Does acquirer R&D level predict post-acquisition returns?

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Abstract: This paper investigates whether acquirer's pre-acquisition R&D intensity is associated with the long-term performance of M&As. We argue that the stock market underreacts to the gains arising from the acquired R&D in technology M&As, and over-reacts to the direct costs associated with such M&As. Consistent with this hypothesis, we find significantly positive Carhart (1999) four-factor model abnormal stock returns the period following M&As where a technology firm acquires another technology firm. 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.

JEL Classification: M40

Keywords: R&D, profitability, stock market valuation, mergers and acquisitions

1. Introduction

Contradicting the efficient market hypothesis, some studies have reported that stock prices adjust with a delay to the publicly available information on the intangible assets of the firm (e.g. Chan, Lakonishok, and Sougiannis, (2001); Daniel and Titman, (2006); Eberhart, Maxwell, and Siddique, (2004). For instance, Daniel and Titman (2006) argue that investors misreact to the information on the intangible assets of the firm, while Hirshleifer and Teoh (2003) argue that investors are likely to attend to more salient, easily processed information and miss less prominent information.

The empirical R&D literature has evidenced two important phenomena associated with R&D: R&D contributes to information asymmetry, and R&D-intensive firms are often undervalued by investors (Guo et al., 2006). Chan, Lakonishok, and Sougiannis (2001) suggest that, due to the uncertainty of the future benefits from the research and development expenditures of the firm (hereafter, R&D), stock prices may not fully incorporate the value of a firm's R&D. Consistently, Aboody and Lev (2000) identify R&D as a major contributor to information asymmetry. The investor undervaluation of R&D-intensive companies is supported by studies that examine the association between

R&D investment and subsequent stock returns. For instance, 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.

In this paper, we investigate whether the information asymmetry and investor undervaluation of R&D is associated with long-term performance of technology mergers and acquisitions (hereafter M&As). Prior literature find M&As to generally generate negative returns to acquirer shareholders (e.g. Agrawal et al., 1992; Mitchell and Stafford, 2000; Oler, 2008). There are, however, numerous motives for M&As, some of which may generate value for the acquirer shareholders. In technology-incentive industries, M&As are often aimed to enhance the acquiring firm's R&D operations, because technology firms need to continuously seek to access other technologies in order to supplement their technology dependent operations. Consequently, 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).

Based on the arguments above we argue that technology-driven M&As generate future cash flows and value for the acquirer but investors do not recognize this at the time of the M&A, because of the information asymmetry and undervaluation associated with the main value driver, R&D. Therefore, we are expecting acquirer shareholders to earn significantly positive long-term returns after the M&A, when the cash flows generated by the M&A are starting to realize. We argue that this investor misreaction occurs because of the failure of investors to recognize the gains arising from R&D and because investors may expect negative stock price behavior for the acquirer from any kind of M&A due to the M&As' general inability to generate value for acquirer

shareholders. The stock price of the acquirer in technology M&A may 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. Therefore, investors may fail to fully recognize the gains arising from R&D in technology M&As, causing the acquirer's investors to over-react to the negative aspects of the announced technology-driven M&A and underreact to its positive value-increasing outcomes.

We contribute to literature in following aspects. First, we identify R&D activities as factor underlying investor misreaction and anomalies associated with M&As. Therefore, we extend the previous research by showing that acquirer's R&D intensity is a significant determinant of investor misreaction and positive long-term abnormal returns after technology M&As. These findings also 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). Specifically, we show that an investor can benefit from the market underreaction associated with the future cash flows that technology M&As generate.

Consistent with our hypothesis, we find significantly positive Carhart (1999) four-factor model abnormal stock returns for 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. In addition, we show that acquirer's pre-M&A R&D level is significantly associated with the long-term positive abnormal returns when both the acquirer and the target firm are technology firms. These findings corroborate the hypothesis that R&D activities lead to technology M&A underreaction.

