks exhibited consistent improvements in technical efficiency after 2005, surpassing foreign banks in 2007. State-owned banks, which were evaluated over the first four years of the sample period before being privatized, recorded the lowest average level of technical efficiency. Moreover, their efficiency worsened over the years because the best banks were privatized first. Foreign banks were the main beneficiaries of privatization, and an analysis of the four takeovers in the years 1999–2002 (not reported in the table) showed that the efficiency of the state-owned banks involved increased on average from 0.82 to 0.90 following privatization. Large banks were found to be the most efficient subsample and determined the best-practice frontier after 2005.

The estimates of cost and allocative efficiency are displayed in Table 3. Cost efficiency improved consistently over the years, witnessing a larger increase in 2006 and reaching a peak of 0.78 in 2007. Foreign-owned banks were again more cost and allocative efficient than domestic banks; however, the gap between the two groups narrowed significantly, especially after domestic banks experienced a dramatic boost in efficiency in 2005. Large banks again had the highest average scores and achieved perfect efficiency in 2007. In contrast, small banks were extremely inefficient and, despite some minor improvements in 2006–7, remained below the average efficiency level for the entire sample period.

The differences in efficiency levels between the years before and after the EU accession are reported in the last column of Tables 2 and 3. The improvements after 2007 were significant for the entire sample across all three types of efficiency. Foreign and small banks were the only categories that did not see significant increases in technical efficiency, mainly because their scores had improved already after the Treaty of Accession in 2005. Regarding cost efficiency, large and small banks recorded insignificant changes as a result of the EU accession, because the former were already highly efficient even before 2007, and the latter remained inefficient even after Bulgaria joined the European Union.

We tested the sensitivity of the efficiency scores for each year to outliers and sampling variation by using the bootstrap method developed by Simar and Wilson (1998). Table 4 reports the bias-corrected efficiency scores obtained from the bootstrapping procedure along with the raw DEA scores. The difference between the two scores is significant (albeit at 10 percent) only for cost and allocative efficiency in 2004 as well as for allocative efficiency in 2005. Therefore, we used the bias-corrected efficiency scores in the second-stage regression in the next section.

Determinants of Efficiency

To identify the determinants of bank efficiency, we regressed the DEA estimates on a number of bank-specific and institutional variables using the following specification:

Table 3. Cost and allocative efficiency by ownership and size, 2003–2007

	2003	2004	2005	2006	2007	2003–2007	EU
Sample							
CE							
Mean	0.53	0.55	0.59	0.72	0.78	0.63	0.18***
Standard deviation	0.28	0.29	0.37	0.25	0.26	0.29	
Minimum	0.10	0.15	0.10	0.24	0.27	0.10	
AE							
Mean	0.62	0.70	0.64	0.77	0.85	0.72	0.17***
Standard deviation	0.24	0.23	0.39	0.22	0.20	0.26	
Minimum	0.20	0.31	0.10	0.31	0.33	0.10	
Private domestic							
CE							
Mean	0.34	0.34	0.65	0.65	0.72	0.54	0.22*
Standard deviation	0.26	0.15	0.29	0.21	0.27	0.24	
Minimum	0.14	0.21	0.15	0.31	0.32	0.15	
AE							
Mean	0.49	0.61	0.75	0.72	0.76	0.67	0.12
Standard deviation	0.20	0.19	0.34	0.21	0.24	0.24	
Minimum	0.20	0.31	0.15	0.31	0.33	0.15	
Foreign							
CE							
Mean	0.62	0.66	0.56	0.76	0.81	0.68	0.16***
Standard deviation	0.29	0.29	0.44	0.28	0.20	0.30	
Minimum	0.22	0.21	0.10	0.24	0.40	0.10	
AE							
Mean	0.68	0.76	0.59	0.80	0.87	0.74	0.16***
Standard deviation	0.25	0.22	0.45	0.23	0.19	0.27	
Minimum	0.27	0.37	0.10	0.38	0.39	0.10	

(continues)

