Internal Governance and
the Wealth Effect of R&D Expenditure Increases

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Abstract

We examine the role of internal governance in explaining the wealth effect of corporate R&D expenditure increases. We find that the stock market values R&D expenditure increases announced by firms in better internal governance more favorably than those announced by firms in poor internal governance. Our findings hold even after controlling for other potentially influential variables. We also find that when the announcer's growth opportunity is regarded as high, firms that have better internal governance will experience a more favorable announcement effect than those have poor internal governance. On the other hand, the response of poorer internal governance interaction elicits a worse announcement effect for firms when the announcer's growth opportunity is regarded as low. Our evidence supports the notion that the internal governance mechanism in a company is important in assessing the effect of corporate R&D expenditure increases on shareholder value. Our findings add to the understanding of the impact of internal governance on the outcomes of corporate R&D investment decisions in general.

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I. Introduction

Investment in research and development (R&D) is considered as a major source of inputs for growth and competitiveness. It is particularly crucial to those firms operating in the technology and science-based industries. Despite the importance role of R&D investments, the effect of R&D on shareholders wealth is less clear. Chan et al. (1990) and Zantout and Tsetskos (1994) report a positive market reaction to the announcements of R&D expenditure increases. On the contrary, Doukas and Switzer (1992) and Sundaram, John and John (1996) find insignificant announcement effects of R&D expenditure increases. The evidence suggests that, from shareholders perspectives, R&D investments do not necessarily create shareholders wealth.

One reason contributing to the mixed evidence may come from the difficulty in evaluating R&D investments. Relative to other corporate investments, R&D investments are more associated with information asymmetry. For example, many R&D projects are unique to the developing firms. The information available for investors in valuating R&D projects is very limited. Furthermore, because R&D is usually a firm-specific investment, it is difficult to assess the value of R&D projects from observing the performance of R&D in other comparable firms (Abody and Lev, 2000). Finally, despite the obvious benefits of R&D that usually extend over extended period of time, the reporting rules of accounting require R&D to be immediately expensed. Thus financial statements leave no trace on the stocks and performance of R&D capital over time.

Furthermore, firms may increase R&D expenditure for strategic reasons. For

example, when compensation is evaluated based on current reported net income only, managers have incentives to change the timing of R&D spending (Healey, 1985). For example, if net income is below certain lever so that no bonus is to be received anyway, managers may increase R&D investments to increase the probability of receiving a greater bonus in the following year. Similarly, if net income is above such levels that a further increase in net income is not going to lead to higher bonus. Managers have incentive to prematurely spend on R&D since current expensing of R&D expenditure will reduce future expenses. Furthermore, Zantout and Tsetskos (1994) suggest that if firms report lower-than-expected earnings as a result of the increase in R&D expenditures, advance disclosure of the decision may forestall a reduction in managerial compensation caused by downward assessment of the firm's market value.

In this paper, we explore whether corporate internal governance influences investor' value assessment of R&D investments. Prior literature has shown that, due to the separation of ownership and control, corporate managers may make investment decisions for their private interests at the expense of shareholders. The problem of agency costs could be more serious for R&D investments due to their strong association with information asymmetry. Jensen (1993) provides direct evidence that R&D investments in many large firms failed to increase firm value, and argue that the ineffectiveness can be attributed to poorly functioning internal control system. A well-functioning internal governance mechanism plays a crucial role in monitoring managerial behavior (Claessens et al., 2002; Brunello et al., 2003; Singh and Davidson III, 2003; and other). Numerous studies have shown that firms operating under better internal governance are more likely to make investment decisions in the interests of shareholders (for instance, Gompers et al., 2003). Upon the

announcements of R&D expenditure increases, the quality of internal governance may convey a strongly positive signal to the markets that the investments are made in the best interest of shareholders. This role of certification on the motives of investment is expected to be particularly important for investments that are associated with strong information asymmetry in the underlying value estimation, such as R&D investments.

