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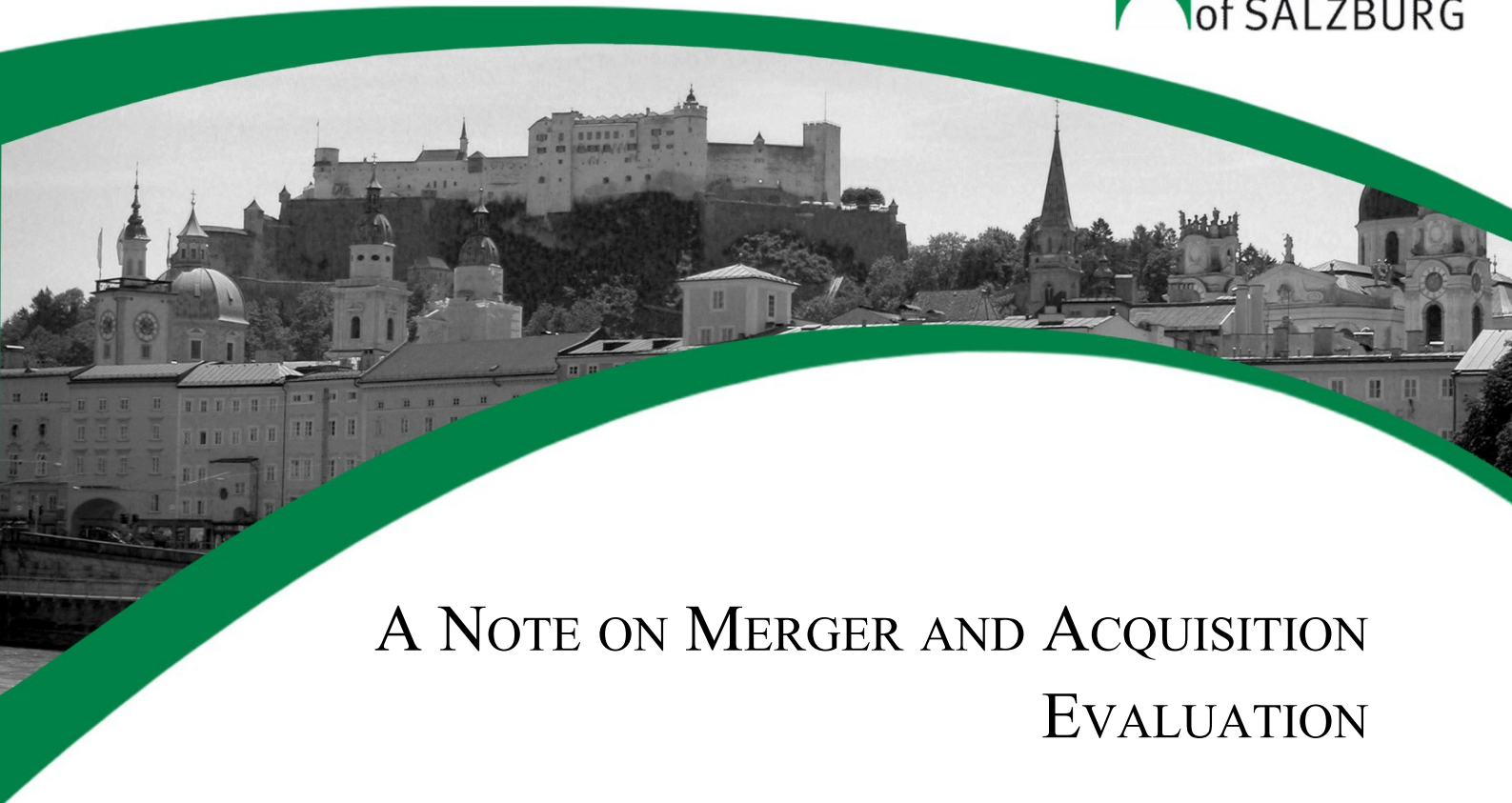
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A NOTE ON MERGER AND ACQUISITION EVALUATION

BENJAMIN FURLAN, HARALD OBERHOFER AND HANNES WINNER

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A Note on Merger and Acquisition Evaluation^{*}

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March 7, 2014

Abstract

This note proposes the continuous treatment approach as a valuable alternative to propensity score matching for evaluating economic effects of merger and acquisitions (M&A). This framework allows to consider the variation in treatment intensities explicitly, and it does not call for the definition of cut-off values in traded ownership shares in order to construct a binary treatment indicator. We demonstrate the usefulness of this approach using data from European M&As and by relying on the example of post-M&A employment effects.

