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Do mergers and acquisitions affect the performance of acquiring firms? Evidence for Swiss small- and medium-sized firms

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KOF Working Papers

Do Mergers and Acquisitions Affect the Performance of Acquiring Firms?
Evidence for Swiss Small- and Medium-sized Firms

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Do Mergers and Acquisitions Affect the Performance of Acquiring Firms? Evidence for Swiss Small- and Medium-sized Firms

Spyros Arvanitis*, Tobias Stucki**

Abstract. This paper investigates the post-merger performance effects of mergers and acquisitions (M&As). Our study is based on a representative sample that includes all Swiss M&As that took place in the period 2006–2008. In contrast to previous studies in this field most of our M&As took place between SMEs. Our data allows us to investigate the impact of M&As not only on different measures of economic performance but also on innovation performance. For the empirical analysis we use a matching framework that accounts for endogenous selection. Based on the sample of all M&As we cannot find statistically significant performance effects of M&As for any of the four performance measures. However, we find some positive and statistically significant performance effects when we examine separately specific sub-samples of M&As, namely (a) the M&As with a relative size (as to sales) of the acquired firm of more than 25% of the acquiring firm and (b) the M&As that took place in 2006, i.e. the M&As with the largest time distance between M&A and performance measurement in our sample.

Keywords: mergers and acquisitions; economic performance; innovation performance

JEL classification: L20; O31

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1 Introduction

The main motivation for this paper is that despite a broad empirical literature on the determinants as well as the economic performance of mergers and acquisitions (M&As; see, e.g., Agrawal and Jaffe 2000; Kaplan 2000; Martynova and Renneboog 2008; Gugler et al. 2012) some aspects of this topic remain rather under-researched, particularly those that concern small and medium-sized firms (SMEs). This neglect of M&A studies that refer to SMEs may be traced back to the fact that the majority of empirical studies rely on stock market-based measures of performance (see, e.g., Andrade et al. 2001; King et al. 2004; and Meglio and Risberg 2011). As such information is not available for the majority of SMEs, the performance of M&As is almost exclusively analyzed for large M&As and it is unclear whether the implications of these studies are valid also for M&As of SMEs (see Weitzel and McCarthy 2011).

A further point is that only a limited number of M&A studies focus on the consequences of M&A on the firms' technological activities (see Veugelers 2005 and Schulz 2007 for a review of this literature). Given the increasing importance of innovation activities as a driver of growth not only for larger firms but also for SMEs, it becomes clear that more insights with respect to the innovation effects of M&A are needed (see, e.g., Cassiman et al. 2005; Cloudt et al. 2006).

While a previous paper analyzed the determinants of M&A performance of SMEs as they are assessed by the acquiring firms themselves (see Arvanitis and Stucki 2012), the paper at hand investigates the post-merger performance effects of M&As. In contrast to previous studies in this field that focus on M&As between large firms, our study is based on a representative sample that includes all Swiss M&As that took place in the period 2006–2008. Average size of these firms is just about 320 employees, whereupon 60% of the firms have less than 100 employees, 86% of them less than 500 employees. Accordingly, we are able to draw conclusions regarding the total of M&As in the respective period of time. In addition, our survey provides us detailed information on the performance and characteristics of M&As. This allows us to investigate the impact of M&As not only on different measures of economic performance but also on the innovation performance. For the empirical analysis we use a matching framework that accounts for endogenous selection.

The paper is organized as follows. Section 2 presents related theoretical and empirical literature and the research hypotheses that are tested in the empirical part. Section 3 provides a short descriptive analysis of the data used in the paper. In Section 4 the specification of the empirical models is presented. Section 5 deals with the estimation results. Section 6 concludes.

2 Related theoretical and empirical literature

The controversy in existing literature over the direction of the effects of M&A on the post-merge performance of merged firms has not only an empirical background but it also reflects conceptual differences. Thus, the literature referring to the explanation of the performance of M&As can be divided in two broad branches: the value-increasing efficient-market approach and the value-decreasing agency approach. According to the former, mergers occur because of the possibility of exploiting synergies (between the acquiring firm and the target firm), which in turn enhance the performance of the merged firm (see, e.g., Hitt et al. 2001). The latter explains the performance failure of mergers through the existence of informational and agency problems between management and owners (see, e.g., Jensen 1986). For SMEs we expect that the value-destroying approach will not apply because in most cases there is no separation of ownership and control (Weitzel and McCarthy 2011). In this study we thus concentrate on the value-increasing efficient-market approach.

Economic performance

Previous studies use various measures to investigate the impact of M&A on corporate performance, where measures might be based on market measures (mostly some measure of stock price performance), accounting measures (e.g., profitability and sales ratios) or mixed measures (e.g., operating cash flow and measures of stock price reaction). In recent surveys of empirical literature linking corporate performance to M&A until 2002 Tuch and O'Sullivan (2007) and Ismail et al. (2011) concluded that the effect of mergers and acquisitions on the "abnormal" returns for corporate stock (that is those returns that were significantly above or below the industry average) were in most reviewed studies inconclusive. Only few studies reported a positive effect, some even a negative impact. Evidence using accounting performance measures was mixed: for example, a negative impact was often found for post-merger sales, but a positive effect for post-merger profitability. More specifically, Tuch and O'Sullivan (2007) reported mostly negative or insignificant effects for short-run event studies (up to 3 months) and overwhelmingly negative effects for long-run event studies (up to 5 years). Further, some studies showed varying results for different industries.

There is a dispute in literature regarding factors that affect post-merger performance. A series of factors that correspond to characteristics of the merger and/or the acquiring and the acquired firm have been investigated as to their influence on performance: mood of the acquisition (friendly or hostile), method of payment (cash or stock), relative size of acquiring and acquired firm, industrial relatedness of acquiring and acquired firm, pre-merger performance and cross-border versus domestic M&A.

The possible differences between SMEs and larger firms that interest primarily in this study have not been the subject of intensive research until now. Weitzel and McCarthy (2011) suggest that SMEs are different from their larger rivals for at least two reasons. Firstly, because as already mentioned above agency problems that occur with the separation of ownership and control arise much less in SMEs. Secondly, even in the case of separated ownership and control the information asymmetries that cause agency problems (because they facilitate self-interested behavior) will be much smaller in a SME. As a consequence, the exclusion of agency problems increases the likelihood of a successful M&A, that is, a M&A that shows positive performance impact. Of course the problems of self-overvaluation (of the acquired firm) or “hubris” of managers or owners remain as potential sources of value-destruction, but according to Moeller et al. (2004) these problems are of small relevance in a SME.

To the best of our knowledge no empirical study has analyzed the impact of M&As on economic performance for SMEs. However, some empirical evidence can be found in studies that analyze the impact of firm size on M&A performance, even if the average firm size in these studies is significantly larger than in our sample. In a comprehensive study based on a sample of 12'023 acquisitions by public firms in the U.S.A between 1980 and 2001 Moeller et al. (2004) found that the announcement return for acquirers is roughly two percentage points higher for small acquirers irrespective of the form of financing and whether the acquired firm is public or private. Further, the size effect is robust to firm and deal characteristics and it is not reversed over time. A serious limitation of this study is that it refers only to public acquiring firms.

Gugler et al. (2003) in a study based on a large panel of about 45'000 mergers and acquisitions around the world (about half of them in the U.S.A) between 1981 and 1998 investigated the performance effects of M&A as measured by sales and profitability. The authors concluded that “one might expect mergers between small firms to be more likely to increase efficiency by creating economies of scale and scope, while mergers between large firms would be more likely to increase market power” (p. 646). These conjectures were supported by the findings that sales increased following profitable mergers between small firms and decreased in the case of mergers between large firms.

To sum up, empirical evidence is quite ambiguous. While a tendency for negative long-term effects on post-merger performance was found in stock price-based studies, the impact tend to be positive for smaller firms. We thus formulate the following hypothesis:

Hypothesis 1: We expect a positive effect of M&A of SMEs on economic performance;

Innovation performance

The literature that deals with the effects of M&A on post-merger innovation performance is rather scarce (see Veugelers 2005 and Schulz 2007). We know only of one study that investigated explicitly the differences between small and large firms as to the impact of M&A on innovation performance (Phillips and Zhdanov 2012), even if in a setting that is different from that of our study. In this study based on data for 11'288 U.S. firms for the period 1984-2006 the authors showed that firms incentives to conduct R&D increase with industry acquisition activity and more for small firms than large firms.

Our review of the literature motivated the formulation of the following hypothesis for the empirical part:

Hypothesis 2: We expect a positive effect of M&A of SMEs on innovation performance.

3 Description of the data

3.1 Construction of the data set

The sample we use in this study refers to the cohort of Swiss M&As that took place between 2006 and 2008. This cohort was registered by the Swiss Federal Statistical Office and contained originally 2048 firms. We checked in detail the original data in a multi-step process. In a first step, the changes in the firm structure of *acquiring* firms were verified using the information of the Swiss Commercial Register. A further verification whether these (legal) changes corresponded to real M&A activities was attained through specific questions in the questionnaire that was addressed to the acquiring firms. 413 firms of the original sample were excluded because (a) the registered M&As were only legal adaptations to already established economic relations; (b) they were non-profit organizations; or (c) they were firms with less than one full-time employee. Further, 237 firms had already left the market in 2011 and could not be contacted anymore. After these adjustments 1398 firms were left in the sample that corresponded to our definition of M&A. We defined M&A as the partial or full merger or acquisition of firms that are legally independent from each other. This definition covers both external M&As and M&As within the same group of firms (internal M&As).

Information on these firms was collected in the course of a postal survey on the “M&A of the Swiss Economy” carried out in spring 2011.¹ The survey yielded information on M&A characteristics (number of M&A per acquiring firm, relative size, method of payment, relatedness, motives, obstacles, etc.). In addition, we collected information on innovative activities and some basic characteristics of the firm (employment, firm age, industry affiliation, etc.). Our questionnaire

¹ The questionnaire is available in German and French on www.kof.ethz.ch/en/surveys/.

also included information on the development of quantitative measures of economic performance and innovation (sales, value added, investment, innovation expenditures) after the M&A, specifically for the period 2008-2010.

The survey yielded data for 405 enterprises, implying a response rate of 29%. This is satisfactory given the very demanding questionnaire and that not all ‘wrong’ M&As could be identified. Depending on the number of missing values of the model variables between 119 (innovation model) and 253 (investment model) observations could be used to analyze econometrically the impact of M&As on the development of performance.

To deal with endogenous selection into M&A a control group is required. The control group of non-merged firms comes from the KOF enterprise panel that is based on a sample of some 6500 firms taken from the Business Register of the Federal Statistical Office. The sample, which covers manufacturing industry, construction and the commercial area of the service sector, is stratified according to sectors and sector-specific variables and is adjusted regularly. Information on these firms has been collected in the course of a postal survey on the innovation activities carried out in fall 2011. The survey also included information on M&A activities of the firms, what allowed us to clean up our control group. To avoid that our performance measures were affected by reorganizations of the firms after 2008, we excluded all firms with M&A and/or outsourcing activities² after this date. Furthermore, the survey included information on the same basic characteristics of the firms that is also available in the M&A survey (sales, value added, employment, firm age, industry affiliation, etc.), what allowed us to specify a selection equation.³

Unfortunately, the innovation survey included information on quantitative measures (sales, value added, investment, innovation expenditures) only for 2010. To get dynamic information on these quantitative measures for the control group as well, we matched the information of the innovation survey with the information of a survey on the “Internationalization of the Swiss Economy” that was based on the same sample of firms and was carried out in spring 2010. This survey included information on the objective measures for 2008, what allowed us to construct comparable measures on the development of the objective variables as available in the M&A survey. Due to the fact that some of the firms did not answer both surveys and to missing values for some of the model variables, the sample size of the control group of non-merged firms that could be effectively used in our estimations diminished significantly. Depending on the model between 300 (innovation model) and 776 (value added model) observations could be used. This seems to be satisfactory as the

² This information came from our surveys and included M&A and outsourcing activities that made a difference of more than 10% of previous total sales.