Specifically, we investigate the effect of internal governance on the market reactions to R&D expenditure increases. Specifically, we ask if investors respond more positively to R&D expenditure increases announced by firms with better internal governance. To the extent that internal governance migrates agency costs, and convey more favorable signals to financial markets, we expect that investors should have more confidence on R&D expenditures by firms with better functioning internal governance mechanism. To the best of our knowledge, the impact of internal governance on the announcement effect of R&D expenditure increases has never been investigated before in the literature.[1]

Despite the importance of internal governance in the wealth gains, the value creation of R&D projects may also depend on the availability of investment opportunities (Szewczyk, et al., 1996). Even though a good internal governance mechanism help reduce resources misallocation by mitigating agency costs, to what extent that investments are able to create shareholders gains may be strongly related with the available growth opportunities. It is difficult to create significant value for Firms with good internal governance but little growth potentials. Recent research shows that investment opportunity plays an important in assessing the wealth effect of

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[1] Chung, Wright and Kedia (2003) examine the effect of corporate governance to the market valuation (Tobin's q) of capital and R&D investments and find that the market valuation of the firm's capital and R&D investments depends critically on corporate governance. The different point of our study is we discuss the wealth effect of the dynamic R&D expenditure announcement of the firm; they consider the market valuation of the static R&D investment.

corporate investments such as capital expenditure (Blose and Shieh, 1997; Chung et al., 1998; Chen and Ho, 1997; Chen et al., 2001), international acquisitions (Doukas, 1995), joint ventures (Chen et al., 2000) and product strategy (Chen and Ho, 1997). Therefore, we predict that R&D investments are likely to create greater shareholders wealth by firms with good internal governance and great investment opportunities. On the contrary, R&D investments made by firms with poor governance and few growth potentials are not as worthwhile.

A sample of R&D expenditure increases announcements during the period of 1988-2001 is collected. Consistent with Doukas and Switzer (1992) and Sundaram, John and John (1996), we find the average market reaction to R&D expenditure increases announcements is statistically insignificant. The evidence further shows that the internal governance mechanism plays an important role on how investors respond to R&D expenditure increases. Firms with better internal governance consistently experience greater market responses. In contrast, firms with poor governance have weak or even negative market reactions. A finer analysis suggests that growth opportunity positively interacts with the quality of internal governance in the value creation of R&D investments. Our findings indicate that the strong market reactions associated with to good governing firms are largely attributed to those with greater growth opportunities, and the negative responses to poor governing firms are mainly from those with few growth potentials. Our results hold for various measures of corporate internal governance, and remain unchanged after controlling for other variables that are found important to the announcements effects of R&D investment in prior literature.

The remainder of the paper is organized as follows. Section   describes the sample and presents summary statistics. Section   examines the relation between

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stock price response and the internal governance for the announcing firms. Section concludes.

II. Sample and Descriptive Statistics

A. Sample Design

An initial sample of announcements of R&D expenditure increases over the period from 1988 to 2001 is collected from the Dow Jones News Retrieval database, which provides selected news service stories and articles from the *Dow Jones News Wire* and the *Wall Street Journal (WSJ)*. We focus on firms listed in the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX) or the NASDAQ exchange. In addition, the following criteria are used to select the final sample. (1) To avoid any confounding events that could distort the measurement of the valuation effects on the announcing firms, we exclude those announcements by firms that have made other announcements three days before or three days after the initial announcement date. (2) We exclude the announcements of R&D expenditure plans involving customers or government contracts. (3) The announcements without specific information of the expenditures amounts are deleted. (4) We also exclude the sample firms without data of stock returns available from the returns files on the Center for Research in Securities Prices (CRSP) tape. (5) Announcing firms that have no data available from the Compustat files are deleted. (6) We exclude those announcements made by financial institutions (SIC code 60-69).

Our final sample comprises 243 announcements of R&D expenditure increases. Table 1 provides the sample distribution by industry classification and announcement year. The major of the announcements come from chemicals (SIC=28) and electric

equipment (SIC=36) industries. There two industries constitute about 67.5% of the total sample. There are about 43.6% of our sample are announced in the fiscal years of 1998, 1999, and 2000.

[Insert Table 1 here]

We employ standard event-study methods to examine stock price responses to announcements of R&D expenditure increases. Day 0 is defined as the initial announcement date. The abnormal return is calculated as the difference between the actual return and an expected return generated by the market model. We use the value weighted CRSP index as a proxy for market returns and estimate the parameters of the market model using the data over the period from 200 to 60 days before the initial announcement date. We calculate the cumulative abnormal returns over the period (-1, 0). The two-day period (-1, 0) captures the price reaction to the R&D expenditure increases announcement.

