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Mergers and Acquisitions in the Austrian Banking Sector

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Abstract

In this paper we investigate the performance of the Austrian banks which have, either actively or passively, participated in a domestic intra-banking merger or acquisition operation since 1995. For this purpose we apply the DEA methodology in combination with a Tobit regression approach to account for the variation of the technical efficiency score due to external determinants. In order to cope with the inherent dependency problem of DEA-based efficiency scores when incorporated into regression analysis we propose a Bootstrap method. The data set used comprises an unbalanced panel of data of about 800 Austrian banks ranging over 1999 to 2002. The empirical findings support the view that intra-banking merger and acquisition activities have a positive influence on banking efficiency.

JEL classification: F36,C23, C52, G21,G24,G34

Keywords: efficiency measurement, data envelopment analysis, mergers and acquisitions, banking

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1. Introduction

The banking sector worldwide has been in a process of fundamental change for quite some time now. Consequently, merger and acquisition (M&A) activities among banks have been running very high in almost all countries over the last twenty years or so. The Austrian banking sector is no exception in this respect. Austria is said to be not only highly over-banked but also its banks are accused of being highly overstaffed, both of which have been causing severe profitability problems. Austrian banks have been among the least profitable banks worldwide ever since.

Since the mid 1990s there has been a restructuring process under way in Austria aimed to reduce the cost overload by decreasing the number of both, banks and employees. Mergers and acquisitions are an appropriate means to achieve this goal. Since 1995 more than 80 mergers and acquisitions within the Austrian banking sector have been counted. However, little is known as to the performance of those banks which were involved in intra-banking M&A activities. In this paper we investigate, apparently for the first time, whether there has been an improvement in productive efficiency of the Austrian banks which have participated in a domestic intra-banking M&A operation since 1995. For this purpose we apply the DEA methodology in combination with a Tobit regression approach to account for the variation of the technical efficiency score due to a set of external variables including M&A operations. To account for the potential impact of M&A activities on banking performance a dummy variable is used aimed to detect whether there are efficiency differences between banks involved in domestic intra-banking M&A activities and banks which have not been involved in such operations.

The paper is set out as follows: Section 2 describes the data sample and the production approach used. Section 3 presents the methodological approach. Section 4 reports the empirical findings. Section 5 concludes.

2. Input and Output Definition and Data Sample

The empirical analysis is based on a data sample consisting of an unbalanced panel of annual report data of about 800 Austrian banks. The bank data were extracted from non-consolidated income statement and balance sheet data ranging over 1999 to 2002. All data are reported in Euro, expressed in real 1995 terms by using the respective GDP deflator. The data set has been drawn from the electronic databank of the Oesterreichische Nationalbank (OeNB).

A still unresolved problem in the banking performance literature is the definition and measurement of the concept of bank output (and, of course, bank input). We do not dwell on this important question in this paper and refer the interested reader to *Berger – Mester* (2003) for a competent treatment of this topic. Instead, we follow the argumentation of *Berger – Mester* (2003) and *Drake – Hall – Simper* (2004), respectively, and employ a profit-oriented approach. According to *Berger – Mester* (2003) the profit approach seems to be better qualified to capture the ongoing changes towards higher quality services in banking

and the stronger profit-orientation of the banks' management observable since the beginning of the 1990s. Thus, we specify cost components as inputs such as employee expenses, other non-interest expenses and risk-weighted assets as measured by Basel I. The latter input variable is supposed to account for a bank's financial risk exposure which might have a significant impact on relative efficiency scores. The argument is that higher financial risk exposure is likely to elevate the bank's cost of funds (see, for example, *Akhigbe – McNulty*, 2003). The output variables consist of the following revenue components: net interest revenue, net commission revenue, and other income. To check the robustness of the regression analysis based on the efficiency scores due to the profit-oriented approach, we additionally apply the intermediation approach which views financial institutions as mediators between the supply and the demand of funds. Following *Casu – Molyneux* (2003) we specify an intermediation-oriented model consisting of two outputs (total loans, other earnings) and two inputs (first, total costs covering interest expenses, non-interest expenses, and employee expenses, respectively, and, second, the total deposits).

