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Grimpe, Christoph; Hussinger, Katrin

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## Pre-empting Technology Competition Through Firm Acquisitions

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## **Non-Technical Summary**

Mergers and acquisitions (M&A) can increase the merged entity's market power in both product and technology markets. Whereas a potentially harmful effect of mergers in output markets can be predicted based on expected price changes after the acquisition, there is no standardized way how to detect a market power effect in technology markets. This has recently received scrutiny from antitrust authorities in order to ensure an appropriate level of competition. The statement that M&A can affect competition in technology markets is almost a triviality. However, whether the merged entity is able to enhance technological market power depends on whether the M&A creates barriers to entry in technology markets or whether the threat of future entry remains.

This paper provides empirical evidence for the objective of pre-empting technology competition through M&A. We make use of the patent application procedure at the European Patent Office to introduce a new measure for the motive of creating entry barriers in technology markets. Based on a sample of horizontal acquisitions in Europe we show that acquiring firms pay more for targets with large patent stocks, for those with highly valuable patents as measured by patent forward citations and such with technologically related patent portfolios. On top of that we find that targets with a patent portfolio that has the potential to block other patents are of high value to the acquiring firm. We interpret this finding as evidence for a pre-emption motive of M&A.

The paper concludes with a suggestion on how to assess the potential to create entry barriers into technology markets. This could be of interest for competition authorities to sharpen their estimation of the impact of M&A on competition in technology markets.

# Pre-empting Technology Competition Through Firm Acquisitions

Christoph Grimpe<sup>a</sup> and Katrin Hussinger<sup>b,a,\*</sup>

<sup>a</sup>*Centre for European Economic Research (ZEW), Mannheim (Germany)*

<sup>b</sup>*K. U. Leuven (Belgium)*

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## Abstract

This paper investigates the motive of pre-empting technology competition through mergers and acquisitions (M&A). Exploiting the patent application procedure at the European Patent Office we introduce a new measure for the possibility to create entry barriers in technology markets. Our results show significant evidence that firms engage in horizontal M&A to pre-empt competition in technology markets.

Keywords: pre-empting technology competition, mergers and acquisitions

JEL: G34, L20, O34

\* Corresponding author, Katholieke Universiteit Leuven (KUL), Department of Economics & Applied Economics, Naamsestraat 69, 3000 Leuven, Belgium, Tel.: +32(0)16/326899, E-mail: [katrin.hussinger@econ.kuleuven.be](mailto:katrin.hussinger@econ.kuleuven.be)

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# 1 Introduction

Mergers and acquisitions (M&A) can increase the merged entity's market power in both product and technology markets. The latter has recently received scrutiny from antitrust authorities (e.g. European Commission, 2005). The statement that M&A can affect competition in technology markets is almost a triviality. However, the ability of the merged entity to enhance technological market dominance depends on whether the M&A creates barriers to entry in technology markets or whether the threat of future entry remains.

This paper provides empirical evidence for the objective of pre-empting technology competition through M&A. We make use of the patent application procedure at the European Patent Office to introduce a new measure for the motive of creating entry barriers in technology markets and find significant evidence for a pre-emption motive of M&A.

# 2 Theory

Since the seminal work by Joseph Schumpeter and Kenneth Arrow the theoretical literature on innovation incentives under the pressure of competition is well developed (see Reinganum, 1989, for a survey). These models can explain pre-emptive behaviour in technology markets. Recent developments are mainly based on two models, the auction model by Gilbert and Newbery (1982) and the stochastic racing model by Reinganum (1983).<sup>1</sup>

Gilbert and Newbery (1982) consider an incumbent firm that faces competition by one or more potential entrants. The firms compete for a process innovation of a third party. The firm with the highest bid, which is determined by its maximum expenditure for R&D, wins the auction. If the challenger wins the auction market entry takes place. The model predicts that incumbent firms have greater incentives to bid more than potential entrants because of pre-emption motives, i.e. to preclude entry.