³ The questionnaire is available in German, French and Italian on www.kof.ethz.ch/en/surveys/.

number of firms in the control group for each model is at least 2.5 times the number in the treatment group.

3.2 Characteristics of the M&As

We consider our sample of M&As to be representative for the entire population of Swiss M&As in the period 2006–2008. Accordingly, the characteristics of these M&As should tell us something about how average M&As look like. Detailed description of the collected data is presented in Table 1.

Most of the M&As took place in the service sector (65%). 27% in the manufacturing sector, the remaining 8% in the construction sector. In the service sector as well as in the manufacturing sector, M&As were equally distributed among the high-tech and the low-tech sub-sector. M&As were relatively equally distributed among industries. Only the industries ‘wholesale’, ‘banks, insurance’ and ‘business services’ had a share of more than 10% of the total sample.

The acquiring firms were for the most part small firms. 60% of the firms had less than 100 employees and only 14% of the firms employed more than 500 employees. The relative size of the target to acquirer was mostly small. The sales of the target firm made less than 5% of the acquirer’s sales in nearly 30% of all M&As. The target firm was larger than the acquiring firm only in 1% of all transactions.

4 Econometric framework

4.1 Potential econometric problems

To be able to make a statement on the impact of M&As on performance, we have to overcome two problems (see Egger and Hahn 2010 for a detailed description of these problems in the context of the assessment of the performance effects of M&As). The first one is a missing data problem. We have only one observable outcome per firm, either with treatment or without treatment. Thus, it is difficult to assess how a firm with M&A would have performed without M&A. The second problem is that self-selection into treatment is usually at work by merger operations. Before firms undergo a merger, their managers usually analyze the costs and benefits of such an operation. Accordingly, selection into treatment should be strongly related to the expected benefits of such a M&A. This makes it difficult to identify merger-generated performance effects, e.g., it is not advisable to take the mean outcome of non-treated firms as an approximation.

There are different solutions to overcome these problems. We apply the matching approach as it seems to be well suited for our data.⁴ The basic idea of this approach is to compare the average outcome of the treated firms with average outcomes of structurally similar firms that are not treated. To ensure that the matching approach identifies and consistently estimates the treatment effect of interest, two key assumptions are required. First, the ‘conditional independence assumption’ (CIA) implies that, given a vector of observed variables which are not affected by treatment, assignment to treatment is independent of the outcomes. Second, the ‘common support condition’ (CSC) ensures that firms with the same vector of observed firm-specific variables have a positive probability of belonging to both treatment and control group. In our case, the two key assumptions should not be violated. Due to the matching of different data sets we have a large group of non-merged firms (see Section 3.1), what should ensure the finding of good matches for the treated firms. Furthermore, the data set includes detailed information on the internal firm characteristics as well as on the external market conditions. This allows us to control in detail for factors that may influence the treatment status and the outcome variables but are not affected themselves by treatment.

4.2 Implementing the matching approach

Due to the high dimensionality of the covariate vector that explains selection into treatment, we will use the propensity score matching (PSM) approach introduced by Rosenbaum and Rubin (1983). The idea of this procedure is to match firms based on balancing scores, i.e. on the probability of treatment given a vector of observed characteristics (for a detailed description of this approach see Caliendo and Kopeinig 2008). To evaluate these propensity scores, a selection equation is estimated in a first step. In a second step, firms from the treatment group and firms from the control group are matched, and the outcome of a treated firm with the outcomes of comparison group members are contrasted. We compare the outcomes for four different performance measures.

Estimating the propensity scores

As M&A is a binary treatment, probit models are used to estimate the propensity scores.⁵ To support the CIA a broad set of variables is tested as explanatory variables in the selection equation. A first group of variables describes the general firm characteristics (firm age; independency of the firm; education level of the employees; export share; firm size), a second one controls for external market conditions (development of the demand; intensity of price competition; intensity of non-

⁴ An alternative solution to estimate causal effects would have been to apply an instrumental variable (IV) approach. In contrast to the matching approach, IV estimation can provide consistent results even in the presence of hidden bias. However, this typically comes at the costs of a reduced precision of the estimates and introduces new uncertainty from its reliance on additional untestable assumptions (see DiPrete and Gangl 2004).

price competition). Furthermore, we control in detail for regional aspects and industry affiliation. The information for these variables comes from the surveys that are described in Section 3.1. A limitation of these variables is that the information mostly refers to the time after the M&A took place. However, as we expect that local market conditions as well as the structures of the firms have remained quite the same for the great majority of firms, this should only marginally affect our results.

Matching procedure

To capture different effects of M&As, we use different measures of firm performance: value added per employee, price cost margin, gross investment expenditures per employee and sales of innovative products per employee. The last variable measures a firm's innovation performance. To reduce the impact of time constant unobserved effects, difference in performance of the years 2008 and 2010, for which the respective information is available, is analyzed. If returns of M&As (that took place in the period 2006-2008) were primarily generated already before 2008, this might lead to an underestimation of the performance effect of M&As. Nevertheless, we assume here that the development of the variables for the period 2008-2010 is a good approximation for the development of post-merger performance.⁶ In order to capture effects of other changes in the firms over time that are not covered by our data (e.g., closure of departments, changes of productivity due to new production techniques, etc.), our performance measures are divided by the number of employees.

As matching method we chose the nearest-neighbor matching algorithm without replacement because the distribution of the propensity scores in the treatment and the control group is comparable (see the respective graphics in the Tables A.1 to A.4 in the appendix) and the number of firms in the control group seems to be sufficiently large to find good matches. To impose a common support we dropped treatment observations whose propensity score was higher than the maximum or less than the minimum propensity score of the controls. Furthermore, bootstrapping was applied to correct the standard errors.

5 Estimation results

5.1 Selection model

In line with similar studies that use a matching framework in order to investigate the performance effects of M&As (see, e.g., Egger and Hahn 2010 and Park and Sonenshine 2012), the selection equation includes different variables that describe the firm structure and the external market

⁵ Alternatively, we also tested logit models. Both models yielded similar results.

⁶ Some robustness tests with respect to this assumption can be found in Section 5.2 where the impact of M&As is separately analyzed for different distances of time between M&A and performance measurement.

conditions. These variables are also in accordance with theoretical and empirical findings on the determinants of a firm's decision to involve itself in a M&A. To reduce the variance of the estimates, potential explanatory variables were dropped, if they did not have a significant impact. This was the reason for excluding the sales share of exports and the intensity of non-price competition. Due to missing values for the different performance variables, the number of observations that can be used to identify the treatment effect can vary substantially. To increase the matching quality, selection models are estimated for the same set of observations that could also be used to identify the treatment effect afterwards. Accordingly, we estimate for each target variable a separate selection model. The results of the final selection models are presented in Table 3.

The quality of the selection model is quite impressive for a model based on firm-level survey data. Pseudo- R^2 varies between 0.19 and 0.24, log-likelihood values between 129.15 and 231.03. Firm age shows a U-shaped relationship to the probability of treatment (that is, the probability of being involved in a M&A). Thus, young and old firms show a higher treatment probability than middle-aged firms. Other attributes of firms that correlate significantly with the treatment propensity are independency, the share of employees with tertiary-level education (only in model 2) and firm size (with the exception of model 4). Furthermore, the M&A probability is affected by external market conditions. A positive demand development as well as a low intensity of price competition do both increase the probability of being involved in a M&A. Due to the varying number of missing values for the different performance variables there are some small differences between the models.

As mentioned before, propensity score matching is only a valid procedure if the CIA and CSC hold. Separate tests on these two assumptions for the different models are presented in the Tables A.1 to A.4 in the appendix. In a first step, the success of the matching was tested. Propensity score matching requires that the treatment group and the control group are similar in each aspect. To check this assumption, we first tested whether the mean value of each model variable after matching was the same in the treatment group and in the control group. Based on t-tests, the null hypothesis that the conditions of the two groups do not differ after matching could not be rejected on the 10% significance level for any explanatory variables in the four models. Furthermore, likelihood-ratio tests indicated joint insignificance of all the right-hand variables after matching. In a next step, we graphically checked the CSC. The graphics showed that after dropping treatment observations whose propensity score was higher than the maximum or less than the minimum propensity score of the controls ('off support' observations), there was an overlap of the propensity scores of the treated and untreated firms for each model. We can thus assume that common support is given.

5.2 Treatment effect

All M&As

Estimations for the average treatment effect for the treated (ATT) that are based on the whole sample of M&As are presented in Table 4. The results show that for all four performance indicators used in this study the average development of performance (differences of the values of the variables in 2008 and 2010) do not significantly differ between firms with M&As and firms without M&As. Thus, based on a sample that can be considered as representative for all M&A activities in Switzerland for the period 2006-2008, we could not observe a significant performance effect of M&As. Accordingly, our two hypotheses as formulated in section 2 are *prima facie* not supported by the empirical findings. Nevertheless, a look on the calculated performance difference shows that three of them are positive (value added per employee, price cost margin and the sales share of innovative products), even if statistically insignificant, and only one (gross investment per employee) is negative (and also statistically insignificant). Thus, the tendency for long-term (one to five years) negative effects on post-merger performance that was found in many stock price-based studies seems to receive no confirmation from our results.

The results for the entire sample of M&As may be driven by the special characteristics of the M&As in our sample. As our survey on M&As includes much information on the characteristics of the M&As, we could test the robustness of our results by analyzing the impact of M&As separately for different types of M&As. We examined the influence (a) of the relative size of the acquired firm, (b) of the M&As being external or internal (inside a conglomerate or group of firms), and (c) of the length of the time period between the M&As and the performance measurement.⁷

Relative size of the acquired firm

In general, a larger relative size correlates with a larger synergy potential generated, e.g., by economies of scale (see, e.g., Agrawal et al. 1992, Capron 1999; for a survey of respective literature see Tuch and O'Sullivan 2007). In line with existing literature we thus assume that the relative size of the target firm is positively correlated with the performance of M&As. In our sample, the sales of the target firm made less than 5% of the acquirer's sales in 29% of all M&As. For 37% of M&As the relative size of the acquired firm fluctuated between 6% and 25% of the acquiring firm. For 24% of all M&As the relative size of the acquired firm varied between 26% and 50% of the acquiring firm. To test whether the results of Table 4 were driven by the small relative size of the firms in our sample, we analyzed in alternative estimations the performance effect only including M&As with a relative size of target to acquirer of more than 25%. The results are presented in

Table 5, Panel A. In this case we could find a statistically significant positive effect of M&As for the performance variable value added per employee ($p\text{-value}=0.063$). The effects for the other performance measures remained insignificant. Thus, our hypothesis 1 at least received some empirical support for M&As with relatively large acquired firms (with sales that amount to at least 25% of the sales of the acquiring firm). However, no empirical evidence is found for hypothesis 2. This result is intuitively plausible when we take into account that the relative size of the M&As can be closely related with the size of economies of scale that can be reached after the merge. Economies of scale are expected to stimulate economic performance. With respect to innovation activities, economies of scale are, however, associated with the elimination of common innovation inputs in combination with small efficiency gains of a common organization of innovation activities. Accordingly, only marginal scale effects are expected with respect to innovation performance (see Cassiman et al. 2005 for a similar argumentation).

Only external M&As

In our study we distinguish between internal and external acquisitions. If the firms belonged to the same group of companies before the transaction took place, it can be expected that the group would have taken advantage of potential synergies between the firms to some extent already before the merger. Accordingly, the potential for additional synergies would be small in case of internal acquisitions. We thus expect that internal acquisitions are less likely to generate a positive M&A performance effect than external acquisitions. We tested this hypothesis in separate estimates for only external M&As. We could not find any significant effect (Table 5, Panel B).