B. Measures of Internal Governance

We measure the corporate internal governance from three different perspectives, (1) board size, (2) ownership structure, and (3) leadership structure (Lehn and Zhao, 2006). The data for variables internal governance are from compact D database. The measures are estimated for the end of the fiscal year prior to R&D expenditure increases announcements.

Board Size

The corporate board of firm been identified a multiple of functions. A board may see its primary function as controlling the corporate performance and serving the corporation in controlling its external environment (Chaganti et al., 1985). Previous

study show a summary of board's size, which relies upon a premise that monitoring by the board, can improve the quality of manager's decisions and provide the specialized operating opinion (Monks and Minow, 1995). Therefore, it is important that how many the member of corporate board should been assigned. A larger board have valuable for the breadth of its services. Board size is a board attribute and affects board functioning and eventually corporate performance. The occurrence of a larger size board in a company might mean that the firm is coopting directors from wide ranging backgrounds and is using them rather profitably (Chaganti et al., 1985). Chaganti, Mahajan and Sharma (1985) suggest that the non-failed firms, as compared to failed ones, tend to have bigger board size. A smaller board is manageable and plays a controlling function, whereas a larger board may not be able to function effectively as a controlling body leaving the management relatively free. According to these attitudes, we expect that firm with larger board size has more positive wealth effect.

Ownership Structure

We consider the role of ownership structure related to the announcement return of R&D expenditure increases. Lehn and Zhao (2006) recognize that an inverse relation exists between the diffusion of equity ownership and the incentives that stockholders have to monitor managers. Under the view that the corporation with many small owners, it may not pay any one of them to monitor the performance of the management. It means that blockholder ownership have more incentive to monitor management and more ability to take the cost to monitor (Shleifer and Vishny, 1986). In general, blockholder ownership has the effect of monitor and then this will increase performance of firms. Shome and Singh (1995) and Allen and Phillips (2000) show that the positive relationship between blockholder ownership and financial

performance. We measure 5% blockholder ownership as the ratio of total more than 5% shareholdings to total common shares outstanding.

Insider ownership is another 'Ownership structure' measure. If insider has adequately diversify risk, the insider has more stocks of the firm means the returns of investing in firm is better than other investment opportunity. It implies that insider provides a signal of high quality of the firm, and then the relationship between insider shareholdings and firm's performance is positive (Cho, 1998; Leland and Pyle, 1977; and Mehran, 1995). An increased insider ownership has the potential to both enhance firm performance because of the incentive effects of insider ownership and impair firm performance because the "entrenchment effect" of management ownership (Lehn and Zhao, 2006). We test whether the wealth effect of R&D expenditure increases announcement is related to the percentage of equity held by insiders. We use the measure of insider ownership, the percent of common equity held by the officers and directors.

Leadership Structure

Board structure control mechanism relates to duality, which occurs when the same person undertakes the combined roles of chief executive officer and chairman of the board. Many scholars and internal governance actives argue that consolidating the positions of CEO and chairman of the board in one person impairs the monitoring function of a board (Lehn and Zhao, 2006). The agency problem argues that boards dominated by executive directors are more difficult to control, a situation that would clearly apply to duality (Fama and Jensen, 1983 and Weir et al., 2002). Following those studies, we also argue that the separation of chairman of the board and the CEO duties increases the effectiveness of monitoring. We measure duality as the dummy variable that equals one if a company combines the posts of chief executive officer

(CEO) and chairman of board and zero if he does not.

C. Control Variables

In addition to the measures of internal governance, we further control for other potential variables that could affect the wealth effect of R&D expenditure increases announcement, including investment opportunities, industry R&D intensity, relative firm R&D intensity, firm size, and industry concentration. Data of the control variables are obtained from the Compustat files.