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, some studies have reported that the stock market does not respond completely to the information on the intangible assets of the firms such as 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, they argue that it is likely that R&D contributes to information asymmetry between corporate

insiders and outside investors. 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. The market is less knowledgeable about high-tech M&As than about other deals (Luo, 2005).

We build on these arguments and argue that because of 1) the uncertainty and information asymmetry associated with R&D and 2) the market's general negative

expectations towards M&As, the stock market does not recognize the future benefits associated with technology M&As. Specifically, we argue that the stock market does not recognize the consequent future cash flows generated through technology M&As. However, when these cash flows start to realize, the market corrects its perceptions of the value generated through the M&A, causing acquirer's stock price to increase. Therefore, we expect the positive long-term abnormal returns, because the stock market underprices the value of the R&D spending and consequent future cash flows.

There are, however, M&As where only the acquirer or the target are technology firms. Higgins and Rodriguez (2006) report that value gains arise in technology M&As because the acquiring and target firms can create technology-specific synergies by improving and supplementing the acquirer's R&D activities. Therefore, both the acquirer and the target firm should be technology firms for the M&A to generate value through R&D activities.

Following these arguments, we expect technology M&As to generate positive long-term abnormal returns and form the following hypotheses:

Hypothesis 1a: M&As with a technology acquirer and a technology target lead to positive long-term abnormal returns.

Hypothesis 1b: M&As with only a technology acquirer or only a technology target do not lead to positive long-term abnormal returns.

Prior literature shows that future benefits associated with technology M&As are generated through enhancing acquiring firm's R&D activities. Many studies report that the main motivation for technology M&As is to enhance and improve acquiring firm's existing R&D base. Consistently, Kallunki, Pyykkö and Laamanen (2009) show that

technology M&As increase acquirer's R&D activities' ability to generate future profitability. Based on these findings, we expect that the underlying factor causing market misreaction to the benefits from technology M&As and leading to positive long-term abnormal stock returns, is acquirer's pre-M&A R&D level. Therefore, we form the following hypothesis:

Hypothesis 2: The pre-M&A R&D level of a technology firm that acquires another technology firm causes positive long-term abnormal stock 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 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.

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

(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. Technology targets of technology firms are also larger than targets in other two groups and the transactions in the main group are also more often mergers of equals rather than acquisitions.

4. Methodology

4.1 Abnormal stock returns

Long-term performance in any investment strategy can be measured by using either a calendar-time 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. On the other hand, Barber and Lyon (1997) suggest that the event-time approach precisely measures investors' experience. Therefore, we use both approaches when assessing the profitability of the suggested trading-strategy.

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 of 14 years. 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_{pt} 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, i.e. the mean calendar-time abnormal returns (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}):

$$CTAR_{it} = R_t - R_{pt} \quad (2)$$

[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).

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. The mean monthly abnormal return (*MCTAR*) is:

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

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 all NYSE, AMEX and NASDAQ firms' 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 effect of acquirer's pre-M&A R&D level on the M&A underreaction

If an item is associated with future positive returns, the item is mispriced. Therefore, in order to test whether acquirer's pre-M&A R&D level is associated with the mispricing of the benefits from the M&A, we need to assess the rational pricing of acquirer's R&D. Mishkin's (1983) test is widely used to test the rational pricing of accounting numbers. The Mishkin test provides a statistical comparison between a

measure of the market's pricing of R&D expenditures (i.e. the market's valuation coefficient) and a measure of R&D expenditures' association with one-year-ahead earnings (i.e. the forecasting coefficient) using the following regression system with an iterative generalized non-linear least squares estimation procedure:

$$EARN_{it+1} = \gamma_0 + \gamma_1 EARN_{it} + \gamma_2 RD_{it} + \upsilon_{t+1}, \quad (5)$$

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

where $EARN_{it}$ is the net income before R&D expenditures for acquirer i in the M&A year t deflated by net sales; RD_{it} is the research and development expenditures for acquirer i in the M&A year t deflated by net sales; and SAR_{it+1} is the annual size adjusted stock return for acquirer i in the year following the M&A year t. If the valuation coefficient is significantly smaller than the forecasting coefficient, then investors underprice the accounting information.

