Strategic Management Journal
Strat. Mgmt. J., **21**: 707–722 (2000)

THE INFLUENCE OF VOLUNTARILY DISCLOSED QUALITATIVE INFORMATION

V. K. NARAYANAN[1]*, GEORGE E. PINCHES[2], KATHRYN M. KELM[3] and DIANE M. LANDER[4]
[1]*School of Business, University of Kansas, Lawrence, Kansas, U.S.A.*
[2]*Bloch School of Business and Public Administration, University of Missouri–Kansas City, Kansas City, Missouri, U.S.A.*
[3]*School of Business, Emporia State University, Emporia, Kansas, U.S.A.*
[4]*School of Management, Babson College, Babson Park, Massachusetts, U.S.A.*

We examine the voluntary disclosure of qualitative information about actions involving governmental agencies and managerial intentions or beliefs in R&D project announcements in The Wall Street Journal. Our analysis indicates that information regarding government approval and managerial intentions/beliefs voluntarily disclosed in R&D project announcements interacts with industry/firm variables to provide significant incremental explanatory power in both the innovation and commercialization stages of R&D projects. Our data also indicate that the biggest impact is from managerial intentions, especially an intent to increase market share when coupled with being a larger firm. Copyright © 2000 John Wiley & Sons, Ltd.

INTRODUCTION

Firms typically try to manage the information disclosed to investors. This information may be in the form of announcements of quarterly earnings, reorganizations or strategy changes initiated by the firm, or discussions with financial analysts. In addition to these formal announcements, firms also make other announcements containing various types of *qualitative* or *non-financial information* that may have economic import. The voluntary disclosure of qualitative information may also be a component of an investor communications strategy of firms, as advocated by major consulting firms (Copeland, Koller and Murrin, 1994; Ernst & Young, 1994). Indeed, case histories of successful investor communications efforts to shape market expectations during periods of strategic change have been reported in the case of Florida Power and Light (Soter, Brigham and Evanson, 1996) and CUC International, Inc. (Healy and Palepu, 1995). There is also emerging evidence that qualitative information pertaining to market growth and market penetration (Amir and Lev, 1996) and patents (Hirschey, Richardson and Scholz, 1998) may have relevance for firm valuation.

We examine qualitative non-financial information voluntarily disclosed in research and development (R&D) project announcements. Our focus is on the R&D context for two reasons. First, there has been no attempt to analyze the influence of the voluntary disclosure of qualitative information on the stock market impact of R&D announcements. Second, such qualitative information is likely to be more important in assisting investors in evaluating the wealth effects of R&D project announcements than in the case of announcements that are frequently examined in the literature such as earnings, dividends, financing decisions, or mergers. Unlike the latter, where the events and/or outlays can be presented in specific monetary terms, announcements of R&D projects are likely to be *ambiguous in terms of their economic impact*. The outcomes of R&D efforts are inherently uncertain, and the time

Key words: asymmetric information; research and development; strategy; voluntary disclosure
* Correspondence to: V. K. Narayanan, School of Business, University of Kansas, Summerfield Hall, Lawrence, KS, 66045-2003, U.S.A.

Received 8 May 1997
Final revision received 24 January 2000

period between initiation and significant results may be long (Lev, 1999; Pinches, Narayanan and Kelm, 1996; Cockburn and Henderson, 1995; Helfat, 1994; Reinganum, 1989). In such situations, managers may have a better grasp of the technical feasibility and/or commercial significance of the project than investors. Hence, investors may pay closer attention to the information voluntarily disclosed in R&D announcements.

We focus on qualitative information pertaining to the *actions involving government agencies and managerial intentions/beliefs* most frequently disclosed in R&D project announcements. The scheme of the paper is as follows. First, we provide the theoretical background linking information asymmetry, types of qualitative information, and wealth creation during the innovation and commercialization stages of R&D projects. This leads to hypotheses about the contribution of qualitative information to the stock market impact of R&D announcements. Second, we discuss the data and methods used. Third, we present the analysis and results. We conclude with a discussion of the findings and implications.

THEORETICAL BACKGROUND

Information asymmetry

The theoretical and empirical literature (Ambarish, John and Williams, 1987; Korajczyk, Lucas and McDonald, 1991; Miller and Rock, 1985; Myers and Majluf, 1984; Ross, 1977; Thakor, 1993) suggests there is significant *information asymmetry* between outside investors and inside managers. Managers who have detailed knowledge of the firm's operations may reduce this asymmetry by *voluntarily disclosing* qualitative nonfinancial information (in addition to either mandated disclosures or other actions by the firms) to investors in an attempt to influence their decisions about the value of the firm. The voluntarily disclosed qualitative information may reduce information asymmetry between managers and investors when it is (1) *credible* and (2) *economically significant*. Credibility and the economic significance of information depend on two sets of factors: the type of qualitative information and the context of the announcement.

Types of qualitative information

In this paper, we focus on six qualitative information characteristics voluntarily disclosed most frequently in R&D project announcements.[1] The six characteristics can be grouped into two types: (1) *actions related to government agencies* and (2) *managerial intentions or beliefs*. Actions related to governmental agencies are captured by government approval or the mention of patents. On the other hand, managerial intentions or beliefs are indicated by (a) a goal of product substitution (a technical goal), (b) the intention to increase market share, (c) a growing market mentioned (a belief), or (d) a diversification goal. Examples of this qualitative information are as follows.

Actions related to governmental agencies

Government approval. A new ceramic material for dental crowns was announced … by Adolph Coors Co. … Even though the new ceramic is dental material, Coors voluntarily submitted test data to the U.S. Food and Drug Administration for approval before marketing, a Coors spokesman said. (*WSJ*, 12/2/81)

Patents mentioned. University Genetics, Co., Norwalk, Conn., said it's sponsoring development of a bovine substance that …. Mr. Walton said he was reluctant to release details of the research because a patent application is being prepared. (*WSJ*, 1/13/1984)

Managerial intentions/beliefs

Goal of product substitution. Exxon U.S.A., one of the nation's leading gasoline marketers, said it will begin offering a new, improved version of its top-of-the-line 'Uniflo' motor oil next month

[1] In addition to these six characteristics, we also examined the following information disclosed in R&D project announcements: whether advertising was mentioned, and whether the firm had a previous failure of a similar product. Neither of these information characteristics was mentioned frequently enough for analysis. In addition, we undertook a detailed analysis of financial information revealed in the announcements. About 20 percent of the announcements contained relevant financial information; an analysis of the potential impact of the financial information failed to indicate any systematic impact on the findings.