Tobin's q has been widely used to discriminate firms with good investment opportunities from those with poor investment opportunities (Lang et al., 1989, 1991; Howe et al., 1992; Doukas, 1995; Szewczyk et al., 1996; and others). The theoretical Tobin's q ratio is defined as the ratio of the market value of a firm to the replacement costs of its assets. Because some data are not available, investment opportunities are estimated by a simple measure of q (the "pseudo q"): the ratio of the market value to the book value of the firm's total assets, where the market value of total assets is evaluated as the book value of total assets minus the book value of common equity plus the market value of common equity. This measure is used extensively in previous research (e.g. Denis, 1994; Perfect and Wiles, 1994; Barclay and Smith, 1995a, b; Agrawal and Knoeber, 1996; Chen and Ho, 1997, and Holderness et al., 1999). We compute the pseudo q in the fiscal year prior to the announcement. High-q firms are regarded as firms with good investment opportunities while low-q firm are regarded as firms with poor investment opportunities.

Industry R&D intensity (IRI) is often taken as a measure of the technological opportunity in an environment (Hambrick and MacMillan, 1985). Firms operating in industries with high R&D intensity are more likely to produce value-creating

innovation (Kelm et al., 1995). Thus, industry R&D intensity is expected to have a positive effect on the announcement abnormal returns of R&D expenditure increases. However, firms in high R&D industries are likely to make more frequent R&D investments, and the announcements of new investments may not surprise investors as much as those made by firms that make infrequent R&D expenditure increases announcements. As a result, the effect of industry R&D intensity is ambiguous. We estimate industry R&D intensity as the ratio of three-year average of R&D expenditures to net sales of all firms with same primary four-digit SIC code in Compustat.

Relative firm R&D intensity (FRI) measures a firm's financial resources allocated to R&D relative to its peers. Firms with larger relative R&D intensity may occupy the leading positions in technological advance (Baysinger and Hoskisson, 1989 and Kelm et al., 1995). Following Chan et al., (1990), Kelm et al. (1995), and Szewczyk et al., (1996), we defined it as the ratio of the three-year average of firm R&D intensity to the three-year average industry R&D intensity.

The degree of industry concentration (IC) is displaced by the Herfindahl index (Lang and Stulz, 1992; Baysinger and Hoskisson, 1989; and others). A small value of Herfindahl index suggests a more competitive industry. Kelm, et al. (1995) argued that the benefits arising from R&D efforts must be positively associated with high market concentration. However, some evidence suggests that when R&D intensity is controlled, industry concentration does not matter (Chan et al., 1990). We measure Herfindahl index as the sum of the squared fraction of industry sales by all firms in the industry for the fiscal year prior to the announcement

Finally we control for the effect of firm size in the analysis. Large firms' R&D expenditures might have less unanticipated information than those of small firms.

This is because information production and dissemination is a positive function of firm size (Atiase, 1985; Hertzel and Smith, 1993; and Kang and Stulz, 1996). Firm size is the natural logarithm of the firm's market value of common equity for the year preceding the announcement.

The descriptive statistics for internal governance proxies are shown in Table 2. Our sample firms on average have around 12 members on the board. The mean equity holding of 5% blockholder ownership is 15%. Insiders of the sample firms hold 7% of equity ownership. There are 152 R&D expenditure increases made by firms that the chairman of board also serves as CEO.

[Insert Table 2 here]

Table 2 also presents the market response to R&D expenditure increases announcements. The average two-day (-1, 0) announcement-period abnormal return is 0.27%, and the median abnormal return is 0.08%, both insignificantly different from zero at the conventional level. This finding is consistent with those in Doukas and Switzer (1992) and Sundaram, John and John, (1996) that the announcements of R&D expenditure increases are not associated do not create strong wealth effects o shareholders wealth.

III. Empirical results

A. Analysis of Subsamples Based on Internal Governance

Table 3 compares the difference in the announcement-period abnormal returns based on the quality of internal governance under different measures. In Panel A, we split the sample based on the median value of board size. The results indicate that firms with larger board size receive a significantly positive mean abnormal return of

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0.98%. In contrast, firms with smaller board size experience an average negative abnormal return of -0.83%. The mean difference in abnormal returns is statistically significant at the 5% level. This result is robust to possible deviations from non-normality, since it also holds for the non-parametric Kruskal-Wallis test statistic. The findings suggest that our prediction that investors take internal governance into consideration in the value assessment of R&D expenditure increases.