Kraft, Leone and Wasley (2007) point out that the Mishkin test is designed for testing the market efficiency hypothesis in general, but not for specific variables in forecasting equation.[3] Therefore, the Mishkin test can be used to reject the market efficiency hypothesis, but one cannot draw inferences about which accounting variables are the source of the inefficiency. Kraft et al. (2007) demonstrate that in accounting research settings (where samples are large) the Mishkin test is asymptotically equivalent to OLS when testing the rational pricing of accounting numbers. Therefore, they suggest

[3] More precisely, one can test whether the market is efficient with respect to earnings forecasts even if there are omitted variables, but one cannot test whether the market is efficient with respect to specific variables in the forecasting equation if the variables omitted from the forecasting equation are not rationally prices and they are also correlated with the variables of interest in the forecasting equation (Kraft et al., 2007).

the use of OLS, which offers several advantages such as the elimination of survivorship bias induced by the Mishkin test where earnings in year *t+1* are required.

Following Kraft et al. (2007), we use the following regression in addition to direct Mishkin test in order to test whether acquirer's pre-M&A R&D after the technology M&A is positively related to the future earnings of the firm:

$$SAR_{it+1} = \phi_0 + \phi_1 EARN_{it} + \phi_2 RD_{it} + \omega_{it}, \tag{7}$$

where all variables are as defined above. In Model (7), the rational pricing of the RD and earnings of the firm can be inferred by testing $\phi_1 = 0$ and $\phi_2 = 0$. If a coefficient is significantly different from zero, the null hypothesis of the rational pricing of the accounting item is rejected. A significantly positive parameter estimate would show that past accounting information is initially underpriced and therefore reflected in future returns.

In order to analyze the rational pricing of R&D separately for technology acquirers of technology targets, we include dummy variables in Model (7) as follows:

$$\begin{aligned} SAR_{it+1} = {} & \phi_0 EARN_{it} + \phi_1 RD_{it} + \phi_2 HIHI_{it} \\ & + \phi_3 HIHI_{it} \times EARN_{it} + \phi_4 HIHI_{it} \times R\&D_{it} + \omega_{it}. \end{aligned} \tag{8}$$

where all variables are as defined earlier.

5. Empirical results

5.1 Post-acquisition abnormal returns

We begin our empirical analyses by examining whether M&As where a technology firm acquires another technology firms lead to positive long-term abnormal stock returns for acquirer investors due to the stock market's failure to immediately recognize the gains arising from these transactions. Figure (1a) depicts the annual size and book-to-market adjusted returns for technology acquirers of technology firms. Abnormal returns are mostly positive and there are no price reversals indicating that positive returns do not result from the high risk of the strategy. For the sake of comparison, we also report the returns for acquisitions where only bidder or target are technology firms. Figures (1b) and (1c) report the abnormal returns for technology acquirers of technology firms and non-technology acquirers of technology firms, respectively. In Figure (1b) the returns are highly volatile and mostly negative. Returns in Figure (1c) 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 Figures 1a, 1b and 1c about here)

Table 3 reports the results regression estimates from the Carhart four-factor model for the three M&A subsamples. 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 positive long-term abnormal returns do occur after a technology firm acquires

another technology firm. 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 insignificant. These results are consistent with the Hypotheses 1a and 1b, confirming that the stock market does not recognize future benefits that technology M&As generate, leading to positive long-term abnormal returns for technology acquirers of technology firms.

(Insert Table 3 about here)

The results from using calendar-time abnormal returns are reported in Table 4. These results report negative or insignificant abnormal returns for all acquirers in all holding periods, except for technology acquirers of technology firms. Consistent with Hypothesis 1a, technology M&As are followed by positive long-term abnormal acquirer returns in a three-year period.