Table 3. Continued

	2003	2004	2005	2006	2007	2003–2007	EU
Large							
CE							
Mean	0.88	0.85	0.96	0.97	1.00	0.93	0.08
Standard deviation	0.07	0.18	0.06	0.04	0.12	0.09	
Minimum	0.81	0.59	0.89	0.89	0.67	0.59	
AE							
Mean	0.88	0.92	0.96	0.97	1.00	0.95	0.07***
Standard deviation	0.07	0.09	0.05	0.04	0.01	0.05	
Minimum	0.81	0.82	0.89	0.89	0.98	0.81	
Small							
CE							
Mean	0.46	0.45	0.42	0.57	0.61	0.50	0.13
Standard deviation	0.32	0.30	0.45	0.26	0.30	0.33	
Minimum	0.14	0.21	0.15	0.31	0.31	0.14	
AE							
Mean	0.54	0.56	0.42	0.61	0.73	0.57	0.20
Standard deviation	0.26	0.24	0.45	0.24	0.29	0.30	
Minimum	0.20	0.31	0.15	0.31	0.33	0.15	

Notes: AE = allocative efficiency; CE = cost efficiency; EU = difference between the efficiency level in 2007 and the average efficiency level in 2003–6. * 10 percent significance level; ** 5 percent significance level; *** 1 percent significance level.

Table 4. Bootstrap analysis of efficiency scores, 1999–2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007
TE									
Raw	0.81	0.84	0.80	0.69	0.82	0.75	0.93	0.91	0.90
Corrected	0.84	0.83	0.82	0.65	0.83	0.75	0.90	0.93	0.89
Bias	0.03	0.01	0.02	0.04	0.01	0.00	0.03	0.02	0.01
AE									
Raw					0.62	0.70	0.64	0.77	0.85
Corrected					0.60	0.61	0.71	0.76	0.85
Bias					0.02	0.09*	0.07*	0.01	0.00
CE									
Raw					0.53	0.55	0.59	0.72	0.78
Corrected					0.50	0.46	0.64	0.71	0.76
Bias					0.03	0.09*	0.05	0.01	0.02

Notes: TE = technical efficiency; AE = allocative efficiency; CE = cost efficiency. Raw scores are the mean efficiency levels from the DEA analysis in Tables 2 and 3. Bias-corrected efficiency scores are the results of the bootstrapping procedure by Simar and Wilson (1998). * 10 percent significance level.

$$EFF_{it} = \alpha_i + \sum_k \beta_k OWN_{it,k} + \sum_m \beta_m CAMEL_{it,m} + \sum_q \beta_q INST_{t,q} + \sum_z \beta_z EU_{t,z} + \varepsilon_{it}. \quad (5)$$

Three separate regressions were estimated with technical, cost, and allocative efficiency as the dependent variable (*EFF*). Because DEA efficiency scores are limited to values between 0 and 1, estimation via OLS would have resulted in inconsistent estimates. Therefore, we employed a Tobit specification, which captures the lower and upper censoring of the dependent variable and produces consistent maximum likelihood estimates.[13] The results of the Tobit regression are presented in Table 5.

The potential correlates of efficiency were broadly grouped into four categories, as shown in Equation (5). The first addressed issues of ownership and size (*OWN*) and included dummy variables for state-owned and foreign banks as well as a variable for relative size in the form of market share defined as the ratio of a bank's assets to the total assets of the banking system.

The second group of variables consisted of bank-specific financial indicators that are part of the CAMEL (Capital adequacy, Asset quality, Management administration, Earnings, and Liquidity) rating system used by supervisory bodies, including the BNB, to assess bank performance. From the numerous CAMEL indicators, we selected the four most frequently used in the literature for which data were available (Derviz and Podpiera 2008). The ratio of equity to total assets was used as a measure of bank capitalization. Asset quality was proxied by loan loss provisions as a fraction of total loans. The return on assets was a proxy for profitability, and liquidity was measured as the share of liquid assets in total assets.

