The success of bank mergers revisited. An assessment based on a matching strategy

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January 2008

Abstract

The question of whether or not mergers and acquisitions have helped to enhance banks' efficiency and profitability has not yet been conclusively resolved in the literature. We argue that this is partly due to the severe methodological problems involved. In this study, we analyze the effect of German bank mergers in the period 1995-2000 on banks' profitability and cost efficiency. We suggest a new matching strategy to control for the selection effects arising from the fact that predominantly under-performing banks engage in mergers. Our results indicate a neutral effect of mergers on profitability and a positive effect on cost efficiency. Comparing our results with those obtained from a naive performance comparison of merging and non-merging banks indicates a severe negative selection bias with regard to the former.

Keywords: Bank mergers, performance measurement, propensity score matching
JEL classification: G21, G34

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1 Introduction

Why do banks engage in M&A activities if success is so often elusive? Empirical evidence at least seems to suggest that mergers and acquisitions do not, on average, enhance the efficiency or the profitability of banks. As Piloff and Santomero (1998) note: *"The literature on the value of bank mergers and acquisitions presents a clear paradox. Empirical evidence indicates clearly that on average there is no statistically significant gain in value or performance from merger activity... Yet, mergers continue."* However, should one not be suspicious of the claim that so many banks adopt such apparently useless business strategies, as many empirical studies seem to suggest? Even if one concedes that the interests of bank managers may not be fully aligned with those of the owners and that the market for corporate control is imperfect, or that political interference can play an important role, we think these facts are unlikely to explain the apparent "paradox". In our view, the apparent empirical evidence indicates rather that merging banks differ in some important aspects from other banks and that it is important to take these aspects into account in any performance study of bank mergers. We think that performance studies often suffer from a severe selection bias which distorts their results against mergers and acquisitions, in particular, when they juxtapose merging and non-merging banks. In doing so, they ignore the fact that merging banks often represent an under-performing sample of banks, especially with regard to those that are the target in a take-over. However, if the merging partners are under-performing before the merger, it is hardly surprising that the merged bank, too, is less profitable than other banks, at least in the short and medium run. But the question really is whether or not mergers have helped the banks to solve their problems in their particular situation. To answer this question empirically, one needs to tackle the problem that the factors influencing the propensity to merge are likely to correlate with those that determine the banks' profitability and efficiency.

To overcome the selection bias we suggest a matching strategy, which is based on estimated propensity scores. Our methodology builds on the statistical treatment literature that, to our knowledge, had not yet been employed in econometrical research on the effects of M&A's. In the treatment literature, the success of a treatment (here "merger") is assessed by comparing the outcomes of two groups: the treatment and the control group. In the standard model, the control group is set up so that its members have the same propensity to belong to the treatment group, ie to engage in merger activity. However,

in our case the situation is more complex. Because at least two banks are involved in a merger, the usual matching strategy, which is based on single entities, cannot be applied. Instead, we suggest a modified matching strategy that is based on pairs of banks. Control merger banks are chosen separately according to estimated propensities to acquire a bank and to become a target respectively. We estimate the effect of mergers by comparing the difference in post-merger performance of merging banks and a control group of non-merging banks that had the closest *ex ante* propensities to merge. The analysis is based on a comprehensive dataset of German banks that comprises detailed balance sheet information and non-public supervisory data provided by the Deutsche Bundesbank. We proceed as follows. In section 2, we briefly discuss the relevant literature on bank mergers before we introduce the matching methodology in section 3 and the data in section 4. In section 5, we describe the propensity score matching and its balancing effect. In section 6, we provide our results on post-merger performance, and in section 7 we conclude.

2 A short review of the bank merger literature

Banks have different reasons as to why they engage in mergers. In this study, we focus on the business motives while acknowledging that other motives, such as managerial incentives, can play an important role (Hadlock et al., 1999; Bliss and Rosen, 2001). With regard to mergers driven by business motives, Berger (1998) distinguishes between the *relative efficiency hypothesis* and the *low efficiency hypothesis*. Under the relative efficiency hypothesis, the acquiring bank is trying to bring the target bank to its own - higher - level of efficiency by transferring its superior management capacities or its business procedures. Under the low efficiency hypothesis, one of the merging banks or both are inefficient relative to their peers. The merger may therefore serve as a disciplinary device for the bank management to improve the performance of the bank or as a means of implementing unpleasant business measures. While the low efficiency hypothesis and the relative efficiency hypothesis are not mutually exclusive, researchers find more evidence for the former. Vander Vennet (1996) confirms this result for European bank takeovers between 1988 and 1992. In the same vain is a study for the German banking market by Koetter et al. (2007), who find that many mergers serve as a pre-emptive distress resolution measure. However, they also find some evidence that acquiring banks are

more efficient than their targets, which stands in contrast to an earlier study by Lang and Welzel (1999) who can find no evidence for the relative efficiency hypothesis. Other studies in support of the relative efficiency hypothesis are Avkiran (1999), Vander Vennet (2003) and Worthington (2004). Support for a 'reverse' Relative Efficiency Hypothesis is provided by Resti (1998), who finds that, for the Italian bank mergers that took place between 1987 and 1995, the buyer appears even less efficient than its target. In a study for the US market, Wheelock and Wilson (2000) finds that, contrary to the low efficiency hypothesis, inefficient banks are less likely to be acquired. This finding contradicts an earlier study by Hadlock et al. (1999) who find that poorly performing banks are more likely to be acquired.

A considerable amount of research has been carried out on whether merger and acquisitions are successful in improving banks' profitability and efficiency. A wide range of performance indicators has been applied in these studies, ranging from simple balance sheet and P&L ratios to more sophisticated statistical efficiency measures. Most of these studies find little or no evidence of M&A-induced productivity gains, but newer studies suggest some enhancement of overall profitability. A number of studies analyzes the effects of M&As on banks' X-efficiency. Berger and Humphrey (1992) points out that, despite substantial potential, US banking mega-mergers in the 1980s were not successful in improving cost efficiency. Moreover, it was often the case that scale dis-economies of the banks that resulted from the merger more than offset the small efficiency gains. DeYoung (1997), who includes smaller banks in his study, finds that efficiency improved in only a small majority of banks. Peristiani (1997), who analyzes all US mergers that took place between 1980 and 1990 even establishes significant declines in X-efficiency and only moderate improvements in scale efficiency. Using a different methodology, Houston and Ryngaert (1994), by analyzing stock prices of large US banks in the period from 1985 to 1991, observe no positive revaluation in the period after a merger took place. According to a case study of Rhoades (1998), mergers can result in significant cost cutting, but less than half of the examined banks were able to improve their cost efficiency. Boyd and Graham (1998) apply a regression analysis on US mergers between 1988 and 1993 and show that the return on assets and expense ratios did not improve after a merger, except for the small banks.