Panel B focuses on the measure of blockholder ownership. The large and small blockholder ownership subgroups are based on whether blockholder ownership is above or below the sample median. The results show that firms with large blockholder ownership experience a significantly positive mean announcement effect of 2.00%, while those with small blockholder ownership have an insignificant market response of -0.44%. The difference is statistically significant at the 1% level. The results are consistent with those in Panel A.

In Panel C, the comparison is made based on the median value of insider ownership. We find that high-insider ownership firms receive a strongly positively market reaction of 1.31%. In a sharp contrast, firms with low insider ownership experience a significantly negative abnormal return of -0.86%. The difference in average abnormal returns for high and low insider ownership groups is statistically significant at the 1% level.

Panel D present the results of comparison between firms with CEO as the chairman of board and those without. The results suggest that CEO as the chair of board is not a good arrangement for shareholders wealth. We find that firms that have the same people as CEO and chair of the board experience a significantly poorer value creation upon the announcements of R&D expenditure increases.

[Insert Table 3 here]

In summary, the results in Table 3 provide strong and consistent evidence on the importance of internal governance in explaining the wealth effect of R&D expenditure increases announcements. Despite the overall insignificant market reaction to R&D expenditure increases, we find that internal governance help distinguish the differential market responses in the valuation of R&D investments. Better internal governance is awarded by investors, while poorer internal governance is punished. Therefore, the results lend a strong support for the hypothesis that the quality of internal governance positively signals to investors for the wealth effect of R&D investments.

B. Analysis of the Joint Effect of Growth Opportunity and Internal Governance

To investigate how growth opportunity influences the influence of internal governance on the wealth effect of R&D expenditure increases, we further classify the sample based on pseudo q and internal governance. High (low) q firms are those with pseudo q above (below) the sample median. We predict investors should respond more positively to announcements by firms with better internal governance and greater growth potentials.

The results of Panel A of Table 4 present the empirical evidence with board size as the measure of internal governance. The evidence shows that the influence of board size on the market reaction to R&D expenditure increases announcements depends on the growth potential. We find that for companies with large board size, the high-q firms experience significantly positive abnormal returns, but the market reaction to the low-q firms is much weaker and not significantly different from zero. When we

compare this result with those in Panel A, Table 3, the evidence suggests that the positive announcement-period abnormal returns associated with large board size firms are attributed to those firms with good growth opportunities. For the subsample of small board size, the abnormal returns of high-q firms are insignificantly positive, but the abnormal returns for low-q firms are significantly negative. This finding indicates that the negative market reactions for small board size firms presented in Table 3 are contributed by those firms with few growth opportunities. The results further indicate that, among the four subgroups, high-q large-board size firms have the greatest mean (median) announcement-period abnormal returns of 2.46% (0.95%), while the low-q, small-board firms experience the worst mean (median) market response of -2.33% (-1.96%). The difference is statistically significant at the 1% level. In sum, the findings suggest that the availability of investment opportunities is an important factor influencing the effect of internal governance on the value creation of R&D expenditure increases.

[Insert Table 4 here]

Panel B, C and D present the evidence for other measures of internal governance. The results under different measures are consistent with those in Panel A. Firms with good growth opportunities and internal governance experience the greatest announcement-period abnormal returns among the four subgroups, and firms with low growth potentials and low quality of internal governance have the worst marker responses. The results in Table 4 provide a strong support for our prediction on the joint influence of the investment opportunities and internal governance in explaining the wealth effect of R&D expenditure increases announcements.

C. Cross-Sectional regression Analyses

Even though the evidences support our prediction, prior literature has documented other variables that are important in explaining the announcement effects of R&D expenditure increases. We further test our hypotheses by controlling these variables in the regression analysis. Table 5 presents cross-sectional regression analyses the relationship between the announcement returns and internal governance for our sample. The number of observations varies across regressions because of data unavailability.

