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and Their Impact on
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Endogenous Bank Mergers and Their Impact on Banking Performance

Evidence from Austria

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Abstract

This paper examines the effect of mergers on the performance of banks. We use a unique and exhaustive panel data set of mergers of Austrian banks covering the period from 1996 to 2002. A probit selection equation is formulated to explain the adoption of a merger strategy. We use various matching techniques to estimate the treatment effects of bank mergers on the banks' performance. The analysis provides evidence in favor of the view that there are longer lasting positive effects on bank performance, especially, in terms of improved cost efficiency. The findings also suggest that pre-merger effects are likely to occur in terms of higher cost efficiency immediately before the establishment of the merger. Finally, smaller banks involved in merger activities are more likely to enjoy cost-efficiency gains earlier than larger banks.

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

Keywords: Sample selection, matching techniques, merger effects, banking performance

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1. Introduction

The strategic priority in banking has changed over the recent decades with the emphasis on profitability, performance and value creation rather than on growth and size. Internationally, a variety of policies has been adopted to achieve these goals, all of which aimed at consolidating, restructuring and rationalizing banking activities. Among the policies applied in-market merging has emerged as one of the most preferred strategies.

The Austrian banking sector has been very much affected by these processes of structural change, particularly by the tendency to improve performance by engaging in merger operations. For decades, Austria was said to be not only highly overbanked but also its banks were accused of being highly overstaffed, both of which lowered banking profitability. With the number of credit institutions well beyond 1,200, a branching network counting almost 4,500 units and a population of 8 million, Austria belonged to the group of countries with the highest banking density in the OECD area. Since the great majority of banks was small or medium-sized and banking activities were hampered by regional demarcation, Austrian banks had been among the least profitable banks within the OECD until the early 1990s (see, for example, *Mooslechner, 1995*).

As in many other OECD countries, performance orientation in banking has led to an increase of concentration and consolidation within the Austrian banking system since then (that is, the early 1990s). However, the reduction in the number of banks from 1,210 (1990) to 883 (2004) was only accompanied by a relatively minor decrease of bank offices from 4,497 (1990) to 4,359 (2004). Despite the ongoing consolidation process the Austrian banking sector has remained relatively low concentrated. Bank concentration, as measured by the share of the 5 largest banks in total assets, increased by a small margin from 39.9 percent (1995) to 46.9 percent (2004).

Though there has been a number of domestic mergers and acquisitions involving the country's then largest banks (i. e., Erste Bank and Girocredit, Bank Austria and Creditanstalt) and one major cross-border acquisition (Bank Austria-Creditanstalt taken over by the German HypoVereinsbank), the core of the "consolidation wave"

was made of domestic mergers among small to medium-scaled regional banks, primarily within the group of mutual and cooperative banks and within the savings banks group. As observed internationally, bank mergers and bank acquisitions crossing two or more bank groups have been quite rare in Austria.

In the analysis to follow we conceptually distinguish between mergers and acquisitions not only because the latter operation is driven by different motives and, hence, may lead to different results but also because banking acquisitions have been too rare in numbers in Austria over the period of investigation, that is, from 1996 to 2002. Accordingly, we refer to a bid as a merger when the active bank fully integrates (the assets and the operations of) the target bank whereas acquisition operations are characterized by purchasing a controlling stake in the target bank with the aim to keep the target bank going as a separate entity (the same distinction between merger and acquisition has been made by *Focarelli – Panetta – Salleo, 2002*). Given these definitions, within the time-span from 1996 to 2002 118 domestic in-market banking mergers have been observed in Austria while there have only been a few domestic acquisitions (only 8, albeit prestigious ones on a national scale). Though the cross-border acquisition activities of Austrian banks have significantly increased since the beginning of the last decade with the primary aim to gain access to the emerging markets in Central Eastern Europe, the number of these operations is also, for the time being, too small to base statistical inference upon.

The far greater empirical importance of mergers and the availability of a newly compiled high-quality dataset covering all domestic in-market bank mergers from 1996 to 2002 have led us to concentrate the analysis solely on the investigation of domestic in-market mergers and their impact on the profit and efficiency performance of the merging banks. The view that domestic in-market mergers are an excellent means to improve banking performance is quite popular among both, academics and bankers (see, for example, *European Central Bank, 2000*).

With too many too small banks and a rather strong regional demarcation, the Austrian banking system resembles to a large degree the banking industries of quite a number of European countries and, hence, may serve as an excellent testbed for exploring the role of domestic in-market mergers in the ongoing process of

increasing consolidation, concentration and profitability in banking. Particularly due to this very instance do we harbor the hope that the findings of this investigation may also be of some value for the international discussion on mergers in banking.

The paper is set out as follows: section 2 outlines the theoretical arguments commonly put forward to justify in-market merger activities, particularly small domestic mergers in a banking industry with both a strong regional demarcation and a division in various bank groups. Section 3 outlines and motivates the methodological approach. Section 4 describes the data sample used and reports the empirical results. Section 5 concludes.

2. Rationale for Domestic Bank Mergers

Increasing competition due to deregulation and liberalization in the financial services sector has triggered a race to improve banking efficiency and banking profitability in almost all countries. Economic theory suggests a variety of motives why mergers may be an appropriate means of achieving this goal. In a sense, economies of scale and scope play the prime role in the theoretical underpinning of merger activities. Scale economies may enable banks to offer more products and services while scope economies may allow providers of multiple products and services to increase the market share of targeted customer activities. It is maintained that increasing scale and scope economies by merging with another bank be the faster and less costly way to improve profitability than spurring internal growth.

Empirical research on post-merger performance gains have primarily focused on efficiency improvements, increased market power, and heightened diversification. Among the efficiency gains, cost efficiency increases are the most prominent. Many mergers have been motivated by the belief that a significant quantity of redundant operating costs could be eliminated through the consolidation of activities. Further, it is argued, cost efficiency may also be improved through merger activity if the management of the acquiring bank is more skilled at holding down expenses for any level of activity than of the target bank. Further, bank mergers are expected to enlarge the market share of the bidder banks and increase their market power which allows for higher prices and, hence, higher profits. Greater diversification may be a reason for raising merger activities because asset and customer diversity can

be increased due to broadening the geographic reach, increasing the breadth of the products and services offered, and adding new customers to the existing clientele.