that will increase auto gasoline mileage an average of 4.5%. (*WSJ*, 8/25/1977)

Intention to increase market share. By becoming the first to solve that problem, Dayco figured it could improve its also-ran status in the $150 million garden hose business, where it ranks fifth or sixth with an 8% market share. (*WSJ*, 7/30/1982)

Growing market mentioned. Minnesota Mining & Manufacturing … (will) market an ear implant device that gives totally deaf people an awareness of sounds. … There are an estimated 200,000 profoundly deaf people in the U.S. who could be candidates for cochlear implant devices …. (*WSJ*, 11/30/1984)

Diversification goal. Olin … said it will market an oral rinse to fight the symptoms of gum disease. … This is a new area for Olin, a maker of chemicals, metals, ammunition and skis, … The company doesn't sell any other health-care products …. (*WSJ*, 9/10/1985)

The types of information disclosed by managers in R&D project announcements differ in the degree to which they are readily accessible to investors. *Actions related to governmental agencies* are accessible to investors from sources other than managers. Thus, when government approval of a process or product is needed or when a firm files for a patent, this information becomes publicly available since outsiders have access to the information provided by the government agencies involved. The *intentions or beliefs* of management are not so readily accessible. For example, only management may know strategic intentions (e.g., technical goals such as product substitution, or market/strategy-related goals, such as increasing market share at the expense of competitors). Similarly, managerial beliefs about market estimates are also known only to management. Thus, managers have greater control over the extent to which information about intentions or beliefs are revealed to investors. Put another way, when disclosed, managerial intentions and beliefs may have greater potential to reduce information asymmetry than actions involving external government agencies.

A priori, we suggest that investors are likely to take into account qualitative nonfinancial information in stock price valuation, only if they are *credible* and *economically relevant*.[2] The types of information vary in terms of their *credibility* to investors. Actions related to governmental agencies such as government approval or patents typically signal the completion of major technical milestones. The validation of such accomplishments by an external agency provides high credibility in the eyes of the investors.

Actions related to government agencies, although credible, may be economically relevant only in *high-technology* industries. For example, Schwert (1981) has argued that government approval or involvement in high-technology (i.e., high R&D intensity) industries may provide artificial barriers to new entry and reduce competition, thereby creating significant value for the firm. Doukas and Switzer (1992) and Kelm, Narayanan and Pinches (1995b) provide empirical evidence substantiating that government approval influences value only in high-technology industries. Similarly, patents reflect scientific accomplishment and may contribute to the intangible assets of the firm resulting from R&D efforts *only* in high-technology industries (Griliches, 1990; Hirschey *et al*., 1998).

Unlike actions related to government agencies, managerial intentions/beliefs may not always be credible to investors since external sources of validation of the information are absent, and their meaning and implications are often difficult to interpret. Investors may judge the credibility of this type of information against the backdrop of industry/firm factors. As Joe Shamma, an electronics expert for Standard & Poor's, recently said, 'a history of R&D accomplishments is important. It lends credibility and significance to company announcements' (Gilbert, 1997: 37). For example, investors may find aggressive technology-related intentions (e.g., *product substitution*) credible only in R&D-intensive industries where the potential for creating value through innovation is likely to be higher (Cohen and Levinthal, 1990). Similarly, an aggressive intention in the form of *increasing a firm's market share* at the expense of competitors is likely to be credible only in the case of large firms

[2] In an options context, as noted by Bowman and Hurry (1993), the value of the firm is equal to the value of the assets in place and the options held by the firm. By releasing information about its R&D, or growth options, the firm is directly attempting to impact the value of the firm.

(Chaney, Devinney, and Winer, 1991) which may have the requisite capabilities already known to the investors. Further, since managers may not have greater access to market information than investors do, managerial beliefs about a growing market may not be particularly credible or relevant to investors. The value creation potential of diversification is uncertain, and hence, even when disclosed, it may not lead investors to revise their estimates of firm value.

Context of announcement: R&D project stage

The economic significance of both types of qualitative information will also depend on the *R&D project stage*. Following Kelm, Narayanan, and Pinches (1995a), we categorize the R&D process, and R&D announcements, into two stages: *innovation* and *commercialization.* Innovation refers to positive announcements[3] about the initiation or continuation of progress, while commercialization represents the culmination of the R&D process leading to new, or revised, products or processes. Examples of these two broad categories of R&D projects and the announcements made by firms are:

Innovation. Eli Lilly & Co. has announced a long term agreement under which the International Plant Research Institute will conduct plant genetic research for Lilly aimed toward improving crop yields. (*WSJ*, 6/26/1981)

Commercialization. Texas Instruments unveiled a multiuser computer system, System 1300 …. This new product, which can be used by as many as 32 people at once, fills a gap in Texas Instruments' line of multiuser systems for business. (*WSJ*, 5/18/1987)

Information asymmetry between managers and investors is likely to be more acute in the innovation stage, when R&D projects are initiated or continued, where managers may choose to withhold information from the public domain to protect the existing shareholders' interests (Bhattacharya and Ritter, 1983).

In addition, investors face different *valuation contexts* during the innovation and commercialization stages. During innovation, the critical task is arriving at technologically feasible solutions that may gain market acceptance. Both technical feasibility and market acceptance together determine the economic significance of a project (Roussel, Saad and Erickson, 1991). Technological features of the project, such as technical goals, completion of milestones (e.g., government approval), and intellectual property protection (e.g., patents), may determine the feasibility and, hence, the ensuing economic consequences of the project (Marquis, 1969; Quinn and Mueller, 1963; Contractor and Narayanan, 1990). Managerial intentions pertaining to the project such as market share (Porter, 1980) may provide clues to a firm's intended market positioning, and thus may also be economically significant. During the commercialization stage, technological concerns recede to the background, and the cash flows are more dependent on whether the firm is appropriately positioned to take advantage of the new product. Thus actions related to government agencies or product substitution goals may be significant only during innovation, whereas market share intentions may be significant in both stages. The above discussion is summarized in Table 1.

Hypotheses

Following the above discussion, we develop separate hypotheses for the innovation and commercialization stages. As summarized in Table 1, we expect mostly interaction effects.

Innovation stage. Although both government approval and patents provide credible information about the technical accomplishment of a project, their economic significance during innovation is uncertain. To examine if they have a direct influence on the stock market impact, we propose:

> *Direct Effects Hypothesis: Voluntary disclosure of actions involving government agencies is positively related to the stock price impact of R&D announcements (over and above the variance explained by industry and firm characteristics) in the innovation stage.*

Unlike actions involving government agencies, we expect no direct effects in the case of managerial intentions/beliefs, since they have dubious credibility, by themselves, to investors.