Table 1: Descriptive Statistics - Total Assets

	Banks M&A-involved		Banks not M&A-involved
	All banks	Without BA, CA, Erste, Girocredit	
1999			
Minimum	6.08	6.08	0.09
Maximum	105,152.83	8,683.32	23,753.04
Mean	3,944.10	835.06	318.03
Median	193.41	183.77	58.26
Standard deviation	15,366.53	1,795.36	1,644.09
Number	57	54	872
2000			
Minimum	6.78	6.78	0.11
Maximum	116,118.35	9,386.00	28,726.48
Mean	3,709.92	910.61	329.39
Median	213.56	189.81	60.53
Standard deviation	15,417.84	2,098.07	1,769.01
Number	70	67	826
2001			
Minimum	6.45	6.45	0.12
Maximum	97,522.94	11,189.83	37,087.02
Mean	3,263.24	1,070.54	341.52
Median	187.84	177.04	66.28
Standard deviation	12,688.62	2,476.48	2,013.06
Number	82	79	799
2002			
Minimum	4.98	4.98	0.14
Maximum	104,882.28	10,989.31	35,899.78
Mean	2,896.90	1,076.70	348.50
Median	216.65	203.43	66.19
Standard deviation	12,727.21	2,447.42	1,966.70
Number	86	84	786

Source: OeNB, own calculations; minimum, maximum, mean and median as mn € at 1995 prices.

Table 1 shows some descriptive statistics of the bank sample used. The average size of the banks involved in intra-banking M&A activities is bigger than that of banks not involved in M&A, even when the 'mega-mergers' of Bank Austria – Creditanstalt and Erste Bank –Giro-credit, respectively, are excluded. The Data Appendix gives the details on the definition of the variables and the data sources, respectively.

3. Measuring Performance – The Formal Approach

The DEA model proposed to compute technical efficiency is the input-oriented slacks-based DEA model (SBM) due to *Tone* (2001). The basic SBM is a linear mathematical program with the following structure:

$$\begin{aligned} \min_{t,\lambda,s^-,s^+} \quad & \tau = t - \tfrac{1}{m}\sum_{i=1}^{m}\frac{S_i^-}{x_{io}} \\ subject\ \ to \quad & 1 = t + \tfrac{1}{s}\sum_{r=1}^{s}\frac{S_r^+}{y_{ro}} \\ & tx_o = \mathrm{X}\Lambda + S^- \\ & ty_o = \mathrm{Y}\Lambda + S^+ \end{aligned} \tag{1}$$

with $\mathrm{X} = \left(x_{ij}\right) \in \Re^{m\times n}$, $\mathrm{Y} = \left(y_{ij}\right) \in \Re^{s\times n}$ representing the set of inputs and outputs, respectively, $S^- = ts^- \geq 0,\ S^+ = ts^+ \geq 0,\ \Lambda = t\lambda,$ where t is a positive scalar variable and $\lambda \in \Re^n$, s^-, s^+ denote the total (that is, radial and non-radial) input and output slack vectors defined as $x_o = \mathrm{X}\lambda + s^-$ and $y_o = \mathrm{Y}\lambda + s^+$, respectively[1]). As usual in the DEA framework, the relative efficiency scores τ_i are bounded by zero (lowest level of efficiency) and unity (highest level of efficiency).

The SBM has two important properties which lack standard DEA models: First, the relative efficiency measure gained by this model is invariant with respect to the unit of measurement of each input and output item, and second, the efficiency measure is monotone decreasing in each input and output slack (*Cooper – Seifried – Tone*, 2000). That is to say, the SBM deals with input excesses and output shortfalls directly by incorporating the information contained in the slacks into the objective function. No matter what the scale of the measurement the SBM generates a representative measure able to gauge the depth of inefficiency by reflecting non-zero slacks in inputs and outputs when they are present.

[1]) For a definition and related illustration of radial and non-radial input slack, see *Fried – Schmidt – Yaisawarng* (1999), Figure 1.