While older studies often focused on the banks' cost efficiency, newer studies have also

focused on their profit efficiency. Akhavein et al. (1997) find that the mega-mergers of the 1980s resulted in significant profit efficiency gains. Similarly, Berger and Mester (2003) ascertain that while cost productivity worsened for US banks engaged in a merger between 1991 and 1997, their profit productivity improved substantially. A contrasting view is taken by Houston et al. (2001), who maintain that, although bank merger effects improved over time, most of them did not result in significant revenue enhancements.
While most of the earlier studies concentrated on the US market Vander Vennet (1996) analyze bank take-overs that took place in the European Community between 1988 and 1992. He provides evidence that, while post-merger efficiency generally deteriorated, mergers of equals often led to significant performance gains. Cuesta and Orea (2002), who analyze the Spanish banking market in the period from 1985 to 1998, show that M&As did improve the technical efficiency of Spanish banks. Focarelli et al. (2002) find a similar result for Italy. An analysis on a sub-sample of German cooperative banks was carried out by Lang and Welzel (1999) who showed that M&As had no significant effect on the banks' X-efficiency even after five years since the merger took place. This finding is confirmed by a more recent study by Koetter (2005) which indicates that only half of the German bank mergers have been successful.

3 The matching model

Below we shall provide the theoretical background of the matching model we use to assess bank mergers in Germany. For ease of exposition, we assume in this section that our performance or target variable, which we denote by Y, directly refers to an item in the P&L accounts (such as total costs). It is then straightforward to generalize our model to more general balance sheet indicators which we actually use in our empirical analysis, such as the return on assets or the cost income ratio.
We focus on two banks in a particular year: the acquiring bank A and the target bank T. With M we denote the new bank resulting from the merger of bank A and bank T. The respective target variables are Y^A, Y^T, and Y^M. In addition, we define by Y^S the aggregate variable $Y^S = Y^A + Y^T$ denoting the aggregate target value obtained from both banks A and T in the case of no merger (e.g. the sum of individual profits). It is instructive to assume that the target variables Y^M and Y^S we which we focus are random,

whose realization depends on whether or not the banks A and T engaged in merger. The expected total merger effect is given by

$$\Delta = E(Y^M - Y^S)$$

which is not directly observable.

Let D denote an indicator variable that assumes the value 1 if bank A *de facto* merged with bank T, and 0 if not. Therefore, in the merger case we observe $Y^M|D = 1$ but not $Y^S|D = 1$. Accordingly, in the non-merger case we observe $Y^S|D = 0$ but not $Y^M|D = 0$. The two outcomes $Y^S|D = 1$ and $Y^M|D = 0$ are counterfactual outcomes and not observable. Below, we concentrate on the merger effect *given* that a merger did take place, ie on

$$\Delta_T = E(Y^M|D = 1) - E(Y^S|D = 1) \tag{1}$$

which is denoted as the treatment effect on the treated in the statistical treatment literature. Here, we refer to it simply as the merger effect (in the merger case). In other words the merger effect describes the difference in the performance if one compares *de facto* merged banks to the aggregate performance indicator of the merging banks if they had decided not to merge. As in the case of the total merger effect, this merger effect in the merger case involves a counterfactual state and cannot be calculated directly.

Because of this difficulty, one may be tempted to calculate a naive (or *prima facie*) merger effect by comparing the performance of factually merged banks and factually non-merging banks:

$$\Delta_{PF} = E(Y^M|D = 1) - E(Y^S|D = 0) \tag{2}$$

However, Δ_{PF} is generally a biased estimator of Δ. It is unbiased only if the assignment to the merging group ($D = 1$) or the non-merging group ($D = 0$) is independent of the outcome variable, ie if

$$Y^S, Y^M \perp D$$

but as we shall show in section 4 the empirical evidence strongly suggests that this assumption is not justified.

A possible solution is to derive an unbiased estimator through assignment on covariates. If the assignment to the two groups ($D = 0, D = 1$) is completely captured by information

contained in some variable X, conditional independence holds:

$$Y^S, Y^M \perp D \,|\, X$$

And the unbiased estimator of the merger effect is thus given by

$$\hat{\Delta}_X = E(Y^M|D=1,X) - E(Y^S|D=0,X) \tag{3}$$

In the most simple case where X is one-dimensional, a suitable stratification on X will provide an unbiased estimator of the merger effect. If X is multidimensional, stratification is usually not feasible but, as Rosenbaum and Rubin (1983) have shown, one may condition on the *propensity score* instead. In our case, the propensity score is given by the probability of merging, given the information X, ie $\Pr(D=1|X)$. The theorem can be stated as

$$Y^M, Y^S \perp D|X \Longrightarrow Y^M, Y^S \perp D|\Pr(D=1|X)$$

In contrast to the classical matching case, our analysis involves *pairs* of banks rather than single entities.[1] We therefore generalize the basic idea of the matching approach in the following way. For each factual merger between an acquiring bank A and target bank T a pair of non-merged control banks $\{A^c, T^c\}$ is selected from the pool of factually non-merging banks.[2] For each year and for all banks in the sample, whether they were involved in a merger or not, we estimate the propensity that it will be an acquiring bank in a merger of the following year. Similarly, we estimate the propensity to become a target using the same set of covariates X. Figure 1 illustrates the matching strategy. Let the estimates of the probabilities of acquiring and of becoming a target be denoted by $\hat{\pi}_A$ and $\hat{\pi}_T$ respectively. Consider a pair of merging banks A and T. For the (*de facto*) acquiring bank A, we choose a control bank A^c from the sample of non-merging banks that minimizes the distance $|\hat{\pi}_A - \hat{\pi}_{A^c}|$ and for the target bank T we choose T^c that minimizes $|\hat{\pi}_T - \hat{\pi}_{T^c}|$. In the case of no replacement, which we apply here, the resulting control sample can differ according to the ordering of the merged banks as the algorithm is path-dependent. In accordance with the literature, we use a random ordering of banks in the matching algorithm (Rosenbaum and Rubin, 1983). Let $Y^M_{A,T}$ be the performance

[1] We ignore the rare case that mergers can involve more than two parties.

[2] A necessary condition is, of course, that all merging banks can be identified as either the acquiring bank or as the target bank, which is the case in our sample.

