Did Concentration on Core Competencies Drive Merger and Acquisition Activities in the 1990s?

Empirical Evidence for Germany

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Abstract

In the context of increasing globalization of markets, merger and acquisition activities in the 1990s are said to be driven by reorganization processes with respect to concentration on firms' core competencies in order to increase or maintain market power in international markets. This paper empirically investigates a sample of German domestic mergers in the 1990s to detect the impact of technology and market relatedness on the choice of the merging partner. Results from a conditional logit model show that firms prefer a merging partner within the same industry and with a related technological profile. These findings approve the hypothesis that mergers in the 1990s were undertaken to concentrate on core competencies.

Keywords: M&A, Technological Firm Performance, Market Relatedness
JEL-Classification: C25, G34, O32, O34

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1 Introduction

Due to increasing globalization of markets, it is often hypothesized that firms engage in merger and acquisition (M&A) activities in order to secure their international competitiveness. While the former merger waves in the 1960s and 1980s were characterized by diversification endeavors, M&A activities in the 1990s are said to be driven by firm strategies that aimed at strengthening competitiveness and market power within their field of core competencies. M&As provide firms the possibility to grow, lower sector or technological competition, and to benefit from economies of scale and scope, which has been important for increasing or maintaining market power in opened, international markets. Besides output market advantages associated with a merger, technological competencies are supposed to have played a major role during the fifth merger wave. Due to a shift from price competition towards competition based on technical inventions the importance of technological assets and competencies has risen over the past decades. Thus, technological proximity as well as output market relatedness enter the econometric model as the key variables. The estimated model maps the firm decision with whom to merge.

Empirically, this question is almost unexamined. Most theoretical and empirical studies on M&A investigate the effects of a merger on profits, overall firm performance or on shareholder value (see Roeller et al., 2001, for a review). Only a few of those studies focus on the technological firm performance (e.g. Cassiman et al., 2004). A second strand of the literature analyzes the determinants for entering the M&A market, either as a target or as an acquiring firm (e.g. Mueller, 1980); among those, some studies explicitly take R&D into account (e.g. Hall, 1999). But the question in between, namely the firm's decision with whom to merge, is largely unexplored. To my knowledge, Hall (1988) is the only study that analyzes the firm's choice of the merging partner, based on a large sample of publicly traded US firms in the period from 1976 to 1986. She explicitly takes R&D into account. In the context of a market value model, Hall (1988) concludes that R&D activities of target firms are of high value to acquiring firms.

Going beyond the question whether R&D in general is important for the merger decision, this paper investigates whether firm-specific technology portfolios drive the decision with whom to merge. The focus is on domestic mergers in Germany during the fifth merger wave in the 1990s. Controlling for firm size, geographical proximity, and firms' credit worthiness it turns out that firms tend to choose merging partners with a related technological profile as well as such within the same industry. This finding approves the hypothesis that mergers in the 1990s are undertaken to concentrate on core competencies.

2   Data and Descriptive Statistics

The underlying data set is based on the Mannheim Innovation Panel (MIP), which is a yearly survey conducted by the Centre for European Economic Research (ZEW) on behalf of the Federal Ministry for Education and Research (BMBF). Started in 1992, the MIP is a representative firm survey of German manufacturing and the service sector and has the advantage of containing a large number of small and privately held companies. For each of the years 1997, 1999, and 2001, the survey contains a question on merger activities over the previous three years. For the period from 1993 to 1995, the survey contains a question on structural changes in the firms followed by a text field, where firms are asked to describe the respective change. Firms who responded that they had undertaken a merger, were searched on the internet in 2004. Merging partners were identified on the basis of information given on firms' websites and public business pages.