The third group of correlates (*INST*) controlled for changes in the institutional environment in which commercial banks operated. In particular, we included three variables representing progress in banking reform, large-scale privatization, and enterprise restructuring in Bulgaria. Each of the variables was measured by a composite index computed by the European Bank of Reconstruction and Development and reported in its annual *Transition Report.* The indices measure institutional development in Bulgaria relative to the standards of industrialized market economies and range from 1 (little or no change from a rigid centrally planned economy) to 4+ (standards of an industrialized market economy).

The fourth group of variables (*EU*) examined the impact of EU accession on bank efficiency. In particular, a dummy variable accounted for the effects of the signing of the Treaty of Accession by taking the value of 1 for the years 2005–7, and 0 otherwise. A second dummy variable for EU accession took the value of 1 for 2007, and 0 otherwise. We also added the growth rate of real GDP per capita to control for macroeconomic changes.

As shown in Table 5, the estimated coefficients of the ownership dummy variables indicate that foreign banks were significantly more cost efficient and more technically efficient than domestic banks, which is consistent with the findings of previous studies on transition economies. The majority of foreign banks in Bulgaria are owned by large and established banks from Germany, France, Italy, and Austria, giving them access to advanced technology and expertise, better risk management and corporate governance, and capital from their parent banks. Moreover, foreign banks have the advantage of counting foreign firms and the most creditworthy Bulgarian companies as their clients (Koford and Tscheogl 2003).[14] Foreign corporate customers have been shown to improve the CE of banks in other transition economies (Nikiel and Opiela 2002).

Table 5. Results of the Tobit regression analysis of efficiency determinants

	Technical efficiency	Cost efficiency	Allocative efficiency
Ownership and size			
State owned	–0.072		
	(–0.95)		
Foreign owned	0.057**	0.156**	0.038
	(2.21)	(2.15)	(0.37)
Market share	0.016***	0.027*	0.021***
	(2.86)	(1.79)	(3.11)
CAMEL			
Equity/Total assets	0.003***	0.001	–0.003
	(2.64)	(0.18)	(–0.86)
Loan loss provisions/Loans	–0.001*	0.013	0.022
	(–1.92)	(0.88)	(1.47)
ROA	0.005	0.016*	0.009
	(1.49)	(1.72)	(1.01)
Liquid assets/Total assets	–0.001**	0.004**	0.004*
	(–2.00)	(2.06)	(1.77)
Institutional reforms			
Privatization	0.075		
	(0.74)		
Banking reform	–0.496***	–0.898***	–0.810***
	(–5.07)	(–2.79)	(–2.54)
Restructuring	0.418***		
	(4.08)		
GDP growth	3.54	15.69***	16.68***
	(1.53)	(3.21)	(3.45)
EU Accession			
Treaty of Accession	0.181***	0.160***	0.065
	(6.78)	(3.27)	(1.34)
EU accession	0.007	0.233***	0.249***
	(0.21)	(4.65)	(5.02)
Period	1999–2007	2003–2007	2003–2007
Observations	234	145	145
Log likelihood	157.72	35.56	37.02
Hausman test statistic	5.18	3.20	4.61
p-value	(0.39)	(0.78)	(0.47)

Notes: Market share = ratio of bank's assets to total assets of banking sector; ROA = return on assets; GDP growth = growth rate of real GDP per capita; Treaty of Accession = dummy variable that takes the value of 1 for 2005–7, and 0 otherwise; EU accession = dummy variable that takes the value of 1 for 2007, and 0 otherwise. *t*-values are in parentheses. * 10 percent significance level; ** 5 percent significance level; *** 1 percent significance level.

State-owned banks were on average found to be less technically efficient than private domestic and foreign banks over the period 1999–2002, which is also in line with previous research. The coefficient for state ownership reported in Table 5 is negative but not statistically significant because two major state-owned banks had to be dropped from the sample for the sake of a balanced panel data set over the period 1999–2007.[15] With respect to size, it appears that TE, CE, and AE were higher for banks with a larger market share because they were able to benefit from lower costs and economies of scale.

