Abnormal Stock Returns and Technology Mergers and Acquisitions

ELINA LÄMPSÄ
University of Oulu, Department of Accounting and Finance

First version: 14 January 2008
This version: 18 April 2008

Abnormal Stock Returns and Technology Mergers and Acquisitions

1. Introduction

Prior studies show that the market is slow to incorporate publicly available information, in contrast to the efficient market hypothesis. When the stock market takes years to correct the publicly available information, stocks may experience positive or negative long-term abnormal returns. Chan, Lakonishok, and Sougiannis (2001) suggest that, due to the uncertainty of the future benefits from R&D, stock prices may not fully incorporate the value of a firm's R&D. Similarly, Daniel and Titman (2006) argue that investors misreact to intangible information, but not to tangible information. Consistent with these arguments, Eberhart, Maxwell, and Siddique (2004) find that shareholders of firms increasing their R&D expenditures experience significantly positive long-term abnormal stock returns following these increases.

The past decades have witnessed a significant number of mergers and acquisitions (hereafter M&A) aimed to enhance the acquiring firm's R&D operations. Many technology firms continuously seek to access other technologies in order to supplement their technology dependent operations. Consistently, many studies show that technology-driven M&As provide an acquirer with means to enhance its existing R&D activities to increase its future cash-flows (e.g. Higgins and Rodriguez 2006; Morck and Yeung 2003). For instance, Morck and Yeung (2003) argue that firms with extensive intangible assets can add value by being larger and more diversified because of the economies of scale and scope in these assets. Therefore, technology M&As can be viewed as an R&D investment for the acquiring firm.

In this paper, we investigate abnormal stock returns on a trading strategy that utilizes the under-pricing of stocks of high-technology firms acquiring other firms in the

high-technology field. The above arguments raise the possibility that technology M&As, as an R&D investment, provide information to which the investors may misreact for two main reasons. First, the gains from technology M&As may be hard to recognize for the stock market because as Kothari, Laguerre, and Leone (2002) show, gains from R&D operations are relatively volatile. Moreover, Aboody and Lev (2000) identify R&D as a major contributor to information asymmetry. With the same repercussions in mind, Hirshleifer and Teoh (2003) argue that investors with limited attention are likely to attend to more salient, easily processed information and miss less prominent information. Therefore, the stock market is unlikely to recognize the full extent of the gains arising from R&D in technology M&As, causing the acquirer's investors over-react to the negative aspects of the announced technology-driven M&A and under-react to its positive value-increasing outcomes.

Second, because companies merge for multiple reasons, it may be the case that companies engaging in mergers for bad reasons are negating the gains to companies engaging for good reasons. Mergers and acquisitions are generally found to destroy acquirer firm's market value. Numerous studies report negative or zero abnormal returns for acquiring firms both during the announcement period and during the long-term post-acquisition period (e.g. Agrawal, Jaffe, and Mandelker 1992; Mitchell and Stafford 2000; Oler 2008). Therefore, the investors do not expect the acquirer to benefit from any kind of M&A, leading to negative stock market reactions to all M&As, on average. The stock price of the acquirer in technology M&A may therefore be temporarily understated, with the correction occurring as investors respond to the more prominent signal of earnings when they are reported in the post-acquisition period.

Consistent with the above discussion, we find significantly positive Carhart (1999) four-factor model abnormal stock returns for a trading strategy that takes a long position

on technology acquirers of technology targets. These results suggest that a significant portion of investors do not recognize the implications of combining two sets of R&D on acquirer's future cash flows. Second, the Mishkin (1983) test shows that investors under-price the research and development (hereafter R&D) spending of technology acquirers of technology targets relative to ability of R&D spending to predict future earnings.

We contribute to earlier literature in following aspects. First, we directly identify a setting where an investor can benefit from the information asymmetries related to R&D suggested by Aboody and Lev (2000). Second, we contribute to studies exploring returns in trading strategies based on technological edge of the firm (e.g. Chan et al. 2001; Eberhart et al. 2004). Third, we add the technology orientation of the firms involved as another predictive variable for post-acquisitions returns (e.g. Agrawal et al. 1992; Mitchell and Stafford 2000).

The paper is organized as follows. In the next section we review the prior literature and develop our hypotheses. Section 3 describes the sample and summary statistics, while section 4 presents the methodology of the study. In section 5 we report the results and present robustness tests. Section 6 concludes the study.