JEL Codes: C21, G34, L25

Keywords: Merger and acquisition evaluation, continuous treatment models, generalized propensity score matching, employment effects.

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1 Introduction

Empirical research on mergers and acquisitions (M&As) is inconclusive with regard to the economic effects of firm takeovers. This note provides one possible explanation for this observation, pointing to the more or less arbitrary definition of cutoff-values in traded ownership shares that is typically used in empirical applications. Focusing exclusively on such cutoffs (commonly used ones are 25 or 50 percent), one might ignore that the extent to which new owners are able to influence a firm's strategic decisions varies over a wide range of ownership levels.¹ In what follows, we rely on the example of post-M&A employment effects to illustrate the importance of this issue.²

From an econometric perspective, defining a discrete treatment variable from continuous ownership information reduces data variation and, in turn, might induce inaccurate estimates of M&A effects. Alternatively, one might rely on a continuous treatment approach based on generalized propensity score matching (GPSM) (see Imbens 2000, Hirano and Imbens 2004). GPSM is widely applied in various fields of economics and business administration,³ but not for M&A evaluation. Given that the strategic impact of a new shareholder on a firm's decisions is varying over the acquired ownership share, it seems particularly attractive for M&A evaluation for (at least) three compelling reasons: First, it allows to estimate heterogeneous effects of M&As over the whole ownership distribution. Second, one might aggregate M&A effects over any arbitrary subset of the distribution of traded shares. Finally, GPSM represents a straightforward generalization of the commonly applied propensity score matching (PSM) and is, therefore, easily available to the applied researcher.

2 A continuous treatment approach for M&A evaluation

In M&A evaluation, the treatment is typically based on the relative ownership shares involved in transactions. By definition, this measure can be continuously distributed within the $[0,1]$ interval. In contrast to PSM which is based on a (arbitrarily defined) binary M&A indicator, GPSM explicitly takes advantage of the variation in treatment intensities (see Imbens and Wooldridge 2009, for an overview).

GPSM is implemented in three steps (see Fryges and Wagner 2008, Appendix I): In the first step, one has to estimate the conditional distribution of the treatment variable given a set of

¹For example, ownership of 75 percent plus one vote assures to overcome blocking minorities (typically at 25 percent) in many countries. At the other end of the ownership distribution, it might be mentioned that European corporate laws typically allow shareholders with (at least) five percent ownership to call for an extraordinary general meeting.

²Among others, Conyon, Girma, Thompson and Wright (2001, 2002), Girma and Görg (2004), Gugler and Yurtoglu (2004), Lehto and Böckerman (2008) and Siegel and Simons (2010) find significantly negative or insignificant employment effects of M&As, while McGuckin and Nguyen (2001), Bandick and Görg (2010), Stiebale and Trax (2011) and Oberhofer (2013) provide evidence in the opposite direction.

³For instance, GPSM is applied to evaluate returns to schooling (see, e.g., Behrman, Cheng and Todd 2004), unemployment programmes (e.g., Lalive, Van Ours and Zweimüller 2007) instruments of regional policies (e.g., Becker, Egger and von Ehrlich 2012) incentive payment schemes (e.g. Bogaard and Svejnar 2013).

observable characteristics, i.e.,

$$E(D_i|X_i) = F(X_i\beta), \quad (1)$$

where X_i denotes a vector of covariates observed for each firm i . D_i is the treatment intensity, measured by the traded ownership shares ranging from zero to one. β represents the parameter vector to be estimated, and $F(\cdot)$ is a cdf which guarantees that $0 < F(X_i\beta) < 1$ for all $X_i\beta \in \mathbb{R}$. Papke and Wooldridge (1996) propose a quasi-maximum likelihood estimator (QMLE) of β based on the Bernoulli log-likelihood function. Equipped with consistent estimates for β , the estimated generalized propensity score, \hat{R}_i , can be expressed as

$$\hat{R}_i = [\Lambda(X_i\hat{\beta})]^{D_i} [1 - \Lambda(X_i\hat{\beta})]^{(1-D_i)}. \quad (2)$$