Goddard – Molyneux – Wilson (2001) mention the pursuit of size or growth for its own sake as one of the important non-profit motives for mergers. They argue that managerially controlled banks may seek to merge in order to become bigger if managerial objectives such as salary, power or status depend primarily upon firm size and market power¹⁾.

However, there is a paradox in conjunction with merger activities: Although bank mergers appear to be well motivated by theory and, more importantly, continue to grow in numbers, empirical research has so far failed to find evidence in favor of merger gains. There is a huge body of studies providing convincing evidence against the existence of merger gains and there are only a few studies which find a positive relationship between merger activities and efficiency gains. This particularly holds for studies which focus on U.S. bank mergers²⁾. *Berger – Humphrey* (1992), for example, find in their seminal paper that, on average, mergers occurring in the U.S. during the 1980s led to no significant gains in productive efficiency. This finding was confirmed by *Akhavain – Berger – Humphrey* (1997) who observed, for the same period, no significant changes of post-merger profitability, as measured by traditional profitability measures such as "return on assets" and "return on equity", respectively. Similarly, *Rhoades* (1993) investigating U.S. in-market bank mergers from 1981 to 1986 cannot detect cost reductions and efficiency gains related to horizontal mergers, either. Studies based on stock market reactions to merger announcements also generally fail to find post-merger gains (for a recent study, see, for example, *Elfakhani – Ghantous – Baalbaki*, 2003). A rare exception is the study of *Zhang* (1995) who observed a significant increase in overall value, as measured by the cumulative-abnormal-returns method, due to mergers taking place between 1980 and 1990 in the U.S.

¹⁾ Greater diversification due to a merger may also contribute to a greater job security for managers.

²⁾ See *Pilloff – Santomero* (1997) for a competent review of the published literature on U.S. bank mergers.

A similar study of the European market on this issue by *Cybo-Ottone – Murgia (2000)* is more in line with the great bulk of U.S. studies. Analyzing 26 mergers of European financial services firms occurring between 1988 and 1995 in 13 European banking markets, the authors detect, in the year following the merger, no significant change of the combined value of the acquirer and target bank. Altogether, however, the evidence from Europe has so far been more mixed than from the U.S., with gains more likely to be detected for small domestic mergers rather than for large bank mergers, particularly for large cross-border mergers (see, for example, *European Central Bank, 2000*, and *Huizinga – Nelissen – Vander Venet, 2001*).

This raises the question why bank mergers continue to be so prevalent when gains are so hard to pin down on average. A popular explanation for this blatant inconsistency is managerial hubris. *Roll (1986)* pioneered this "hubris" theory of M&A activities stressing "that successful acquirers may be optimistic and overconfident in their own valuation of deal synergies, and fail to properly account for the winner's curse" (*Baker – Ruback – Wurgler, 2004*).

In our view, the prime reason for the more affirmative and differentiated evidence as to the gains of bank mergers in Europe is, first of all, due to the fact that small-scaled domestic merger operations are more frequent in Europe than in the U.S. and, hence, the data situation in Europe allows, to a much larger degree than in the U.S., for the application of advanced econometric methods³). Beyond that, as compared with the U.S., banking in European countries is much stronger divided in various sub-sections such as commercial banks, mortgage banks, savings banks, and cooperative banks, with the latter two groups being stronger vertically integrated than the former (for example, in Austria each savings bank or cooperative bank belongs to a banking group that is organized as a multiple-tier system with the group's largest bank, the so-called 'Spitzeninstitut', at the top functioning not only as an in-group clearing and settlement institution but also as the strategic mastermind of the banking group). As a result, in many European countries mergers between banks belonging to the same sub-sector occur more frequently than those crossing two or more sub-sectors. This is often viewed as a *sine qua non* to improve both the

³) Large bank mergers or even mega-mergers, mostly at the centre of U.S. studies, are often too complex to be fully covered by the econometric tools available.

performance at the firm level and at the sector level within a banking industry which is characterized by both a division in various sub-groups and a traditionally strong regional demarcation. The latter particularly applies to Austria.

The availability of a comprehensive micro-database for Austrian universal banks covering the period from 1996 to 2002 together with a set of local and regional data compiled by the Austrian Institute of Economic Research (WIFO) puts us into the position to tackle modeling these very forces that are likely to have driven the in-market-in-group mergers in the Austrian banking sector since 1996.

3. Methodological Approach

Due to the predominance of in-market-in-group bank mergers in Austria, we choose an analytical approach which appreciates the idea that bank mergers do not occur randomly but arise endogenously. Accordingly, taking account of the potential endogeneity of bank mergers is a prerequisite for consistent inference as to the impact of in-market merger operations on bank performance. For the empirical analysis, two questions are of interest here. First, we are interested in an explanation of selection into treatment (i. e., establishing a merger). Hence, the determinants of bank merger activity are at issue. Since bank mergers are captured by a binary, time-variant variable this issue can be analyzed in a probit or a logit model. The reasonable selection of independent variables shows up in a relatively high pseudo- R^2 , indicating a good explanatory power of the empirical model. Second, there are three branches of literature on addressing the second question of interest, in our case the impact of endogenous mergers on measures of bank performance. These three industries of research are associated with (i) matching techniques based on the propensity score (see *Rosenbaum – Rubin*, 1983, 1984, *Abadie*, 2005, *Imbens*, 2004), (ii) estimating the selection equation and the average treatment effect equation jointly by maximum likelihood (see *Heckman*, 1978), or (iii) adopting an instrumental variable approach (see *Wooldridge*, 2002).