Out of 2,356 firms in German manufacturing and 1,643 firms in the German service sector that declared that they had engaged in M&A in the period from 1993 to 2001, 424 merging pairs were found on the web. One possible source of loosing observations is firm exit. Moreover, firms may have changed their names after the merger and are, therefore, not traceable on the web. Since the MIP contains many small and medium-sized companies some firms are simply not present on the internet. A large share of the mergers found - 250 deals out of 424 - were cross-boarder. These cases had to be excluded as there was no information on foreign firms available to me. The internet search highlighted, moreover, the fact that many firms who declared that they had merged actually did something else. For example, one of two branches of the same company exited and the other took over responsibilities. Furthermore, in the case of some firms no information on the year prior to the merger was available.[2]

The final sample consists of 101 domestic M&A pairs. Information on the partner and the acquiring firms in the year prior to the merger are taken from the database of Creditreform, a German credit rating agency, that contains the whole population of firms in Germany. Creditreform also provides a credit rating index, which is used to proxy the financial situation of the sample firms. Patent information is taken from the database of the German Patent and Trade Mark Office (GPTO).

Table 1 shows descriptive statistics distinguishing between acquiring and target firms in case of acquisitions and firms involved in a merger. It emerges that acquiring firms face the best overall firm performance followed by target firms, whereas merging firms

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[2]Notice that the pattern of M&As per year does not show a selection bias towards early sample years (see Appendix).

perform less well. This shows that the best performers acquire promising candidates, whereas firms that do less well combine their assets and competencies to jointly maintain competitiveness.

Table 1: Descriptive Statistics

		Characteristics of the firms					
		acquiring firms		target firms		mergers	
# obs.		71		71		60	
	unit	mean	std.dev.	mean	std.dev.	mean	std.dev.
employees	persons	32,722	100,110.70	8,467	29,338.25	3,033	6,758.40
> 250 employees	[0/1]	.55	.50	.55	.50	.42	.35
credit rating	[100;600]	170.18	75.09	173.03	85.80	175.58	82.48
age	years	31.11	40.79	27.82	34.49	36.57	40.02
patent activity	[0/1]	.23	.42	.10	.36	.13	.26
East Germany	[0/1]	.17	.38	.15	.36	.33	.44
		Characteristics of the merger					
# pairs		101					
		mean		t-stat^a		std.dev	
Δ log(employees)	persons	6.73***		24.11		2.80	
Δ credit rating	[0;500]	78.94***		9.93		79.89	
Δ age	years	32.40***		8.71		37.36	
geogr. proximity	km	185.40***		9.50		19.52	
techn. proximity	[0;1]	.10***		3.43		.28	
same industry	[0/1]	.43***		8.61		.50	

*** indicate a significance level of 1%.
^{a} t-statistics on a two-tailed test of mean differences.

In detail, acquiring firms are the largest firms in terms of average employment. Firms involved in a merger have the smallest labor force, on average. This also holds when the share of large firms with more than 250 employees is focused on. Acquiring firms, moreover, have the best credit rating, on average. Credit ratings are used by potential lenders, such as banks and suppliers, to predict the default probability of the firm in question. Accordingly, the credit rating proxies the firm's financial status.[3] The credit rating ranges from 100 to 600, where 100 corresponds to the best rating. In general, the mean of the credit rating does not vary much across the three firm groups and lies in the upper range of possible values, which shows that weak performers are not present in this M&A sample. Focusing on innovation activities, it turns out that the share of innovative firms, measured by a dummy that equals one if a firm has filed at least one patent in the past, is highest among the acquiring firms.

Eastern German firms turn out to be less involved in M&A activities than Western German firms. Up to the fall of the Berlin Wall in 1989, Eastern Germany has been a planned economy and since then has been undergoing a transition process into a market economy. Nowadays, Eastern German firms still lag behind their Western German counterparts in

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[3]Detailed information on the credit rating index can be found in Czarnitzki and Kraft (2004).

many respects, e.g. in productivity (Czarnitzki, 2005). Thus, they are supposed to lack the financial means to acquire another firm and, moreover, present rather unattractive acquisition targets.

With respect to firm age, there are no large mean differences among the firm groups. Firms involved in M&A activities have been founded about 31 years ago, on average.

In addition, Table 1 shows descriptive statistics of the characteristics of the mergers. The absolute mean differences Δ in size[4], credit rating and age of the merger pairs differ in statistical significance from zero as a t-test shows. This might suggest that large firms with a good market performance merge with smaller and, particularly, with younger firms, whose credit rating is good, though worse than their own.