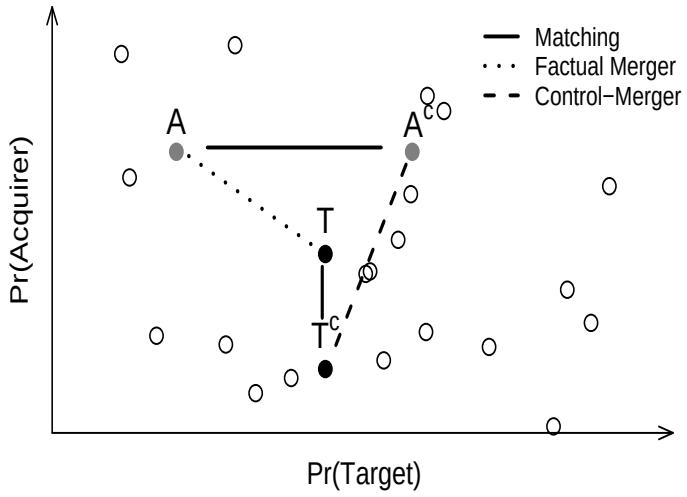


Figure 1: The pair-matching strategy

indicator of the merged bank and $Y^S_{A^c,T^c}$ the aggregated performance indicator of the control. The unbiased estimator of the merger effect $\hat{\Delta}_X$ is then based on the comparison of the distributions of $Y^M_{A,T}$ and $Y^S_{A^c,T^c}$.

4 The data and descriptive statistics

Information on German bank mergers that took place between 1994 and 2003 was kindly provided by the Deutsche Bundesbank. The data differentiates between acquiring and acquired banks. Due to the consolidation process, the number of banks dropped considerably during the observation period. While 3,265 universal banks operated in Germany at the beginning of the period [3] only 1,861 were in business in 2003, equivalent to a reduction of nearly 44 %. The bulk of mergers were pair mergers involving two banks at a time but sometimes three or even more banks were involved (up to seven in two cases, cf. table 1). Below, we shall focus solely on pair mergers.

In our statistical analysis below, we use the usual performance indicators derived from balance sheet and P&L data (also provided by the Deutsche Bundesbank) in order to assess the success of bank mergers. In particular, we use the return on assets (ROA) as a measure of a bank's profitability and the cost income ratio (CI) as a measure of its its

[3] In our analysis we consider only savings banks and credit cooperatives, which constitute the largest share of the German banking system. We did not include private banks here because they constitute a very heterogeneous group of banks ranging from very large commercial banks to small specialized lending institutions.at the beginning of the period

Table 1: Merger activities in the sector of corporate and savings banks

Year	All banks	Non-merging banks	Mergers of ... 2	3	4	5	6	7	Percent Mergers	Percent Pair-mergers
1994	3265	3129	122	13	1	0	0	0	8.4	89.7
1995	3177	3098	72	6	1	0	0	0	5.1	91.1
1996	3076	2987	81	7	0	1	0	0	5.9	91.0
1997	2981	2894	81	6	0	0	0	0	5.9	93.1
1998	2809	2655	140	12	1	0	0	1	11.0	90.9
1999	2581	2395	156	26	2	2	0	0	14.6	83.9
2000	2328	2112	187	23	4	1	0	1	18.2	86.6
2001	2136	1969	147	17	1	1	1	0	15.5	88.0
2002	1986	1854	117	14	0	1	0	0	13.2	88.6
2003	1861	1744	107	8	2	0	0	0	12.4	91.5

efficiency. The ROA is defined as the bank's operating profit (before tax and after value adjustments) over total assets. The CI is given by the bank's operating expenses over total income. Operating expenses are before value adjustments; total income is net of value adjustments. ROA and CI are both used as performance indicators and as covariates in the matching model. In passing, we wish to note that we refrain from calculating more advanced measures of efficiency, such as those derived from a stochastic frontier or data envelope analysis, for the following reason: mostly because these methods rely on specifying a production function, which is a difficult task in itself, estimated efficiency scores are not very robust with regard to the choice of model, definition of inputs and outputs, distributional assumptions etc. To avoid these specification problems and in order to better separate between efficiency effects and selection effects, we choose ROA and CI as our performance indicators. These are relatively easy to interpret while the main advantage of statistical measures of efficiency – creating a common benchmark for a diverse set of banks – is (at least in part) accounted for by the structure of the matching approach in our analysis below.

Apart from ROA and CI, several other variables are used in the matching model: the return on equity (ROE), which is defined as the ratio of a bank's operating profit to its equity capital, the equity ratio (EQR) as the ratio of equity capital over total assets, the interest rate margin which is calculated as the difference between the interest rate on given loans minus interest rate on borrowed funds. As a control variable for a bank's risk we use the ratio of non-performing loans to loans to non-banks and non-governments (NPL). Non-performing loans are all loans where specific loan provisions have been made

and we use the gross nominal amount of these loans.

It is instructive to look at some of the descriptive statistics before presenting the matching approach in the next section, especially with regard to the differences between acquiring banks, target banks, and non-merging banks.

In Figure 2, we display the distributions of key balance sheet indicators for the three different samples.[4] We find that target banks are significantly smaller than non-merging banks and have a lower return on total assets, a lower return on equity, a higher cost-income ratio, and a higher ratio of non-performing loans. Comparing acquiring banks with non-merging banks, we find that acquiring banks are considerably larger, have a significantly lower equity ratio and a higher ratio of non-performing loans.

This indicates that banks try to achieve economies of scale when they engage in mergers, while there is little support for the relative efficiency hypothesis. In addition, the empirical evidence clearly rejects the hypothesis that merging banks form a random sample from the set of all banks. In particular, the fact that merging banks are weaker than non-merging banks lends strong support to a negative selection effect.

5 The propensity score matching

5.1 Estimating propensities to merge

Our selection of a control group for bank mergers is based on the concept of "merger probabilities", which is defined as the probability that a specific bank participates in a merger during the following year. Here, we calculate merger probabilities separately for acquiring banks and targets. In a similar context, merger probabilities have been used in the literature to analyze the reasons as to why banks engage in mergers and acquisitions (cf section 2). Most of these studies use standard parametric logit or probit models whose advantage is that they are easy to interpret with regard to the impact of specific explanatory variables (eg size, profitability, risk etc). This comes at the disadvantage, though, that the functional form of the link function of these models is not very flexible. This is a serious drawback in our case since our main task is to derive a measure of similarity – in order to construct an appropriate control sample – rather than "explain" mergers. The aim is thus to use the information contained in the explanatory variables

[4]Plots are derived using normal kernel density estimation. The Silverman rule is applied to obtain the optimal bandwidth (Silverman, 1986). Descriptive statistics and p-values of the sample comparison are given in Table 3 below.