Length of the time period

The M&As in our sample took place in different points of time between 2006 and 2008, so that the time distance between M&A and performance measurement is varying. We examined whether this time difference could lead to differing performance effects (see, e.g. Meglio and Risberg 2010; see Tuch and O'Sullivan (2007) for a survey of literature referring to the time effect). To this end, we estimated separately the treatment effects for the sub-samples of firms with M&As in the years 2006, 2007 and 2008, respectively. The results are found in Table 5, Panels C.1 to C.3. We found a significantly positive performance effect for the variable 'sales of innovative products per employee' for the sub-sample of the firms with M&As in the year 2006 ($p=0.070$). Accordingly, it seems that M&As require some time to have a significant effect on innovation performance. The other performance indicators are not affected by the acquisition date. This result seems plausible, as we would expect that it requires more time for synergies between two firms to result in innovation output than in economic output. Thus, hypothesis 2 is confirmed only for the M&As that took place

⁷ The respective tests on balancing property and common support are not presented here, but are available on request.

in 2006, that is, the post-merger effect on innovation performance showed not before two to four years after the merger. The performance differences in Panel C.3 for 2008, other as in the Panels C.1 (2006) and Panel C.2 (2007), are throughout negative, even if statistically insignificant. This is a (further) hint that it needs a considerable time distance between the structure change (caused by the M&A) and the post-merger performance measurement for discernible post-merger performance effects to come out.

6 Summary and conclusions

In this paper we investigated the actual performance effects of M&As based on a representative sample that includes all Swiss M&As that took place in the period 2006–2008. To capture different aspects of performance we used the development of four different performance measures: (a) value added per employee, (b) price cost margin, (c) investment expenditures per employees and (d) sales of innovative products per employee. To deal with potential endogeneity problems a matching procedure was applied.

Based on the sample of all M&As we could not find statistically significant performance effects of M&As for any of the four performance measures. Nevertheless, a look on the calculated performance difference shows that three of them are positive (value added per employee, price cost margin and the sales share of innovative products), even if statistically insignificant, and only one (gross investment per employee) is negative (also statistically insignificant). Thus, the tendency for long-term (one to five years) negative effects on post-merger performance that was found in many stock price-based studies (see Tuch and O’Sullivan 2007) seems to receive no confirmation from our results.

We found some statistically significant results when we examined separately specific sub-samples of M&As. Our hypothesis 1 of a positive impact of M&A on economic performance received some partial empirical support with respect to value added per employee only for M&As with relative large acquired firms (with sales that amount to at least 25% of the sales of the acquired firm). Hypothesis 2 that predicts a positive impact of M&A on innovation performance was confirmed only for the M&As that took place in 2006, that is, the post-merger effect on innovation performance (variable: sales share of innovative products) showed not before two to four years after the merger. This is a hint that it needs a considerable time distance between the structure change (caused by the M&A) and the post-merger performance measurement for discernible post-merger performance effects. We could not find a significant effect in separate estimates for the external M&As.

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Table 1: Sample composition by sector, industry and firm size

Industry/sector	N	Percentage
<i>Manufacturing</i>	<i>106</i>	<i>27%</i>
- High-tech manufacturing	51	13%
- Low-tech manufacturing	55	14%
Food, beverage, tobacco	9	2%
Textiles	3	1%
Clothing, leather	0	0%
Wood processing	3	1%
Paper	3	1%
Printing	16	4%
Chemicals	8	2%
Plastics, rubber	2	1%
Glass, stone, clay	4	1%
Metal	0	0%
Metalworking	9	2%
Machinery	23	6%
Electrical machinery	6	2%
Electronics, instruments	8	2%
Watches	3	1%
Vehicles	4	1%
Other manufacturing	3	1%
Energy	2	1%
<i>Construction</i>	<i>30</i>	<i>8%</i>
<i>Services</i>	<i>257</i>	<i>65%</i>
- Knowledge-intensive services	129	33%
- Traditional services	128	32%
Wholesale trade	57	15%
Retail trade	18	5%
Hotels, catering	7	2%
Transport, telecommunication	24	6%
Banks, insurance	60	15%
Real estate, leasing, computer services	14	4%
Computer services	21	5%
Business services	44	11%
Personal services	2	1%
Education	2	1%
Health, veterinary and social work	0	0%
Sewage and refuse disposal, sanitation and similar activities	2	1%
Recreational, cultural and sporting activities	6	2%
Total	393	100%
Firm size	N	Percentage
1-9 employees	53	13%
10-19 employees	32	8%
20-49 employees	88	22%
50-99 employees	66	16%
100-499 employees	106	26%
500 and more employees	58	14%
Total	403	100%

Notes: Firm size information is based on information for the year 2010. Due to different response rates, the number of observations differs between variables.

Table 2: Variable definition and measurement

Variable	Definition/measurement
$\Delta(\text{value added per employee})$	Change of the value added per employee between 2008 and 2010 (Value added is defined as sales less the cost of materials, expenditure on plant machinery and other fixed assets and expenditure on buildings)
$\Delta(\text{price cost margin})$	Change of the price cost margin between 2008 and 2010 (Price cost margin is defined as the value added less labor costs divided by value added)
$\Delta(\text{investments per employee})$	Change of gross investment per employee between 2008 and 2010
$\Delta(\text{innovative sales per employee})$	Change of the sales of innovative products (new product and significant modifications of existing products) per employee between 2008 and 2010
firm_age	Firm age (in years) and square of firm age
independent	Firm is not part of a group of companies yes/no
tertiary_share	Share of employees with a tertiary-level degree
firm_size	Number of employees (2010) (Dummy variables for two firm size classes: (a) 10-99; (b) more than 99; reference group: 'less than 10')
demand_development	Development of a firm's specific product demand (transformation of a five-level ordinal variable (level 1: 'strong decrease'; level 5: 'strong increase') to a binary variable (value 1: levels 4 and 5; value 0: levels 1, 2 and 3 of the original five-level variable))
price_competition	Intensity of price competition (five-level ordinal variable: level 1: 'very weak'; level 5: 'very strong')
Region dummies	Dummies for six regions (Espace Midland; Northwestern Switzerland; Zurich; Eastern Switzerland; Central Switzerland; Ticino; reference region: Lac Léman)
Industry dummies	Dummies for 25 industries

Table 3: Selection equations for the different target variables

Selection equation	(1)	(2)	(3)	(4)
<i>Firm characteristics</i>				
firm_age	-0.014*** (0.003)	-0.015*** (0.003)	-0.016*** (0.003)	-0.019*** (0.005)
firm_age*firm_age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
independent	0.366*** (0.105)	0.363*** (0.106)	0.333*** (0.104)	0.181 (0.167)
tertiary_share	0.003 (0.002)	0.005** (0.002)	0.002 (0.002)	0.000 (0.004)
firm_size_10-99	-0.442** (0.186)	-0.398** (0.196)	-0.371** (0.185)	-0.175 (0.384)
firm_size_>99	-0.755*** (0.194)	-0.620*** (0.201)	-0.645*** (0.191)	-0.647 (0.394)
<i>Market conditions</i>				
demand_development	0.632*** (0.099)	0.612*** (0.100)	0.633*** (0.098)	0.846*** (0.154)
price_competition	-0.104** (0.051)	-0.100* (0.052)	-0.111** (0.049)	-0.194** (0.080)
<i>Control variables</i>				
Region dummies	yes	Yes	yes	yes
Industry dummies	yes	Yes	yes	yes
N	1015	988	1023	431
Log-likelihood	212.52***	201.08***	231.03***	129.15***
Pseudo R ²	0.19	0.19	0.20	0.24

Notes: See Table 2 for the variable definitions; standard errors are in brackets under the coefficients; ***, **, * denote statistical significance at the 1%, 5% and 10% test level, respectively.

Table 4: Treatment effect for the treated (ATT)

Target variable	$\Delta(\text{value added per employee})$	$\Delta(\text{price cost margin})$	$\Delta(\text{investments per employee})$	$\Delta(\text{innovative sales per employee})$
ATT	10831.30	0.006	-2417.70	10800.15
p-value	0.154	0.620	0.678	0.331
95% confidence interval	[-4055.93; 25718.52]	[-0.018; 0.030]	[-13820.33; 8984.93]	[-10991.42; 32591.71]
N treated	233	226	253	119
N untreated	776	755	765	300
N off support	6	7	5	12

Notes: Bootstrapping is used to correct standard errors (1000 replications).

Table 5: Model extensions (ATT for different sub-samples)

A. M&As with relative firm size of acquired firm above 25%

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	24836.87	0.014	-7060.37	15303.3
p-value	0.063	0.482	0.534	0.407
95% confidence interval	[-1385.92; 51059.67]	[-0.025; 0.053]	[-29305.79; 15185.05]	[-20893.68; 51500.28]
N treated	104	99	110	49
N untreated	744	658	727	279
N off support	1	0	1	8

B. External M&As

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	5850.19	-0.003	-6803.22	20954.46
p-value	0.668	0.892	0.462	0.226
95% confidence interval	[-20885.3; 32585.7]	[-0.043; 0.037]	[-24921.7; 11315.3]	[-12969.8; 54878.7]
N treated	85	83	96	44
N untreated	730	721	730	276
N off support	4	4	3	11

C.1 M&As of 2006

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	11005.91	-0.008	-705.85	22954.19
p-value	0.324	0.732	0.955	0.070
95% confidence interval	[-10870.0; 32881.8]	[-0.056; 0.039]	[-25401.3; 23989.6]	[-1888.4; 47796.7]
N treated	67	63	72	30
N untreated	723	700	730	237
N off support	3	2	0	6

C.2 M&As of 2007

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	19799.5	0.014	7073.3	9373.3
p-value	0.181	0.519	0.376	0.627
95% confidence interval	[-9217.0; 48816.0]	[-0.028; 0.056]	[-8590.9; 22737.4]	[-28382.9; 47129.5]
N treated	72	76	81	43
N untreated	752	731	678	273
N off support	6	4	7	5

C.3 M&As of 2008

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	-1114.96	-0.010	-8791.0	-3417.4
p-value	0.936	0.603	0.349	0.875
95% confidence interval	[-28315.2; 26085.3]	[-0.049; 0.028]	[-271981; 9616.0]	[-45987.2; 39152.3]
N treated	82	82	91	33
N untreated	636	645	658	208
N off support	9	6	7	14

Notes: Bootstrapping is used to correct standard errors (1000 replications).