2. Gains arising from R&D in technology M&As and information asymmetry

In an efficient capital market, all value-relevant public information should be quickly and fully impounded into stock price (Fama 1970). However, numerous studies with different research focuses indicate that the market does not respond completely to some public information, such as M&As and R&D. For instance, Eberhart, Maxwell,

and Siddique (2004) find evidence of misreaction, as manifested by a significantly positive abnormal stock returns that the shareholders of firms unexpectedly increasing their R&D expenditures experience. Their results provide evidence of investor underreaction to the benefit of R&D increases, showing that the market does not recognize the future cash flows that the R&D generates.

Aboody and Lev (2000) discuss the role of R&D in creating information asymmetry and provide some reasoning for the market's possibly slow incorporation of publicly available R&D-related information. Maintaining that investment in R&D is a major productive input especially in firms operating in technology and science-based sectors, they also argue that investors can derive little or no information about the productivity and the value of a firm's R&D from observing the R&D performance of other firms. Combined with the fact that there are no organized markets for R&D and hence no asset prices from which to derive information, together with the different accounting measurement and reporting rules for R&D relative to other investments, it is likely that R&D contributes to information asymmetry between corporate insiders and outside investors (Aboody and Lev 2000). Consequently, R&D may well be a significant factor causing long-term abnormal returns as outside investors do not have the information to react the way that inside investors do to such a potentially productive investment but slowly react to the gains later observed after R&D investment.

Hirshleifer and Teoh (2003) argue that informationally equivalent disclosures can have different effects on investor perceptions, depending on the limited attention and processing power of investors. Their model of the effect of limited investor attention on stock prices suggests that market prices are a weighted average of the beliefs of both inattentive and attentive investors. While attentive investors attend to relevant but less

prominent information, investors with limited attention react to more salient, easily processed information.

Technology M&As provide a setting where limited investor attention may have an impact as the released information associated with these M&As involves the combination of two technology firms' R&D operations – information that is less prominent for investors but certainly relevant. The accumulation of acquirer's R&D with that of the target firm also makes these transactions similar to the events investigated in Eberhart et al. (2004) and to the setting examined by Aboody and Lev (2000). Many technology M&As are driven by the objective to supplement the acquiring firm's R&D operations, which is why these M&As can be considered as one type of R&D investment. Therefore, these M&As are associated with the same information asymmetries and investor underreaction as are R&D investments in general.

We build on these arguments and argue that the stock market does not recognize the future benefits associated with technology M&As, causing investors of acquirers in these M&As to experience significantly positive long-term abnormal returns.

3. Sample characteristics

We retrieve the data of mergers and acquisitions from the Thomson Financial Deals database. We focus on M&As involving technology firms, conducted during 1992-2004 with a U.S. acquirer. Following Dessyllas and Hughes (2005), we define technology firms as those having their primary business sector in a technology-intensive industry according to the OECD two-digit SIC code classification[1]. We include M&As

[1] Technology-intensive industries are those having one of the following two-digit SIC codes: 28, 35, 36, 37, 38, 48, 73 and 87.

with targets of all sizes, but require available information of both acquirer's and target's net sales in the year prior the M&A. The financial statement information and return data were obtained from Thomson Worldscope and Thomson Datastream, respectively. We exclude M&As where information about the market capitalization, book-to-market, earnings, or R&D spending of the acquirer is not available. To avoid overlapping observations, we include only one M&A per each acquirer in every 36-month period. Table 1 reports the distribution of the M&As in each sub-sample in the sample period.

(Insert Table 1 about here)

Table 2 reports descriptive statistics of acquirers in our sample. Acquirers in M&As of our main interest, that is those with technology acquirer and technology target, have on average higher market capitalization than acquirers in other M&As, both in dollar values and relative to book value of equity. The acquirers in the main group also have higher R&D intensity, as expected.

4. Methodology

4.1 Abnormal stock returns

In measuring long-term performance, the focus can be placed either on the calendar-time approach or the event-time approach. Fama (1998) strongly advocates the monthly calendar-time portfolio approach because by forming monthly calendar-time portfolios, all cross-correlations of event-firm abnormal returns are automatically

accounted for in the portfolio variance. Therefore, we use the calendar-time approach, but also account for event-time buy-and-hold abnormal returns recommended by Barber and Lyon (1997), because that approach "precisely measures investor experience".