[Insert Table 5 here]

In Model 1, we regress the announcement effect on board size, and other control variables. We use the natural logarithm of the number of directors sitting on each company's board as the measure of internal governance. The coefficient for board size is positive and statistically significant at the 1% level. This finding is consistent with those in Table 3 that the announcement effect of R&D expenditure increases is more favorable for firms with large board size. Model 2 tests the effect of blockholder ownership as measured by the percentage of equity held by shareholders owning 5% or more of the company stocks. The results suggest that blockholder ownership is significantly positively related to the announcing firms' announcement-period abnormal returns. Larger blockholder ownership creates greater wealth gains from the announcements of R&D expenditure increases. Model 3 examines the influence of internal governance as measured by insider ownership. Consistent with the results of other measures, we find that insider ownership is strongly and positively associated with announcing firms' value creation. In Model 4, we examine the explaining power of duality. The coefficient of duality is negative and statistically significant at the 5% level, suggesting that the announcement effect of R&D expenditure increases is

stronger when the chair of board does not serve as the CEO of the announcing firm. This finding is consistent with those in other models.

As for the control variables, we find that pseudo q is important in explaining the wealth effect associated with R&D expenditure increases. The announcement-period abnormal returns are significantly positively related to the announcing firm's investment opportunities. As in Szewczyk, Tsetsekos and Zantout (1996), the result on pseudo q is consistent with the investment opportunities hypothesis that increase R&D expenditures by firm with good investment opportunities are more valuable than those by firms with poor investment opportunities. Most of the other variables have little explaining power on the variation of the announcement-period abnormal returns.

Table 6 examines the interaction effect of investment opportunities and internal governance. Firms with better governance and growth opportunities are expected to receive significantly greater market reactions. We use two dummy variables to catch this interaction effect. High-q high-governance dummy equals one for firms with both pseudo q and internal governance measures greater than their sample medians, and otherwise equal zero. Low-q low-governance dummy equals one for firms with pseudo q and internal governance measures less than their sample medians, and otherwise equal zero.

[Insert Table 6 here]

Model 1 measures internal governance by board size. We find that high-q high-governance dummy is significantly positive at the 1% level. In contrast, the coefficient of the low-q low-governance dummy is significantly negative. Model 2 uses blockholder ownership as the alternative measure of internal governance. The

results are very similar to those in model 1. Firms with high (low) internal governance and growth potentials receive more (less) favorable market reactions to announcements of R&D expenditure increases. Model 3 test the interaction effect by insider ownership as the measure of internal governance. The results are consistent with those in model 1 and 2. In model 4, measure internal governance by duality. High-q, high-governance dummy equals one when firms have pseudo q above the sample median, and the CEO is not the chairman of the board. The low-q low-governance dummy equals one when firms have pseudo q below the sample median, and the CEO also serves as the chairman of the board. The conclusion under this measure remains the same. The empirical results in Table 6 are consistent with those in Table 4. The overall results in Table 5 and 6 support the notion that the nature of investment opportunities and internal governance in a firm are important consideration in assessing the wealth effect of R&D expenditure increases.

IV. Conclusion

Prior studies documented mixed evidence on the announcements effect of R&D expenditure increases. This study reexamines this issue from the perspective of internal governance. Because the information available for R&D investments is very limited, investors may consider the quality of internal governance in their value assessment on shareholders wealth. The evidence shows that internal governance has a significant impact on the valuation of R&D investments. We find better internal governance is associated with stronger shareholders wealth upon the announcements of R&D expenditure increases. We further show that the growth opportunity positively influences the impacts of internal governance on how investors evaluate R&D expenditure increases announcements. Our empirical results suggest that the

availability of growth opportunities jointly determines the value creation of R&D expenditure increases. The evidence in this study also suggest that failure to consider the joint effect of internal governance growth potentials may contribute to the mixed evidence on the announcement effect of R&D expenditure increases in prior studies.

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Table 1
Sample Distribution of Research and Development Expenditure Increases Announcement

This table summarizes the distribution of research and development expenditure increases announcements by NYSE, AMEX, and NASDAQ firms from 1988 to 2001. There are 243 announcements. The sample distribution is reported in Panel A by two-digit SIC code, and in Panel B by R&D expenditure increases fiscal year.