Appendix

Table A.1: Test balancing property and common support of model (1)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
Firm_age	Unmatched	46.485	61.381	-5.13	0.000
	Matched	47.369	49.339	-0.53	0.594
Firm_age*firm_age	Unmatched	3834	5263.6	-2.75	0.006
	Matched	3926.4	3917	0.01	0.989
independent	Unmatched	.40586	.28222	3.63	0.000
	Matched	.39914	.3691	0.67	0.506
tertiary_share	Unmatched	30.918	23.632	4.41	0.000
	Matched	30.13	27.602	1.08	0.281
Firm_size_10-99	Unmatched	.52301	.46778	1.49	0.135
	Matched	.52361	.50644	0.37	0.712
Firm_size_>99	Unmatched	.3431	.48454	-3.87	0.000
	Matched	.35193	.39485	-0.96	0.339
<i>Market conditions</i>					
demand_development	Unmatched	.56904	.30284	7.68	0.000
	Matched	.55794	.50644	1.11	0.266
price_competition	Unmatched	3.8159	4.0322	-2.98	0.003
	Matched	3.8112	3.8541	-0.46	0.647
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	13.9			
	Matched	4.4			
LR chi ²	Unmatched	212.52***			
	Matched	12.88			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

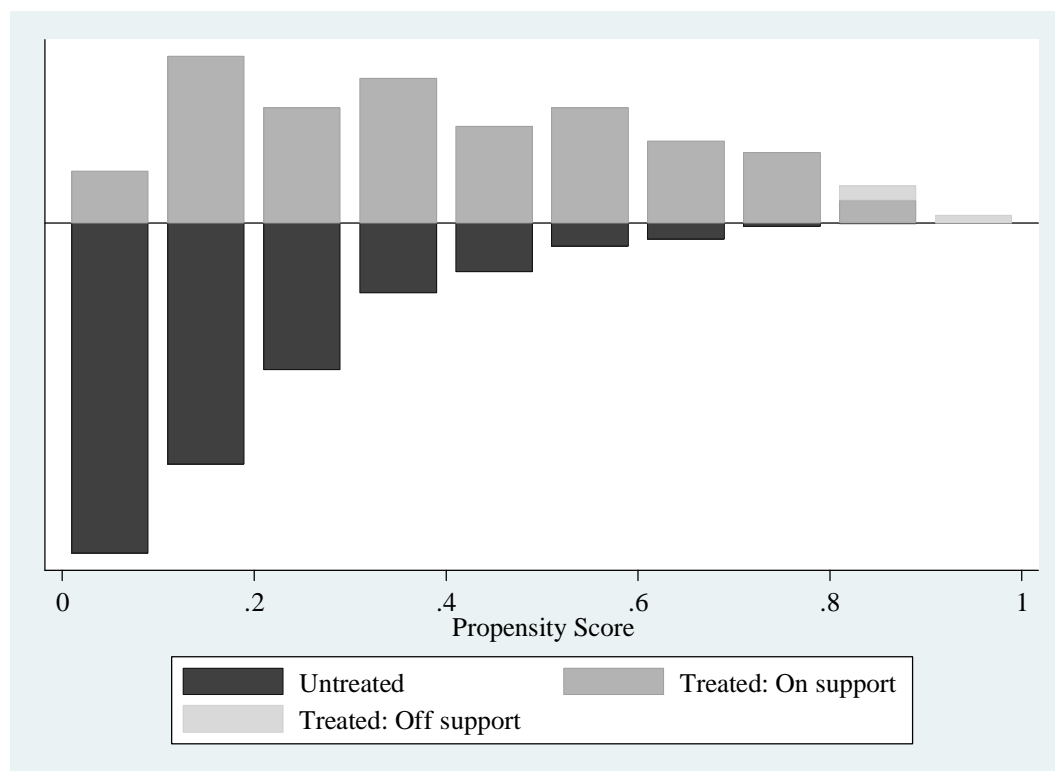


Table A.2: Test balancing property and common support of model (2)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
Firm_age	Unmatched	46.253	61.344	-5.19	0.000
	Matched	45.916	49.973	-1.14	0.256
Firm_age*firm_age	Unmatched	3819.4	5211.2	-2.67	0.008
	Matched	3484.2	3983.5	-0.84	0.401
independent	Unmatched	.40343	.28477	3.43	0.001
	Matched	.40265	.37168	0.67	0.500
Tertiary_share	Unmatched	31.951	23.35	5.16	0.000
	Matched	30.835	28.043	1.17	0.243
firm_size_10-99	Unmatched	.49356	.46755	0.69	0.487
	Matched	.50442	.46903	0.75	0.453
firm_size_>99	Unmatched	.38197	.48609	-2.80	0.005
	Matched	.38938	.4469	-1.24	0.216
<i>Market conditions</i>					
demand_development	Unmatched	.56223	.30993	7.15	0.000
	Matched	.56195	.5708	-0.19	0.850
price_competition	Unmatched	3.8026	4.0238	-3.03	0.003
	Matched	3.8053	3.8363	-0.33	0.743
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	13.68			
	Matched	4.8			
LR chi ²	Unmatched	201.08***			
	Matched	14.04			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

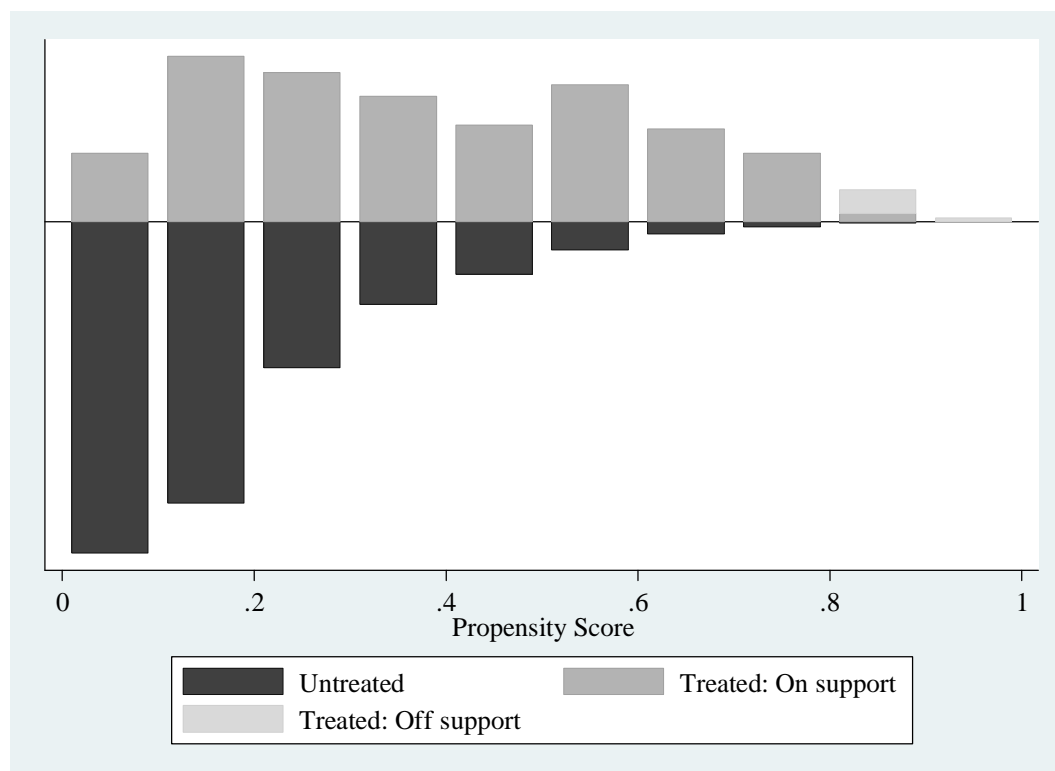


Table A.3: Test balancing property and common support of model (3)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
firm_age	Unmatched	45.256	62.153	-6.02	0.000
	Matched	44.7	45.672	-0.31	0.757
firm_age*firm_age	Unmatched	3648.6	5353.1	-3.39	0.001
	Matched	3319.3	3260.7	0.12	0.904
independent	Unmatched	.3876	.27843	3.30	0.001
	Matched	.3834	.35968	0.55	0.582
Tertiary_share	Unmatched	30.246	23.734	4.06	0.000
	Matched	29.82	26.748	1.36	0.173
firm_size_10-99	Unmatched	.50775	.45098	1.58	0.114
	Matched	.50593	.51779	-0.27	0.790
firm_size_>99	Unmatched	.36047	.50196	-3.97	0.000
	Matched	.36364	.3913	-0.64	0.522
<i>Market conditions</i>					
demand_development	Unmatched	.55814	.30196	7.58	0.000
	Matched	.55336	.54545	0.18	0.859
price_competition	Unmatched	3.7713	4.034	-3.67	0.000
	Matched	3.7668	3.913	-1.63	0.103
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	13.8			
	Matched	5.0			
LR chi ²	Unmatched	231.03***			
	Matched	18.31			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

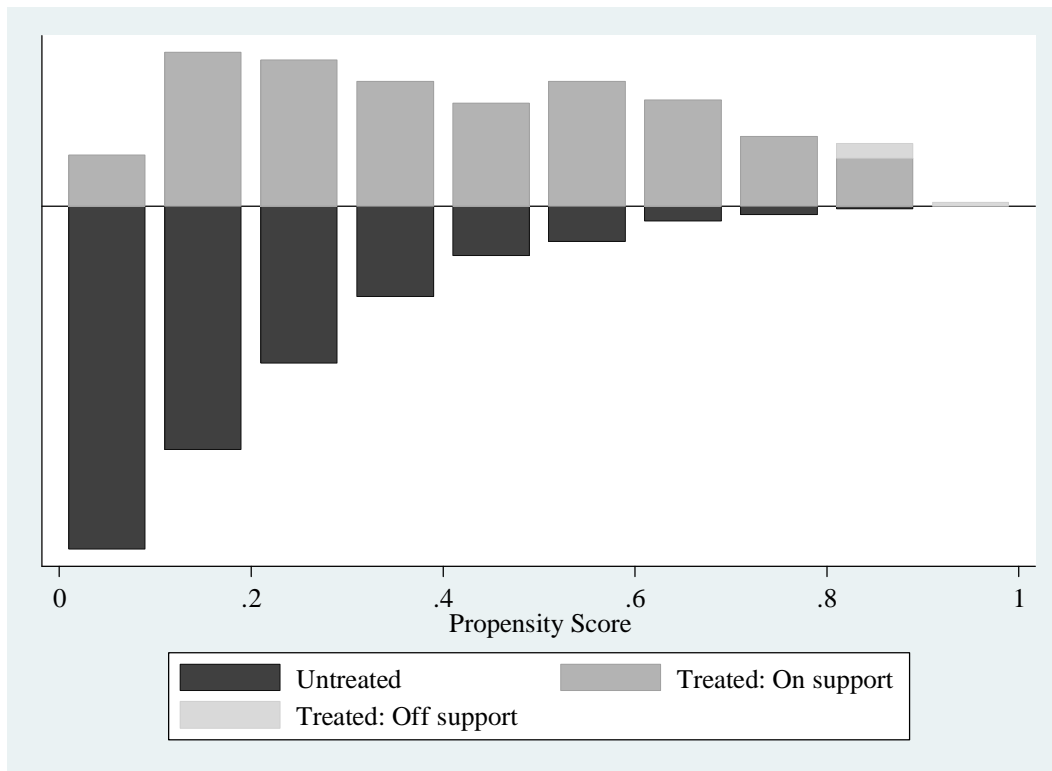
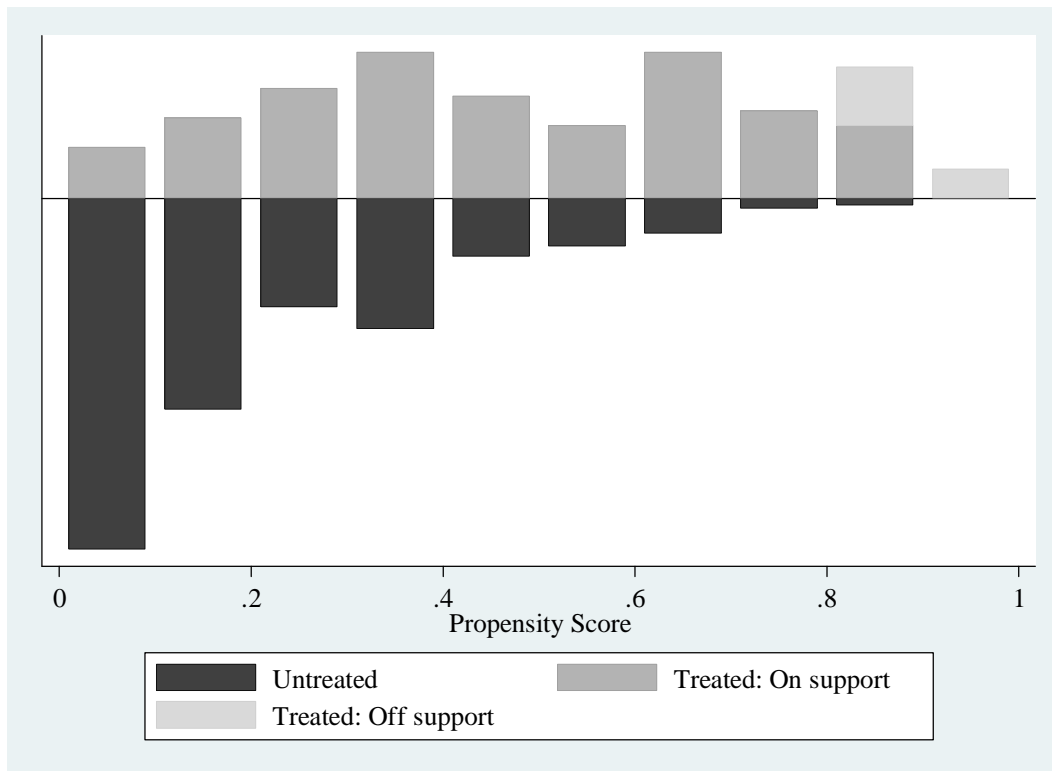


Table A.4: Test balancing property and common support of model (4)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
firm_age	Unmatched	44.733	59.907	-3.72	0.000
	Matched	44.723	50.487	-1.17	0.245
firm_age*firm_age	Unmatched	3866.2	4949.2	-1.37	0.172
	Matched	3312	4123.3	-0.96	0.336
independent	Unmatched	.38168	.33333	0.97	0.334
	Matched	.37815	.36134	0.27	0.789
tertiary_share	Unmatched	30.835	26.096	1.98	0.048
	Matched	30.205	26.662	1.16	0.249
firm_size_10-99	Unmatched	.67176	.35667	6.30	0.000
	Matched	.65546	.60504	0.80	0.423
firm_size_>99	Unmatched	3.7786	4.1033	-3.38	0.001
	Matched	3.7563	3.8571	-0.78	0.436
<i>Market conditions</i>					
demand_development	Unmatched	.53435	.37333	3.14	0.002
	Matched	.52941	.51261	0.26	0.796
price_competition	Unmatched	.38168	.6	-4.26	0.000
	Matched	.40336	.45378	-0.78	0.434
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	14.4			
	Matched	5.4			
LR chi ²	Unmatched	129.15***			
	Matched	11.22			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.