[3] As noted subsequently, firms only infrequently reveal negative information about R&D projects; consequently, we examine only positive R&D project announcements.

Table 1. Qualitative information, and impact on the value of the firm

	Influence on the stock market impact of R&D project announcement			
	Stage of announcement			
	Innovation		Commercialization	
Qualitative information	Direct	Interaction	Direct	Interaction
Actions involving government agencies				
Government approval	Uncertain	Positive in R&D-intensive industries	None	None
Patents	Uncertain	Positive in R&D-intensive industries	None	None
Managerial intentions/beliefs				
Goal of product substitution	None	Positive in R&D-intensive industries	None	None
Intention to increase market firms share	None	Positive for larger firms	None	Positive for larger firms
Growing market mentioned	None	None	None	None
Diversification goal	None	None	None	None

Turning to interaction effects, we expect government approval and patents to be economically significant for high-technology industries. The goal of product substitution may be valued only in *high-technology industries* whereas intention to increase market share may be credible only in the case of large firms.

Interaction Effects Hypothesis: The interaction of voluntary information and industry/firm characteristics is positively related to the wealth effects from R&D project announcements in the innovation stage. The following interactions—(1) government approval and industry R&D intensity, (2) patents and industry R&D intensity, (3) product substitution goals and industry R&D intensity, and (4) an intention to increase market share and firm size—will be positively related to the wealth effects from R&D project announcements.

Commercialization stage. Since during commercialization technical concerns have receded to the background, actions related to government agencies (that focus on technical accomplishment) have no economic significance. Similarly, since managerial intentions/beliefs have dubious credibility by themselves, we expect no direct effects. However, just as during innovation, we expect *positive* interaction between market share and firm size.

Interaction Effects Hypothesis: The interaction of voluntary information and industry/firm characteristics is positively related to the wealth effects from R&D project announcements in the commercialization stage. Specifically, the interaction between an intention to increase market share and firm size is positively related to the wealth effects from R&D project announcements.

There have been no studies of the impact of qualitative information on the valuation impacts of R&D announcements; hence, no definite hypotheses can be advanced regarding the *relative* contribution of each type of qualitative information on the evoked stock price impact. However, since managerial intentions/beliefs (when credible) are likely to reduce information asymmetry between managers and investors to a greater extent than actions involving external (government) agencies, their disclosure may influence the stock price impacts to a greater degree than actions involving government agencies.

DATA AND METHOD

Sample

The specifics of the sample employed, data collection methods, and the background analysis are contained in the Technical Appendix. In our initial sample only 16 R&D announcements related to disruptions or the abandonment of projects. Since these negative announcements were few, we did not include them in our analysis; hence, our study assumes that R&D project

announcements indicate progress or are positive in nature. The sample consisted of 501 R&D announcements that appeared in *The Wall Street Journal* from 1977 to 1989.

Measures

Control variables. Previous research has explained the wealth effects of announcements in terms of industry and/or firm factors that are publicly available. Kelm *et al.* (1995a) provided empirical evidence of the valuational differences between R&D stages in the case of *industry* (technological opportunity and concentration) and *firm* (technological leadership and size) factors. In the case of industry factors, since new product introductions are generally expected in technology-intensive industries, industry R&D intensity would be negatively related to the stock impact during commercialization. Similarly, since firms are able to appropriate value of new products mainly in concentrated industries, industry concentration would be positively related to stock market impact only during commercialization. In the case of firm factors, since a firm's technological leadership (measured by relative R&D intensity) was a marker of the probability of its technical success, during innovation, it would be positively related to the evoked stock market impact. Finally, firm size would be negatively related during both stages.

In testing the hypotheses, we are focused on the explanatory power of the direct and interaction effects of qualitative information *over and above industry and firm factors*. Following Kelm *et al.* (1995a) we employed four industry- and firm-related factors as control variables in the regression analyses, which set the baseline against which the tests of hypotheses were conducted.[4] Two of these, *industry R&D intensity* and *industry concentration*, are industry-related factors, whereas *relative R&D intensity* and *size* (as measured by log of total sales)[5] are firm-related factors. The measurement of the four control variables is discussed in the Technical Appendix.[6]

Qualitative information in R&D announcements. We coded as much of the information as possible regarding actions involving government agencies, managerial intentions, and beliefs that we could discover in the announcements. Two independent coders and one of the authors read each article containing the R&D announcements utilized in the study. For each of the announcements, the presence or absence of the voluntarily disclosed qualitative information was determined and coded using a 0/1 variable, with 1 signifying the presence of the information in the article and 0 indicating the absence. There was over 94 percent agreement among the three coders; disagreements were resolved by discussion among them.

A minimum frequency threshold is needed to draw any meaningful statistical conclusions about any specific variable; we set the threshold at 30 or 6 percent of the total sample. The six variables employed in the study met this criterion. Although there were no theoretical grounds for expecting two variables—growing market and diversification—to contribute to stock price impact, we included them in order to verify our expectation of *no relationships* to the stock price impact. In the test of interaction effects, we focused on the four previously discussed interaction terms: (1) (government approval) $*$ (industry R&D intensity), (2) (patents) $*$ (industry R&D intensity), (3) (goal of product substitution) $*$ (industry R&D intensity), and (4) (intention to increase market share) $*$ (firm size).[7]

Stage of announcement

Following Kelm *et al.* (1995a), announcements about the initiation or continuation of R&D projects were coded as innovation, whereas the culmination of the R&D projects leading to new, or

[4] We used only the four variables that were significant in Kelm *et al.* (1995a).

[5] Total assets and R&D expenditures were also examined; there is essentially no difference in the results if total assets, R&D expenditures, or sales are employed to measure size.

[6] A number of firms in the sample had more than one R&D announcement. The frequency of announcement and firm size are highly correlated; hence, there is no additional explanatory power if the frequency with which a firm made R&D announcements is included in the control variables.

[7] As per our theoretical expectation, there should be no relationship between any other interaction terms and the dependent variable. To test this, we explored other interactions between the information characteristics and industry/firm variables. The analysis indicated no consistent additional explanatory power by considering these interactions.

revised, products or processes were coded as commercialization. As in the case of the qualitative information, two independent coders and one of the authors read each article and coded the announcements as falling into the innovation or commercialization stage. There was 95 percent agreement in the case of coding of stages. As before, disagreements were resolved through discussion.