We calculate the hedge portfolio abnormal returns for our trading strategy as follows. For each month in the sample period, we first identify technology firms that have acquired another technology firm during the preceding month. We then calculate equally-weighted averages of the monthly returns of these acquirers over the sample period. We keep a given acquirer in the portfolio for 36 months after an M&A. Finally, we estimate the Carhart (1997) four-factor models from the time-series of 168 (14×12) monthly portfolio returns. Specifically, we estimate the following model:

$$R_{pt} - R_{ft} = \alpha + b(R_{mt} - R_{ft}) + sSMB_t + hHML_t + mUMD_t + \varepsilon_{it}, \quad (1)$$

where R_{it} is average raw return for stocks of technology acquirers of technology targets in calendar month t, R_{ft} is the one-month T-bill return, R_{mt} is the value-weighted market index return, SMB_t is the return on a portfolio of small stocks minus the return on a portfolio of large stocks, HML_t is the return on a portfolio of stocks with high book-to-market ratios minus the return on a portfolio of stocks with low book-to-market ratios, and UMD_t is the return on high momentum stocks minus the return on low momentum stocks.[2] The estimated intercept α in Model (1) is the measure of abnormal return on the trading strategy.

We also use another variation of the calendar-time portfolio approach that allows the simulation of an investment strategy: mean calendar-time abnormal returns

[2] We thank Kenneth French for providing data for the SMB, HML, and UMD factors on his web site (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

(CTARs). For each calendar month, we calculate the abnormal return as the difference between the return for each security (R_{it}) and the return on the 25 size-B/M corresponding reference portfolios (R_{pt}):

$$CTAR_{it} = R_t - R_{pt} \tag{2}$$

Then, in each calendar month t, we calculate a mean return across the firms in the portfolio:

$$\overline{CTAR}_{it} = \sum_{i=1}^{Nt} {}^{1}\!/\!_{N_t} CTAR_{it} \tag{3}$$

Where N_t is the number of firms in the calendar-time month t. Then we calculate the mean monthly abnormal return ($MCTAR$):

$$MCTAR = ({}^{1}\!/\!_{T}) \sum_{i=1}^{T} \overline{CTAR_t} \tag{4}$$

where T is the total number of calendar months.

We follow Barber and Lyon (1997), Kothari and Warner (1997) and André, Kooli, and L'Her (2004) by using reference portfolios that are purged from event firms and formed continuously on the basis of firm size and book-to-market ratios. To construct the size control portfolios, we rank sample acquirers' stocks each month according to their market capitalizations into five portfolios. Then, we repeat this according to their book-to-market ratios. We calculate the returns of the 25 portfolios and assign each M&A a control portfolio based on its market capitalization and book-to-market ratio.

4.2 The Mishkin test

In order to test whether acquirer's R&D after the technology M&A is relevant for future cash flows even though the investors may not react to it as it can be considered

less prominent information, we use the Mishkin (1983) test. It tests whether the stock market rationally prices value-relevant information with respect to its implications for future earnings of the firm. Our trading strategy implies that stock market under-prices the value of the R&D spending and consequent future cash flows of the technology acquirers of technology targets. Therefore, the Mishkin test allows us to directly test the market pricing of the R&D spending of the technology acquirers of technology targets with respect to impact of the R&D spending on future earnings. Specifically, we estimate the following regression system with an iterative generalized non-linear least squares estimation procedure:

$$\frac{EARN_{it+1}}{BV_{it+1}} = \gamma_0 + \gamma_1 \frac{EARN_{it}}{BV_{it}} + \gamma_2 \frac{RD_{it}}{BV_{it}} + \upsilon_{t+1}, \tag{5}$$

$$RET_{it+1} = \alpha + \beta(\frac{EARN_{it+1}}{BV_{it+1}} - \gamma_0 - \gamma_1^* \frac{EARN_{it}}{BV_{it}} + \gamma_2^* \frac{RD_{it}}{BV_{it}}) + \varepsilon_{t+1}, \tag{6}$$

where $EARN_{it}$ is the net income before R&D expenditures for acquirer *i* in the M&A year *t*; BV_{it} is the book value of equity for acquirer *i* in the M&A year *t*; RD_{it} is the research and development expenditures for acquirer *i* in the M&A year *t*; and RET_{it+1} is the annual size and B/M adjusted stock return for acquirer *i* in the year following the M&A year *t*.