We will adopt matching techniques which, in addition to a reasonable set of relevant observables on which the selection is based, hinge on what is referred to as the "balancing property". The latter requires that the treatment group (i. e., the merging banks) and the controls (the subgroup of non-merging banks which the

treated are compared to with respect to an outcome variable such as bank profitability) are virtually identical to the treated besides the treatment. Hence, we need to rely on a metric (such as the propensity score metric or the Mahalanobis distance metric) to define "similarity" between treated and control units and for this metric to be meaningful, the two groups of units need to be similar (ideally identical) with respect to each explanatory variable ("observable"). Several concepts of treatment effects are available. Specifically, the treatment effect of the treated (i. e., the impact of merging on the actually merged banks) and the average treatment effect (i. e., the effect of merging on a randomly drawn unit, unconditional on having actually merged) are typically estimated.

With time-variant treatment and outcome data, it is possible, to analyze the impact of switching into treatment (i. e., a new merger) on the change of an outcome variable. This is potentially important since in cross-sections we often are faced with treated units that differ substantially with respect to the time when they have received the treatment. Especially, if the treatment effect does not immediately take place, the estimated effect is contaminated by complicated time composition effects. This can be avoided by a difference-in-difference analysis that (i) provides treatment effect estimates which are free of the described sample-composition effects and (ii) can address issues of the time pattern of treatment effects on outcome (such as bank profitability). For example, one can study immediate versus sluggish adjustment and anticipation versus lag effects. Due to this obvious advantage, we will stick to difference-in-difference estimation below.

4. Empirical Analysis

4.1 The Data

We use a unique dataset consisting of annual report data of more than 800 Austrian universal banks. The bank data were extracted from non-consolidated income statement and balance sheet data ranging over 1996 to 2002. The bank data were drawn from the electronic database of the Oesterreichische Nationalbank (OeNB).

Table 1 provides details on the overall sample size and the occurrence of bank mergers in each year. Altogether, about 10 percent of the banks in the sample have

been merged within the covered time span. Additionally, we have information on which banks were merged before 1996. This will allow us later on to select only those banks in the control group that never were part of a merger.

We consider four different outcome variables that are assumed to reflect a bank's performance. These are the "cost-income ratio" (operating expenditure over operating revenue) which is the most common measure of cost efficiency in banking, the "return on employee" (operating revenue per employee) which is supposed to measure labor productivity in banking, and the profitability measures "net revenue ratio" (net yield over equity) and "return on equity" (net profit over equity), respectively. In case of a positive impact of mergers on the performance of the involved banks, we would expect to detect a negative impact on the cost-income ratio and a positive impact on return on employee, net revenue ratio and return on equity, respectively.

The employed explanatory variables cover four different areas aimed at collecting information (i) on the banks' operations as reflected in the balance sheet, (ii) on the banks' cost-income structure as reflected in the income statement, (iii) on the banks' position in their local bank market and their competitive environment and (iv) on the demand structure for banking services at the local level as provided by the Austrian Census⁴⁾. Descriptive statistics of all these variables are given in Table 1. The Appendix gives the details on the definitions of the variables and the data sources, respectively.

⁴⁾ The local or home market of a bank is proxied by the administrative district (or county) where its head office is located. An Austrian administrative district is a geographic unit just below the NUTS-III level of EUROSTAT, covering, on average, an area of 847 square kilometers with a population of 87,000. Only less than 20 percent of the Austrian banks entertain branch offices outside of the administrative district where their head office is established. Although the demand for banking services is not restricted by district borders, we hold that the likelihood be high that local banks do provide most of the services demanded by their local clientele.

Table 1: Descriptive Statistics

| Variable | Observation | Mean | Standard deviation | Minimum | Maximum |
|--|-------------|--------|--------------------|---------|-----------|
| <i>Balance sheet:</i> | | | | | |
| Total assets | 5,491 | 286.50 | 1,590.74 | 0.09 | 40,030.21 |
| Supplementary capital | 5,491 | 18.14 | 91.05 | 0.03 | 2,361.75 |
| Other earning assets | 5,491 | 119.90 | 942.10 | 0.00 | 24,417.90 |
| Deposits | 5,491 | 193.51 | 1,011.66 | 0.00 | 29,943.30 |
| Equity | 5,491 | 18.29 | 86.73 | 0.00 | 2,393.86 |
| <i>Income statement:</i> | | | | | |
| Net profit | 5,491 | 0.29 | 2.17 | -17.62 | 51.50 |
| Operating revenues | 5,491 | 7.70 | 26.94 | 0.00 | 744.93 |
| Total expenses | 5,491 | 15.66 | 79.48 | 0.00 | 2,002.25 |
| Net commission earned | 5,491 | 1.51 | 6.01 | -27.32 | 184.53 |
| Net interest revenue | 5,491 | 6.83 | 24.64 | -1.99 | 727.94 |
| <i>Performance indicators:</i> | | | | | |
| Cost-income ratio | 5,490 | 69.52 | 25.72 | 0.26 | 675.71 |
| Return on employee | 5,350 | 172.46 | 457.03 | 8.00 | 21733.00 |
| Net revenue ratio | 5,491 | 61.80 | 54.90 | -19.51 | 2063.37 |
| Return on equity | 5,491 | 7.79 | 21.00 | -488.81 | 542.79 |
| <i>Regional variables based on a bank's home district:</i> | | | | | |
| Population | 5,491 | 75,086 | 41,542 | 1,714 | 2226,244 |
| Population density | 5,491 | 1,266 | 3,269 | 21 | 24,433 |
| Share of elderly | 5,491 | 15.59 | 2.55 | 11.4 | 23.5 |
| Unemployment rate | 5,491 | 6.39 | 2.02 | 2.7 | 11.4 |
| Growth of real gross regional product | 5,491 | 2.30 | 1.74 | -3.4 | 7.5 |
| Gross regional product per capita | 5,491 | 22,806 | 6,580 | 11,200 | 36,800 |

4.2 Selection on Observables into Merging

We formulate the following probit model to assess the determinants of the occurrence of a bank merger:

$$(1) \quad P(\Delta M_{it} > 0) \approx P\left(\alpha_0 + \sum_{k=1}^K \alpha_k X_{k,i,t-1} + \varepsilon_{it} > 0\right)$$

where α_0 is a constant, K denotes the number of explanatory variables $X_{k,i,t-1}$ in the selection equation, and $\varepsilon_{it} \sim iid N(0, \sigma_\varepsilon^2)$ is a standard error term. The left-hand-side variable ΔM_{it} is set at one in year t from the period where the treatment is applied

(in our case, banks are merged). Tables 2 and 3 summarize our findings for different probit model specifications that aim at explaining the probability of a merger. Whereas the models in Table 2 cover all cases between 1996 and 2002, the models in Table 3 exclude those banks that are active in all states ("Bundesländer") of the country. We refer to these banks as "national players". We report these results separately, since there is some likelihood that a few big banks behave very differently from the median so that the probability of merging as well as its effect on these banks' performance could dominate the overall result.