	Panel A: Sample Distribution by Industry		
SIC	Industry	Number	Percent of Sample
20	Food	1	0.4
28	Chemicals	114	46.9
33-34	Metal and stone work	4	1.6
35	Machinery and computer equipment	12	4.9
36	Electric equipment	50	20.6
37	Transportation equipment	21	8.6
38	Photo equipment	12	4.9
48	Communications	3	1.2
51	Durable and non-durable goods	1	0.4
73	Business Services	23	9.5
78	Motion Pictures	2	0.8
	Total	243	100.0

Panel B: Sample Distribution by Year		
Year	Number	Percent of Sample
1988	4	1.6
1989	2	0.8
1990	10	4.1
1991	13	5.3
1992	16	6.6
1993	17	7.0
1994	14	5.8
1995	13	5.3
1996	13	5.3
1997	14	5.8
1998	28	11.5
1999	37	15.2
2000	41	16.9
2001	21	8.6
Total	243	100.0

Table 2
Firm Characteristic Statistics

The sample consists of 243 R&D expenditure increases announcements by NYSE, AMEX and NASDAQ firms from 1988 to 2001. Data are obtained from the Dow Jones News Wire, CRSP, Compustat and Compact D. Two-day (-1,0) announcement period abnormal returns (CAR) are estimated using the standard market model procedure with parameters estimated for the period 200 days to 60 days before the announcement. Board size is number of the board of directors in the fiscal year -1. 5% blockholder ownership is the total percentage of company's stock held by shareholder owning more 5% or more of the company's stock. Insider ownership is the total percentage of company's stock held by directors and officers owning. Duality is a dummy variable, which the chairman of the board served as chief executive officer (CEO) equal one and otherwise equal zero. Pseudo q is estimated as the ratio of the market value of the firm's assets to the book value of the firm's assets for the fiscal year before the announcement, where the market value of assets is estimated as the book value of assets minus the book value of common equity plus the market value of common equity. The industry R&D intensity is the ratio of industry R&D expenditures to industry sales in fiscal year -1. Relative firm R&D intensity is the ratio of firm R&D expenditure to sales in fiscal year -1. Market value of common equity is measured as the capitalization of the firm. Industry concentration is measured by the Herfindahl index, which is equal to the sum of squares of the financial market shares of all firms with the same primary four-digit SIC industry code in Compustat.

Variable	N	Mean	Std	Q1	Median	Q3
CAR (%)	243	0.27	5.83	-1.99	0.08	2.06
Board Size	212	11.87	8.87	8.00	11.00	14.00
5% Blockholder Ownership	209	0.15	0.20	0.00	0.06	0.22
Insider Ownership	193	0.07	0.16	0.00	0.01	0.05
Duality	227	0.67	0.47	0.00	1.00	1.00
Pseudo q	243	4.20	4.38	1.82	2.97	5.03
Industry R&D Intensity	243	0.11	0.08	0.08	0.11	0.13
Relative Firm R&D Intensity	243	3.09	9.32	0.86	1.05	1.30
Market Value of Equity ($Million)	243	45,566	69,793	2,715	19,050	54,538
Industry Concentration	243	0.18	0.23	0.03	0.08	0.25

Table 3
Mean and Median Cumulative Abnormal Returns (CAR) for Subsamples Stratified According to Internal Governance

Two-day (-1,0) announcement period abnormal returns are estimated using the standard market model procedure with parameters estimated for the period 200 days to 60 days before the announcement. Board size is number of the board of directors in the fiscal year -1. 5% blockholder ownership is the total percentage of company's stock held by shareholder owning more 5% or more of the company's stock. Insider ownership is the total percentage of company's stock held by directors and officers owning. Duality is a dummy variable, which the chairman of the board served as chief executive officer equal one 1 and otherwise equal zero. In Panel A to C, high internal governance firms are proxy variables above median; low internal governance firms are proxy variables below median. In Panel D, high internal governance firms indicate that chairman of the board didn't served as CEO. Low internal governance firms indicate that chairman of the board served as CEO. "***" represents a 1% significance level; "**" represents a 5% significance level; "*" represents a 10% significance level.