The efficiency measures derived from the DEA estimations are then used as the dependent variable in the following Tobit-censored regression approach:

$$\tau_i = \beta_0 + \beta_1 FUSI_i + \beta_2 SPAS_i + \beta_3 BRPK_i + \beta_4 OFF_i + \beta_5 ROE_i + \varepsilon_i \,, \quad i = 1,....,n, \qquad (2)$$

where $FUSI$ is a dummy variable to distinguish between banks which have been part of a intra-banking merger and/or acquisition activity since 1995 and banks which have not. The variable $SPAS$ denotes the total assets of a bank. By including the total assets of each bank in the regression equation we try to account for the differences in efficiency due to different size. A common result in the established literature is that larger banks are more likely to be more efficient than smaller banks. The variable $BRPK$ represents the GDP per capita of the region (that is, the political district) where the bank under study is headquartered. This indicator is supposed to reflect the state of economic development of a bank's home market. Though for riskness is controlled in the profit-oriented DEA approach we introduce an additional risk indicator to the regression approach. A bank's exposure to credit risk is captured by OFF defined as risky credits over total assets. A bank with more risky credits in its books is expected to be less efficient than a bank with a less risky credit portfolio. Since many studies observe a positive relationship between profitability and efficiency we add ROE, the return on equity of each bank, to the set of explanatory variables.

An inherent property of all DEA models is that all measures generated by these models are dependent on each other in the statistical sense. This critical point has been recently raised by *Xue – Harker* (1999). The authors argue that the dependency property triggers a serious setback when the DEA efficiency scores are used in standard regression analysis to explain the variations of efficiency. Because the DEA measures violate the assumption of independence within the sample, statistical inference is impaired when standard regression techniques are applied without controlling for this constraint. Thus, conclusions reached on the basis of standard regression analysis may be flawed since given dependency of the response variable the standard errors of the regression coefficient estimates are no longer correct. That is, the $t-$ratios and the $p-$values for the hypothesis tests are very likely to be severely biased. As a possible tool to fix this problem *Xue – Harker* (1999) suggest the Bootstrap method. We follow this recommendation and use the Bootstrap estimator to check the standard errors of the Tobit estimates. For a formal description of the used procedure the reader is referred, among others, to *Hahn* (2004). A similar approach to overcome the dependency problem in a two-stage framework has been chosen by *Casu – Molyneux* (2003).

4. Empirical Results

First, we report the results of the DEA efficiency analysis relative to the common frontier. Table 2 shows the average efficiency scores of the input-oriented, variable returns-to-scale SBM model based on the profit-oriented approach and the intermediation approach, respectively[2]). The period of analysis ranges from 1999 to 2002.

Table 2: Input-oriented SBM Efficiency – Total Sample

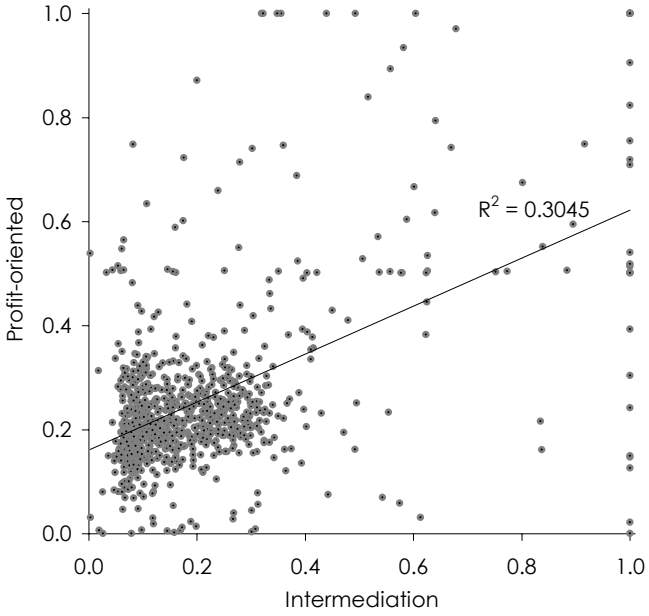
		Profit-oriented model	Intermediation model
1999			
	Mean	0.1934	0.2285
	Median	0.1374	0.1902
	Standard deviation	0.2072	0.1602
2000			
	Mean	0.1686	0.2717
	Median	0.0726	0.2337
	Standard deviation	0.2126	0.1684
2001			
	Mean	0.1826	0.2996
	Median	0.0977	0.2672
	Standard deviation	0.2138	0.1656
2002			
	Mean	0.2198	0.2626
	Median	0.1611	0.2216
	Standard deviation	0.2010	0.1679

The summary of the efficiency results reveals a rather high degree of inefficiency. Both models generate low efficiency levels for all years under study. The low levels of efficiency are not uncommon in bank efficiency studies which do not account for environmental factors (for a discussion of this topic, see *Hahn*, 2004). The scores range from 0.17 (2000) to 0.30 (2001) with the estimates due to the intermediation approach slightly higher than that of the profit-oriented approach. As illustrated in Figure 1 the efficiency scores generated by the used approaches are only weakly correlated.