In both Tables, we report the preferred specification in the first column after the variable labels. In order to shed light on the relative importance of the four blocks of explanatory variables, we also run regressions where we employ each block of determinants separately. It is easy to see that each of these specifications is significantly rejected against the least parsimonious Model 1 in terms of likelihood ratio tests. Also, Model 1 is characterized by a very high pseudo- R^2 , also as compared to Model 2 to 5, irrespective of whether we consider Table 2 or 3.

From Table 2 and Table 3 it becomes obvious that the regional determinants are quite important to explain merger activity of Austrian banks. Hence, an analysis that focuses on the firm-specific variables likely suffers from omitted variables bias. Among the firm-specific variables, those reflecting a bank's market position tend to be relatively more important than the determinants contained in balance sheet or income statement data. However, the variables in each of these blocks enter jointly significantly Model 1 and Model 6, respectively.

Table 2: Probit Selection Equation (including national players)

| Explanatory variables | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | |
|--|---------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| | β | std | β | std | β | std | β | std | β | std |
| <i>Home market position:</i> | | | | | | | | | | |
| Dominant player | -4.462 | 1.451 *** | -2.512 | 0.598 *** | - | - | - | - | - | - |
| Oligopolistic player | -2.299 | 0.477 *** | -1.204 | 0.215 *** | - | - | - | - | - | - |
| Regional player | -0.536 | 0.573 | -0.076 | 0.259 | - | - | - | - | - | - |
| Number of the bank's branches | -0.023 | 0.022 | 0.009 | 0.004 ** | - | - | - | - | - | - |
| Maximum home market share | 15.052 | 2.525 *** | 5.194 | 0.853 *** | - | - | - | - | - | - |
| Minimum home market share | 2.753 | 2.164 | 2.450 | 0.930 *** | - | - | - | - | - | - |
| National player | 1.107 | 2.163 | -0.136 | 0.491 | - | - | - | - | - | - |
| <i>Income statement:</i> | | | | | | | | | | |
| Net profit | -0.135 | 0.064 ** | - | - | -0.027 | 0.023 | - | - | - | - |
| Operating revenues | 0.000 | 0.016 | - | - | 0.009 | 0.003 *** | - | - | - | - |
| Total expenses | 0.010 | 0.005 ** | - | - | -0.002 | 0.002 | - | - | - | - |
| Net commission earned | -0.025 | 0.028 | - | - | 0.020 | 0.010 ** | - | - | - | - |
| Net interest revenue | 0.074 | 0.030 ** | - | - | -0.001 | 0.005 | - | - | - | - |
| <i>Balance sheet:</i> | | | | | | | | | | |
| Total assets | -0.003 | 0.001 *** | - | - | - | - | -0.000 | 0.000 | - | - |
| Supplementary capital | 0.001 | 0.011 | - | - | - | - | -0.011 | 0.006 * | - | - |
| Other earning assets | 0.004 | 0.001 *** | - | - | - | - | 0.000 | 0.000 | - | - |
| Deposits | -0.000 | 0.000 | - | - | - | - | 0.000 | 0.000 | - | - |
| Equity | 0.005 | 0.012 | - | - | - | - | 0.015 | 0.006 ** | - | - |
| <i>Regional variables based on a bank's home district:</i> | | | | | | | | | | |
| Population | -0.000 | 0.000 *** | - | - | - | - | - | - | -0.000 | 0.000 *** |
| Population density | 0.000 | 0.000 ** | - | - | - | - | - | - | 0.000 | 0.000 *** |
| Share of elderly | -0.280 | 0.063 *** | - | - | - | - | - | - | -0.332 | 0.056 *** |
| Unemployment rate | -0.058 | 0.071 | - | - | - | - | - | - | -0.176 | 0.054 *** |
| Growth of real gross regional | -0.085 | 0.063 | - | - | - | - | - | - | -0.030 | 0.042 |
| Gross regional product per capita | -0.000 | 0.000 *** | - | - | - | - | - | - | -0.000 | 0.000 *** |
| Number of banks | 0.047 | 0.004 *** | - | - | - | - | - | - | 0.041 | 0.003 *** |
| Constant | 1.962 | 1.354 | -2.725 | 0.076 *** | -2.265 | 0.048 *** | -2.224 | 0.046 *** | 4.542 | 1.108 *** |
| Observations | 5,422 | | 5,422 | | 5,491 | | 5,491 | | 5,491 | |
| Log-likelihood | -97.564 | | -348.600 | | -403.235 | | -412.217 | | -183.750 | |
| R ² | 0.771 | | 0.180 | | 0.054 | | 0.033 | | 0.569 | |
| Logit LL | -76.220 | | -352.274 | | -404.479 | | -413.388 | | -152.597 | |

std ... standard deviation; *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 3: Probit Selection Equation (excluding national players)