The second step involves to estimate the conditional expectation of ΔY_i (e.g., post-M&A employment growth) given the treatment variable D_i and the estimated propensity score \hat{R}_i . Following Hirano and Imbens (2004), we chose a quadratic approximation for the conditional expectation of ΔY_i , given by

$$E[\Delta Y_i|D_i, \hat{R}_i] = \alpha_0 + \alpha_1 D_i + \alpha_2 D_i^2 + \alpha_3 \hat{R}_i + \alpha_4 \hat{R}_i^2 + \alpha_5 D_i \hat{R}_i. \quad (3)$$

Equation (3) is estimated by OLS. The third step comprises to calculate the average treatment effect for any intensity interval d (in our case 10 percent traded ownership), making use of the obtained parameter estimates from the second step

$$\hat{E}[\Delta Y(d)] = \frac{1}{N} \sum_{i=1}^N (\hat{\alpha}_0 + \hat{\alpha}_1 d + \hat{\alpha}_2 d^2 + \hat{\alpha}_3 \hat{r}(d, X_i) + \hat{\alpha}_4 \hat{r}(d, X_i)^2 + \hat{\alpha}_5 d \hat{r}(d, X_i)). \quad (4)$$

Standard errors for the conditional expectations are calculated via bootstrapping methods.

3 Empirical application: Employment effects of M&As

Our sample combines information on European M&As (collected in Bureau van Dijk's Zephyr database) with firm-level balance sheet information and profit and loss accounts (taken from the Amadeus database) between 2003 and 2010. Overall, our sample contains 1,369 M&As, of which 1,004 cases represent 100 percent takeovers. Applying the GPSM, we employ two different control groups: One including only M&A targets with strictly positive treatment intensities (see Hirano and Imbens 2004), and one with additional non-treated control firms drawn from a random sample, containing 25 percent of all non-acquired firms in the Amadeus database with non-missing data (i.e., 162,989 firms). The outcome variable is defined as the average post-M&A employment growth rate over a two year time window. The choice of observable characteristics collected in X is mainly based on the selection equation reported in Oberhofer (2013), who also provides a detailed data description and descriptive statistics.

Table 1 summarizes our empirical results regarding step 1 from above. We find that the extent of acquired ownership shares is higher for larger targets (in terms of employment) and ones that are older, less capital intense, more profitable and more productive. The interaction term between age and size is significantly negative, suggesting that the extent of traded ownership shares is reduced for larger and older takeover targets. Qualitatively, the obtained estimates are very similar across the control groups considered. Therefore, it seems that in our example general equilibrium effects of M&A's are less of importance, which in turn is an important assumption underlying most treatment estimation approaches (see, e.g., Heckman, Lochner and Taber 1998).⁴ Moreover, the (Pseudo-) R^2 measures are well above 60 percent, suggesting that the included covariates are suitable to explain the variation in our treatment intensity, which in turn indicates that GPSM works well. This is also confirmed by a series of balancing property tests based on Hirano and Imbens (2004).⁵

Table 1: Estimation of traded ownership shares (QMLE)

Variable	Only M&A targets		M&A targets and non-acquired firms	
	Estimate	ME	Estimate	ME
Firm size (employees)	0.425* (0.227)	0.044* (0.023)	0.695*** (0.051)	0.005*** (0.000)
Firm age	1.377*** (0.365)	0.142*** (0.037)	0.401*** (0.098)	0.003*** (0.001)
Firm age \times firm size	-0.255*** (0.066)	-0.026*** (0.007)	-0.068*** (0.016)	0.000*** (0.000)
Capital intensity	-0.568*** (0.115)	-0.059*** (0.012)	-0.314*** (0.055)	-0.002*** (0.000)
Return on assets	0.012 (0.066)	0.001 (0.007)	0.143*** (0.037)	0.001*** (0.000)
Labor productivity	0.597*** (0.127)	0.062*** (0.013)	0.827*** (0.077)	0.006*** (0.001)
Time effects: $\chi^2[6]$	9.984		121.288***	
Industry effects: $\chi^2[2]$	4.844**		3.037	
McFadden- R^2	0.7070		0.6602	
Observations	1,369		164,358	

Notes: ME ... Marginal effect. Standard errors in parentheses. *, **, *** Significant at 10-, 5- and 1- percent level.