1 Introduction

The main motivation for this paper is that despite a broad empirical literature on the determinants as well as the economic performance of mergers and acquisitions (M&As; see, e.g., Agrawal and Jaffe 2000; Kaplan 2000; Martynova and Renneboog 2008; Gugler et al. 2012) some aspects of this topic remain rather under-researched, particularly those that concern small and medium-sized firms (SMEs). This neglect of M&A studies that refer to SMEs may be traced back to the fact that the majority of empirical studies rely on stock market-based measures of performance (see, e.g., Andrade et al. 2001; King et al. 2004; and Meglio and Risberg 2011). As such information is not available for the majority of SMEs, the performance of M&As is almost exclusively analyzed for large M&As and it is unclear whether the implications of these studies are valid also for M&As of SMEs (see Weitzel and McCarthy 2011).

A further point is that only a limited number of M&A studies focus on the consequences of M&A on the firms' technological activities (see Veugelers 2005 and Schulz 2007 for a review of this literature). Given the increasing importance of innovation activities as a driver of growth not only for larger firms but also for SMEs, it becomes clear that more insights with respect to the innovation effects of M&A are needed (see, e.g., Cassiman et al. 2005; Cloudt et al. 2006).

While a previous paper analyzed the determinants of M&A performance of SMEs as they are assessed by the acquiring firms themselves (see Arvanitis and Stucki 2012), the paper at hand investigates the post-merger performance effects of M&As. In contrast to previous studies in this field that focus on M&As between large firms, our study is based on a representative sample that includes all Swiss M&As that took place in the period 2006–2008. Average size of these firms is just about 320 employees, whereupon 60% of the firms have less than 100 employees, 86% of them less than 500 employees. Accordingly, we are able to draw conclusions regarding the total of M&As in the respective period of time. In addition, our survey provides us detailed information on the performance and characteristics of M&As. This allows us to investigate the impact of M&As not only on different measures of economic performance but also on the innovation performance. For the empirical analysis we use a matching framework that accounts for endogenous selection.

The paper is organized as follows. Section 2 presents related theoretical and empirical literature and the research hypotheses that are tested in the empirical part. Section 3 provides a short descriptive analysis of the data used in the paper. In Section 4 the specification of the empirical models is presented. Section 5 deals with the estimation results. Section 6 concludes.

2 Related theoretical and empirical literature

The controversy in existing literature over the direction of the effects of M&A on the post-merge performance of merged firms has not only an empirical background but it also reflects conceptual differences. Thus, the literature referring to the explanation of the performance of M&As can be divided in two broad branches: the value-increasing efficient-market approach and the value-decreasing agency approach. According to the former, mergers occur because of the possibility of exploiting synergies (between the acquiring firm and the target firm), which in turn enhance the performance of the merged firm (see, e.g., Hitt et al. 2001). The latter explains the performance failure of mergers through the existence of informational and agency problems between management and owners (see, e.g., Jensen 1986). For SMEs we expect that the value-destroying approach will not apply because in most cases there is no separation of ownership and control (Weitzel and McCarthy 2011). In this study we thus concentrate on the value-increasing efficient-market approach.

Economic performance

Previous studies use various measures to investigate the impact of M&A on corporate performance, where measures might be based on market measures (mostly some measure of stock price performance), accounting measures (e.g., profitability and sales ratios) or mixed measures (e.g., operating cash flow and measures of stock price reaction). In recent surveys of empirical literature linking corporate performance to M&A until 2002 Tuch and O'Sullivan (2007) and Ismail et al. (2011) concluded that the effect of mergers and acquisitions on the "abnormal" returns for corporate stock (that is those returns that were significantly above or below the industry average) were in most reviewed studies inconclusive. Only few studies reported a positive effect, some even a negative impact. Evidence using accounting performance measures was mixed: for example, a negative impact was often found for post-merger sales, but a positive effect for post-merger profitability. More specifically, Tuch and O'Sullivan (2007) reported mostly negative or insignificant effects for short-run event studies (up to 3 months) and overwhelmingly negative effects for long-run event studies (up to 5 years). Further, some studies showed varying results for different industries.

There is a dispute in literature regarding factors that affect post-merger performance. A series of factors that correspond to characteristics of the merger and/or the acquiring and the acquired firm have been investigated as to their influence on performance: mood of the acquisition (friendly or hostile), method of payment (cash or stock), relative size of acquiring and acquired firm, industrial relatedness of acquiring and acquired firm, pre-merger performance and cross-border versus domestic M&A.

The possible differences between SMEs and larger firms that interest primarily in this study have not been the subject of intensive research until now. Weitzel and McCarthy (2011) suggest that SMEs are different from their larger rivals for at least two reasons. Firstly, because as already mentioned above agency problems that occur with the separation of ownership and control arise much less in SMEs. Secondly, even in the case of separated ownership and control the information asymmetries that cause agency problems (because they facilitate self-interested behavior) will be much smaller in a SME. As a consequence, the exclusion of agency problems increases the likelihood of a successful M&A, that is, a M&A that shows positive performance impact. Of course the problems of self-overvaluation (of the acquired firm) or “hubris” of managers or owners remain as potential sources of value-destruction, but according to Moeller et al. (2004) these problems are of small relevance in a SME.

To the best of our knowledge no empirical study has analyzed the impact of M&As on economic performance for SMEs. However, some empirical evidence can be found in studies that analyze the impact of firm size on M&A performance, even if the average firm size in these studies is significantly larger than in our sample. In a comprehensive study based on a sample of 12'023 acquisitions by public firms in the U.S.A between 1980 and 2001 Moeller et al. (2004) found that the announcement return for acquirers is roughly two percentage points higher for small acquirers irrespective of the form of financing and whether the acquired firm is public or private. Further, the size effect is robust to firm and deal characteristics and it is not reversed over time. A serious limitation of this study is that it refers only to public acquiring firms.

Gugler et al. (2003) in a study based on a large panel of about 45'000 mergers and acquisitions around the world (about half of them in the U.S.A) between 1981 and 1998 investigated the performance effects of M&A as measured by sales and profitability. The authors concluded that “one might expect mergers between small firms to be more likely to increase efficiency by creating economies of scale and scope, while mergers between large firms would be more likely to increase market power” (p. 646). These conjectures were supported by the findings that sales increased following profitable mergers between small firms and decreased in the case of mergers between large firms.

To sum up, empirical evidence is quite ambiguous. While a tendency for negative long-term effects on post-merger performance was found in stock price-based studies, the impact tend to be positive for smaller firms. We thus formulate the following hypothesis:

Hypothesis 1: We expect a positive effect of M&A of SMEs on economic performance;

Innovation performance

The literature that deals with the effects of M&A on post-merger innovation performance is rather scarce (see Veugelers 2005 and Schulz 2007). We know only of one study that investigated explicitly the differences between small and large firms as to the impact of M&A on innovation performance (Phillips and Zhdanov 2012), even if in a setting that is different from that of our study. In this study based on data for 11'288 U.S. firms for the period 1984-2006 the authors showed that firms incentives to conduct R&D increase with industry acquisition activity and more for small firms than large firms.

Our review of the literature motivated the formulation of the following hypothesis for the empirical part:

Hypothesis 2: We expect a positive effect of M&A of SMEs on innovation performance.

3 Description of the data

3.1 Construction of the data set

The sample we use in this study refers to the cohort of Swiss M&As that took place between 2006 and 2008. This cohort was registered by the Swiss Federal Statistical Office and contained originally 2048 firms. We checked in detail the original data in a multi-step process. In a first step, the changes in the firm structure of *acquiring* firms were verified using the information of the Swiss Commercial Register. A further verification whether these (legal) changes corresponded to real M&A activities was attained through specific questions in the questionnaire that was addressed to the acquiring firms. 413 firms of the original sample were excluded because (a) the registered M&As were only legal adaptations to already established economic relations; (b) they were non-profit organizations; or (c) they were firms with less than one full-time employee. Further, 237 firms had already left the market in 2011 and could not be contacted anymore. After these adjustments 1398 firms were left in the sample that corresponded to our definition of M&A. We defined M&A as the partial or full merger or acquisition of firms that are legally independent from each other. This definition covers both external M&As and M&As within the same group of firms (internal M&As).

Information on these firms was collected in the course of a postal survey on the “M&A of the Swiss Economy” carried out in spring 2011.¹ The survey yielded information on M&A characteristics (number of M&A per acquiring firm, relative size, method of payment, relatedness, motives, obstacles, etc.). In addition, we collected information on innovative activities and some basic characteristics of the firm (employment, firm age, industry affiliation, etc.). Our questionnaire

¹ The questionnaire is available in German and French on www.kof.ethz.ch/en/surveys/.

also included information on the development of quantitative measures of economic performance and innovation (sales, value added, investment, innovation expenditures) after the M&A, specifically for the period 2008-2010.

The survey yielded data for 405 enterprises, implying a response rate of 29%. This is satisfactory given the very demanding questionnaire and that not all ‘wrong’ M&As could be identified. Depending on the number of missing values of the model variables between 119 (innovation model) and 253 (investment model) observations could be used to analyze econometrically the impact of M&As on the development of performance.

To deal with endogenous selection into M&A a control group is required. The control group of non-merged firms comes from the KOF enterprise panel that is based on a sample of some 6500 firms taken from the Business Register of the Federal Statistical Office. The sample, which covers manufacturing industry, construction and the commercial area of the service sector, is stratified according to sectors and sector-specific variables and is adjusted regularly. Information on these firms has been collected in the course of a postal survey on the innovation activities carried out in fall 2011. The survey also included information on M&A activities of the firms, what allowed us to clean up our control group. To avoid that our performance measures were affected by reorganizations of the firms after 2008, we excluded all firms with M&A and/or outsourcing activities² after this date. Furthermore, the survey included information on the same basic characteristics of the firms that is also available in the M&A survey (sales, value added, employment, firm age, industry affiliation, etc.), what allowed us to specify a selection equation.³

Unfortunately, the innovation survey included information on quantitative measures (sales, value added, investment, innovation expenditures) only for 2010. To get dynamic information on these quantitative measures for the control group as well, we matched the information of the innovation survey with the information of a survey on the “Internationalization of the Swiss Economy” that was based on the same sample of firms and was carried out in spring 2010. This survey included information on the objective measures for 2008, what allowed us to construct comparable measures on the development of the objective variables as available in the M&A survey. Due to the fact that some of the firms did not answer both surveys and to missing values for some of the model variables, the sample size of the control group of non-merged firms that could be effectively used in our estimations diminished significantly. Depending on the model between 300 (innovation model) and 776 (value added model) observations could be used. This seems to be satisfactory as the

² This information came from our surveys and included M&A and outsourcing activities that made a difference of more than 10% of previous total sales.