(Insert Table 4 about here)

5.2 Rational pricing of acquirer's R&D

Table 5 reports the results of testing the effect of M&As on the rational pricing of acquirer's R&D spending. For brevity, we report only the results of estimating Model (8), although the results from the Mishkin test (Models 6 and 7) are qualitatively similar. The results reported Table (5) show that the parameter estimates for the interaction variable $HIHI_{it} \times R\&D_{it}$ by using future abnormal returns of different time-

periods as a dependent variable are all significantly positive. This result indicates that that acquirer's current R&D spending is positively related to future abnormal returns for technology firms acquiring other technology firms, i.e. R&D spending is underpriced in the market for these firms. No such under-pricing is observed for other types of M&As. Therefore, consistent with Hypothesis 2, these results support our view that the investor underreaction and positive long-term abnormal returns occur because the stock market fails to recognize the future cash flows that acquirer's R&D activities, improved by technology M&A, generate. These findings are consistent with Hirshleifer and Teoh (2003) who suggest 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

The past decades have witnessed a significant number of mergers and acquisitions aimed to enhance the acquiring firm's R&D operations. However, the stock market is unlikely to recognize the full extent of the gains arising from R&D in technology M&As because of 1) the information asymmetry and the uncertainty of future benefits associated with R&D and 2) the negative sentiment of the stock market towards M&As in general. 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 our expectations, we find positive long-term abnormal returns for technology firms that acquired other technology firms. 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. This interpretation is corroborated with our second finding that acquirer's pre-M&A R&D level is positively associated with the long-term acquirer returns, indicating that R&D is an important factor causing market underreaction to the future benefits from technology M&As.

Our findings have important implications for both the accounting and finance literature investigating the information asymmetries related to R&D as well as the merger and acquisition literature investigating the economic benefits from these transactions. Particularly, we show that technology M&As are beneficial for acquiring firms in the long run. One of the most important sources for these benefits is the R&D, which the market recognizes with a delay.

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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	33	6	5	
1993	36	11	5	
1994	58	9	6	
1995	87	10	9	
1996	96	10	7	
1997	161	32	17	
1998	157	23	15	
1999	195	29	16	
2000	189	37	13	
2001	134	23	9	
2002	109	11	6	
2003	124	7	15	
2004	124	21	10	
Total	1503	226	133	1862

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
Panel A: Technology acquirers of technology targets (N=1503)			
Book-to-market	0.391	0.300	0.355
Market capitalization	5,321	661	19,747
R&D-to-sales	0.190	0.069	1.144
Relative size	0.554	0.120	5.676
Merger	0.577	1.000	0.494
Domestic	0.823	1.000	0.382
Panel B: Technology acquirers of non-technology targets (N=226)			
Book-to-market	0.466	0.362	0.470
Market capitalization	4,805	788	12,681
R&D-to-sales	0.074	0.027	0.163
Relative size	0.382	0.123	0.791
Merger	0.451	0.000	0.499
Domestic	0.779	1.000	0.416
Panel C: Non-technology acquirers of technology targets (N=133)			
Book-to-market	0.405	0.380	0.239
Market capitalization	3,809	817	8,197
R&D-to-sales	0.072	0.020	0.288
Relative size	0.289	0.063	0.545
Merger	0.421	0.000	0.496
Domestic	0.729	1.000	0.446