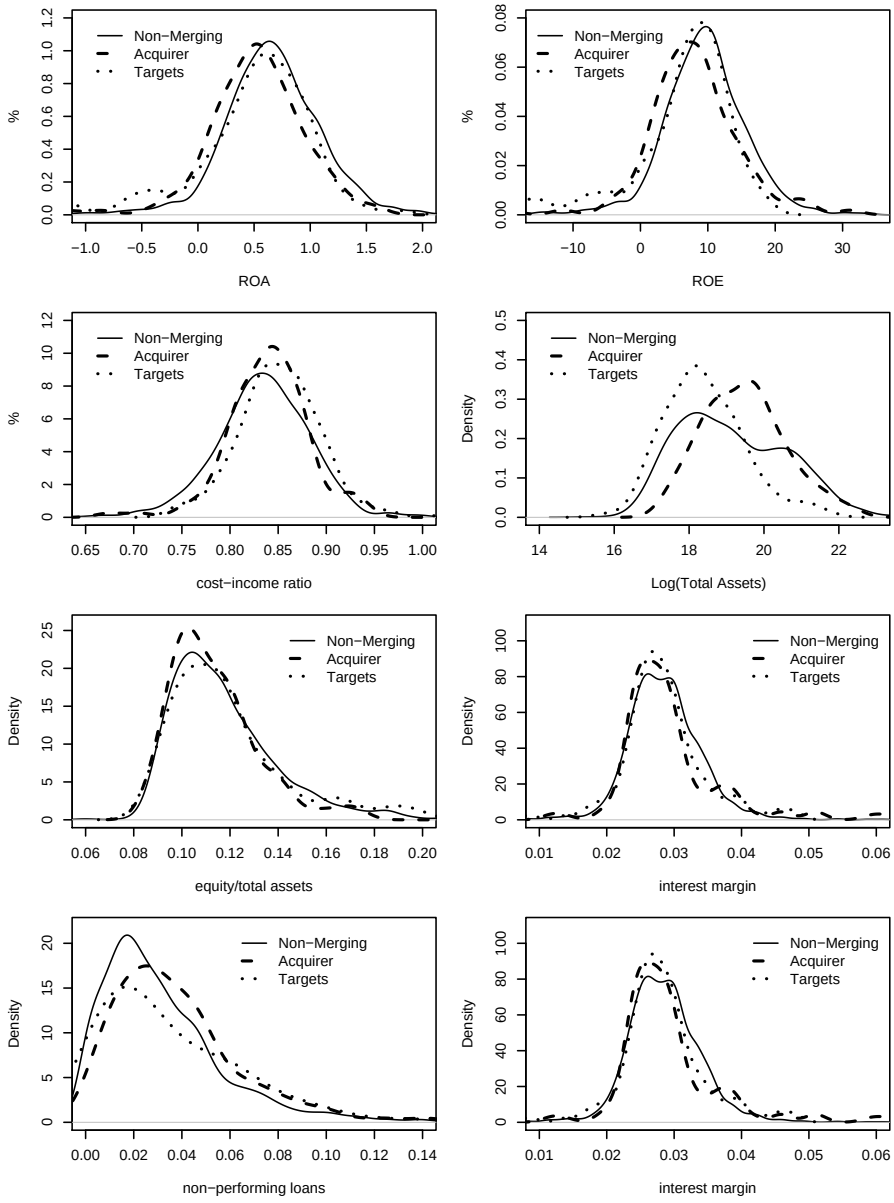


Figure 2: Distributions of bank characteristics for acquiring, target and non-merging banks in the pre-merger year

relevant to the selection process in a comprehensive and efficient way. To this end, it is important to allow flexible nonlinear influences when modelling the propensity score (Rosenbaum and Rubin, 1983). For our analysis we apply non-parametric Generalized Additive Models (GAM) and use cubic spline bases with two knots for all metric variables (Wood, 2006). We also include a dummy variable to allow for different intercepts for savings and cooperative banks.

Table 2: Merger probability model* for the year 2000

Model for target probability

	Basis 1	Basis 2	Basis 3	p-value
Intercept	-4.982			0.240
Cooperative	-0.185			0.634
Size	-0.119	-1.196	-3.872	0.000
Return on assets	0.085	0.111	0.395	0.910
Return on equity	-0.398	-0.544	-2.498	0.539
Cost-income ratio	2.496	2.655	-4.430	0.117
Equity ratio	0.002	0.059	0.400	0.723
Interest margin	-0.001	-0.027	-0.645	0.715
Non-performing loans	-0.444	-0.432	2.185	0.069
# banks	2143			
Deviance expl.	0.09			

Model for acquirer probability

	Basis 1	Basis 2	Basis 3	p-value
Intercept	-4.429			0.000
Cooperative	2.079			0.000
Size	0.500	1.470	2.721	0.000
Return on assets	1.029	1.215	8.183	0.011
Return on equity	-0.717	-0.980	-4.501	0.220
Cost-income ratio	-0.342	-0.272	3.310	0.350
Equity ratio	-0.013	-0.423	-2.830	0.086
Interest margin	0.006	0.164	3.884	0.006
Non-performing loans	0.435	0.410	-2.153	0.327
# banks	2143			
Deviance expl.	0.08			

*Generalized Additive Model (GAM) with cubic splines and 2 knots for metric variables

As outlined in section 4, we use for each year and each bank in the observation some key balance sheet indicators to predict mergers in the following year. For each year, we estimate two separate models, one model for the propensity to become a takeover target and one for the propensity to be the acquiring part in a bank merger. To save space, we

only report here the details for the 2000 mergers, covariates are from 1999 (cf table 2). In the matching model below we take the estimated propensity scores obtained from the corresponding cross-sectional models in order to define the set of control banks. (Details for the models of merger years 1995-1999 are available on request from the authors.)
When interpreting the parameter values in table 2 one needs to take into account the fact that, since the GAMs allow for nonlinear dependencies, the magnitude and the direction of each variable's impact depends on the size of the respective variable. Nevertheless, some general tendencies can be established. Not surprisingly, we find that the propensity to become a target decreases with the bank's size, and conversely, that the propensity to be the acquirer in a merger is an increasing function of size. This indicates that mergers and acquisitions are in part driven by the fact that banks try to achieve economies of scale. Furthermore, targets tend to be banks with relatively large equity ratios. Hence, the findings do suggest that target banks are relatively inefficient, at least with regard to their cost-income ratio. The acquiring banks, on the other hand, tend to have a larger share of non-performing loans and a lower capital ratio. Like the target banks, the acquiring banks seem to have higher cost-income ratios.