5. Results

5.1 Post-acquisition abnormal returns

Figure (1) depicts the annual size and book-to-market adjusted returns for our trading strategy. Returns are consistently positive and there are no price reversals indicating that positive returns do not result from the high risk of the strategy. Figures (2) and (3) report the corresponding returns for technology acquirers of technology firms and non-technology acquirers of technology firms, respectively. In Figure (2) the returns are highly volatile and mostly negative. Returns in Figure (3) are consistently negative. Together these figures indicate that acquirers of technology firms that acquire other technology firms earn consistently positive abnormal returns, while investors of acquirers in other M&As involving technology firms do not.

(Insert Figure 1 about here)

(Insert Figure 2 about here)

(Insert Figure 3 about here)

Table 3 reports the results of exploring the profitability of the trading strategy compared to other alternatives. We estimate Model (1) from the time-series of monthly portfolio returns by constructing the portfolio such that a given stock is included in the portfolio for 12, 24 and 36 months after the M&A completion. The estimated intercept from the four-factor model is the measure of abnormal returns. The results in Panel A show that taking a long position on technology acquirers that acquire other technology targets yields significantly positive abnormal returns. Even though there is no significant increase in abnormal returns during the second year of holding period, the abnormal returns increase substantially during the final holding year. Returns for other

acquirers, reported in Panel B and C, are consistently negative or insignificant. These results are consistent with the returns reported in Figures 1, 2 and 3.

(Insert Table 3 about here)

The results from using calendar-time abnormal returns are reported in Table 4. These results report consistently negative abnormal returns for investors of all acquirers for all holding periods, except for the investors of technology acquirers of technology firms holding these stocks for 36 months.

(Insert Table 4 about here)

Figure 2 depicts the cumulative monthly abnormal returns for a trading strategy that takes a long position in technology acquirers of technology targets and a short position in non-technology acquirers of technology targets. The figure shows that taking a long position on technology firms when they acquire another technology target generates steadily positive abnormal returns for the three following years.

(Insert Figure 2 about here)

5.2 Rational pricing of acquirer's R&D

Table 3 reports the results of the Mishkin test. A likelihood ratio statistic shows that valuation effect of the current R&D spending of a technology acquirer is significantly smaller than the implications of the current R&D spending for future earnings. Also, a

likelihood ratio statistic shows that the valuation effect of the current earnings of a technology acquirer is significantly greater than their implications for future earnings. These results indicate that investors under-react to the positive valuation implications of the current R&D of technology acquirers of technology targets and that they over-react to short-term negative effects of these M&As to the acquirer's earnings. Therefore, theses results support our view that the positive abnormal returns for the suggested trading strategy occur, because the stock market under-prices the value of the R&D spending and consequent future cash flows of those technology firms that acquire other technology firms. These findings are consistent with the suggestions of Hirshleifer and Teoh (2003), that investors with limited attention are likely to attend to more salient, easily processed information and may miss less prominent but relevant information.

(Insert Table 5 about here)

5.3 Robustness tests

The calendar-time portfolio approach used in this study solves the dependence problem associated with event-time abnormal performance measures. However, Mitchell and Stafford (2000) lists several problems that should be addressed when using this approach. First, the regressions assume that the factor loadings are constant through time, which is unlikely since the composition of the event portfolio changes each month, which may lead to biased estimates. Second, the changing portfolio composition may introduce heteroskedasticity as the variance is related to the number of firms in the portfolio. A third concern is that the calendar-time portfolio approach weights each month equally, so that months that reflect heavy event activity are treated the same as

months with low activity. One common correction for these problems is weighted least squares. The WLS procedure allows to weight months with more acquiring firms more heavily and it deals with potential heteroskedastic residuals induced by calendar clustering (André et al. 2004). Therefore, as a robustness test we run the Carhart four-factor model using WLS. The results (not reported in tables) are qualitatively similar to those in Table 3.

6. Conclusions

[To be done]

References

Aboody, D., and B. Lev. 2000. Information Asymmetry, R&D, and Insider Gains. *Journal of Finance* 55 (6): 2747-2766.