Wealth effects of the announcements

The wealth created by the R&D project announcements was operationalized as the excess returns resulting from the conventional event study methodology (Brown and Warner, 1985; McWilliams and Siegel, 1997). The OLS market model was employed to estimate the wealth effects of the R&D project announcements for the (–1, 0) period (i.e., the day before and the day of the announcement).[8] The simple market model was estimated for each firm/announcement $R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}$ where R_{it} is the return to firm i at time t, R_{mt} is the return on the market portfolio at time t, and e_{it} is the error term, which has an expected value of zero. After estimating the unknown parameters, α_i and β_i , the excess returns, i.e., the difference between the actual and the predicted return, are determined via $ER_{it} = R_{it} - \alpha_i - \beta_i R_{mt}$ These excess returns are averaged across the announcements to generate the mean excess return.

Analysis

To assess the impact of voluntarily disclosed qualitative information on shareholder value, three primary sets of multiple regressions with excess returns, ERs, as the dependent variable were run separately for the innovation and commercialization stages. The first regression with the *control* variables served as the baseline. The second regression included, in addition, the *direct* effects of the six qualitative information characteristics. The third regression added the interaction terms to assess the incremental explanatory power of the *interaction* terms.

[8] The estimation period was from –120 to –21 days before the date of the announcement in *The Wall Street Journal*. The equally weighted CRSP index was employed. The excess returns were also estimated by the market adjusted return procedure; these excess returns are almost identical to those reported.

RESULTS

Sample profile

A profile of the sample is presented in Table 2. There were 197 innovation stage R&D project announcements, while there were 304 commercialization stage announcements. In terms of the qualitative information voluntarily disclosed in the R&D announcements, firms mentioned patents and a growing market significantly more often in innovation stage announcements, whereas the intention to increase market share at the expense of competitors was predominantly mentioned in commercialization stage announcements. Thus, firms disclose different qualitative information during different stages of an R&D project.[9]

Table 2 also shows that firms that made innovation stage announcements were significantly higher in terms of relative R&D intensity, as opposed to firms announcing during the commercialization stage. On the other hand, firms in more concentrated industries and larger firms were represented more in commercialization stage announcements than in innovation stage announcements.[10] Finally, during both R&D stages—innovation and commercialization—there were significant positive wealth effects from the R&D announcements. During the innovation stage the mean 2-day excess return was 0.88 ($t = 3.30$, $p < 0.01$), indicating that the value of the firm increased by almost 1 percent concurrently with the R&D announcement. Likewise, during commercialization the value of the announcing firms increased, on average, by 1.02 percent ($t = 4.13$, $p < 0.001$).

Contribution of qualitative information to the stock market impact of R&D announcements

Tables 3 and 4, respectively, present the results of the innovation and commercialization stage regressions performed to assess if the qualitative

[9] This finding was confirmed by a logit regression. Specifically, patents and the expectation of a growing market are mentioned more frequently at the innovation stage, while commercialization stage announcements contained significantly more mention of the intention to increase market share and diversification (which was also significant in the logit regression).

[10] The correlation matrix for the control variables, information characteristics, interaction terms, and excess returns is available from the authors.

Table 2. Control variable means,[a] qualitative information,[a] and 2-day excess returns for 501 R&D projects announcements

	Stage of announcement[b]	
	Innovation	Commercialization
Number of observations (*n*)	197	304
Control variables		
Industry R&D intensity	0.05	0.05
	(0.03)	(0.02)
Industry concentration	0.44	0.50
	(0.13)	(0.14)
Total sales (log) (millions of $)	7.43	7.93
	(2.79)	(2.02)
Relative R&D intensity	4.35	1.81
	(9.26)	(2.74)
Qualitative information		
Government approval	24	25
	(12.2)	(8.2)
Patents mentioned	22	8
	(11.2)	(2.6)
Goal of product substitution	13	27
	(6.6)	(8.9)
Intention to increase market share	66	268
	(33.5)	(88.2)
Growing market mentioned	147	43
	(74.6)	(14.1)
Diversification goal	13	30
	(6.6)	(9.9)
2-day (–1, 0) excess return[c]	0.88**	1.02***

†$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]For qualitative information, the frequency of occurrence in the sample (as a percentage) is in parentheses: for the control variables the standard deviations are in parentheses.

[b]There are significant differences for frequency of occurrence for patents mentioned ($\chi^2 = 15.47$)***, growing market mentioned ($\chi^2 = 160.69$)***, and intention to increase market share ($\chi^2 = 185.70$)***, and for control variables means for industry concentration ($t = 4.90$)***, total sales ($t = 2.34$)* and relative R&D intensity ($t = 3.75$)***.

[c]There are significant differences from zero for both the innovation ($t = 3.30$)** and the commercialization ($t = 4.13$)*** stages.

information revealed in R&D project announcements is related to the wealth effects of the announcements.[11]

Innovation stage As shown in Table 3, the control variables—industry and firm characteristics (column 1)—produced an R^2 of 0.065 ($F = 3.36$; $p < 0.05$). Consistent with Kelm *et al.* (1995a), only one control variable, relative R&D intensity, is positively related to the evoked stock market impact. The addition of the six qualitative nonfinancial information variables (column 2) has no significant *incremental* impact on the ability to explain the wealth effects. Turning to the interaction effects, we see that the addition of the four interactions between qualitative information and industry/firm characteristics (column 3) results in a significant increase in R^2 (0.085 to 0.178), adjusted R^2 (0.035 to 0.114) and explanatory power ($F = 5.11$; $p < 0.001$). Thus the direct effects hypothesis was not supported whereas there is statistically significant support for the interaction effects hypothesis. Three interaction terms—government approval and industry R&D intensity ($p < 0.01$), goal of product substitution

[11] The presence of severe multicollinearity was assessed for all of the regressions in Tables 3 and 4 using the Belsley, Kuh, and Welsch (1980) diagnostic procedures. There is no indication of severe multicollinearity in any of the innovation stage regressions. For the commercialization stage, the 14-variable model indicates moderate multicollinearity between intention to increase market share and (intention to increase market share) ∗ (firm size). Therefore, the finding of significant results indicates they are powerful, as we would expect high multicollinearity to mitigate the results.