While the model by Gilbert and Newbery is static, Reinganum (1983) proposes a stochastic racing model. In her model, an innovation occurs after an unknown time

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<sup>1</sup> For an empirical test of the oppositional predictions of both models see Czarnitzki and Kraft (2004).

period. The length of that period depends on the amount of the firm's R&D expenditure in the market. The incumbents have less incentives to innovate than potential entrants as the innovation would cannibalize their existing profits, i.e. the replacement effect (Arrow, 1962).

Gans and Stern (2000) build on Reinganum (1983) and propose a model in which technologically successful entrants can cooperate in the post-innovation market with the incumbent through licensing or firm acquisitions. In their model, incumbents have strategic incentives to invest in R&D because innovation increases their bargaining power in licensing and M&A negotiations. As in Reinganum's model, incumbents are likely to invest less than potential entrants, who make their profits in the market for ideas rather than in the post-innovation market.

In line with the predictions of the theoretical literature, empirical studies show that technological assets increase the likelihood of being acquired (see Veugelers, 2006, for a survey), especially if the target's technologies are highly valuable and related to the acquiring firm's technology portfolio. The particular question whether firm acquisitions aim at creating barriers to entry into technology markets has, however, not yet been tackled.

### **3 Data and Variable Definition**

Our sample of 657 target firms with known deal values is taken from the ZEPHYR database of Bureau van Dijk Electronic Publishing (BvDEP). We identified manufacturing firms located in Europe that were subject to a horizontal acquisition in the period 1997-2003.<sup>2</sup> Financial information is added from BvDEP's Amadeus database.<sup>3</sup> In order to get information on target firms' innovation activities the patent history of the firms is taken from the database of the European Patent Office (EPO). The data were linked using a computer supported text search algorithm on firm names and addresses. Each match proposed by the search engine was checked manually.

We use four measures to describe the attractiveness of each target  $i$ 's technological assets. As a measure for quantity of innovations we use the patent stock:

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<sup>2</sup> Horizontal acquisitions are characterized as a transaction with the acquirer and target company being from the same industry as defined in terms of the NACE (2-digit) classification.

<sup>3</sup> Additional statistics on the sample, e.g. country and industry distribution, are available upon request.

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

$\delta$  represents a constant knowledge depreciation rate, which is set to 15 percent in line with previous studies (e.g. Hall, 1990).

Patent quality is measured by the target's citation rate, i.e. the number of forward citations the target's patents receive in a five year window over the total number of patents.

To control for technological proximity of the patent portfolios of acquiring and target firm we use the proximity measure introduced by Jaffe (1986). In order to calculate this measure we determined for each firm patent stocks for each 2-digit technology class according to the International Patent Classification (IPC). This yields a technology vector  $F$  for each target  $i$  and acquirer  $j$ , which can be interpreted as their technology portfolio. Using these vectors (as a percentage of the total patent stock) technological proximity  $T$  is now calculated as:

$$T_{ij} = \frac{F_i F_j}{\sqrt{(F_i' F_i)(F_j' F_j)}}; \quad 0 \leq T_{ij} \leq 1$$

Finally, building on Harhoff et al. (2005) we introduce a new measure to map pre-emptive behavior in technology markets, which is done by making use of the patent application procedure at the EPO (see Harhoff and Reitzig, 2004, for a detailed description). The EPO patent examiner prepares a search report for each patent application in order to evaluate whether the invention fulfils the novelty requirement for protection by a patent. In particular, the search report lists all relevant prior art, patents and other documents, and classifies them with respect to their relevance for the invention in question. Prior art is classified with an X if - even when taken alone - a claimed invention could possibly not be considered novel. Referenced documents are categorized with a Y if the document threatens novelty only if combined with other documents. Hence, the more X and Y references a patent application receives the less likely it will be granted. For our analysis we use the X and Y *forward* citations within a five year window which indicate to what extent a particular patent threatens other patents' chance for being granted. The more X and Y *forward* citations a patent receives, the higher its strategic value for pre-empting competition in technology markets.