Agrawal, A., J. Jaffe, and G. Mandelker. 1992. The Post-Merger Performance of Acquiring Firms: A Re-Examination of an Anomaly. *Journal of Finance* 47 (4): 1605-1621.

André, P., M. Kooli, and J.-F. L'Her. 2004. The long-run performance of mergers and acquisitions: Evidence from the Canadian stock market. *Financial Management* 33 (4): 27-43.

Barber, B. M., and J. D. Lyon. 1997. Detecting long run abnormal stock returns: The empirical power and specification of test statistics. *Journal of Financial Economics* 43 (3): 341-372.

Chan, L. K. C., J. Lakonishok, and T. Sougiannis. 2001. The stock market valuation of research and development expenditures. *Journal of Finance* 56 (6): 2431-2456.

Daniel, K., and S. Titman. 2006. Market reactions to tangible and intangible information. *Journal of Finance* 61 (4): 1605-1643.

Dessyllas, P., and A. Hughes. 2005. R&D and patenting activity and the propensity to acquire in high technology industries.

Eberhart, A. C., W. F. Maxwell, and A. R. Siddique. 2004. An Examination of Long-Term Abnormal Stock Returns and Operating Performance Following R&D Increases. *Journal of Finance* 59 (2): 623-650.

Fama, E. F. 1970. Efficient capital markets: A review of theory and empirical work. *Journal of Finance* 25 (2): 383-417.

Fama, E. F. 1998. Market efficiency, long-term returns, and behavioral finance. *Journal of Financial Economics* 49 (3): 283-306.

Higgins, M., and D. Rodriguez. 2006. The outsourcing of R&D through acquisitions in the pharmaceutical industry. *Journal of Financial Economics* 80: 351-383.

Hirshleifer, D., and S. H. Teoh. 2003. Limited attention, information disclosure, and financial reporting. *Journal of Accounting and Economics* 36 (1-3): 337-386.

Kothari, S. P., T. E. Laguerre, and A. J. Leone. 2002. Capitalization versus expensing: Evidence on the uncertainty of future earnings from capital expenditures versus R&D outlays. *Review of Accounting Studies* 7 (4): 355-382.

Kothari, S. P., and J. B. Warner. 1997. Measuring long-horizon security price performance. *Journal of Financial Economics* 43 (3): 301-339.

Mishkin, F. S. 1983. *A Rational Expectations Approach to Macroeconometrics: Testing Policy Effectiveness and Efficient Markets Models*. Chicago, IL: University of Chicago Press for the National Bureau of Economic Research.

Mitchell, M. L., and E. Stafford. 2000. Managerial decisions and long-term stock price performance. *Journal of Business* 73 (3): 287-329.

Morck, R., and B. Yeung. 2003. Why Firms Diversify: Internalization vs Agency Behaviour. In *Intangible Assets - Values, Measures, and Risks*, ed. J. Hand and B. Lev. New York: Oxford University Press.

Oler, D. 2008. Does acquirer cash level predict post-acquisition returns? *Review of Accounting Studies* (In Press).

Table 1

Distribution of M&As over the sample period.

Year	Type of M&A			All
	Technology acquirers of technology targets	Technology acquirers of non-technology targets	Non-technology acquirers of technology targets	
1992	63	10	8	81
1993	87	28	9	124
1994	123	25	7	155
1995	140	24	9	173
1996	130	14	11	155
1997	201	46	21	268
1998	224	31	28	283
1999	282	41	24	347
2000	273	52	21	346
2001	191	30	14	235
2002	153	14	9	176
2003	156	12	16	184
2004	191	30	13	234
Total	2214	357	190	2761

Notes:

Following e.g. Dessyllas and Hughes (2005), technology-intensive industries are defined according to the OECD two-digit SIC code classification. Only acquirers with available return, R&D spending, Book-to-Market, market capitalization, and sales information are included and only those M&As where target firm's sales information is available.

Table 2

Variable	Mean	Median	Std. Deviation	N
Panel A: Technology acquirers of technology targets				
Book-to-market	0.351	0.286	0.855	2214
Market capitalization	10,890	871	37,753	2214
R&D-to-sales	0.389	0.070	7.627	2214
Net sales	4,039	339	12,300	2214
Panel B: Technology acquirers of non-technology targets				
Book-to-market	0.398	0.325	0.482	357
Market capitalization	9,136	982	40,094	357
R&D-to-sales	1.278	0.028	17.971	357
Net sales	4,297	815	11,706	357
Panel C: Non-technology acquirers of technology targets				
Book-to-market	0.758	0.336	5.060	190
Market capitalization	5,238	111	9,994	190
R&D-to-sales	0.074	0.024	0.299	190
Net sales	2,800	939	4,881	190

Notes:
The variables book-to-market, market capitalization, R&D-to-sales, and net sales are measured as of the beginning of the M&A year. Market capitalization and net sales are in millions.