³ The questionnaire is available in German, French and Italian on www.kof.ethz.ch/en/surveys/.

number of firms in the control group for each model is at least 2.5 times the number in the treatment group.

3.2 Characteristics of the M&As

We consider our sample of M&As to be representative for the entire population of Swiss M&As in the period 2006–2008. Accordingly, the characteristics of these M&As should tell us something about how average M&As look like. Detailed description of the collected data is presented in Table 1.

Most of the M&As took place in the service sector (65%). 27% in the manufacturing sector, the remaining 8% in the construction sector. In the service sector as well as in the manufacturing sector, M&As were equally distributed among the high-tech and the low-tech sub-sector. M&As were relatively equally distributed among industries. Only the industries ‘wholesale’, ‘banks, insurance’ and ‘business services’ had a share of more than 10% of the total sample.

The acquiring firms were for the most part small firms. 60% of the firms had less than 100 employees and only 14% of the firms employed more than 500 employees. The relative size of the target to acquirer was mostly small. The sales of the target firm made less than 5% of the acquirer’s sales in nearly 30% of all M&As. The target firm was larger than the acquiring firm only in 1% of all transactions.

4 Econometric framework

4.1 Potential econometric problems

To be able to make a statement on the impact of M&As on performance, we have to overcome two problems (see Egger and Hahn 2010 for a detailed description of these problems in the context of the assessment of the performance effects of M&As). The first one is a missing data problem. We have only one observable outcome per firm, either with treatment or without treatment. Thus, it is difficult to assess how a firm with M&A would have performed without M&A. The second problem is that self-selection into treatment is usually at work by merger operations. Before firms undergo a merger, their managers usually analyze the costs and benefits of such an operation. Accordingly, selection into treatment should be strongly related to the expected benefits of such a M&A. This makes it difficult to identify merger-generated performance effects, e.g., it is not advisable to take the mean outcome of non-treated firms as an approximation.

There are different solutions to overcome these problems. We apply the matching approach as it seems to be well suited for our data.⁴ The basic idea of this approach is to compare the average outcome of the treated firms with average outcomes of structurally similar firms that are not treated. To ensure that the matching approach identifies and consistently estimates the treatment effect of interest, two key assumptions are required. First, the ‘conditional independence assumption’ (CIA) implies that, given a vector of observed variables which are not affected by treatment, assignment to treatment is independent of the outcomes. Second, the ‘common support condition’ (CSC) ensures that firms with the same vector of observed firm-specific variables have a positive probability of belonging to both treatment and control group. In our case, the two key assumptions should not be violated. Due to the matching of different data sets we have a large group of non-merged firms (see Section 3.1), what should ensure the finding of good matches for the treated firms. Furthermore, the data set includes detailed information on the internal firm characteristics as well as on the external market conditions. This allows us to control in detail for factors that may influence the treatment status and the outcome variables but are not affected themselves by treatment.

4.2 Implementing the matching approach

Due to the high dimensionality of the covariate vector that explains selection into treatment, we will use the propensity score matching (PSM) approach introduced by Rosenbaum and Rubin (1983). The idea of this procedure is to match firms based on balancing scores, i.e. on the probability of treatment given a vector of observed characteristics (for a detailed description of this approach see Caliendo and Kopeinig 2008). To evaluate these propensity scores, a selection equation is estimated in a first step. In a second step, firms from the treatment group and firms from the control group are matched, and the outcome of a treated firm with the outcomes of comparison group members are contrasted. We compare the outcomes for four different performance measures.

Estimating the propensity scores

As M&A is a binary treatment, probit models are used to estimate the propensity scores.⁵ To support the CIA a broad set of variables is tested as explanatory variables in the selection equation. A first group of variables describes the general firm characteristics (firm age; independency of the firm; education level of the employees; export share; firm size), a second one controls for external market conditions (development of the demand; intensity of price competition; intensity of non-

⁴ An alternative solution to estimate causal effects would have been to apply an instrumental variable (IV) approach. In contrast to the matching approach, IV estimation can provide consistent results even in the presence of hidden bias. However, this typically comes at the costs of a reduced precision of the estimates and introduces new uncertainty from its reliance on additional untestable assumptions (see DiPrete and Gangl 2004).

price competition). Furthermore, we control in detail for regional aspects and industry affiliation. The information for these variables comes from the surveys that are described in Section 3.1. A limitation of these variables is that the information mostly refers to the time after the M&A took place. However, as we expect that local market conditions as well as the structures of the firms have remained quite the same for the great majority of firms, this should only marginally affect our results.

Matching procedure

To capture different effects of M&As, we use different measures of firm performance: value added per employee, price cost margin, gross investment expenditures per employee and sales of innovative products per employee. The last variable measures a firm's innovation performance. To reduce the impact of time constant unobserved effects, difference in performance of the years 2008 and 2010, for which the respective information is available, is analyzed. If returns of M&As (that took place in the period 2006-2008) were primarily generated already before 2008, this might lead to an underestimation of the performance effect of M&As. Nevertheless, we assume here that the development of the variables for the period 2008-2010 is a good approximation for the development of post-merger performance.⁶ In order to capture effects of other changes in the firms over time that are not covered by our data (e.g., closure of departments, changes of productivity due to new production techniques, etc.), our performance measures are divided by the number of employees.

As matching method we chose the nearest-neighbor matching algorithm without replacement because the distribution of the propensity scores in the treatment and the control group is comparable (see the respective graphics in the Tables A.1 to A.4 in the appendix) and the number of firms in the control group seems to be sufficiently large to find good matches. To impose a common support we dropped treatment observations whose propensity score was higher than the maximum or less than the minimum propensity score of the controls. Furthermore, bootstrapping was applied to correct the standard errors.

5 Estimation results

5.1 Selection model

In line with similar studies that use a matching framework in order to investigate the performance effects of M&As (see, e.g., Egger and Hahn 2010 and Park and Sonenshine 2012), the selection equation includes different variables that describe the firm structure and the external market

⁵ Alternatively, we also tested logit models. Both models yielded similar results.

⁶ Some robustness tests with respect to this assumption can be found in Section 5.2 where the impact of M&As is separately analyzed for different distances of time between M&A and performance measurement.

conditions. These variables are also in accordance with theoretical and empirical findings on the determinants of a firm's decision to involve itself in a M&A. To reduce the variance of the estimates, potential explanatory variables were dropped, if they did not have a significant impact. This was the reason for excluding the sales share of exports and the intensity of non-price competition. Due to missing values for the different performance variables, the number of observations that can be used to identify the treatment effect can vary substantially. To increase the matching quality, selection models are estimated for the same set of observations that could also be used to identify the treatment effect afterwards. Accordingly, we estimate for each target variable a separate selection model. The results of the final selection models are presented in Table 3.

The quality of the selection model is quite impressive for a model based on firm-level survey data. Pseudo- R^2 varies between 0.19 and 0.24, log-likelihood values between 129.15 and 231.03. Firm age shows a U-shaped relationship to the probability of treatment (that is, the probability of being involved in a M&A). Thus, young and old firms show a higher treatment probability than middle-aged firms. Other attributes of firms that correlate significantly with the treatment propensity are independency, the share of employees with tertiary-level education (only in model 2) and firm size (with the exception of model 4). Furthermore, the M&A probability is affected by external market conditions. A positive demand development as well as a low intensity of price competition do both increase the probability of being involved in a M&A. Due to the varying number of missing values for the different performance variables there are some small differences between the models.

As mentioned before, propensity score matching is only a valid procedure if the CIA and CSC hold. Separate tests on these two assumptions for the different models are presented in the Tables A.1 to A.4 in the appendix. In a first step, the success of the matching was tested. Propensity score matching requires that the treatment group and the control group are similar in each aspect. To check this assumption, we first tested whether the mean value of each model variable after matching was the same in the treatment group and in the control group. Based on t-tests, the null hypothesis that the conditions of the two groups do not differ after matching could not be rejected on the 10% significance level for any explanatory variables in the four models. Furthermore, likelihood-ratio tests indicated joint insignificance of all the right-hand variables after matching. In a next step, we graphically checked the CSC. The graphics showed that after dropping treatment observations whose propensity score was higher than the maximum or less than the minimum propensity score of the controls ('off support' observations), there was an overlap of the propensity scores of the treated and untreated firms for each model. We can thus assume that common support is given.

5.2 Treatment effect

All M&As

Estimations for the average treatment effect for the treated (ATT) that are based on the whole sample of M&As are presented in Table 4. The results show that for all four performance indicators used in this study the average development of performance (differences of the values of the variables in 2008 and 2010) do not significantly differ between firms with M&As and firms without M&As. Thus, based on a sample that can be considered as representative for all M&A activities in Switzerland for the period 2006-2008, we could not observe a significant performance effect of M&As. Accordingly, our two hypotheses as formulated in section 2 are *prima facie* not supported by the empirical findings. Nevertheless, a look on the calculated performance difference shows that three of them are positive (value added per employee, price cost margin and the sales share of innovative products), even if statistically insignificant, and only one (gross investment per employee) is negative (and also statistically insignificant). Thus, the tendency for long-term (one to five years) negative effects on post-merger performance that was found in many stock price-based studies seems to receive no confirmation from our results.

The results for the entire sample of M&As may be driven by the special characteristics of the M&As in our sample. As our survey on M&As includes much information on the characteristics of the M&As, we could test the robustness of our results by analyzing the impact of M&As separately for different types of M&As. We examined the influence (a) of the relative size of the acquired firm, (b) of the M&As being external or internal (inside a conglomerate or group of firms), and (c) of the length of the time period between the M&As and the performance measurement.⁷

Relative size of the acquired firm

In general, a larger relative size correlates with a larger synergy potential generated, e.g., by economies of scale (see, e.g., Agrawal et al. 1992, Capron 1999; for a survey of respective literature see Tuch and O'Sullivan 2007). In line with existing literature we thus assume that the relative size of the target firm is positively correlated with the performance of M&As. In our sample, the sales of the target firm made less than 5% of the acquirer's sales in 29% of all M&As. For 37% of M&As the relative size of the acquired firm fluctuated between 6% and 25% of the acquiring firm. For 24% of all M&As the relative size of the acquired firm varied between 26% and 50% of the acquiring firm. To test whether the results of Table 4 were driven by the small relative size of the firms in our sample, we analyzed in alternative estimations the performance effect only including M&As with a relative size of target to acquirer of more than 25%. The results are presented in

Table 5, Panel A. In this case we could find a statistically significant positive effect of M&As for the performance variable value added per employee (p -value=0.063). The effects for the other performance measures remained insignificant. Thus, our hypothesis 1 at least received some empirical support for M&As with relatively large acquired firms (with sales that amount to at least 25% of the sales of the acquiring firm). However, no empirical evidence is found for hypothesis 2. This result is intuitively plausible when we take into account that the relative size of the M&As can be closely related with the size of economies of scale that can be reached after the merge. Economies of scale are expected to stimulate economic performance. With respect to innovation activities, economies of scale are, however, associated with the elimination of common innovation inputs in combination with small efficiency gains of a common organization of innovation activities. Accordingly, only marginal scale effects are expected with respect to innovation performance (see Cassiman et al. 2005 for a similar argumentation).