Notes:
The variables book-to-market, market capitalization (in millions), 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*	Adj R^2
Panel A: Technology acquirers of technology targets						
[1,12]	**0.474**	**1.248**	**0.830**	–0.095	**–0.355**	0.893
	(0.029)	**(0.000)**	**(0.000)**	(0.285)	**(0.000)**	
[1,24]	**0.402**	**1.209**	**0.800**	–0.035	**–0.380**	0.887
	(0.049)	**(0.000)**	**(0.000)**	(0.655)	**(0.000)**	
[1,36]	**0.709**	**1.149**	**0.790**	–0.018	**–0.388**	0.854
	(0.002)	**(0.000)**	**(0.000)**	(0.824)	**(0.000)**	
Panel B: Technology acquirers of non-technology targets						
[1,12]	–0.410	**1.215**	**0.513**	**0.413**	**–0.417**	0.666
	(0.231)	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	
[1,24]	–0.115	**1.166**	**0.465**	**0.395**	**–0.377**	0.761
	(0.640)	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	
[1,36]	0.300	**1.096**	**0.503**	**0.355**	**–0.378**	0.669
	(0.254)	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	
Panel C: Non-technology acquirers of technology targets						
[1,12]	–0.017	**1.195**	**0.713**	**0.703**	–0.053	0.533
	(0.962)	**(0.000)**	**(0.000)**	**(0.001)**	(0.539)	
[1,24]	–0.013	**1.112**	**0.773**	**0.701**	**–0.240**	0.651
	(0.965)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	
[1,36]	0.082	**1.159**	**0.732**	**0.666**	**–0.198**	0.678
	(0.741)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.002)**	

Table 4

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

Holding period	Mean	Median	Std	p-value	N
Panel A: Technology acquirers of technology targets					
[1,12]	–0.031	–0.012	1.900	0.865	166
[1,24]	–0.083	–0.090	1.494	0.459	178
[1,36]	**0.101**	**0.089**	**0.810**	**0.029**	**190**
Panel B: Technology acquirers of non-technology targets					
[1,12]	**–0.625**	**–0.419**	**4.027**	**0.047**	**166**
[1,24]	–0.332	–0.032	3.170	0.164	178
[1,36]	0.101	0.145	3.167	0.660	190
Panel C: Non-technology acquirers of technology targets					
[1,12]	0.103	–0.087	5.371	0.808	161
[1,24]	–0.065	–0.009	4.129	0.834	173
[1,36]	0.083	0.217	3.740	0.763	185

Table 5

Test of the market pricing of R&D spending with respect to its implications for post-M&A returns

Dependent variable Variable	(1) SAR_{t+1}	(2) $SAR_{t+1,2}$	(3) $SAR_{t+1,3}$
Intercept	–0.160	–0.368	–0.492
	(0.000)	(0.000)	(0.000)
$HIHI_{it}$	–0.009	–0.022	–0.132
	(0.844)	(0.718)	(0.158)
$EARN_{it}$	–0.155	–0.043	0.039
	(0.003)	(0.543)	(0.531)
RD_{it}	–0.346	–0.386	–0.602
	(0.064)	(0.130)	(0.008)
$HIHI_{it} \times EARN_{it}$	0.205	0.098	0.017
	(0.000)	(0.185)	(0.797)
$HIHI_{it} \times R\&D_{it}$	**0.457**	**0.485**	**0.673**
	(0.017)	**(0.063)**	**(0.004)**
N	1751	1751	1751
Adj R^2	0.009	0.004	0.017

Notes:
The dependent variable is size and book-to-market adjusted return after the M&A year t. $HIHI_{it}$ indicates that both the acquirer and the target are technology firms $EARN_{it}$ is the net income before R&D expenditures of acquirer i in year t deflated by net sales; and $R\&D_{it}$ is the research and development expenditures of acquirer i in year t deflated by net sales; $SALES_{it}$ is the net sales of acquirer i in year t. P-values are reported in parentheses with 0.000 denoting a p-value of less than 0.0005. N is the number of observations used in the estimations.