| Explanatory variables | Model 6 | | Model 7 | | Model 8 | | Model 9 | | Model 10 | |
|--|---------|-------|---------|----------|---------|-------|----------|-------|----------|--------|
| | β | std | β | std | β | std | β | std | β | std |
| <i>Home market position:</i> | | | | | | | | | | |
| Dominant player | -4.808 | 1.781 | ** | -2.627 | 0.615 | *** | - | - | - | - |
| Oligopolistic player | -2.320 | 0.491 | ** | -1.344 | 0.223 | *** | - | - | - | - |
| Regional player | -0.398 | 0.642 | | -0.590 | 0.328 | * | - | - | - | - |
| Number of the bank's branches | -0.019 | 0.025 | | 0.026 | 0.006 | *** | - | - | - | - |
| Maximum home market share | 15.700 | 3.051 | ** | 4.925 | 0.910 | *** | - | - | - | - |
| Minimum home market share | 2.334 | 2.576 | | 2.685 | 0.972 | *** | - | - | - | - |
| <i>Income statement:</i> | | | | | | | | | | |
| Net profit | -0.110 | 0.065 | * | - | -0.086 | 0.029 | *** | - | - | - |
| Operating revenues | 0.004 | 0.020 | | - | 0.012 | 0.005 | *** | - | - | - |
| Total expenses | 0.008 | 0.013 | | - | -0.004 | 0.003 | | - | - | - |
| Net commission earned | -0.019 | 0.034 | | - | 0.002 | 0.014 | | - | - | - |
| Net interest revenue | 0.064 | 0.033 | ** | - | 0.008 | 0.007 | | - | - | - |
| <i>Balance sheet:</i> | | | | | | | | | | |
| Total assets | -0.003 | 0.001 | ** | - | - | - | -0.001 | 0.001 | ** | - |
| Supplementary capital | 0.028 | 0.016 | * | - | - | - | 0.001 | 0.008 | | - |
| Other earning assets | 0.004 | 0.001 | ** | - | - | - | 0.001 | 0.000 | * | - |
| Deposits | -0.001 | 0.001 | | - | - | - | 0.001 | 0.000 | ** | - |
| Equity capital | -0.022 | 0.017 | | - | - | - | 0.010 | 0.008 | | - |
| <i>Regional variables based on a bank's home district:</i> | | | | | | | | | | |
| Population | -0.000 | 0.000 | ** | - | - | - | - | - | -0.000 | 0.000 |
| Population density | 0.000 | 0.000 | | - | - | - | - | - | -0.000 | 0.000 |
| Share of elderly | -0.382 | 0.069 | ** | - | - | - | - | - | -0.222 | 0.059 |
| Unemployment rate | -0.064 | 0.072 | | - | - | - | - | - | -0.152 | 0.054 |
| Growth of real gross regional | -0.078 | 0.063 | | - | - | - | - | - | -0.034 | 0.041 |
| Gross regional product per capita | -0.000 | 0.000 | ** | - | - | - | - | - | -0.000 | 0.000 |
| Number of banks | 0.048 | 0.004 | ** | - | - | - | - | - | 0.042 | 0.003 |
| Constant | 1.960 | 1.441 | | -2.768 | 0.080 | *** | -2.286 | 0.050 | *** | -2.111 |
| Observations | 5,371 | | | 5,371 | | | 5,371 | | 5,371 | |
| Log-likelihood | -95.699 | | | -334.157 | | | -391.466 | | -400.547 | |
| R2 | 0.770 | | | 0.197 | | | 0.059 | | 0.037 | |
| Logit LL | -75.108 | | | -335.337 | | | -393.117 | | -402.014 | |

sfd ... standard deviation; *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

From the results, it turns out that bank mergers likely occur in rural (that is, low populated) and overbanked regions with a comparatively low level of per capita income. Especially, smaller, non-dominant banks with a high share of branches in the home market tend to merge. Further, these banks tend to be characterized by low profit and high total expenses (see Table 2). Roughly the same picture arises for the sub-sample that excludes big, national players (see Table 3). It is worth stressing that the findings presented corroborate the observation that the core of the "merger wave" in Austria was made of in-market mergers among small to medium-scaled banks, primarily within the group of mutual and cooperative banks and within the savings banks group, respectively.

According to the log-likelihood values reported in Table 2 and 3, we find that the logistic distribution function underlying the logit model leads to preferred estimates as compared to the normal-distribution-function-based probit. This is also confirmed by the associated likelihood-ratio tests that are distributed as χ^2 with one degree of freedom (see *Davidson – MacKinnon, 2004*). Since the logit models are preferred over their probit counterparts, we summarize the corresponding logit specifications in Table 4.

Armed with the estimates summarized in Table 4, we proceed to infer the impact of entering a merger on various measures of bank performance in the subsequent analysis.

Table 4: Logit Selection Equations

| Explanatory variables | Model 5' | | Model 10' | |
|--|----------|-----------|-----------|-----------|
| | β | std | β | std |
| <i>Home market position:</i> | | | | |
| Dominant player | -10.167 | 3.389 *** | -11.936 | 4.569 *** |
| Oligopolistic player | -5.845 | 1.322 *** | -6.118 | 1.426 *** |
| Regional player | -0.696 | 1.226 | -0.675 | 1.521 |
| Number of the bank's branches | -0.033 | 0.055 | -0.023 | 0.056 |
| Maximum home market | 39.551 | 6.962 *** | 43.008 | 8.934 *** |
| Minimum home market | 9.379 | 5.371 * | 7.332 | 6.836 |
| National player | 1.150 | 5.861 | - | - |
| <i>Income statement:</i> | | | | |
| Net profit | -0.237 | 0.137 * | -0.185 | 0.140 |
| Operating revenues | 0.018 | 0.045 | 0.013 | 0.049 |
| Total expenses | 0.021 | 0.012 * | 0.022 | 0.029 |
| Net commission earned | -0.097 | 0.092 | -0.099 | 0.092 |
| Net interest revenue | 0.172 | 0.079 ** | 0.173 | 0.078 ** |
| <i>Balance sheet:</i> | | | | |
| Total assets | -0.007 | 0.002 *** | -0.007 | 0.003 ** |
| Supplementary capital | 0.019 | 0.028 | 0.085 | 0.048 * |
| Other earning assets | 0.008 | 0.002 *** | 0.009 | 0.003 *** |
| Deposits | -0.002 | 0.001 ** | -0.003 | 0.002 |
| Equity | -0.014 | 0.031 | -0.080 | 0.048 * |
| <i>Regional variables based on a bank's home district:</i> | | | | |
| Population | -0.000 | 0.000 *** | -0.000 | 0.000 *** |
| Population density | 0.000 | 0.000 | 0.000 | 0.000 |
| Share of elderly | -1.180 | 0.219 *** | -1.182 | 0.231 *** |
| Unemployment rate | -0.245 | 0.217 | -0.225 | 0.215 |
| Growth of real gross regional product | -0.094 | 0.166 | -0.080 | 0.168 |
| Gross regional product per capita | -0.000 | 0.000 *** | -0.000 | 0.000 ** |
| Number of banks | 0.149 | 0.018 *** | 0.150 | 0.019 *** |
| Constant | 7.752 | 4.519 * | 7.110 | 4.626 |
| Observations | 5,422 | | 5,371 | |
| Log-likelihood | -76.220 | | -75.108 | |
| R ² | 0.821 | | 0.819 | |

std ... standard deviation; *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