Table 3. Innovation stage regressions of 2-day excess returns as a function of control variables, qualitative information, and interactions[a]

Estimated model: excess return = *f*(control variables, qualitative characteristics, interactions) (n = 197)					
Explanatory variables	(1)	(2)	(3)	(4)	(5)
Intercept	0.006 (0.015)	–0.001 (0.017)	0.024 (0.018)	0.003 (0.017)	0.019 (0.017)
Control variables					
Industry R&D intensity	0.069 (0.110)	0.081 (0.120)	–0.118 (0.129)	–0.010 (0.124)	–0.013 (0.120)
Industry concentration	–0.001 (0.022)	0.002 (0.022)	0.022 (0.022)	0.015 (0.023)	0.008 (0.021)
Total sales (log) (millions of $)	–0.001 (0.000)	–0.001 (0.001)	–0.003† (0.002)	–0.001 (0.001)	–0.002 (0.001)
Relative R&D intensity	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.001 (0.000)	0.001* (0.001)
Direct effects					
Government approval		0.003 (0.008)	–0.041* (0.018)	–0.039* (0.018)	0.003 (0.008)
Patents mentioned		–0.013 (0.009)	–0.013 (0.017)	0.002 (0.018)	–0.016† (0.008)
Goal of product substitution		0.010 (0.012)	–0.022 (0.017)	0.006 (0.012)	–0.014 (0.017)
Intention to increase market share		–0.001 (0.007)	–0.056** (0.018)	–0.003 (0.007)	–0.056** (0.018)
Growing market mentioned		0.007 (0.008)	–0.000 (0.008)	0.005 (0.008)	–0.003 (0.007)
Diversification goal		0.014 (0.012)	0.010 (0.012)	0.009 (0.012)	0.012 (0.012)
Interactions					
(Government approval) × (Industry R&D intensity)			0.885** (0.317)	0.842* (0.324)	
(Patents mentioned) × (Industry R&D Intensity)			–0.326 (0.379)	–0.334 (0.390)	
(Goal of product substitution) × (Industry R&D intensity)			1.156* (0.550)		0.978† (0.555)
(Intention to increase market share) × (Total sales)			0.006** (0.002)		0.006** (0.002)
F	3.36*	1.73†	2.81**	2.06*	2.53*
R^2	0.065	0.085	0.178	0.11	0.14
Adj. R^2	0.046	0.035	0.114	0.06	0.08
ΔF[b]		0.67	5.11***	3.16*	6.11*

†$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Standard errors are in parentheses.

[b]ΔF based on 4-variable (column 1) vs. 10-variable (column 2) model, 10-variable vs. 14-variable (column 3) model and 10-variable vs. 12-variable models (columns 4 and 5) as appropriate.

Table 4. Commercialization stage regressions of 2-day excess returns as a function of control variables, qualitative information, and interactions[a]

Estimated model: excess return = f(control variables, qualitative characteristics, interactions) (n = 304)					
Explanatory variables	(1)	(2)	(3)	(4)	(5)
Intercept	0.074***	0.072***	0.186***	0.07[1]***	0.187***
	(0.013)	(0.015)	(0.024)	(0.015)	(0.023)
Control variables					
Industry R&D intensity	–0.335**	–0.352**	–0.421**	–0.402**	–0.401***
	(0.115)	(0.121)	(0.130)	(0.133)	(0.119)
Industry concentration	0.062**	0.064**	0.056**	0.071**	0.053***
	(0.020)	(0.021)	(0.021)	(0.217)	(0.019)
Total sales (log) (millions of $)	–0.010***	–0.010***	–0.024***	–0.010***	–0.024***
	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)
Relative R&D intensity	–0.000	–0.000	–0.002†	–0.000	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Direct effects					
Government approval		0.007	–0.008	–0.013	0.010
		(0.009)	(0.018)	(0.019)	(0.013)
Patents mentioned		0.004	0.018	0.019	–0.005
		(0.012)	(0.027)	(0.029)	(0.013)
Goal of product substitution		–0.006	–0.006	–0.008	–0.094
		(0.008)	(0.014)	(0.008)	(0.301)
Intention to increase market share		–0.000	–0.124***	–0.001	–0.124***
		(0.001)	(0.022)	(0.009)	(0.022)
Growing market mentioned		–0.003	–0.001	–0.002	–0.124
		(0.008)	(0.008)	(0.008)	(0.022)
Diversification goal		0.000	0.004	0.001	0.017
		(0.008)	(0.008)	(0.008)	(0.002)
Interaction effects					
(Government approval) × (Industry R&D intensity)			0.173	0.432	
			(0.357)	(0.374)	
(Patents mentioned) × (Industry R&D intensity)			–0.216	–0.345	
			(0.643)	(0.676)	
(Goal of product substitution) × (Industry R&D intensity)			–0.080		–0.094
			(0.303)		(0.301)
(Intention to increase market share) × (Total sales)			0.017***		0.017***
			(0.003)		(0.002)
F	19.38***	7.79***	8.85***	6.61***	10.36***
R^2	0.206	0.210	0.300	0.21	0.30
Adj. R^2	0.195	0.183	0.266	0.18	0.27
ΔF[b]		0.25	5.84***	0.47	11.68***

†$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Standard errors are in parentheses.

[b]ΔF based on 4-variable (column 1) vs. 10-variable (column 2) model, 10-variable vs. 14-variable (column 3) model and 10-variable vs. 12-variable models (columns 4 and 5) as appropriate.

and industry R&D intensity ($p < 0.05$), and intention to increase market share and firm size ($p < 0.01$)—were significantly related to the wealth effect of R&D announcement.

Commercialization stage. As shown in column 1 of Table 4, the control variables—industry and firm factors—had an R^2 of 0.206 (F = 19.38; $p < 0.001$). Both industry R&D intensity and total sales are negatively related to the stock market impact whereas industry concentration is positively related. Just as in the case of inno-

vation stage, the influence of control variables in the commercialization stage is consistent with the theoretical and empirical work of Kelm *et al.* (1995a).

To provide a baseline against which to test the proposed interaction effects hypothesis in the commercialization stage, we added the six qualitative information variables to the industry and firm variables. As expected, there is no additional explanatory power (column 2). Further, to be consistent with the analysis in the innovation stage, we added all four interaction terms. Their addition (column 3) resulted in an increase in R^2 (0.210 to 0.300) and adjusted R^2 (0.183 to 0.266), as well as a significant increase in explanatory power ($F = 5.84$; $p < 0.001$). As predicted, the interaction between market share intention and size was significant ($p < 0.001$).

In summary, the control variable regressions in both the innovation and commercialization stages affirm the conformance of our data with the received literature. As expected, there is statistical support for the interaction effects.