The regression results reveal further that capitalization was positively related to TE but not to CE and AE.[16] A possible explanation is that well-capitalized banks attract more

deposits because they offer implicit deposit insurance, which is reflected in lower interest expenses. Moreover, higher returns on assets were positively associated with CE.[17] The share of loan loss provisions in total loans had an adverse effect only on TE, which concurs with the results of Brissimis et al. (2008), Havrylchiyk (2006), and Yildirim and Philippatos (2007). The reason for lack of significant impact of impaired assets on the overall CE is that the average provisions-to-loans ratio of the large efficient foreign-owned banks was only slightly lower than for the rest of the banking sector. In addition, the coefficient of variation decreased over the years as the quality of the credit portfolio of less efficient banks improved.

Liquidity had a positive effect on CE and AE.[18] Given the limited role of BNB as a lender of last resort under the currency board, commercial banks need to either maintain high liquidity or rely on short-term money markets in case of a liquidity crisis. Keeping a larger share of liquid assets seems to be more efficient because it minimizes the costs of borrowing.

Enterprise restructuring contributed to higher levels of TE of banks. This reflects improvements in the credit portfolio of banks and an increase in their willingness to lend as a result of the hardening of the budget constraint, the risk of bankruptcy, and better corporate governance of firms. Large-scale privatization of state-owned enterprises did not significantly affect the TE of banks.[19] Banking reform was negatively associated with all types of efficiency. This suggests that fundamental reforms of the banking system in Bulgaria (e.g., tighter reserve requirements) adversely affected bank operations and efficiency. This finding is consistent with Fries and Taci (2005) and Asaftei and Kumbhakar (2008) but contradicts the positive relationship reported by Brissimis et al. (2008).[20]

The results also show that the efficiency of the banking system in Bulgaria was boosted during the process of EU accession. The Treaty of Accession in 2005 marked a significant improvement in TE, whereas the first year of EU membership led to pronounced gains in AE. CE improved as a result of both events. Claeys and Vander Vennet (2008) have shown that banks in EU accession countries in Central and Eastern Europe exhibit lower net interest margins than those in nonaccession countries due to increased competition, higher operational efficiency, and improved risk management.[21] In the case of Bulgaria, the adoption of EU regulations and the conclusion of accession negotiations in 2004 led to large inflows of capital, especially through subsidiaries of foreign banks. As a result, the amount of loans doubled over the period 2003–5 and doubled again over the years 2005–7 (see Table 1), which explains the increases in technical efficiency. Furthermore, EU accession increases competition and reduces sovereign and borrowing risks, which in turn exerts pressure on bank margins and profits (Kager 2002). Our findings suggest that when Bulgaria joined the European Union, CE and AE in the banking sector increased because narrowing margins triggered streamlining measures intended to cut costs and improve productivity.

Conclusions

In this paper, we measured the efficiency of commercial banks in Bulgaria and examined its determinants over the period 1999–2007. Our findings indicate that estimates for the different types of efficiency varied between 0.63 and 0.83, and improved over time, exhibiting particularly large gains in 2005. Foreign banks were found to be more efficient than private domestic banks, which is consistent with previous research. However, the efficiency gains attained by private domestic banks in 2005–7 helped them catch up with

their foreign-owned competitors. State-owned banks were the worst performers, but their efficiency recovered following privatization and restructuring.

Furthermore, our analysis identified a number of financial, institutional, and EU-related variables that determined efficiency levels of Bulgarian banks over the sample period. Profitability, liquidity, and capitalization were shown to have a positive effect on efficiency. A larger market share and foreign ownership were also associated with higher efficiency levels. Enterprise restructuring boosted bank efficiency by improving the governance and creditworthiness of corporate clients. Bank reforms, on the other hand, were inversely related to TE and had no significant effect on CE or AE. Our findings also indicate that accession to and membership in the European Union have contributed to marked improvements in bank performance.

Notes

1. For an overview of the 1996–97 financial crisis in Bulgaria and its implications, see Berlemann and Nenovsky (2004), Dobrinsky (2000), Horvath and Szekely (2003), and Vutcheva (2001).