4.3 The Treatment Effect of Bank Mergers on Bank Performance

As mentioned before, consistent estimation of treatment effects by selection on observables using matching requires the construction of a suitable control group based on some measure of similarity. The propensity score (in our case, the probability of entering a merger predicted by the preferred logit models) is only a valid compound measure of similarity, if the treatment group and the control group are similar in each and every respect, besides the merger activity. Otherwise, we cannot be sure whether the difference in the outcome variable which we are ultimately interested in is in fact due to the difference in some other determinants rather than entering a merger. The relevant condition for the propensity score to be a valid measure of similarity is referred to as the balancing property. The corresponding results of a comparison of the explanatory variables for the treatment and control group, respectively, are summarized in Table 5.

Again, Table 5 groups the explanatory variables in the same blocks as in the previous tables. For inference, it is important to focus on explanatory variables that are not significantly different for the matched treated and control units. As can be easily seen, this condition holds for all included explanatory variables. Hence, in this regard there is no concern about matching based on propensity scores derived from logit models as specified in Table 4. In the following analysis, we estimate average treatment effects of the treated (ATT, conditional on having entered a merger) and average treatment effects (ATE, unconditional on the actual merger activity) on four different measures of bank performance: cost-income ratio, return on employee, net revenue ratio, and return on equity.

Table 5: Balancing Property

| Explanatory variables | Sample | Treated | Control | t | p> t |
|--|-----------|------------|-------------|-------|-------|
| <i>Home market position:</i> | | | | | |
| Dominant player | Unmatched | 0.016 | 0.014 | 0.13 | 0.916 |
| | Matched | 0.012 | 0.048 | -1.06 | 0.480 |
| Oligopolistic player | Unmatched | 0.162 | 0.119 | 1.18 | 0.448 |
| | Matched | 0.108 | 0.452 | -3.84 | 0.162 |
| Regional player | Unmatched | 0.087 | 0.031 | 2.93 | 0.209 |
| | Matched | 0.051 | 0.071 | 0.31 | 0.809 |
| Number of the bank's branches | Unmatched | 13.298 | 3.491 | 9.93 | 0.064 |
| | Matched | 7.210 | 5.465 | 1.99 | 0.297 |
| Maximum home market | Unmatched | 0.175 | 0.068 | 12.87 | 0.049 |
| | Matched | 0.132 | 0.179 | -0.13 | 0.919 |
| Minimum home market | Unmatched | 0.117 | 0.051 | 10.12 | 0.063 |
| | Matched | 0.097 | 0.132 | -0.57 | 0.672 |
| National player | Unmatched | 0.024 | 0.009 | 1.42 | 0.391 |
| | Matched | 0.023 | 0.048 | -0.67 | 0.623 |
| <i>Income statement:</i> | | | | | |
| Net profit | Unmatched | 1.276 | 0.277 | 4.15 | 0.150 |
| | Matched | 0.706 | 1.046 | 0.18 | 0.886 |
| Operating revenues | Unmatched | 36.369 | 7.267 | 9.79 | 0.065 |
| | Matched | 14.310 | 25.312 | 0.64 | 0.636 |
| Total expenses | Unmatched | 72.638 | 14.800 | 6.57 | 0.096 |
| | Matched | 32.692 | 57.988 | 0.31 | 0.806 |
| Net commission earned | Unmatched | 8.447 | 1.401 | 10.65 | 0.060 |
| | Matched | 2.647 | 5.641 | 0.65 | 0.631 |
| Net interest revenue | Unmatched | 32.237 | 6.441 | 9.48 | 0.067 |
| | Matched | 13.563 | 22.620 | 0.60 | 0.658 |
| <i>Balance sheet:</i> | | | | | |
| Total assets | Unmatched | 1,313.700 | 270.930 | 5.91 | 0.107 |
| | Matched | 496.070 | 1,126.000 | 0.20 | 0.874 |
| Supplementary capital | Unmatched | 89.464 | 17.061 | 7.18 | 0.088 |
| | Matched | 28.301 | 74.836 | 0.25 | 0.845 |
| Other earning assets | Unmatched | 626.660 | 112.210 | 4.92 | 0.128 |
| | Matched | 218.740 | 605.500 | 0.04 | 0.975 |
| Deposits | Unmatched | 846.540 | 183.610 | 5.91 | 0.107 |
| | Matched | 269.400 | 381.060 | 0.84 | 0.556 |
| Equity | Unmatched | 90.560 | 17.191 | 7.64 | 0.083 |
| | Matched | 31.429 | 74.947 | 0.27 | 0.833 |
| <i>Regional variables based on a bank's home district:</i> | | | | | |
| Population | Unmatched | 74,287.000 | 75,099.000 | -1.18 | 0.889 |
| | Matched | 67,853.000 | 110,000.000 | -2.97 | 0.207 |
| Population density | Unmatched | 1,217.500 | 1,266.900 | -1.84 | 0.914 |
| | Matched | 1,080.700 | 2,203.400 | -1.86 | 0.314 |
| Share of elderly | Unmatched | 15.721 | 15.584 | 0.48 | 0.715 |
| | Matched | 15.316 | 16.991 | -2.65 | 0.230 |
| Unemployment rate | Unmatched | 5.999 | 6.397 | -1.77 | 0.328 |
| | Matched | 5.960 | 6.221 | -0.66 | 0.629 |
| Growth of real gross regional product | Unmatched | 1.957 | 2.307 | -1.81 | 0.321 |
| | Matched | 1.899 | 1.812 | 0.51 | 0.700 |
| Gross regional product per capita | Unmatched | 22,805.000 | 22,806.000 | 0.00 | 0.999 |
| | Matched | 22,065.000 | 26,758.000 | -3.09 | 0.199 |
| Number of banks | Unmatched | 152.320 | 63.969 | 23.25 | 0.027 |
| | Matched | 111.590 | 89.860 | 5.08 | 0.124 |