Only external M&As

In our study we distinguish between internal and external acquisitions. If the firms belonged to the same group of companies before the transaction took place, it can be expected that the group would have taken advantage of potential synergies between the firms to some extent already before the merger. Accordingly, the potential for additional synergies would be small in case of internal acquisitions. We thus expect that internal acquisitions are less likely to generate a positive M&A performance effect than external acquisitions. We tested this hypothesis in separate estimates for only external M&As. We could not find any significant effect (Table 5, Panel B).

Length of the time period

The M&As in our sample took place in different points of time between 2006 and 2008, so that the time distance between M&A and performance measurement is varying. We examined whether this time difference could lead to differing performance effects (see, e.g. Meglio and Risberg 2010; see Tuch and O'Sullivan (2007) for a survey of literature referring to the time effect). To this end, we estimated separately the treatment effects for the sub-samples of firms with M&As in the years 2006, 2007 and 2008, respectively. The results are found in Table 5, Panels C.1 to C.3. We found a significantly positive performance effect for the variable 'sales of innovative products per employee' for the sub-sample of the firms with M&As in the year 2006 (p =0.070). Accordingly, it seems that M&As require some time to have a significant effect on innovation performance. The other performance indicators are not affected by the acquisition date. This result seems plausible, as we would expect that it requires more time for synergies between two firms to result in innovation output than in economic output. Thus, hypothesis 2 is confirmed only for the M&As that took place

⁷ The respective tests on balancing property and common support are not presented here, but are available on request.

in 2006, that is, the post-merger effect on innovation performance showed not before two to four years after the merger. The performance differences in Panel C.3 for 2008, other as in the Panels C.1 (2006) and Panel C.2 (2007), are throughout negative, even if statistically insignificant. This is a (further) hint that it needs a considerable time distance between the structure change (caused by the M&A) and the post-merger performance measurement for discernible post-merger performance effects to come out.

6 Summary and conclusions

In this paper we investigated the actual performance effects of M&As based on a representative sample that includes all Swiss M&As that took place in the period 2006–2008. To capture different aspects of performance we used the development of four different performance measures: (a) value added per employee, (b) price cost margin, (c) investment expenditures per employees and (d) sales of innovative products per employee. To deal with potential endogeneity problems a matching procedure was applied.

Based on the sample of all M&As we could not find statistically significant performance effects of M&As for any of the four performance measures. Nevertheless, a look on the calculated performance difference shows that three of them are positive (value added per employee, price cost margin and the sales share of innovative products), even if statistically insignificant, and only one (gross investment per employee) is negative (also statistically insignificant). Thus, the tendency for long-term (one to five years) negative effects on post-merger performance that was found in many stock price-based studies (see Tuch and O’Sullivan 2007) seems to receive no confirmation from our results.

We found some statistically significant results when we examined separately specific sub-samples of M&As. Our hypothesis 1 of a positive impact of M&A on economic performance received some partial empirical support with respect to value added per employee only for M&As with relative large acquired firms (with sales that amount to at least 25% of the sales of the acquired firm). Hypothesis 2 that predicts a positive impact of M&A on innovation performance was confirmed only for the M&As that took place in 2006, that is, the post-merger effect on innovation performance (variable: sales share of innovative products) showed not before two to four years after the merger. This is a hint that it needs a considerable time distance between the structure change (caused by the M&A) and the post-merger performance measurement for discernible post-merger performance effects. We could not find a significant effect in separate estimates for the external M&As.

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Table 1: Sample composition by sector, industry and firm size

Industry/sector	N	Percentage
<i>Manufacturing</i>	<i>106</i>	<i>27%</i>
- High-tech manufacturing	51	13%
- Low-tech manufacturing	55	14%
Food, beverage, tobacco	9	2%
Textiles	3	1%
Clothing, leather	0	0%
Wood processing	3	1%
Paper	3	1%
Printing	16	4%
Chemicals	8	2%
Plastics, rubber	2	1%
Glass, stone, clay	4	1%
Metal	0	0%
Metalworking	9	2%
Machinery	23	6%
Electrical machinery	6	2%
Electronics, instruments	8	2%
Watches	3	1%
Vehicles	4	1%
Other manufacturing	3	1%
Energy	2	1%
<i>Construction</i>	<i>30</i>	<i>8%</i>
<i>Services</i>	<i>257</i>	<i>65%</i>
- Knowledge-intensive services	129	33%
- Traditional services	128	32%
Wholesale trade	57	15%
Retail trade	18	5%
Hotels, catering	7	2%
Transport, telecommunication	24	6%
Banks, insurance	60	15%
Real estate, leasing, computer services	14	4%
Computer services	21	5%
Business services	44	11%
Personal services	2	1%
Education	2	1%
Health, veterinary and social work	0	0%
Sewage and refuse disposal, sanitation and similar activities	2	1%
Recreational, cultural and sporting activities	6	2%
Total	393	100%
Firm size	N	Percentage
1-9 employees	53	13%
10-19 employees	32	8%
20-49 employees	88	22%
50-99 employees	66	16%
100-499 employees	106	26%
500 and more employees	58	14%
Total	403	100%

Notes: Firm size information is based on information for the year 2010. Due to different response rates, the number of observations differs between variables.

Table 2: Variable definition and measurement

Variable	Definition/measurement
$\Delta(\text{value added per employee})$	Change of the value added per employee between 2008 and 2010 (Value added is defined as sales less the cost of materials, expenditure on plant machinery and other fixed assets and expenditure on buildings)
$\Delta(\text{price cost margin})$	Change of the price cost margin between 2008 and 2010 (Price cost margin is defined as the value added less labor costs divided by value added)
$\Delta(\text{investments per employee})$	Change of gross investment per employee between 2008 and 2010
$\Delta(\text{innovative sales per employee})$	Change of the sales of innovative products (new product and significant modifications of existing products) per employee between 2008 and 2010
firm_age	Firm age (in years) and square of firm age
independent	Firm is not part of a group of companies yes/no
tertiary_share	Share of employees with a tertiary-level degree
firm_size	Number of employees (2010) (Dummy variables for two firm size classes: (a) 10-99; (b) more than 99; reference group: 'less than 10')
demand_development	Development of a firm's specific product demand (transformation of a five-level ordinal variable (level 1: 'strong decrease'; level 5: 'strong increase') to a binary variable (value 1: levels 4 and 5; value 0: levels 1, 2 and 3 of the original five-level variable))
price_competition	Intensity of price competition (five-level ordinal variable: level 1: 'very weak'; level 5: 'very strong')
Region dummies	Dummies for six regions (Espace Midland; Northwestern Switzerland; Zurich; Eastern Switzerland; Central Switzerland; Ticino; reference region: Lac Léman)
Industry dummies	Dummies for 25 industries

Table 3: Selection equations for the different target variables

Selection equation	(1)	(2)	(3)	(4)
<i>Firm characteristics</i>				
firm_age	-0.014*** (0.003)	-0.015*** (0.003)	-0.016*** (0.003)	-0.019*** (0.005)
firm_age*firm_age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
independent	0.366*** (0.105)	0.363*** (0.106)	0.333*** (0.104)	0.181 (0.167)
tertiary_share	0.003 (0.002)	0.005** (0.002)	0.002 (0.002)	0.000 (0.004)
firm_size_10-99	-0.442** (0.186)	-0.398** (0.196)	-0.371** (0.185)	-0.175 (0.384)
firm_size_>99	-0.755*** (0.194)	-0.620*** (0.201)	-0.645*** (0.191)	-0.647 (0.394)
<i>Market conditions</i>				
demand_development	0.632*** (0.099)	0.612*** (0.100)	0.633*** (0.098)	0.846*** (0.154)
price_competition	-0.104** (0.051)	-0.100* (0.052)	-0.111** (0.049)	-0.194** (0.080)
<i>Control variables</i>				
Region dummies	yes	Yes	yes	yes
Industry dummies	yes	Yes	yes	yes
N	1015	988	1023	431
Log-likelihood	212.52***	201.08***	231.03***	129.15***
Pseudo R ²	0.19	0.19	0.20	0.24

Notes: See Table 2 for the variable definitions; standard errors are in brackets under the coefficients; ***, **, * denote statistical significance at the 1%, 5% and 10% test level, respectively.

Table 4: Treatment effect for the treated (ATT)

Target variable	$\Delta(\text{value added per employee})$	$\Delta(\text{price cost margin})$	$\Delta(\text{investments per employee})$	$\Delta(\text{innovative sales per employee})$
ATT	10831.30	0.006	-2417.70	10800.15
p-value	0.154	0.620	0.678	0.331
95% confidence interval	[-4055.93; 25718.52]	[-0.018; 0.030]	[-13820.33; 8984.93]	[-10991.42; 32591.71]
N treated	233	226	253	119
N untreated	776	755	765	300
N off support	6	7	5	12

Notes: Bootstrapping is used to correct standard errors (1000 replications).

Table 5: Model extensions (ATT for different sub-samples)

A. M&As with relative firm size of acquired firm above 25%

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	24836.87	0.014	-7060.37	15303.3
p-value	0.063	0.482	0.534	0.407
95% confidence interval	[-1385.92; 51059.67]	[-0.025; 0.053]	[-29305.79; 15185.05]	[-20893.68; 51500.28]
N treated	104	99	110	49
N untreated	744	658	727	279
N off support	1	0	1	8

B. External M&As

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	5850.19	-0.003	-6803.22	20954.46
p-value	0.668	0.892	0.462	0.226
95% confidence interval	[-20885.3; 32585.7]	[-0.043; 0.037]	[-24921.7; 11315.3]	[-12969.8; 54878.7]
N treated	85	83	96	44
N untreated	730	721	730	276
N off support	4	4	3	11

C.1 M&As of 2006

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	11005.91	-0.008	-705.85	22954.19
p-value	0.324	0.732	0.955	0.070
95% confidence interval	[-10870.0; 32881.8]	[-0.056; 0.039]	[-25401.3; 23989.6]	[-1888.4; 47796.7]
N treated	67	63	72	30
N untreated	723	700	730	237
N off support	3	2	0	6

C.2 M&As of 2007

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	19799.5	0.014	7073.3	9373.3
p-value	0.181	0.519	0.376	0.627
95% confidence interval	[-9217.0; 48816.0]	[-0.028; 0.056]	[-8590.9; 22737.4]	[-28382.9; 47129.5]
N treated	72	76	81	43
N untreated	752	731	678	273
N off support	6	4	7	5

C.3 M&As of 2008

Target variable	Δ (value added per employee)	Δ (price cost margin)	Δ (investments per employee)	Δ (innovative sales per employee)
ATT	-1114.96	-0.010	-8791.0	-3417.4
p-value	0.936	0.603	0.349	0.875
95% confidence interval	[-28315.2; 26085.3]	[-0.049; 0.028]	[-271981; 9616.0]	[-45987.2; 39152.3]
N treated	82	82	91	33
N untreated	636	645	658	208
N off support	9	6	7	14

Notes: Bootstrapping is used to correct standard errors (1000 replications).