2. Nenovsky and Hristov (2002) provide a comprehensive review of the currency board arrangement in Bulgaria and its implications for the financial system.

3. In accordance with EU directives, the regulations introduced new accounting standards, imposed limits on large credit exposure, set the level and structure of minimum capital requirements, defined the classification of risk exposure and required adequate provisions for loan losses, limited the investment by banks in less liquid assets, and strengthened the supervision of the banks' liquidity management by the BNB (for an overview, see the annual reports of the BNB for 2005–7).

4. The only study in this group that has focused on Bulgarian banks is Nenovsky et al. (2008). They estimate only technical efficiency, do not investigate the determinants of efficiency, and use a shorter period than our study, which prevents them from exploring the effects of EU accession on efficiency.

5. Some studies found that foreign banks in Central and Eastern Europe were not more efficient than domestic banks (Green et al. 2004). For the Balkans, Bonin (2004) showed that foreign ownership in the banking sector was neither a necessary nor sufficient condition for effective financial intermediation.

6. It is important to note that the efficiency estimates resulting from the bootstrap procedure evaluate the original input bundle relative to the bootstrapped isoquant rather than to the original set of output variables (Ray 2004, p. 325).

7. For the alternative production approach, which treats deposits as an output rather than an input, see Sherman and Gold (1985). In the literature on bank efficiency in transition economies, the production approach has been adopted by Grigorian and Manole (2006) and Fries and Taci (2005).

8. For the price of capital, we used alternatively the ratio of operating expenses (net of interest and personnel expenses) to total assets; however, this did not result in any significant changes in the CE estimates.

9. Although BankScope reports personnel expenses by bank, they were not used because of incomplete data for some banks and years in our sample. Nevertheless, the correlation between our estimates and the actual personnel expenses available from BankScope for each year varied between 0.95 and 0.98.

10. For the descriptive statistics of the subsamples, see Tochkov and Nenovsky (2009, table 2).

11. Two state-owned banks continued to operate after 2002 and were included in the sample, but the small number and their relatively small size were not sufficient to justify a separate category.

12. Despite mergers and takeovers, the composition of these two groups remained very stable over the sample period, resulting in a remarkably consistent categorization of banks by size across years.

13. We conducted a Hausman test with the null hypothesis that the fixed effects model is appropriate. The test statistics along with their *p*-values are reported for all three regressions at the bottom

of Table 5 and indicate that there is not enough evidence to reject the null hypothesis. Accordingly, we estimated a panel data Tobit model with group fixed effects denoted by α_i in Equation (5).

14. Greek and Turkish banks, for instance, followed corporate clients from their home countries to the Bulgarian market, where they continued servicing their needs.

15. When the model was estimated for the years 1999–2002 with all state-owned banks included, the coefficient for state ownership remained negative, but it was now significant. The corresponding estimate was −0.535 with a *t*-value of −2.38 and a *p*-value of 0.02.

16. Several studies have reported similar results, including Fries and Taci (2005), Grigorian and Manole (2006), and Yildirim and Philippatos (2007).

17. Matousek and Taci (2003) found an overall positive correlation between return on assets and CE for the Czech Republic. They further showed that although this was also true for big and foreign banks, the correlation was negative for small banks.

18. Hasan and Marton (2003) also showed that a higher share of liquid assets was linked to less cost inefficiency in the case of Hungary.

19. Although privatization accelerated after 1997, the process faced many bureaucratic hurdles and was slow in abolishing monopolies (Bitzenis 2003). The indices for large-scale privatization and enterprise restructuring remained constant over the period 2003–7 and were therefore excluded from the regressions of CE and AE.

20. A more detailed analysis of the various reform measures as conducted by Grigorian and Manole (2006) for a number of transition economies suggests that prudential requirements can have differing effects on efficiency.

21. Claeys and Vander Vennet (2008) classify Bulgaria as a nonaccession country because their study focuses on the sample period 1994–2001.

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