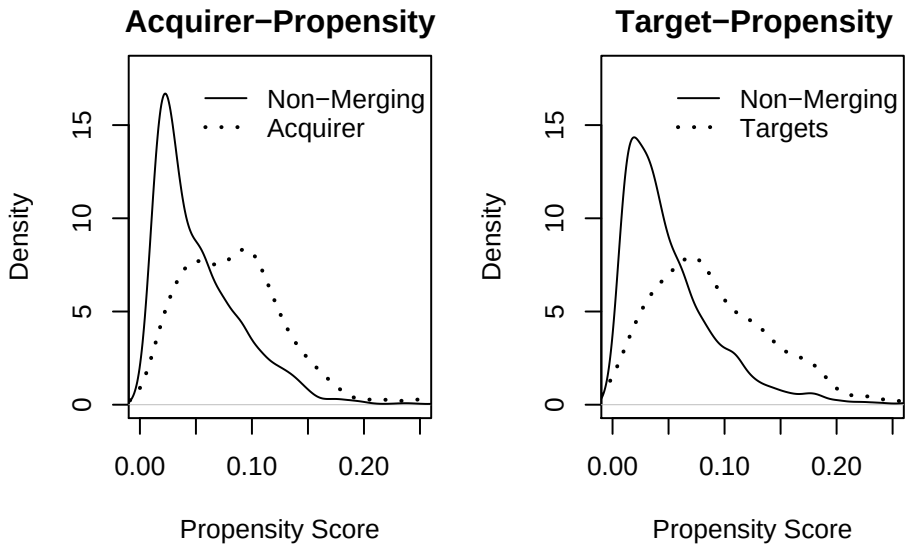


Figure 3: Distributions of estimated propensity scores

5.2 The balancing effect of the matching strategy

Below we describe the matching strategy outlined in the previous section for the base year 2000 only. Merger years 1995-1999 are treated accordingly.

Table 3: Balancing effect of the matching approach, 1999

		Non-merging	Targets	Control targets	Acquirer	Control acquirer
# banks		1484	119	119	119	119
ROA	Mean	0.658	0.471	0.486	0.611	0.601
	SD	0.483	0.578	0.458	0.645	0.523
	p-value		0.001	0.816	0.435	0.894
Size	Mean	19.16	18.41	18.40	19.47	19.54
	SD	1.454	1.067	1.144	1.096	1.099
	p-value		0.000	0.917	0.005	0.613
ROE	Mean	9.449	6.308	6.584	8.463	8.566
	SD	6.959	7.550	6.218	9.019	6.816
	p-value		0.000	0.758	0.246	0.921
CI	Mean	0.837	0.856	0.852	0.842	0.843
	SD	0.076	0.052	0.050	0.049	0.060
	p-value		0.000	0.614	0.283	0.845
EQR	Mean	0.119	0.123	0.123	0.114	0.116
	SD	0.028	0.038	0.026	0.021	0.020
	p-value		0.212	0.897	0.027	0.587
IM	Mean	0.029	0.029	0.028	0.030	0.031
	SD	0.006	0.006	0.005	0.010	0.012
	p-value		0.824	0.581	0.126	0.718
NPL	Mean	0.033	0.043	0.041	0.039	0.038
	SD	0.030	0.046	0.045	0.029	0.032
	p-value		0.023	0.775	0.034	0.830

ROA: return on assets; Size: log of total assets; ROE: return on equity; EQR: equity ratio (equity over total assets); CI: cost-income ratio; IM: interest margin; NPL: ratio of non-performing loans. p-value of t-test on equal means: for "Targets" and "Acquirer" comparison with "Non-merging"; for "Control Targets" ("Control Acquirer") comparison with "Targets" ("Acquirer").

As a first step, we restrict our sample of merged banks to pair mergers and exclude multiple mergers. For the banks involved in these mergers, we observe the individual pre-merger balance sheets and the consolidated post-merger balance sheet of the merged bank. The group of *potential* control banks is restricted to institutions that were not involved in any merger activities in the years from 2000 to 2003. This is necessary in order to prevent a bias in the estimation results for the medium-run merger effects arising from the fact that control banks were involved in mergers themselves.

Figure 3 depicts the distributions of the estimated propensities for banks to be the acquiring party or the target respectively, both for factually merging banks and non-merging banks. As expected, merging banks have, on average, a higher *ex ante* probability of merging than non-merging banks. As a second step, for each bank engaged in a bank merger in 2000, we select, from the set of non-merging banks, a control bank that mini-

mizes the distance in the propensity score, separately for acquirers and targets. In doing so, we look only at the 118 banks of a total of 183 pair mergers that were not involved in any further merger in the following three years after the mergers.

Table 3 shows that the difference between merging banks and their controls is insignificant for all key balance sheet ratios, while the difference between merging banks and non-merging banks is not, and it is larger for the target banks than for the control banks. [5] Since overt selection effects have been removed from the control sample we regard our matching strategy as providing a suitable basis for the following performance comparisons.

6 Merger effects on profitability and cost efficiency

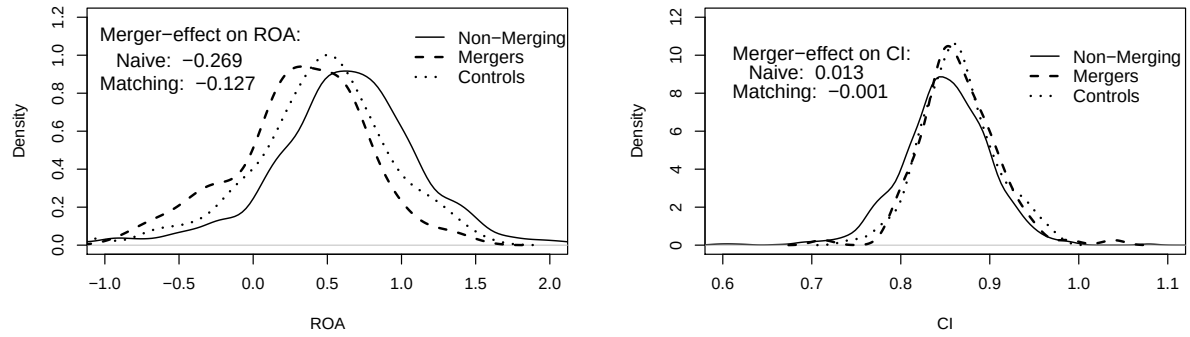
In this section, we finally assess the success of bank mergers with regard to profitability and efficiency. As we noted in section 4, our key performance indicators are the return on assets (ROA) and the cost-income ratio (CI). These indicators are considered as measures of a bank's profitability and efficiency respectively. In order to facilitate the presentation, we start with a detailed analysis of the mergers that took place in 2000, and analyze their performance during the following three years up to 2003, the last year for which merger information was available.[6] Full results of the mergers that occurred in the observation period from 1995 to 2005 are provided thereafter.