To answer the question whether concentration on technological core competencies has driven the choice of the merging partner, a measure of technological proximity is obtained from the angular separation (or uncentered correlation) measure, which was introduced to the patent literature by Jaffe (1986). Technological proximity T between two firms i and j is defined on the basis of their technology vectors F_i and F_j:

$$T_{ij} = \frac{F_i F_j}{\sqrt{(F_i' F_j)(F_i' F_j)}}, \qquad 0 \leq T_{ij} \leq 1, \tag{1}$$

with $F_i = (PS_{iA}, PS_{iB}, ..., PS_{iH})$ and $F_j = (PS_{jA}, PS_{jB}, ..., PS_{jH})$, where PS equals the firm's patent application stocks per IPC (International Patent Classification) class, A-H, as a percentage of the firm's total patent application stock in the same year. The patent stock PS for each IPC class is calculated as:

$$PS_{it} = PS_{i,t-1}(1 - \delta) + patent\ applications_{it}, \tag{2}$$

where the constant depreciation rate of knowledge δ is set to .15 as common in the literature (see e.g. Hall, 1990). By definition, this measure can take values between 0 and 1, where 1 corresponds to an identical technology portfolio of firms i and j.

Furthermore, it is controlled for output market relatedness of the merger pairs as opposed to technological proximity. A distinction between merging firms in the same industry sector and others provides a rough measure for the hypothesis that M&A activities are driven by concentration on core competencies on the output side. A merger in the same industry can lead to economies of scale in output and/or distribution (Cassiman et al., 2004). As output market relatedness is measured on a two-digit NACE level, mergers in the same field may also generate economies of scope by product diversification within an industry branch. Table 1 shows that almost half of the mergers have occurred in the same industry.

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[4]As the distribution of the Δ size shows a considerable skewness, the difference in logs is used.

Moreover, geographical proximity of the merging firm pairs is calculated on the basis of the degree of longitude and degree of latitude determined by firms' zip codes. From this information, the distance between firms is calculated using the well-known theorem of Pythagoras. The distance between the merging partners averages out at 185 km.

3 Econometric Model and Empirical Results

The model follows Hall (1988) and was developed originally in the context of a market value model. It is assumed that the value V of a firm is a function of firm characteristics X. In the presence of efficient markets and full information, $V(X_i)$ equals the price at which i's asset bundle is traded. However, acquisitions take place at a significant positive premium over pre-announcement stock and some agents place a higher value on X_i than the market. Therefore, acquisition decisions are assumed to be driven by disequilibria. Moreover, it is assumed that each year, the optimal configuration of corporate characteristics changes due to external shocks to the economic environment. Acquiring firms j can acquire any other firm i. If acquisition occurs, the increment to the value of firm j is $V_j(X_i)$. Thus, j acquires i, if j's gain from acquiring firm i is positive and larger than the gain from a merger with any other target k:

$$V_j(X_i) - P_i > 0 \quad and \quad V_j(X_i) - P_i > V_j(X_k) - P_k, \ \forall \ k \in C, \tag{3}$$

where P_i is the price of i's assets and C is the entire pool of firms. Prices are endogenous, assuming that firm j acts as a bidder. A new bid above the current trading price occurs because j has revealed new information about the value of i's assets. The price at which firms evaluate the purchase is assumed to be an unobservable function of the firm characteristics $V(X_i)$. Separating j's profit from the acquisition into observable and unobservable components yields:

$$V_j(X_i) - P_i = f(X_i, X_j) + \varepsilon_{ij}, \tag{4}$$

where ε_{ij} is independent and follows an extreme value distribution by assumption. This leads to a conditional logit probability that an acquisition takes place:[5]

$$P(j \ buys \ i|C) = \frac{e^{f(X_j, X_i)}}{\sum_{k \in C} e^{f(X_j, X_k)}}. \tag{5}$$

Specifying the value function $f(\cdot)$ as the difference between the valuation of the acquiring firm v_j and the equilibrium price v yields:

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[5]If the assumption of constant effects of the regressors on the choice probability is relaxed, a multinomial model could be assumed, alternatively.

$$P(j\ buys\ i|C) = \frac{e^{v_j(X_i)-v(X_i)}}{\sum_{k\epsilon C} e^{v_j(X_k)-v(X_k)}}, \tag{6}$$

where small letters correspond to the measurable components of V and V_j.