Table 6: Treatment Effect for the Treated (ATT; all banks)

| Period and statistic | Cost-income ratio | Return on employee | Net revenue ratio | Return on equity |
|--------------------------------|--------------------|--------------------|-------------------|------------------|
| T-2 | | | | |
| ATT | 10.119 *** | 31.248 ** | 29.734 *** | 39.883 *** |
| Standard deviation | 1.061 | 13.761 | 2.895 | 10.960 |
| 95 percent confidence interval | [8.040; 12.198] | [4.277; 58.219] | [24.059; 35.408] | [18.402; 61.365] |
| T-1 | | | | |
| ATT | -4.692 *** | 0.427 | 42.912 *** | 10.760 *** |
| Standard deviation | 1.500 | 5.250 | 6.818 | 3.839 |
| 95 percent confidence interval | [-7.632; -1.753] | [-9.862; 10.717] | [29.550; 56.274] | [3.236; 18.284] |
| T | | | | |
| ATT | 14.519 *** | 35.263 * | -8.036 | -4.584 |
| Standard deviation | 2.558 | 20.050 | 5.710 | 3.936 |
| 95 percent confidence interval | [9.506; 19.533] | [-4.035; 74.561] | [-19.227; 3.156] | [-12.299; 3.131] |
| T+1 | | | | |
| ATT | -24.942 *** | 114.445 *** | 10.526 *** | 30.965 *** |
| Standard deviation | 1.213 | 7.301 | 2.528 | 2.694 |
| 95 percent confidence interval | [-27.320; -22.564] | [100.137; 128.754] | [5.570; 15.481] | [25.684; 36.245] |

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 7: Treatment Effect for the Treated (ATT; excluding national players)

| Period and statistic | Cost-income ratio | Return on employee | Net revenue ratio | Return on equity |
|--------------------------------|--------------------|--------------------|--------------------|------------------|
| T-2 | | | | |
| ATT | 15.695 *** | 70.119 *** | 47.302 *** | 59.228 *** |
| Standard deviation | 1.180 | 13.941 | 2.598 | 11.082 |
| 95 percent confidence interval | [13.381; 18.009] | [42.795; 97.443] | [42.211; 52.393] | [37.508; 80.949] |
| T-1 | | | | |
| ATT | -6.660 *** | 9.640 * | 39.816 *** | 7.093 ** |
| Standard deviation | 1.430 | 5.106 | 6.879 | 3.906 |
| 95 percent confidence interval | [-9.462; -3.858] | [-0.367; 19.648] | [26.333; 53.298] | [-0.562; 14.747] |
| T | | | | |
| ATT | -29.411 *** | -1.411 | 3.457 | 2.600 |
| Standard deviation | 2.575 | 21.024 | 5.746 | 3.957 |
| 95 percent confidence interval | [-34.459; -24.363] | [-42.617; 39.796] | [-7.805; 14.719] | [-5.156; 10.356] |
| T+1 | | | | |
| ATT | -9.166 *** | 49.730 *** | -40.550 *** | 6.132 *** |
| Standard deviation | 1.229 | 7.414 | 2.581 | 2.857 |
| 95 percent confidence interval | [-11.575; -6.757] | [35.199; 64.261] | [-45.608; -35.491] | [0.532; 11.732] |

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 6 (for all banks) and Table 7 (for all banks except national players) summarize our estimates for ATT not only for the year where the merger was established but also for two previous years and one subsequent year. Especially, it seems relevant to include the years before the merger was actually established due to possible anticipation effects (leading to what is referred to as Ashenfelter's dip; i. e., the lack of a treatment effect in the year where the treatment comes into effect). Due to the availability of data on bank mergers, it is infeasible to estimate the effect of entering a merger on bank performance in earlier or later periods than the covered ones.

Comparing the findings in Table 6 and Table 7, we observe not only similar merger effects both at the regional and at the national level but also quite similar time patterns for the sample including national players as compared to the sample excluding them. Let us first focus on the sample including national players in Table 6. Most importantly, all performance indicators under study signal clearly that there are significant post-merger gains as measured in the year following the actual merger (see, also, *Hahn, 2006*). However, the analysis also indicates quite strongly that, in the year the actual merger is being conducted, there are substantial losses in terms of lower cost efficiency and, less strongly, in terms of lower profitability, all of which most likely due to the respective merger activities. We consider the latter a natural finding for the implementation of a merger is frequently associated, temporarily, with extra-costs and, thus, with extra-stress on profitability. In essence, these findings also hold true for the sample without the nationally operating, large banks, though, with one noteworthy exception (Table 7). The smaller regional banks involved in merger activities do enjoy cost-efficiency gains even in the very year the merger has been established.

The time pattern of the treatment effects for the treated unveils that there are bank activities prior to the merger that may have to do with the occurrence of the merger. Most interestingly, two years before a merger has taken place, we detect a high positive cost-income ratio effect together with high positive effects linked to productivity and profitability. Obviously, this finding supports the view that it is low cost efficiency, and not low profitability which primarily triggers merger aspiration in the Austrian banking system. However, as to the year immediately before the establishment of the merger, the analysis provides evidence in favor of the existence of anticipatory merger effects in terms of higher cost efficiency. This may be

interpreted as a sign of 'anticipatory obedience' on the part of the mostly rural cooperative banks pressed to merge.