It is worth noting that the results are not sensitive to outliers according to standard outlier checks (see, for example, *Resti*, 1997).

[2]) The relative efficiency scores were obtained from the DEA Solver Professional Program due to *Cooper – Seifried – Tone* (2000).

Figure 1: SBM-Efficiency Scores 2002
Profit-oriented approach versus intermediation approach



A summary of descriptive statistics of the estimated efficiency scores of banks which have been involved in intra-banking M&A activities since 1995 and that of banks which have not are reported in Table 3.

Table 3: Input-oriented SBM Efficiency

		Banks M&A-involved		Banks not M&A-involved	
		Profit-oriented model	Intermediation model	Profit-oriented model	Intermediation model
1999					
	Mean	0.3436	0.2897	0.1871	0.2236
	Median	0.2518	0.1974	0.1260	0.1895
	Standard deviation	0.2618	0.2318	0.2048	0.1519
2000					
	Mean	0.3003	0.3327	0.1612	0.2648
	Median	0.2220	0.2449	0.0685	0.2312
	Standard deviation	0.2628	0.2375	0.2101	0.1574
2001					
	Mean	0.3213	0.3747	0.1713	0.2914
	Median	0.2258	0.2763	0.0920	0.2660
	Standard deviation	0.2796	0.2318	0.2045	0.1555
2002					
	Mean	0.3530	0.3278	0.2101	0.2568
	Median	0.2669	0.2328	0.1496	0.2208
	Standard deviation	0.2566	0.2273	0.1958	0.1603

The findings shown in Table 3 suggest that intra-banking M&A activities do have a positive impact on banking efficiency. We check this impression by running a Tobit-censored regression which controls for standard external determinants of bank efficiency as described in equation (1). The results of the Tobit regression for 1999, 2000, 2001, and 2002 are summarized in Table 4. We report the conventional estimates since these results do not differ significantly from those of the Bootstrap estimators based on 1,000 Bootstrap samples.

Overall, the Tobit results presented in Table 4 suggest that intra-banking M&A activities may cause efficiency differences among banks. There is a positive and statistically significant relationship between the dummy $FUSI$ and banking efficiency for all years under study based on efficiency scores derived from the profit-oriented approach. The evidence is less persuasive when efficiency scores due to the intermediation approach are used as dependent variable.

Table 4: Tobit-censored Regression Estimates

		Profit-oriented model				Intermediation model			
		$\hat{\beta}_i$	Standard error	*t- value*	Pr(>|t|)	$\hat{\beta}_i$	Standard error	*t-value*	*Pr(>|t|)*
1999									
	Constant	-0.06595	0.02233	-2.953	0.0032	0.01387	0.01717	0.808	0.4189
	FUSI	0.06925	0.02446	2.831	0.0046	0.00035	0.01868	0.019	0.9851
	SPAS	0.00010	0.00001	10.239	0.0000	0.00001	0.00000	2.268	0.0234
	BRPK	0.00001	0.00000	8.079	0.0000	0.00001	0.00000	10.190	0.0000
	OFF	-0.00029	0.00006	-4.470	0.0000	0.00010	0.00004	2.949	0.0032
	ROE	0.00102	0.00011	8.927	0.0000	0.00059	0.00008	7.441	0.0000
2000									
	Constant	-0.10337	0.02289	-4.516	0.0000	0.06090	0.01789	3.404	0.0007
	FUSI	0.06647	0.02274	2.923	0.0035	0.01133	0.01769	0.641	0.5218
	SPAS	0.00008	0.00001	8.864	0.0000	0.00003	0.00001	4.947	0.0000
	BRPK	0.00001	0.00000	8.994	0.0000	0.00001	0.00000	9.488	0.0000
	OFF	-0.00018	0.00006	-2.809	0.0050	0.00001	0.00004	0.172	0.8633
	ROE	0.00074	0.00009	8.370	0.0000	0.00043	0.00006	7.333	0.0000
2001									
	Constant	-0.11168	0.02160	-5.172	0.0000	0.10417	0.01844	5.650	0.0000
	FUSI	0.05516	0.02020	2.731	0.0063	0.03168	0.01686	1.880	0.0602
	SPAS	0.00011	0.00001	11.883	0.0000	0.00002	0.00000	4.313	0.0000
	BRPK	0.00001	0.00000	9.239	0.0000	0.00001	0.00000	8.184	0.0000
	OFF	-0.00021	0.00005	-3.963	0.0001	0.00008	0.00004	2.184	0.0290
	ROE	0.00106	0.00009	11.978	0.0000	0.00055	0.00007	7.701	0.0000
2002									
	Constant	-0.05137	0.02124	-2.419	0.0156	0.05076	0.01882	2.698	0.0070
	FUSI	0.06378	0.01916	3.329	0.0009	0.02644	0.01672	1.582	0.1137
	SPAS	0.00011	0.00001	12.308	0.0000	0.00004	0.00001	6.922	0.0000
	BRPK	0.00001	0.00000	8.905	0.0000	0.00001	0.00000	8.791	0.0000
	OFF	-0.00023	0.00005	-4.656	0.0000	-0.00013	0.00004	-3.435	0.0006
	ROE	0.00091	0.00009	10.249	0.0000	0.00061	0.00008	7.988	0.0000