Figure 4 shows, for the year 2000, the distribution of ROA and CI for the 118 merged banks, the 118 control mergers and the non-merging banks. Note that we only consider those merger banks that did not participate in any further merger during the following three years. First, it is evident that the ROA density distribution of the control mergers is located left of the ROA density distribution of non-merging banks. This confirms our previous finding in section 4 that merging banks are on average less profitable than non-merging banks and, therefore, form a highly selective sample. Second, the ROA density distribution of factually merging banks is located left of both the density distribution of control banks and non-merging banks, which indicates a negative immediate merger effect on profitability. This finding is in line with expectations since mergers often lead to short-term disruptions in the business process which may lower the profitability of

[5] The appendix provides kernel density estimates which visualize these findings (figures 6 and 8). The principal findings for the year 2000 can also be established for all other years in our sample. Detailed results are available from the authors on request.

[6] The database on mergers does not end with the year 2003, but since the data is being processed with a time lag, data on the years 2004 to 2006 was not yet complete at the time of the present analysis.

Figure 4: ROA and CI distributions of merger, control and non-merging banks



the bank. On the other hand, comparing merging banks with non-merging banks would overestimated this effect, whereas the difference between merging banks and their control is significantly smaller.

In fact, the unbiased merger effect on ROA turns out to be -0.127, which is 53% lower than the naive merger effect (-0.269).[7] Interestingly, with regard to the cost-income ratio, we observe almost identical CI distributions for the merged and the control banks with the difference in means being insignificant. By contrast, the naive comparison yields a positive and significant difference of 0.013, which would – wrongly – indicate a worsening of the cost situation.

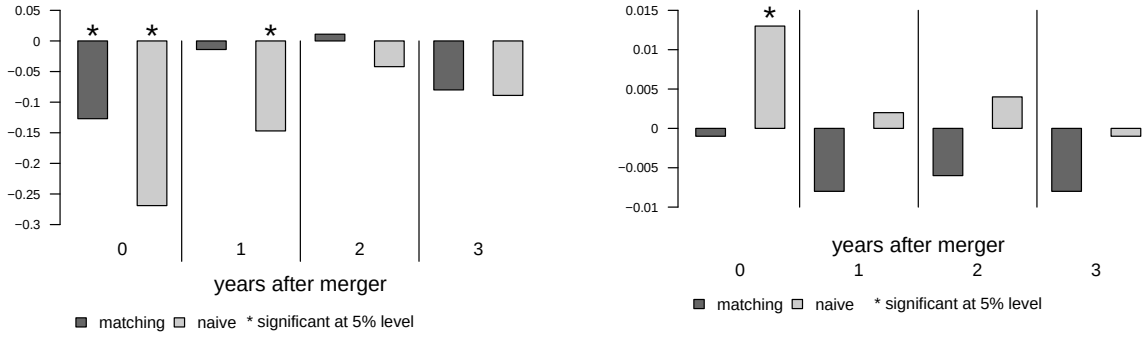
We also analyze the medium-term effects, ie those arising after one to three years after the merger. Tracking the factually merged banks and their controls for the following three years reveals a declining negative merger effect (cf. Figure 5) on the banks' profitability. At the end of the first post-merger year, the effect is small and statistically insignificant and remains so in the following two years. Regarding the cost-income ratio, we find no statistically significant effect in the post-merger years. By contrast, the naive comparison would have indicated a significant negative merger effect on ROA not only in the merger year but also in the first year after the merger.

After having described our approach in detail for the year 2000 mergers, we now present the results for the years from 1995 up to 1999. The estimated merger effects on ROA based on our suggested pair matching strategy are given in table 4.

We find that for all years, with the exception of 1996, the immediate merger effect is negative. For the years 1995, 1999 and 2000, the negative effect on profitability is strong in size and statistically significant. The mergers taking place in 1996-1998 have smaller

[7]Due to non-normality and the existence of outliers, we use the Hodges-Lehmann estimate for estimating the differences and we apply the paired Wilcoxon test when testing for significance.

Figure 5: The short and long term effects of the year 2000 mergers on ROA and CI



negative effects in the short run and slightly positive effects in subsequent years. In all the years years from 1995 to 2000, the negative merger effect diminishes in the years after the merger and even reverses to a small positive effect in the third post-merger year for the mergers of 1995, 1997 and 1998. For all merger years under analysis, the naive estimation of the merger effects strongly overestimates the negative merger effect Again, these differences in results can be attributed to the negative selection bias as merging banks are under-performers in the pre-merger year.

We now turn to the analysis of the cost efficiency effects of bank mergers (table 5). We find a positive merger effect on the cost-income ratio in the merger year for those mergers that occurred in the years from 1995 to 1997 but the increase is statistically significant only for the year 1996 (according to the Wilcoxon signed rank test). Immediate increases in the cost-income ratio are not significant, mergers taking place in 1996 being the exception. There is almost no immediate effect of the mergers that occurred in the years from 1998 to 2000. The estimates indicate efficiency improvements in the post merger years (except for 1996 mergers), though results are statistically insignificant for all but the 1998 mergers. As we already observed in the analysis on banks' profitability, the naive estimates give too negative a picture the of merger effects, with the exception of the years 1995 and 1996. In addition, while the matching estimates indicates small improvements in efficiency in the years after the merger, no lasting reduction in the cost-income ratio is found by the naive comparison, 1995 mergers being the only exception.