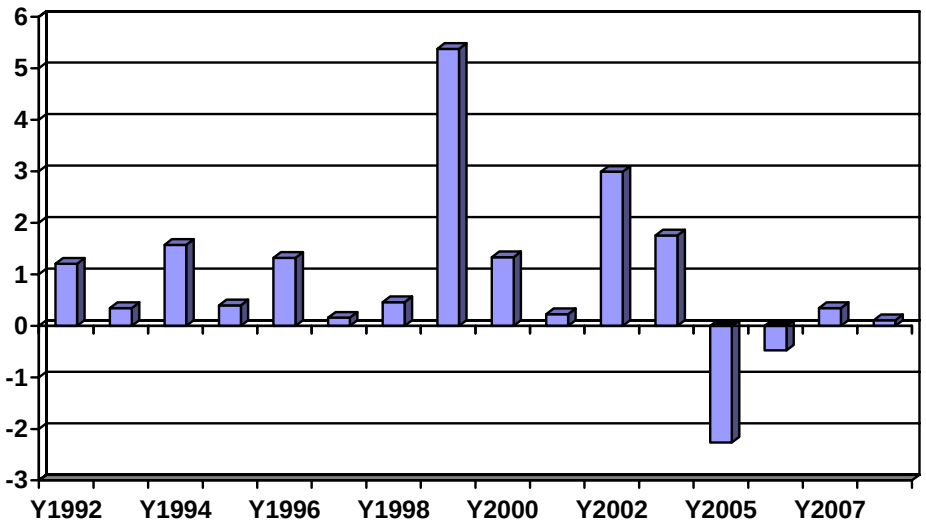

Figure 1a. Annual BM and size adjusted returns over the sample period for *technology acquirers of technology targets*.

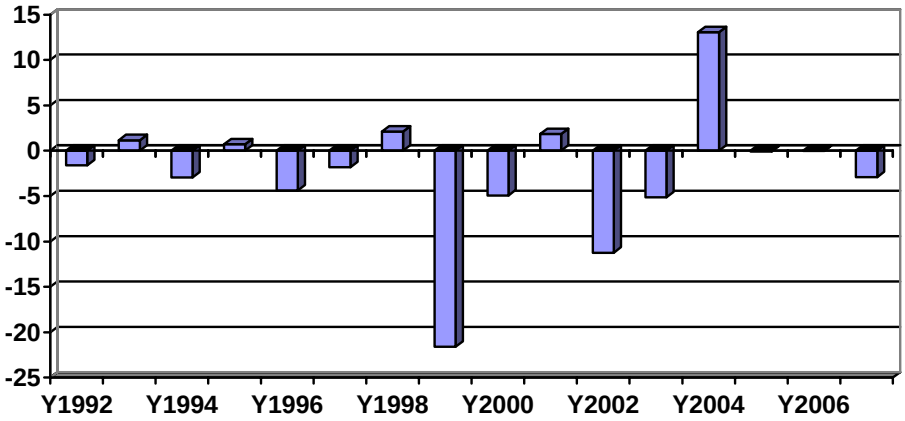

Figure 1b. Annual BM and size adjusted returns over the sample period for *technology acquirers of non-technology targets*.

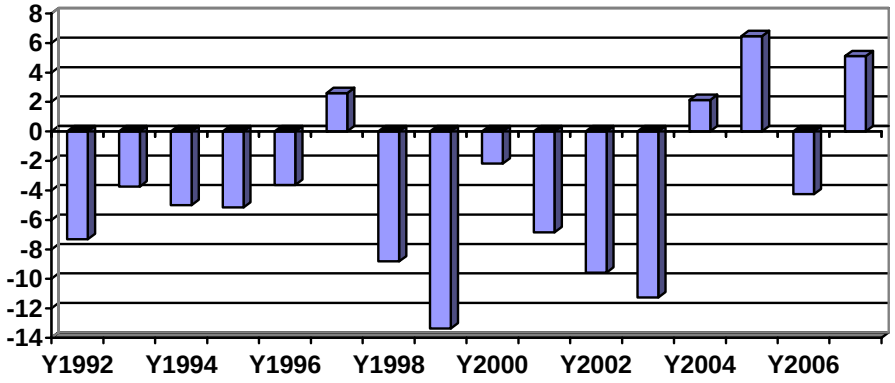

Figure 1c Annual BM and size adjusted returns over the sample period for *non-technology acquirers of technology targets*.