The econometric specification of the value function as a function of the firm characteristics is specified as follows:[6]

$$v_j(X_i) - v(X_i) = X_j\beta_1 + X_i\beta_2 + |X_j - X_i|\beta_3 \tag{7}$$

The characteristics X include firm size, age, a credit rating index, firm location, technological and geographical proximity. Moreover, intra-industry deals are controlled for.

To analyze the decision with whom to merge, a conditional logit model is applied. Since the choice set C is huge as it includes every firm in Germany, an alternative choice set of ten possible target firms that have not been acquired in the same year is drawn for each acquirer[7] as proposed by McFadden (1978). Alternative targets are drawn from the MIP. Eventually, the database contains the actual target as well as ten alternative targets for each acquiring firm. In order to prove independence of irrelevant alternatives (IIA), which is a necessary condition for the application of a conditional logit model, the regression is repeated for a sample with only five alternative targets included. Under the IIA assumption, no systematic change in the coefficients of the regression model is expected if alternatives are excluded. The test-statistic is χ^2-distributed with 10 degrees of freedom and takes the value 12.35. The p-value for this Hausman-statistic is .26 and is, therefore, not different from zero at any conventional level of statistical significance. In other words, the IIA assumption is valid for the respective model.

For interpretational reasons Table 2 shows the marginal effects evaluated at the sample means instead of the regression coefficients. The first column (I) contains the results for the larger sample with ten alternative targets, the second column (II) shows the results for the sample, where five alternatives are excluded. The little difference between the estimated models (I) and (II) illustrates the validity of the IIA. The interpretation of the marginal effects is based on the estimation results (I).

It turns out that M&As associated with large size differences are more likely to occur. Concrete, a 100% increase in size difference between firms at the sample mean increases the probability of a merger or acquisition by 6%-points. This result contradicts Hall's (1988) finding for publicly traded US firms that mergers associated with large size differences are less likely to occur. As the underlying sample contains many small and medium-

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[6]Notice that β_1 will not be estimated because the firm characteristics of the acquiring firm cancel from numerator and denominator.

[7]In the case of a merger, the larger firm in terms of employment is defined as the acquiring firm.

sized firms, it is not surprising to find the opposite. I interpret this result as a hint that large firms tend to acquire smaller firms in line with Mueller (1980), who states that the probability of acquiring another firm increases with firm size. The measure for geographical proximity shows that firms located close to each other are more likely to merge. Concrete, a 100km decrease in the distance between firms increases the likelihood of a merger or acquisition by 10%-points. The differences in credit rating and in firm age of the merger pairs turn out not to be statistically significant.

Table 2: Conditional Logit Regression of Acquisition Choice

	(I)	(II)
	marg. eff.	marg. eff.
	(std. err.)	(std. err.)
Δ log(employees)	.06**	.04**
	(.02)	(.02)
Δ credit rating/100	.01	-.005
	(.06)	(.05)
Δ firm age	-.001	.001
	(.001)	(.001)
technological proximity	.63***	.55*
	(.24)	(.30)
same industry	.45**	.36*
	(.19)	(.20)
geographical proximity/100	-.10***	-.06*
	(.03)	(.03)
target's age	.02***	.02**
	(.01)	(.01)
(target's age)^2/100	-.01***	-.01**
	(.004)	(.006)
target's credit rating	.13*	.12**
	(.07)	(.06)
> 250 employees	-.05	-.09
	(.08)	(.09)
Eastern German target	-.74***	-.74***
	(.08)	(.13)
# obs.	1111	606
LR-χ^2	239.33	193.59
Pseudo-R^2	.49	.53

*** (**,*) indicate a significance level of 1% (5%, 10%).

Looking at the variables of special interest, it emerges that output market related mergers are very likely to occur: a discrete change from zero to one in the affiliation to the same industry increases the probability of a merger or acquisition by 45%, ceteris paribus. Moreover, technological proximity turns out to be a strong driver of M&As: if the overlap of firms' patent portfolios increases by 100% at the mean, which corresponds to a 20%

overlap, the probability of a merger increases by about 6.3%-points. M&A activities in the 1990s, therefore, are significantly driven by firms' concentration on their core competencies.