7 Conclusion

Given that the motive for engaging in merger activities is to improve the bank's business performance, it is quite surprising that many studies have found efficiency and profitabil-

Table 4: Evaluation of merger effects on ROA, control group comparison and naive merger effects

Control group comparison*

Base year	Sample size mergers	Sample size control group	Merger effects: Immediate	1 year	2 years	3 years
1995	60	60	-0.203	-0.002	-0.09	-0.069
			(0.011)	(0.974)	(0.179)	(0.387)
1996	66	66	-0.208	-0.071	-0.029	-0.028
			(0.008)	(0.322)	(0.632)	(0.678)
1997	48	48	-0.083	-0.017	0.114	0.17
			(0.251)	(0.772)	(0.107)	(0.073)
1998	84	84	-0.105	-0.01	0.076	0.018
			(0.105)	(0.825)	(0.306)	(0.829)
1999	97	97	-0.171	-0.064	-0.012	0.118
			(0.001)	(0.368)	(0.804)	(0.118)
2000	119	119	-0.127	-0.014	0.011	-0.08
			(0.032)	(0.839)	(0.85)	(0.131)

The naive merger-effects*

Base year	Sample size mergers	Sample size control group	Merger effects: Immediate	1 year	2 years	3 years
1995	60	2652	-0.295	-0.114	-0.078	-0.081
			(0)	(0.036)	(0.166)	(0.169)
1996	66	2348	-0.184	-0.049	-0.057	-0.067
			(0.009)	(0.379)	(0.235)	(0.224)
1997	48	1963	-0.158	-0.163	-0.008	0.029
			(0.006)	(0.042)	(0.879)	(0.699)
1998	84	1640	-0.384	-0.141	-0.099	-0.044
			(0)	(0.001)	(0.117)	(0.481)
1999	97	1366	-0.312	-0.209	-0.074	0.032
			(0)	(0.001)	(0.122)	(0.59)
2000	119	1184	-0.269	-0.147	-0.042	-0.089
			(0)	(0.008)	(0.5)	(0.146)

*In brackets: p-value of t-test on equal means of merging banks and control sample

Table 5: Evaluation of merger effects on CI, control group comparison and naive merger effects

Control group comparison*

Base year	Sample size mergers	Sample size control group	Merger effects: Immediate	1 year	2 years	3 years
1995	60	60	0.008	0.001	0.000	0.007
			(0.165)	(0.974)	(0.956)	(0.379)
1996	66	66	0.021	0.017	0.015	0.007
			(0.002)	(0.026)	(0.017)	(0.292)
1997	48	48	0.008	-0.004	-0.005	-0.012
			(0.234)	(0.566)	(0.572)	(0.204)
1998	84	84	0.000	-0.005	-0.016	-0.008
			(0.956)	(0.406)	(0.021)	(0.159)
1999	97	97	0.005	0.001	0.001	-0.006
			(0.263)	(0.911)	(0.900)	(0.302)
2000	119	119	-0.001	-0.008	-0.006	-0.008
			(0.873)	(0.079)	(0.220)	(0.124)

The naive merger-effects*

Base year	Sample size mergers	Sample size control group	Merger effects: Immediate	1 year	2 years	3 years
1995	60	2652	-0.006	-0.012	-0.012	-0.007
			(0.409)	(0.130)	(0.116)	(0.322)
1996	66	2348	0.014	0.009	0.007	0.003
			(0.013)	(0.116)	(0.182)	(0.599)
1997	48	1963	0.012	0.000	0.001	-0.001
			(0.031)	(0.978)	(0.850)	(0.918)
1998	84	1640	0.011	0.005	-0.003	0.008
			0.050)	(0.336)	(0.642)	(0.145)
1999	97	1366	0.017	0.006	0.008	0.006
			(0.000)	(0.135)	(0.086)	(0.331)
2000	119	1184	0.013	0.002	0.004	-0.001
			(0.003)	(0.600)	(0.396)	(0.851)

*In brackets: p-value of t-test on equal means of merging banks and control sample

ity of the merged bank to be weakening during and after the merger event. These findings could suggest, if taken literally, that mergers are detrimental and should be avoided. However, when a negative effect of bank mergers on profitability and efficiency is maintained, it is often the case that the study rests on a simple comparison of merging banks with non-merging banks. As we have shown in our analysis, this comparison suffers from a severe selection bias because merging banks – in particular, the target banks – often represent an under-performing part of the banking industry. For the case of Germany, we find that target banks are usually smaller, less profitable, and less cost-efficient and riskier than non-merging banks. For the acquiring banks, we find that they are, on average, larger, less profitable and have a larger share of non-performing loans than non-merging banks. In order to better control for the selection bias, we suggest a new estimation strategy based on statistical matching methods. These methods are well established in clinical studies but have not been used so far in bank merger studies. In our matching approach, we estimate propensities that a particular bank will engage in a merger, either as an acquirer or a target. For each *de facto* merging pair of banks, we select a control pair of banks from the set of non-merging banks whose *ex ante* probabilities of merging are closest to the probabilities of the acquiring and target bank respectively. This approach allows us to derive a set of control pairs of banks which share similar characteristics with the set of merging banks and thereby avoid a selection bias.

Our empirical results indicate, in contrast to previous research, a neutral effect of mergers on profitability and a positive effect on cost efficiency. This finding suggests that the main motive of bank mergers is indeed to enhance the efficiency of banks, but the increase in operating profits is partly offset by revaluation effects in the course of the restructuring process. However, further research is necessary to disentangle the specific conditions under which merged banks thrive or fail.