Secondary analysis

We explored the relative contribution of the interactions involving the two types of qualitative information—actions related to government agencies and managerial intentions/beliefs—by separate regression analyses. These are also reported in Tables 3 and 4.

As shown in Table 3, during the *innovation* stage, the two interactions involving actions related to government agencies—(government approval) ∗ (industry R&D intensity) and (patents mentioned) ∗ (industry R&D intensity)—explain 3.4 percent more variance than the direct effects model (compare columns 2 and 4 in Table 3). The *additional* explanatory power is significant ($\Delta F = 3.16$; $p < 0.05$). As can be seen from the table, the increase in explanatory power is *solely* due to the interaction term involving government approval. Contrary to our hypothesis, patent information was not related to the evoked stock market impact in R&D-intensive industries. Patents represent scientific accomplishments that may later trigger project initiation. Thus, investors may have already factored in the value of patents *before* the project announcement. Alternately, investors may assess that the exploitation of patents in specific projects is uncertain or far in the future, and may wait for tangible evidence of project progress before they revalue the firm. Government approval, however, may signal more *tangible* progress in the innovation phase of projects than patents in the valuation of specific R&D project announcements.

To interpret the effect of the interaction term involving government approval, we split the sample of innovation stage announcements at the median of R&D intensity, and traced the stock impact in the case of announcements containing government approval disclosure. For the high R&D intensity condition, excess returns averaged 3.23 percent (significantly greater than zero at $p < 0.01$ level); for the low R&D intensity condition, the respective mean was –0.011 percent and not significantly different from zero. Thus, consistent with prior research (Schwert, 1981), government approval is valued only in high-technology (i.e., high R&D intensity) industries. Further, if we delete the pharmaceutical industry, where government approval is fairly routine, the interaction of government approval and industry R&D intensity is even more significant in high R&D intensive industries during the innovation phase. Thus, when less expected, government approval strengthens the wealth impact of R&D project announcements than when it is routinely expected, as in the pharmaceutical industry.

Similarly, the two interactions involving managerial intentions/beliefs—(product substitution) ∗ (industry R&D intensity) and (intention to increase market share) ∗ (firm size) (columns 2 and 5, Table 3)—explain 5.7 percent more of the variance than the direct effects model. As in the case of government-related actions, the *additional* explanatory power of managerial intentions/beliefs is statistically significant ($F = 6.11$; $p < 0.01$). Consistent with our expectations, product substitution intentions are valued only in R&D-intensive industries; however, the results are only suggestive ($p < 0.10$), and do not reach conventional levels of significance. On the other hand, the interaction of market share intentions with firm size is significant, and in the predicted direction.

To further examine the interaction of market share intention and firm size, we split the sample of innovation stage announcements into two: those containing market share intentions and those that did not. In the absence of the disclosure of market share intentions, the stock price impact is

not related to the size of the firm. However, when aggressive market share intentions are announced, the larger the size of the firm the greater the impact. It is likely that in the innovation stage investors may regard as credible only the disclosure of aggressive market share intentions by large firms. Whereas investors look to *external sources* such as government for valuing technical accomplishments, they may judge aggressive market intentions credible when weighed against *known* firm capabilities.

In the *commercialization* stage, the interactions involving actions related to government agencies do not add any statistically significant explanatory power to the direct effects model (compare columns 2 and 4, Table 4). However, the interactions involving managerial intentions/beliefs *add* significant explanatory power *over* and *above* the direct effects (columns 2 and 5 of Table 4; ($\Delta F = 11.68$; $p < 0.001$). The effect is due solely to the interaction between market share intentions and firm size. In the absence of the disclosure of market share intentions, small firms, in general, tend to benefit from commercialization stage announcements—a result that is consistent with the previous literature (Chaney *et al.*, 1991; Kelm *et al.*, 1995a). However, the disclosure of market share intentions *alleviates* the small firm effect: relative to the nondisclosure condition, the disclosure depresses the magnitude of the stock price impact in the case of smaller firms and raises the impact in the case of larger firms. Just as in the case of the innovation stage, investors are cautious in the assessment of market share intentions during the commercialization stage: they judge the intentions against *known* capabilities of firms.

In the innovation stage, the interaction terms containing qualitative information have greater explanatory power than the industry and firm control variables, suggesting that in assessing the value of R&D announcements investors are sensitive to qualitative information pertaining to *both* technical accomplishments and market-related intentions of firms. However, as we move from innovation to commercialization stage announcements, industry and firm controls explain more of the stock market impact, and only the interaction involving market share contributes to the evoked stock market impact. As expected, qualitative information that may help assess the technical feasibility of a project during innovation—government approval or product substitution goal—are no longer important. Although our cross-sectional data do not permit us to draw conclusions about the carryover of wealth effects from the innovation stage to the commercialization stage, it is likely that investors are sensitive to different types of qualitative information over the stages of a project.

DISCUSSION

In this paper, we examined the role played by the voluntary disclosure of qualitative information, often a key component of an investor relations strategy, in explaining the wealth effects created by R&D project announcements. We have argued that to the extent the qualitative nonfinancial information reduces information asymmetry between managers and investors, it may contribute to the stock market impact of R&D projects. We have further argued that to influence investors' valuation of stock price the information should be *credible* and *economically relevant*—conditions that are met when certain industry/firm factors are present. Our data provide support to this line of reasoning. Thus, our study makes two primary contributions. First, we have extended our understanding of the factors that explain the value created by R&D project announcements. Second, we have taken a step toward isolating the conditions under which an investor communications strategy would lead to positive stock market impact. We will discuss each in turn.

R&D projects and value creation

In high-technology industries R&D is considered to be the engine of growth, and indeed a central feature of business or corporate strategy. In recent years, there has not only been a significant increase in the investment in R&D (Jarrett, 1999), but the project mix represented by these investments has also been shifting from basic research to product and processes (Whiteley, Bean and Russo, 1998).

In spite of its importance, however, the value created by R&D projects has not received much attention in the strategic management literature. The literature on the contribution of R&D to firm value has mostly focused on R&D expenditures (Chan, Martin, and Kensinger, 1990; Woolridge and Snow, 1990), which typically represent the total resources

devoted to a *portfolio of projects* in different stages from initiation to commercialization. The literature has only infrequently focused on *project-level* analysis. Since major R&D projects are likely to be significant elements of a firm's product market strategy, project-level analysis contributes to understanding competition and competitive advantage. The few project-level studies to date have documented the influence of industry/firm factors on the stock market impact evoked by the announcement of R&D projects. In this paper, we take the project-level analysis one step further by examining the contribution of qualitative nonfinancial information to the evoked stock market impact.