With respect to the firm characteristics of the target firm, it turns out that the age effect on the M&A probability is inversely U-shaped. Very young firms are not very likely to be targets for a merger or acquisition, but after a certain time when the firm has built up its organization structure and its reputation, the likelihood of acquiring or being acquired increases. When the firm reaches a certain age, the probability of a M&A decreases. The target firm's credit rating as a proxy for the firm's financial situation shows that the probability of being acquired falls, the better the financial situation of the firm. Moreover, it is evident that Eastern German firms, which still lag behind their Western German counterparts, are less likely to be acquired. This hints at a 'picking the winners' strategy of the acquiring firms with respect to the target choice. There is no effect for large target firms measured by the dummy variable that equals one if the firm has more than 250 employees, on the probability of becoming a target firm.

4   Conclusion

In the context of the fifth merger wave, this paper analyzes whether concentration on core competencies has driven M&A activities, as is often hypothesized, for a sample of domestic mergers in Germany. The results provide quite a strong support for this hypothesis: firms tend to choose M&A partner firms within the same industry and, moreover, prefer merging partners with a similar technological profile. This leads to the conclusion that M&A deals in the 1990s are used to concentrate on output market related as well as on technological competencies in order to secure or maintain competitiveness against the background of an increasing globalization of markets.
A further finding is that firms with a bad performance are not present in this M&A sample. Moreover, Eastern German firms, which still lag behind their Western German counterparts in many respects, are less likely to be involved in M&A activities than their Western Germany counterparts. Firms located in Eastern Germany are supposed to lack the financial means to acquire another firm, on the one hand, and to present rather unattractive targets for a merger, on the other hand.

References

Cassiman, B., M. Colombo, P. Garrone and R. Veugelers (2004). The Impact of M&A on the R&D Process. An Empirical Analysis of the Role of Technological and Market relatedness, *Research Policy, forthcoming.*

Czarnitzki, D. (2005). Extent and Evolution of the Productivity Gap in Eastern Germany, *Journal of Productivity Analysis, forthcoming.*

Czarnitzki, D. and K. Kraft (2004). *Are Credit Ratings Valuable Information?*, ZEW Discussion Paper No. 04-07. Mannheim.

Hall, B.H. (1988). The Effect of Takeover Activity on Corporate Research and Development. In: Auerbach, A. (ed.). *The Economic Effects of Takeover Activity.* Chicago: University of Chicago Press.

Hall, B.H. (1990). *The Manufacturing Master File: 1959-1987*, NBER Working Paper No. 3366. Cambridge MA.

Hall, B.H. (1999). *Mergers and Acquisition Revisited, mimeo.* Berkeley.

Jaffe, A.B. (1986). Technological Opportunity and Spillovers of R&D: Evidence from Firm Patents, Profits and Market Value. *American Economic Review* 26: 1023-46.

McFadden, D. (1987). Modelling the Choice of Residual Location. In: Karlqvist, A. (ed.). *Spatial Interaction Theory and Residential Location.* Amsterdam: North Holland.

Mueller, D. (1980). *The Determinants and Effects of Merger.* Cambridge, MA.

Roeller, L.-H., J. Stenneck and F. Verboven (2001). *Efficiency Gains from Mergers.* European Economy No. 5. European Communities. Belgium.

Appendix

Table 3: Sample M&As per Year

year	number of acquisitions
1993	3
1994	10
1995	10
1996	10
1997	7
1998	26
1999	16
2000	11
2001	8
total	101