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8 Appendix

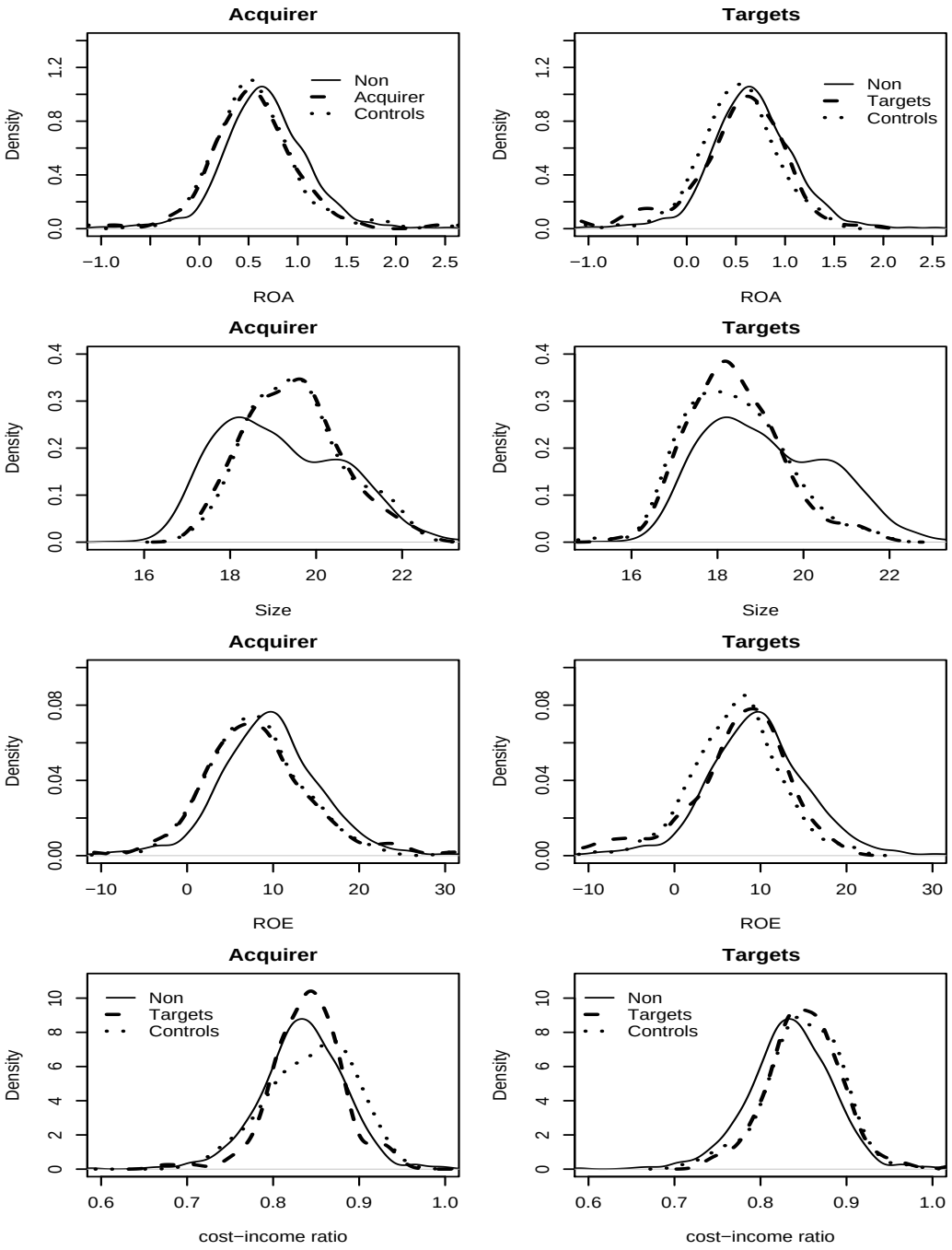

Figure 6: The balancing effect of the matching routine

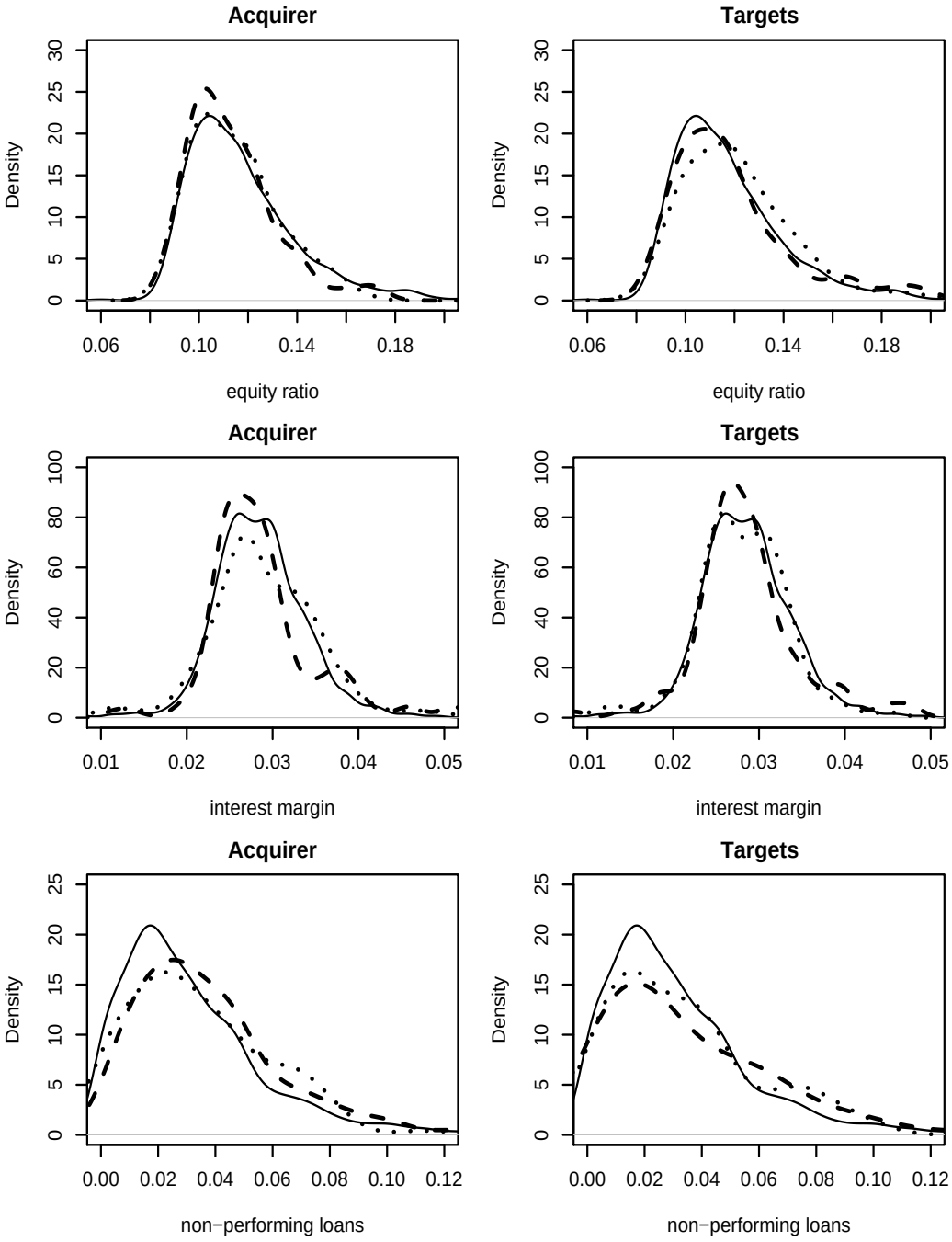

Figure 7: The balancing effect of the matching routine (continued)