Our results suggest that both during innovation and commercialization stages qualitative information disclosed in R&D project announcements evoke a significant stock market impact. The documented stock market impact is economically significant in two ways. First, qualitative information regarding R&D is often not as discrete and unanticipated as in the case of discrete events such as acquisition. Other things equal, this would tend to depress the announcements effects revealed by an event study focusing on qualitative information. Second, the results compare favorably with other announcement effects for events such as corporate governance (e.g., adoption of golden parachutes).

Further, we have shown that the linkage between types of qualitative information and stock market impact is *complex*, and is moderated by the stage of the R&D project. As the project moves from innovation to commercialization, technical challenges recede to the background. Therefore, investors are likely to be sensitive to qualitative information pertaining to technical factors (government approval and product substitution) only during innovation, while market share intentions are important throughout the course of a project. Indeed, our data suggest that the qualitative information explains the evoked stock market impact relatively more than industry/firm factors in the innovation stage. Thus, it is likely that the information asymmetry between investors and managers is higher during the innovation than the commercialization stage.

Investor relations strategy

Recent renditions of the strategic management literature have enumerated investor relations as one of the possible pathways to value creation (Copeland *et al.*, 1994). The role of investor relations is to reduce the 'perception gap' of investors who tend to value a firm less than managers who have more detailed knowledge of their firms' strategies. Empirical studies of the effectiveness of investor relations strategies are only emerging in the strategic management literature. We contribute to this emerging literature by presenting evidence that an investor communications strategy of managing the details of the information made available to investors, under appropriate industry/firm conditions, is an important determinant of investor responses.

Our results suggest that when uncertainty and information asymmetries are high, as in the innovation stage, the investors may look for evidence of accomplishment from external sources. Thus, when the accomplishment is difficult to assess (as in the case of many technical projects), the investors look for *external validation* of a firm's accomplishment, i.e., from credible external sources (such as the government) that are not under the control of a firm. Further, investors under all circumstances assess the appropriateness of declared goals and intentions against a firm's known capabilities. For a firm's investor communications to lead to value creation, the declared strategic intentions must be credible when compared to the known capabilities of the firm.

Thus, investor valuations in conditions of uncertainty are shaped not merely by a firm's own communication acts but also by the judgements of relevant others. Extending the line of argument put forth by Rindova and Fombrun (1999), we may suggest that investors attend to institutionally transmitted information from external sources to judge a firm's ability to deliver value. This view of investor valuation extends the social constructionist perspective of competition and markets (Porac, Thomas and Baden-Fuller, 1989) to the realm of stock market impacts. From a pragmatic point of view, this implies that under conditions of uncertainty for the investors a firm may seek endorsement from credible external sources, in addition to voluntarily disclosing credible information.

Finally, our results highlight the need for a more fine-grained analysis of the specific qualitative nonfinancial information revealed by firms, and how the information does, or does not, impact the market value of the firm. This type of analysis

is in line with recent increased attention given to investor communications (Byrd *et al.*, 1993; Ernst & Young, 1994; Healy and Palepu, 1995; Soter *et al.*, 1996), as well as the evidence pointing to the complementarity of qualitative and financial information (Amir and Lev, 1996). Finer-grained analysis of the qualitative nonfinancial information disclosed in announcements may also reveal the interaction between the firm's investor communications policies and the market value of the firm in contexts other than R&D announcements. Thus, as firms reveal more *credible and economically significant* information, information asymmetry may also be reduced in ways beyond the simple impact of these other announcements made by firms.

ACKNOWLEDGEMENTS

We want to thank Paul Kerber, Anna Kniazian, Paul Koch, the participants in the Accounting/Finance Seminar at the University of Kansas, and three reviewers for their perceptive comments, along with the University of Kansas School of Business Research Fund, and the University of Kansas School of Business Center for Management of Technology.

REFERENCES

Ambarish R, John K, Williams J. 1987. Efficient signaling with dividends and investments. *Journal of Finance* **42**: 321–343.

Amir E, Lev B. 1996. Value-relevance of nonfinancial information: the wireless communications industry. *Journal of Accounting and Economics* **22**: 3–30.

Baysinger B, Hoskisson RE. 1989. Diversification strategy and R&D intensity in multiproduct firms. *Academy of Management Journal* **32**: 310–332.

Belsley DA, Kuh AE, Welsch RE. 1980. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. Wiley: New York.

Bhattacharya S, Ritter JR. 1983. Innovation and communication: signalling with partial disclosure. *Review of Economic Studies* **50**: 331–346.

Bowman EH, Hurry D. 1993. Strategy through the option lens: an integrated view of resource investments and the incremental-choice process. *Academy of Management Review* **18**: 760–782.

Brown SJ, Warner JB. 1985. Using daily stock returns: the case of event studies. *Journal of Financial Economics* **14**: 3–31.

Byrd J, Goulet W, Johnson M, Johnson M. 1993. Finance theory and the new investor relations. *Journal of Applied Corporate Finance* **6**: 48–53.

Chan SH, Martin JD, Kensinger JW. 1990. Corporate research and development expenditures and share value. *Journal of Financial Economics* **26**: 255–276.

Chaney PK, Devinney TM, Winer RS. 1991. The impact of new product announcements on the market value of the firm. *Journal of Business* **64**: 573–610.

Cockburn I, Henderson R. 1995. Racing to invest? the dynamics of competition in ethical drug discovery. *Journal of Economics and Management Strategy* **2**: 481–519.

Cohen WM, Levinthal DA. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* **35**: 128–152.

Contractor FJ, Narayanan VK. 1990. Technology development in the multinational firm: a framework for planning and strategy. *R&D Management* **20**: 305–322.

Copeland T, Koller T, Murrin J. 1994. *Valuation: Measuring and Managing the Value of Companies*. Wiley: New York.

Dess GD, Ireland RD, Hitt MA. 1990. Industry effects and strategic management research. *Journal of Management* **16**: 7–27.

Doukas J, Switzer LN. 1992. The stock market's view of R&D spending and market concentration. *Journal of Economics and Business* **44**: 95–114.

Ernst & Young. 1994. *Should you Rethink your Approach to Disclosure?* Ernst & Young Center for Business Innovation: Boston, MA.

Galbraith JR, Kazanjian RK. 1986. *Strategy Implementation: Structure, Systems and Process*. West Publishing: St Paul, MN.

Gilbert N. 1997. How security analysts see industrial R&D. *Research Technology Management* **40**: 37–40.