Appendix

Table A.1: Test balancing property and common support of model (1)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
Firm_age	Unmatched	46.485	61.381	-5.13	0.000
	Matched	47.369	49.339	-0.53	0.594
Firm_age*firm_age	Unmatched	3834	5263.6	-2.75	0.006
	Matched	3926.4	3917	0.01	0.989
independent	Unmatched	.40586	.28222	3.63	0.000
	Matched	.39914	.3691	0.67	0.506
tertiary_share	Unmatched	30.918	23.632	4.41	0.000
	Matched	30.13	27.602	1.08	0.281
Firm_size_10-99	Unmatched	.52301	.46778	1.49	0.135
	Matched	.52361	.50644	0.37	0.712
Firm_size_>99	Unmatched	.3431	.48454	-3.87	0.000
	Matched	.35193	.39485	-0.96	0.339
<i>Market conditions</i>					
demand_development	Unmatched	.56904	.30284	7.68	0.000
	Matched	.55794	.50644	1.11	0.266
price_competition	Unmatched	3.8159	4.0322	-2.98	0.003
	Matched	3.8112	3.8541	-0.46	0.647
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	13.9			
	Matched	4.4			
LR chi ²	Unmatched	212.52***			
	Matched	12.88			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

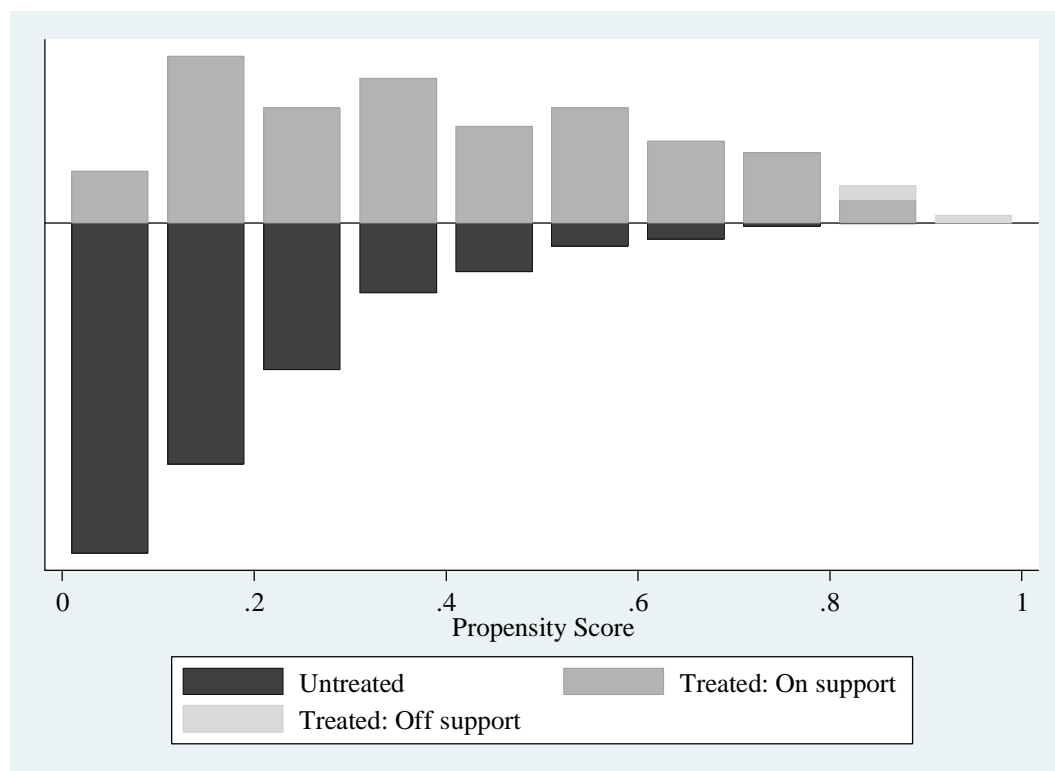


Table A.2: Test balancing property and common support of model (2)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
Firm_age	Unmatched	46.253	61.344	-5.19	0.000
	Matched	45.916	49.973	-1.14	0.256
Firm_age*firm_age	Unmatched	3819.4	5211.2	-2.67	0.008
	Matched	3484.2	3983.5	-0.84	0.401
independent	Unmatched	.40343	.28477	3.43	0.001
	Matched	.40265	.37168	0.67	0.500
Tertiary_share	Unmatched	31.951	23.35	5.16	0.000
	Matched	30.835	28.043	1.17	0.243
firm_size_10-99	Unmatched	.49356	.46755	0.69	0.487
	Matched	.50442	.46903	0.75	0.453
firm_size_>99	Unmatched	.38197	.48609	-2.80	0.005
	Matched	.38938	.4469	-1.24	0.216
<i>Market conditions</i>					
demand_development	Unmatched	.56223	.30993	7.15	0.000
	Matched	.56195	.5708	-0.19	0.850
price_competition	Unmatched	3.8026	4.0238	-3.03	0.003
	Matched	3.8053	3.8363	-0.33	0.743
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	13.68			
	Matched	4.8			
LR chi ²	Unmatched	201.08***			
	Matched	14.04			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

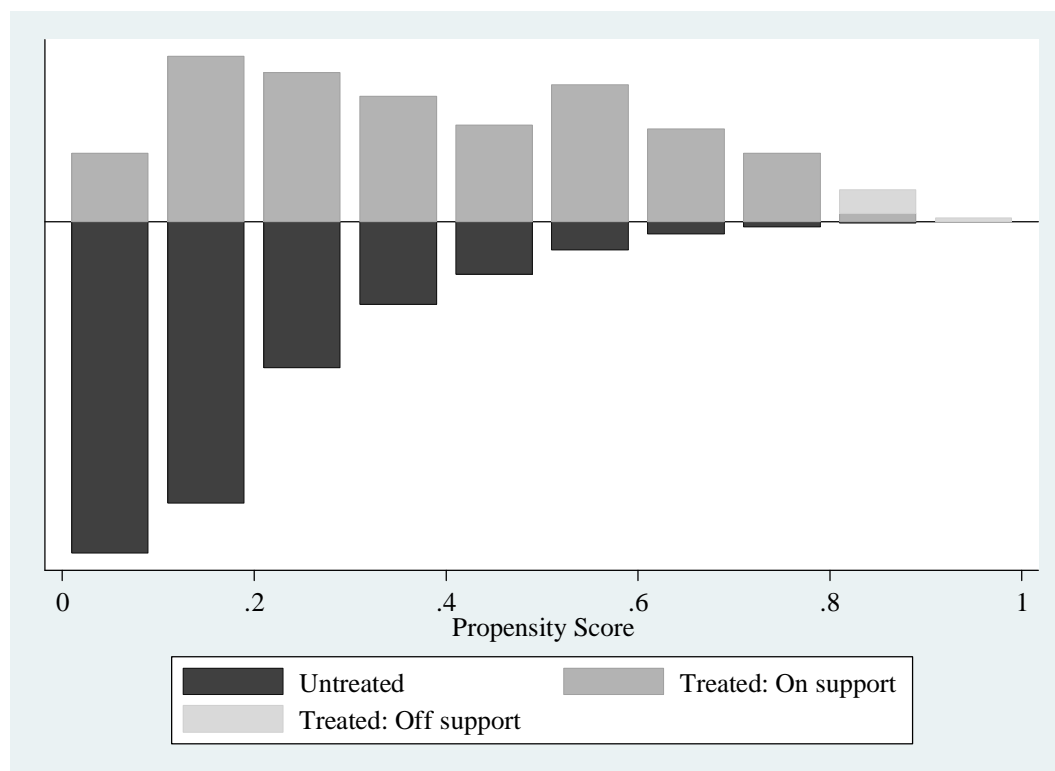


Table A.3: Test balancing property and common support of model (3)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
firm_age	Unmatched	45.256	62.153	-6.02	0.000
	Matched	44.7	45.672	-0.31	0.757
firm_age*firm_age	Unmatched	3648.6	5353.1	-3.39	0.001
	Matched	3319.3	3260.7	0.12	0.904
independent	Unmatched	.3876	.27843	3.30	0.001
	Matched	.3834	.35968	0.55	0.582
Tertiary_share	Unmatched	30.246	23.734	4.06	0.000
	Matched	29.82	26.748	1.36	0.173
firm_size_10-99	Unmatched	.50775	.45098	1.58	0.114
	Matched	.50593	.51779	-0.27	0.790
firm_size_>99	Unmatched	.36047	.50196	-3.97	0.000
	Matched	.36364	.3913	-0.64	0.522
<i>Market conditions</i>					
demand_development	Unmatched	.55814	.30196	7.58	0.000
	Matched	.55336	.54545	0.18	0.859
price_competition	Unmatched	3.7713	4.034	-3.67	0.000
	Matched	3.7668	3.913	-1.63	0.103
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	13.8			
	Matched	5.0			
LR chi ²	Unmatched	231.03***			
	Matched	18.31			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

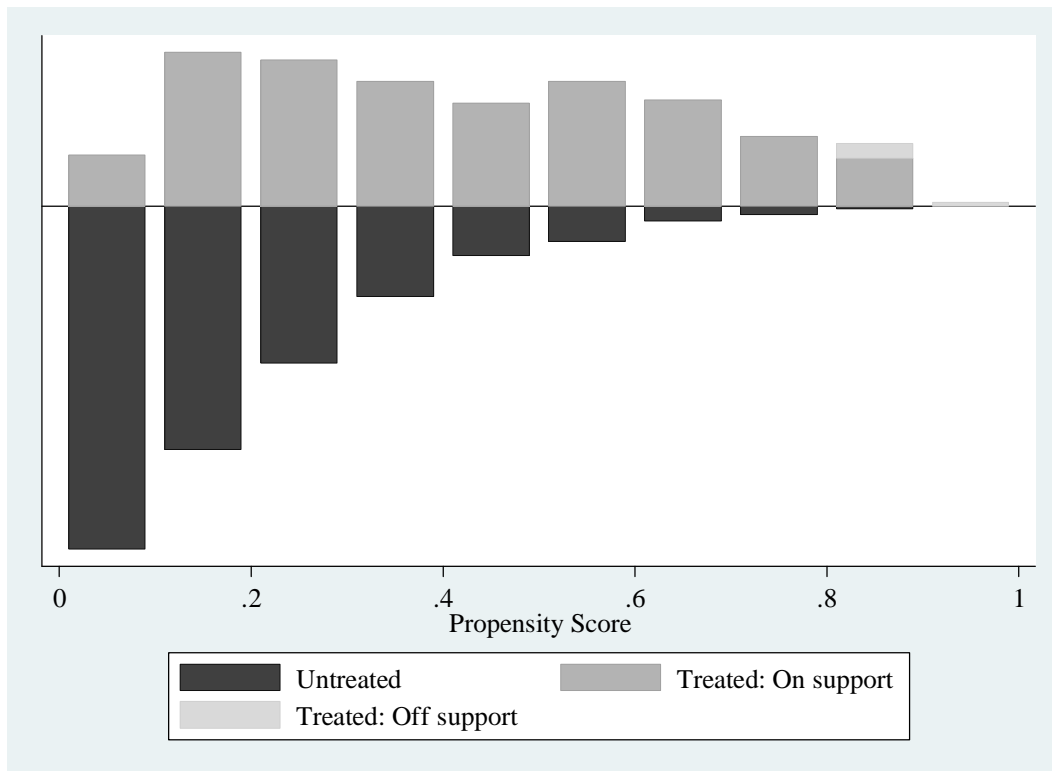


Table A.4: Test balancing property and common support of model (4)

Variable	Sample	Treated	Control	t	p> t
<i>Firm characteristics</i>					
firm_age	Unmatched	44.733	59.907	-3.72	0.000
	Matched	44.723	50.487	-1.17	0.245
firm_age*firm_age	Unmatched	3866.2	4949.2	-1.37	0.172
	Matched	3312	4123.3	-0.96	0.336
independent	Unmatched	.38168	.33333	0.97	0.334
	Matched	.37815	.36134	0.27	0.789
tertiary_share	Unmatched	30.835	26.096	1.98	0.048
	Matched	30.205	26.662	1.16	0.249
firm_size_10-99	Unmatched	.67176	.35667	6.30	0.000
	Matched	.65546	.60504	0.80	0.423
firm_size_>99	Unmatched	3.7786	4.1033	-3.38	0.001
	Matched	3.7563	3.8571	-0.78	0.436
<i>Market conditions</i>					
demand_development	Unmatched	.53435	.37333	3.14	0.002
	Matched	.52941	.51261	0.26	0.796
price_competition	Unmatched	.38168	.6	-4.26	0.000
	Matched	.40336	.45378	-0.78	0.434
<i>Summary of the distribution of the abs(bias)</i>					
Mean abs(bias)	Unmatched	14.4			
	Matched	5.4			
LR chi ²	Unmatched	129.15***			
	Matched	11.22			

Notes: Furthermore, control variables for region and industry affiliation were included. All these variables are not significantly different for the matched treated and control units.