Table 1 shows the descriptive statistics for non-patenting and patenting acquisition targets. 16 percent of the acquisition targets have a positive patent stock, i.e. they have applied for a patent at the EPO at least once since firm foundation. On average, patenting firms are associated with a higher deal value and a higher deal value per total assets than the average non-patenting target. They are, however, less profitable than the average target without patents as indicated by their return on assets, defined as the sum of profits and capital gains of assets over total assets in the year prior to the acquisition. The average patenting firms is not different with respect to its leverage defined as liabilities over total assets. All variables refer to the year prior to acquisition.

**Table 1: Descriptive statistics**

<b>European Acquisition Targets</b>		
Number of observations = 657		
	Mean	St.dev.
<b>Firms without EPO patents:</b>		
	Number of observations = 553	
Deal value (M Euro)	68.852	224.461
Total assets (M Euro)	174.418	479.002
Return on assets (%)	3.194	16.542
Leverage	0.583	0.231
Age (years)	21.342	23.630
<b>Firms with EPO patents:</b>		
	Number of observations = 104	
Deal value (M Euro)	285.039	577.397
Total assets (M Euro)	316.506	597.993
Return on assets (%)	-3.235	23.685
Leverage	0.530	0.238
Age (years)	22.055	25.122
Patent stock	37.922	107.341
Techn. proximity	0.019	0.066
# Citations/# patents	0.956	0.796
# XY citations/# citations	0.262	0.261

## 4 Empirical Results

In order to investigate whether pre-empting competition in technology markets is an objective of M&A we define the acquired company in a hedonic way as a bundle of its characteristics and assets and conduct a multivariate regression for the deal value. The specification follows the market value literature (see Czarnitzki et al., 2006, for a survey).

Table 2 shows the estimation results. It turns out that technological assets are of high value to the acquiring firm as they raise the deal value significantly. Besides the quantity of patents (patent stock/assets), their value (#citation/#patents) and their relatedness to the patent portfolio of the acquiring firm (techn. prox.) the results show that firms have a clear preference for acquisition targets with potentially blocking patents (#XYcitations/#citations). The deal value of a target increases by 13% if there is a 0.01 increase in the blocking potential of the target firm's patent portfolio. This corresponds to an increase of the deal value by approximately 37M Euro for the average patenting firm.

**Table 2: OLS regression for the log(deal value)**

	(1)	(2)	(3)	(4)
	Coefficient (St.err.)	Coefficient (St.err.)	Coefficient (St.err.)	Coefficient (St.err.)
Log(total assets)	0.40 *** (0.03)	0.40 *** (0.03)	0.39 *** (0.03)	0.38 *** (0.03)
Return on assets	0.01 *** (0.00)	0.01 *** (0.00)	0.01 *** (0.00)	0.01 *** (0.00)
Leverage	-0.40 (0.25)	-0.39 (0.26)	-0.39 (0.25)	-0.39 (0.26)
Age	0.01 *** (0.00)	0.01 *** (0.00)	0.01 *** (0.00)	0.01 *** (0.00)
Patent stock/assets	0.18 *** (0.05)	0.18 *** (0.05)	0.17 *** (0.05)	0.14 *** (0.04)
Techn. prox.		7.82 ** (3.20)	6.91 ** (3.20)	5.85 * (3.08)
(Techn. prox.) <sup>2</sup>		-14.99 ** (6.51)	-14.22 ** (6.52)	-11.87 * (6.24)
#Citations/#patents			0.14 *** (0.04)	0.10 *** (0.04)
#XYcitations/#citations				1.13 *** (0.41)
Constant	5.01 *** (0.46)	5.04 *** (0.46)	4.98 *** (0.46)	5.12 *** (0.46)
Industry dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
F-stat	12.09	11.74	11.94	12.64
R <sup>2</sup>	0.27	0.27	0.28	0.29

\*\*\*, \*\*, \* indicate statistical significance at the 1%, 5%, 10% level.

Standard errors in parentheses are robust using the Huber/White correction.

## 5 Conclusion

This paper provides empirical evidence for the objective of creating barriers to entry into technology markets through firm acquisitions. In line with the predictions of

economic theory the estimation results show that firms with technologies that have the potential to deter entry are of high value to the acquiring firms. Our paper provides a suggestion for competition authorities to sharpen their estimation of the impact of M&A on competition in technology markets.

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