So far, we have analyzed the effects of mergers on the performance of those banks that actually entered a merger, i. e., ATT, within the considered period of time. Sometimes, it is of interest to know the potential effect of a merger on a unit (a bank) that is randomly drawn from the sample, irrespective of whether it was exposed to the treatment (i. e., it entered a merger) or not, i. e., ATE. We summarize the results in Tables 8 (all banks) and 9 (excluding national players). In accordance with the findings for the treated, the average treatment effects calculated for both samples provide convincing evidence that it is the upgrading of cost efficiency which is most likely to drive a merger wave within a banking system like the Austrian. For the sake of brevity, we leave a detailed inspection of the results in Table 8 and 9 to the interested reader.

5. Concluding Remarks

This paper provides an in-depth analysis of the impact of entering an in-market merger on bank performance in an exhaustive sample of Austrian banks over the period from 1996 to 2002. We argue that mergers in a banking system like the Austrian do not arise randomly but occur endogenously. A probit selection equation is formulated to explain the adoption of a merger strategy. We use various matching techniques based on our set of observable variables to estimate the treatment effect of bank mergers on the banks' performance reflected in measures of banking profitability, productivity and efficiency. The findings support the view that there are longer-lasting positive merger effects on banking performance, particularly in terms of improved cost efficiency. The analysis also suggests that pre-merger effects are likely to occur in terms of improved cost efficiency immediately before the establishment of the merger. Finally, there is evidence that smaller banks involved in merger activities are more likely to enjoy cost-efficiency gains earlier than larger banks.

Table 8: Average Treatment Effect (ATE; all banks)

| Period and statistic | Cost-income ratio | Return on employee | Net revenue ratio | Return on equity |
|--------------------------------|-------------------|---------------------|--------------------|--------------------|
| T-2 | | | | |
| ATE | -1.428 | -1.730 | 11.844 *** | -36.193 *** |
| Standard deviation | 1.589 | 3.243 | 0.974 | 1.718 |
| 95 percent confidence interval | [-4.542; 1.686] | [-8.087; 4.626] | [9.935; 13.752] | [-39.561; -32.826] |
| T-1 | | | | |
| ATE | -21.839 ** | -1.309 | 29.887 *** | 18.088 *** |
| Standard deviation | 9.545 | 5.720 | 1.555 | 5.547 |
| 95 percent confidence interval | [-40.547; -3.132] | [-12.521; 9.902] | [26.838; 32.935] | [7.216; 28.960] |
| T | | | | |
| ATE | 22.947 *** | -126.254 *** | -40.823 *** | -37.289 *** |
| Standard deviation | 8.073 | 46.154 | 4.146 | 7.086 |
| 95 percent confidence interval | [7.124; 38.770] | [-216.714; -35.794] | [-48.948; -32.698] | [-51.177; -23.402] |
| T+1 | | | | |
| ATE | -6.922 *** | -7.317 | -5.970 *** | 4.490 *** |
| Standard deviation | 2.002 | 8.201 | 1.805 | 1.662 |
| 95 percent confidence interval | [-10.847; -2.998] | [-23.391; 8.758] | [-9.509; -2.432] | [1.232; 7.748] |

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 9: Average Treatment Effect (ATE; excluding national players)

| Period and statistic | Cost-income ratio | Return on employee | Net revenue ratio | Return on equity |
|--------------------------------|-------------------|--------------------|--------------------|--------------------|
| T-2 | | | | |
| ATE | -0.534 | 9.932 *** | -2.301 *** | -26.850 *** |
| Standard deviation | 1.533 | 3.016 | 0.897 | 1.688 |
| 95 percent confidence interval | [-3.540; 2.471] | [4.021; 15.843] | [-4.059; -0.543] | [-30.159; -23.541] |
| T-1 | | | | |
| ATE | -28.366 *** | -38.080 *** | -33.911 *** | -5.739 |
| Standard deviation | 9.876 | 5.579 | 1.674 | 5.679 |
| 95 percent confidence interval | [-47.722; -9.010] | [-49.015; -27.145] | [-37.193; -30.629] | [-16.870; 5.393] |
| T | | | | |
| ATE | 22.887 *** | 32.434 | 2.120 | -17.815 ** |
| Standard deviation | 8.324 | 23.371 | 4.151 | 7.347 |
| 95 percent confidence interval | (6.572; 39.203] | [-13.372; 78.240] | [-6.016; 10.256] | [-32.216; -3.414] |
| T+1 | | | | |
| ATE | -6.155 *** | -24.223 *** | -7.087 *** | 3.492 ** |
| Standard deviation | 2.000 | 8.014 | 1.810 | 1.752 |
| 95 percent confidence interval | [-10.074; -2.236] | [-39.931; -8.515] | [-10.634; -3.540] | [0.059; 6.925] |

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

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Appendix

Variables and Sources

| | | |
|-----------------------|--|--|
| Total assets | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Supplementary capital | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Other earning assets | OeNB, annual reports statistics of Austrian banks | Total assets minus loans, at 1995 prices |
| Deposits | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Equity | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Net profit | OeNB, annual reports statistics of Austrian banks | Operating income minus operating expenses, at 1995 prices |
| Operating income | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Total expenses | OeNB, annual reports statistics of Austrian banks | Interest expenses, non-interest expenses and employee expenses, at 1995 prices |
| Net commission earned | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Net interest income | OeNB, annual reports statistics of Austrian banks | At 1995 prices |
| Cost-income ratio | | Operating expenses divided by operating income |
| Net revenue ratio | | Net interest income over equity |
| Return on employee | | Operating income per employee, at 1995 prices |
| Return on equity | | Profit over equity |
| Dominant player | Banks holding a market share larger than 30 percent, 1996 (measured by the number of bank branches in a district) | |
| Oligopolistic player | Two or more banks holding a market share between 20 and 30 percent, 1996 (measured by the number of bank branches in a district) | |
| Regional player | Banks active in a state, 1996 | |
| National player | Banks active in all states, 1996 | |
| Population | Population in a district, 2001 | |
| Population density | Population per square kilometer in a district, 2001 | |
| Share of elderly | 65 and older as percent of total population in a district, 2001 | |
| Unemployment rate | Unemployed as percent of total labor force in a district | |
| Number of banks | Number of banks and branches in a district, 1996 | |
| Home market | Administrative district or county, where the bank headquarters | |

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