Table 3

Acquirers' monthly calendar-time abnormal stock returns on a trading strategy that takes a long-position on technology acquirers of technology targets for months [1,12], [1,24] and [1,36] after the M&A completion date

Holding period	Intercept	*b*	*s*	*h*	*m*
Panel A: Technology acquirers of technology targets					
[1,12]	**0.590**	**1.167**	**0.792**	**–0.188**	**–0.375**
	(0.004)	**(0.000)**	**(0.000)**	**(0.028)**	**(0.000)**
[1,24]	**0.576**	**1.146**	**0.793**	–0.116	**–0.403**
	(0.005)	**(0.000)**	**(0.000)**	(0.150)	**(0.000)**
[1,36]	**0.913**	**1.097**	**0.779**	–0.084	**–0.378**
	(0.000)	**(0.000)**	**(0.000)**	(0.268)	**(0.000)**
Panel B: Technology acquirers of non-technology targets					
[1,12]	–0.217	**1.110**	**0.554**	**0.297**	**–0.383**
	(0.497)	**(0.000)**	**(0.000)**	**(0.016)**	**(0.000)**
[1,24]	–0.136	**1.077**	**0.520**	**0.297**	**–0.348**
	(0.538)	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**
[1,36]	0.345	**1.030**	**0.554**	**0.281**	**–0.371**
	(0.132)	**(0.000)**	**(0.000)**	**(0.005)**	**(0.000)**
Panel C: Non-technology acquirers of technology targets					
[1,12]	0.129	**1.149**	**0.608**	**0.408**	**–0.229**
	(0.734)	**(0.000)**	**(0.000)**	**(0.001)**	**(0.041)**
[1,24]	–0.359	**1.145**	**0.646**	**0.521**	**–0.251**
	(0.213)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**
[1,36]	–0.027	**1.146**	**0.643**	**0.565**	**–0.237**
	(0.909)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**

Table 4

Calendar-time size and B/M adjusted abnormal portfolio returns

Holding period	Mean	Median	Std	t-value	N
Panel A: Technology acquirers of technology targets					
[1,12]	–0.124	–0.124	1.931	–0.83	167
[1,24]	–0.196	–0.080	1.679	–1.56	179
[1,36]	0.103	0.022	0.666	2.11	189
Panel B: Technology acquirers of non-technology targets					
[1,12]	–0.684	–0.877	3.537	–2.50	167
[1,24]	–0.522	–0.192	2.746	–2.54	179
[1,36]	–0.251	–0.189	2.496	–1.38	189
Panel C: Non-technology acquirers of technology targets					
[1,12]	–0.370	–0.258	6.639	–0.72	166
[1,24]	–0.163	–0.163	5.701	–1.98	178
[1,36]	–0.379	–0.017	3.317	–1.57	189

Table 5

Results on the Mishkin (1983) test of the market pricing of R&D spending with respect to its implications for post-M&A earnings

Panel A: Technology acquirers of technology targets

Forecasting coefficients			*Valuation coefficients*		
Parameter	*Estimate*	*Asymptotic Std. Error*	*Parameter*	*Estimate*	*Asymptotic Std. Error*
γ_1	0.589	0.021	γ^*_1	1.042	0.821
γ_2	0.011	0.070	γ^*_2	–7.573	7.179

Tests of rational pricing of R&D spending

Null hypotheses	*Likelihood Ratio Statistic*	*Marginal Significance Level*
EARN: $\gamma^*_1 = \gamma_1$	0.56	0.455
RD: $\gamma^*_2 = \gamma_2$	**10.88**	**0.001**

Panel B: Technology acquirers of non-technology targets

Forecasting coefficients			*Valuation coefficients*		
Parameter	*Estimate*	*Asymptotic Std. Error*	*Parameter*	*Estimate*	*Asymptotic Std. Error*
γ_1	0.387	0.055	γ^*_1	–10.827	75.521
γ_2	0.481	0.270	γ^*_2	23.590	157.600