Figure 1 displays the estimated average employment effects of M&As and the corresponding 95 percent confidence intervals, where the left-hand (right-hand) panel focuses on the control group of only M&A targets (M&A targets and non-acquired firms).

The figures in both panels indicate serious heterogeneity with regard to employment effects of M&As over the whole distribution of M&A intensities. In particular, we observe significantly positive employment effects for takeovers below 50 and above 99 percent of traded ownership

⁴General equilibrium effects of M&As might be present when the merging firms (representing the treatment group) affect the market situation of their non-merging competitors (the control group). So far, this issue has not been addressed in the empirical M&A literature. In our example, the second sample contains a large number of firms making it less likely that a firm from the control group is directly affected by an M&A. Accordingly, one might argue that general equilibrium effects are of limited relevance in our case.

⁵These are not reported in the Table but available from the authors upon request.

shares, while the effects between 50 and 99 percent remain insignificant throughout. This, in turn, clearly shows that empirical results regarding employments effects of M&As are not insensitive to the choice of ownership cut-off values.

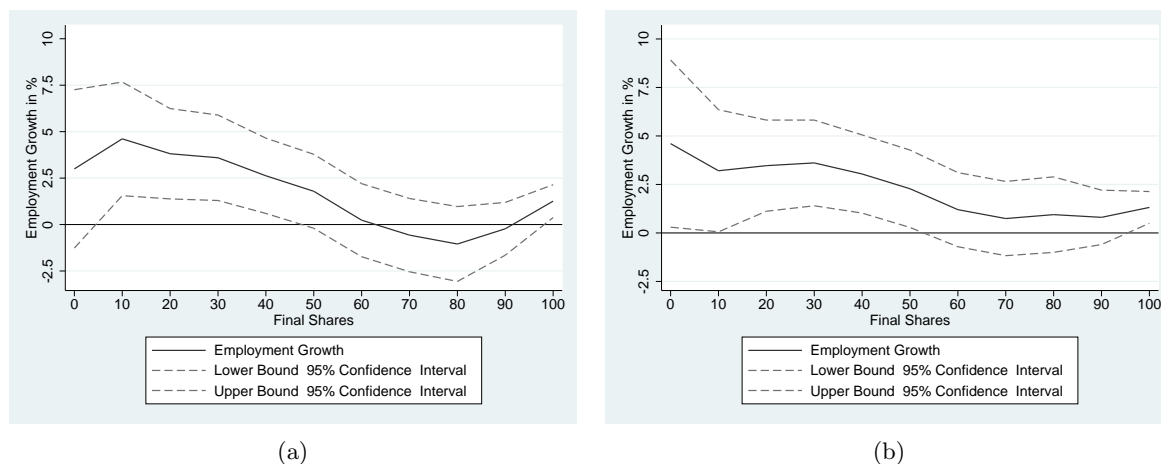


Figure 1: Average employment effects of M&As for samples containing (a) only M&A targets, and (b) M&A targets and non-acquired firms

4 Conclusion

This note proposes the application of a continuous treatment approach to analyze the economic effects of merger and acquisitions (M&As). Rather than reducing variation in the treatment variable via the choice of more or less arbitrary cutoff-values in traded ownership shares, this framework allows to evaluate the impact of M&As over the whole distribution of treatment intensities. Using a sample of European M&As and relying on the example of post-M&A employment effects, we observe that the impact of M&As varies considerably over the traded ownership distribution. At least, our suggestion for applied work in M&A evaluation would be to provide comprehensive sensitivity analysis at different cutoff-values in traded ownership shares.

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