Griliches Z. 1990. Patent statistics as economic indicators: a survey. *Journal of Economic Literature* **28**: 1661–1707.

Healy PM, Palepu KG. 1995. The challenges of investor communication: the case of CUC International. *Journal of Financial Economics* **38**: 111–140.

Helfat CE. 1994. Evolutionary trajectories in petroleum firm R&D. *Management Science* **40**: 1720–1747.

Hirschey M, Richardson VR, Scholz S. 1998. Value relevance of non-financial information: the case of patent data. Monograph, University of Kansas School of Business, Lawrence, KS.

Jarret L. 1999. Industrial Research Institute's R&D trends forecast for 1999. *Research Technology Management*, January–February: 19–21.

Kelm KM, Narayanan VK, Pinches GE. 1995a. Shareholder value creation during the R&D innovation and commercialization stages. *Academy of Management Journal* **38**: 770–786.

Kelm KM, Narayanan VK, Pinches GE. 1995b. The response of capital markets to the R&D process. *Technological Forecasting and Social Change* **49**: 75–88.

Korajczyk RA, Lucas D, McDonald RL. 1991. The effect of information releases on the pricing and timing of equity issues: theory and evidence. *Review of Financial Studies* **4**: 685–708.

Lev B. 1999. R&D and capital markets. *Journal of Applied Corporate Finance* **11**(4): 21–35.
Marquis DG. 1969. The anatomy of successful innovations. Reprinted 1988. In *Readings in the Management of Innovation*, Tushman ML, Moore WL (eds.). Ballinger: Cambridge, MA; 79–86.
McWilliams A, Siegel D. 1997. Event studies in management research: theoretical and empirical issues. *Academy of Management Journal* **40**: 626–657.
Miller M, Rock K. 1985. Dividend policy under asymmetric information. *Journal of Finance* **40**: 1033–1052.
Myers S, Majluf NS. 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* **13**: 187–221.
Pinches G, Narayanan VK, Kelm K. 1996. How the market values different stages of corporate R&D: initiation, continuation and commercialization. *Journal of Applied Corporate Finance* **9**(1): 60–69.
Porac J, Thomas H, Baden-Fuller C. 1989. Competitive groups as cognitive communities: the case of Scottish knitwear industry. *Journal of Management Studies* **26**: 397–416.
Porter M. 1980. *Competitive Strategy*. Free Press: New York.
Quinn JB, Mueller JA. 1963. Transferring research results to operations. *Harvard Business Review* **41**(1): 49–66.
Reinganum J. 1989. The timing of innovation: research, development, and diffusion. In *Handbook of Industrial Organization*, Schmalensee R, Willig RD (eds.). Vol. I: Elsevier: New York; 849–908.
Rindova V, Fombrun CJ. 1999. Constructing competitive advantage: the role of firm-constituent interactions. *Strategic Management Journal* **20**(8): 691–710.
Ross S. 1977. The determination of financial structures: the incentive signalling approach. *Bell Journal of Economics* **8**: 23–40.
Roussel PA, Saad KN, Erickson TJ. 1991. *Third Generation R&D*. Harvard Business School Press: Boston, MA.
Schwert WG. 1981. Using financial data to measure the effects of regulation. *Journal of Law and Economics* **24**: 121–158.
Soter D, Brigham E, Evanson P. 1996. The dividend cut heard 'round the world': the case of FPL. *Journal of Applied Corporate Finance* **9**: 4–15.
Thakor A. 1993. Information, investment horizon, and price reactions. *Journal of Financial and Quantitative Analysis* **28**: 459–482.
Whiteley RL, Bean AS, Russo MJ. 1998. Using the IRI/CIMS database. *Research Technology Management* November–December: 16–18.
Woolridge JR, Snow CW. 1990. Stock market reaction to strategic investment decisions. *Strategic Management Journal* **11**(5): 353–363.

TECHNICAL APPENDIX

Sample selection

We searched The *Wall Street Journal Index* from 1977 to 1989 for announcements in the categories of biotechnology, new products, science and research, and technology. This search yielded 811 announcements for further examination. To reduce the noise in the data due to contemporaneous announcements by a firm, we eliminated R&D announcements that occurred within 15 days before or after another announcement by the same firm or when two or more announcements occurred on the same day. This reduced the number of announcements to 740. Owing to data requirements for determining the stock returns from the CRSP tapes, the sample was reduced to 662 announcements. Data from the COMPUSTAT tapes necessary for estimating the industry- and firm-related control variables used in the regressions in Table 3 were available for 501 observations. The 501 observations represent 478 distinct projects.

Control variables

The four control variables are measured as follows:

Industry R&D intensity is operationalized as the ratio of industry R&D expenditures (sum of R&D expenditures of firms in the industry) to sales (sum of firms' sales in the industry) over the last 3 years prior to the announcement.
Industry concentration is the sum of sales of the top four firms in the industry divided by total industry sales, both measured over the last 3 years.
Size is operationalized as the log transformation of total sales of the firm for the 3 years prior to the announcement.
Relative R&D intensity is operationalized as the firm's R&D expenditures divided by sales,

averaged for the 3 years preceding the announcement, divided by the industry R&D intensity over the same 3 years.

Consistent with previous studies on R&D (Baysinger and Hoskisson, 1989; Chan *et al.*, 1990; Chaney *et al.*, 1991), and critical reviews of operationalization (Dess, Ireland, and Hitt, 1990), the primary industry of a firm—as indicated by its dominant SIC code—was chosen to measure industry R&D intensity. As argued by Baysinger and Hoskisson (1989) a firm's orientation and distinctive competencies tend to focus on strategic issues involved in its primary industry; also, allocation of resources is likely to be based on a historical orientation to the primary industry (e.g., Galbraith and Kazanjian, 1986). The firms included in the study come from 23 SIC industries as follows: 0100 (agriculture production), 0700 (agricultural services), 2000 (food and kindred), 2500 (furniture and fixtures), 2600 (paper and allied products), 2700 (printing and publishing), 2800 (chemicals), 2830 (drugs), 2900 (petroleum refining), 3000 (rubber and miscellaneous plastic), 3300 (primary metal), 3400 (fabricated metals), 3500 (industrial and commercial machinery), 3570 (computers and office equipment), 3600 (electronics), 3700 (transportation equipment), 3800 (measuring instruments), 3900 (miscellaneous manufacturing), 4800 (communications), 5100 (nondurable goods—wholesale), 7300 (business services), 8000 (health services), and 8700 (engineering, accounting and management related services).