Tests of rational pricing of R&D spending

Null hypotheses	*Likelihood Ratio Statistic*	*Marginal Significance Level*
EARN: $\gamma^*_1 = \gamma_1$	4.05	0.044
RD: $\gamma^*_2 = \gamma_2$	0.72	0.398

Panel C: Non-technology acquirers of technology targets t

Forecasting coefficients			*Valuation coefficients*		
Parameter	*Estimate*	*Asymptotic Std. Error*	*Parameter*	*Estimate*	*Asymptotic Std. Error*
γ_1	0.862	0.120	γ^*_1	–3.463	27.904
γ_2	–0.612	0.246	γ^*_2	10.908	73.119

Tests of rational pricing of R&D spending

Null hypotheses	*Likelihood Ratio Statistic*	*Marginal Significance Level*
EARN: $\gamma^*_1 = \gamma_1$	0.30	0.584
RD: $\gamma^*_2 = \gamma_2$	0.50	0.478

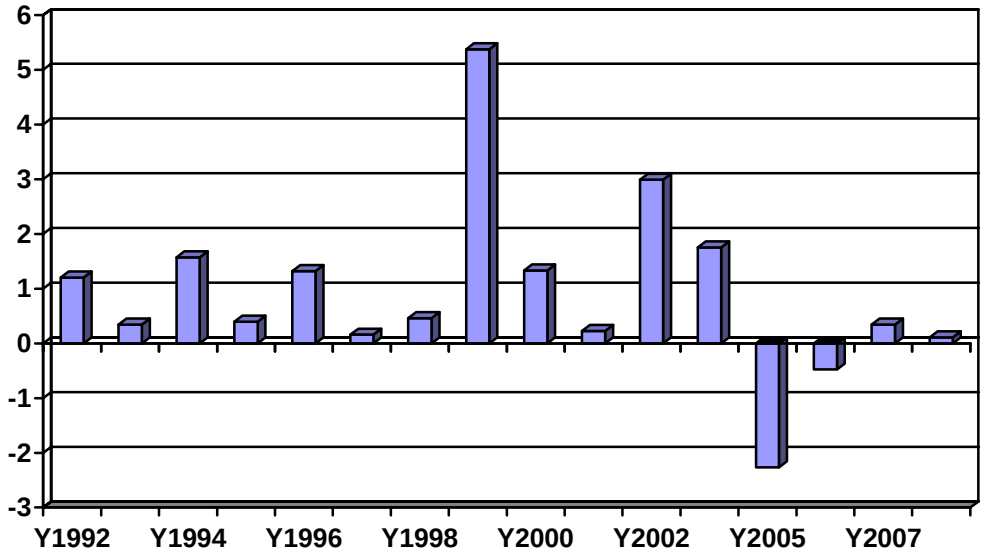

Figure 1. Annual BM and size adjusted returns over the sample period on trading strategy that takes a long position on *technology acquirers of technology targets*.

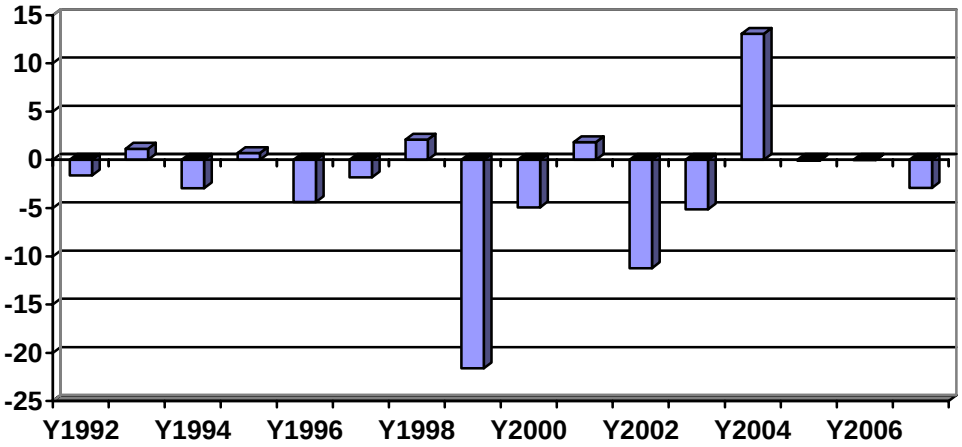

Figure 2. Annual BM and size adjusted returns over the sample period on trading strategy that takes a long position on *technology acquirers of non-technology targets*.