The signs of the coefficients of the other determinants meet, to a large extent, the expectation established in the respective literature. The positive and statistically significant sign on the $SPAS$ and the $BRPK$ variable, respectively, indicates that larger banks are more technically efficient than their smaller counterparts, and banks headquartering in high-income regions are more efficient than banks located in rural or low-income areas. We also find sufficient evidence in favor of the hypothesis that credit risk exposure (OFF) influences bank efficiency levels negatively. Finally, in accordance with a huge body of related studies we also detect a positive and statistically significant relationship between bank efficiency and profitability as measured by ROE.

5. Conclusion

The paper investigates whether there has been an improvement of productive efficiency across the Austrian banking sector due to intra-banking M&A activities occurring since 1995. Applying an input-oriented, slacks-based DEA model to derive relative efficiency measures for each bank of the sample we evaluated the determinants of bank efficiency by using the Tobit-censored regression approach.

Overall, the DEA results indicate that the average efficiency level of the Austrian banks is low and shows no improvement over the years under study (that is, 2002, 2001, 2000 and 1999). This finding is in line with the established literature. Low levels of efficiency are common in bank efficiency studies which do not account for environmental factors. More importantly, the subsequent regression analysis provides evidence that intra-banking M&A activities did have a positive impact on bank efficiency in Austria in recent years. The empirical evidence gained also suggests that larger banks are more efficient than smaller banks, and banks headquartering in rich regions are more productive than banks in rural or low-income areas. Finally, the estimates suggest that high credit risks is likely to drag bank efficiency down.

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Data Appendix: Variables and Sources

Variable	Position code resp. definition	Original source
Employee expenses (mn. €)	0040000	OeNB, Annual Reports Statistics of Austrian Banks
Non-interest expenses (mn. €)	0050000	OeNB, Annual Reports Statistics of Austrian Banks
Risk-weighted assets (mn. €)	4150500	OeNB, Annual Reports Statistics of Austrian Banks
Other income (mn. €)	0806000	OeNB, Annual Reports Statistics of Austrian Banks
Net interest revenue (mn. €)	1800000	OeNB, Annual Reports Statistics of Austrian Banks
Net commission revenue (mn. €)	030100-030200	OeNB, Annual Reports Statistics of Austrian Banks
Total costs (mn. €)	0802020+0030200+808000+0810000	OeNB, Annual Reports Statistics of Austrian Banks
Total deposits (mn. €)	4020000	OeNB, Annual Reports Statistics of Austrian Banks
Total loans (mn. €)	3040000	OeNB, Annual Reports Statistics of Austrian Banks
Other earnings (mn. €)	0030100	OeNB, Annual Reports Statistics of Austrian Banks
SPAS (total assets) (mn. €)	4000000	OeNB, Annual Reports Statistics of Austrian Banks
OFF (risky credits over total assets, mn. €)	4150200	OeNB, Annual Reports Statistics of Austrian Banks
ROE (return on equity) (%)	(1800000+0803020+0030100–0030200+0806000) / (4090000+4100000+4110000+4120000+4140000) x 100	OeNB, Annual Reports Statistics of Austrian Banks
GDP-deflator	1995 = 100	WIFO data base
FUSI (dummy)	Banks at least once involved in intra-banking M&A activities since 1995	OeNB
BRPK (€)	Regional GDP per capita	Statistics Austria

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