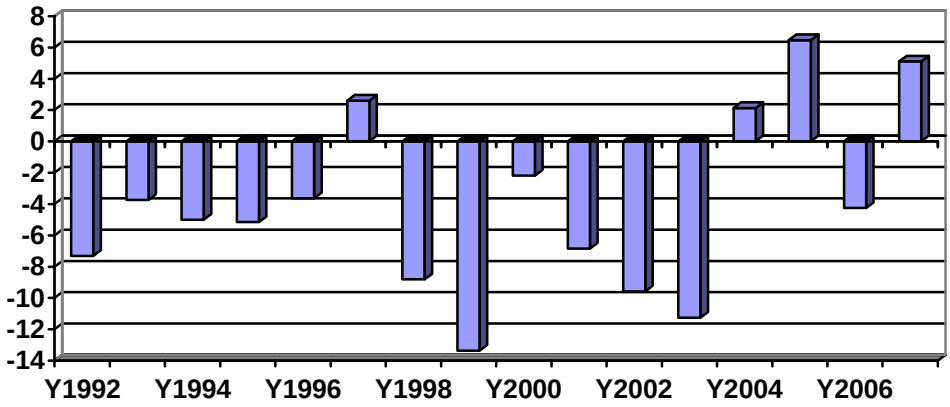

Figure 3. Annual BM and size adjusted returns over the sample period on trading strategy that takes a long position on *non-technology acquirers of technology targets*.

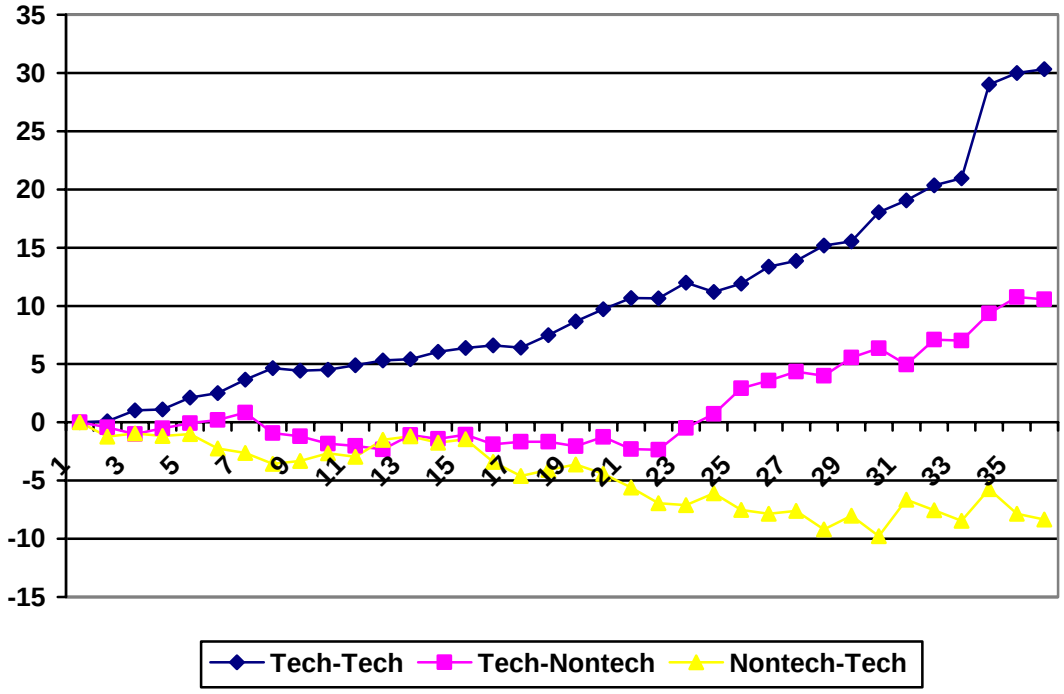

Figure 4. Cumulative event-time monthly abnormal stock returns for technology acquirers of technology targets, technology acquirers of non-technology targets and non-technology acquirers of technology targets for a 36-month period after the M&A announcement day.