Panel A: Internal Governance Measured by Board Size			
	High	Low	Diff.
N	123	89	
Mean	0.98	-0.83	1.81**
T	(2.63)***	(-1.15)	
Median	0.39	-0.25	0.63*
Prob.	1.05%	53.04%	

Panel B: Internal Governance Measured by 5% Blockholder Ownership			
	High	Low	Diff.
N	110	99	
Mean	2.00	-0.44	2.44***
T	(3.80)***	(-1.07)	
Median	0.85	-0.01	0.86***
Prob.	0.10%	25.87%	

Panel C: Internal Governance Measured by Insider Ownership			
	High	Low	Diff.
N	100	93	
Mean	1.31	-0.86	2.17***
T	(3.12)***	(-2.31)**	
Median	0.57	-0.31	0.88***
Prob.	1.47%	4.18%	

Panel D: Internal Governance Measured by Duality			
	High	Low	Diff.
N	76	151	
Mean	1.07	-0.13	1.20*
T	(2.16)**	(-0.30)	
Median	0.44	-0.42	0.86*
Prob.	4.72%	50.19%	

Table 4
Mean and Median Cumulative Abnormal Returns (CAR) for Subsamples Stratified According to Pseudo Q and Internal Governance

Two-day (-1,0) announcement period abnormal returns are estimated using the standard market model procedure with parameters estimated for the period 200 days to 60 days before the announcement. Pseudo q is estimated as the ratio of the market value of the firm's assets to the book value of the firm's assets for the fiscal years before the announcement, where the market value of assets is estimated as the book value of assets minus the book value of common equity plus the market value of common equity. Board size is number of the board of directors in the fiscal year -1. 5% blockholder ownership is the total percentage of company's stock held by shareholder owning more 5% or more of the company's stock. Insider ownership is the total percentage of company's stock held by directors and officers owning. Duality is a dummy variable, which the chairman of the board served as chief executive officer (CEO) equal one and otherwise equal zero. High-q firms are firms with pseudo q above median; Low-q firms are firms with pseudo q blow median. In Panel A to C, high internal governance firms are proxy variables above median; low internal governance firms are proxy variables below median. In Panel D, high internal governance firms indicate that chairman of the board didn't served as CEO. Low internal governance firms indicate that chairman of the board served as CEO. "***" represents a 1% significance level; "**" represents a 5% significance level; "*" represents a 10% significance level.

Panel A: Internal Governance Measured by Board Size			
IG / Pseudo q		High	Low
High	N	44	56
	Mean	2.46***	0.06
	Median	0.95***	0.85
Low	N	79	33
	Mean	0.16	-2.33**
	Median	0.04	-1.96**
High Q & IG –Low Q & IG	Mean	4.80***	
	Median	2.92***	

Panel B: Internal Governance Measured by 5% Blockholder Ownership			
IG / Pseudo q		High	Low
High	N	55	51
	Mean	3.16***	0.40
	Median	1.68***	0.04
Low	N	55	48
	Mean	0.83	-1.33*
	Median	-0.18	-0.29
High Q & IG –Low Q & IG	Mean	4.50***	
	Median	1.97***	

Table 4 (continued)

Panel C: Internal Governance Measured by Insider Ownership			
IG ⟍ Pseudo *q*		High	Low
High	N	54	42
	Mean	1.93***	-0.47
	Median	0.95***	0.02
Low	N	46	51
	Mean	0.58	-1.19*
	Median	-0.07	-0.42*
High Q & IG –Low Q & IG	Mean	3.12***	
	Median	1.37***	

Panel D: Internal Governance Measured by Duality			
IG ⟍ Pseudo *q*		High	Low
High	N	40	77
	Mean	2.40***	0.65
	Median	1.30***	0.04
Low	N	36	74
	Mean	-0.41	-0.93
	Median	-0.29	-0.53
High Q & IG –Low Q & IG	Mean	3.33***	
	Median	1.84***	

Table 5
Cross-Sectional Impact of Internal Governance on Cumulative Abnormal Return (CAR)

The dependent variable is two-day (-1, 0) cumulative abnormal return (CAR). Two-day announcement period abnormal returns are estimated using the standard market model procedure with parameters estimated for the period 200 days to 60 days before the announcement. Board size is nature logarithm of number of the board of directors in the fiscal year -1. 5% blockholder ownership is the total percentage of company's stock held by shareholder owning more 5% or more of the company's stock. Insider ownership is the total percentage of company's stock held by directors and officers owning. Duality is a dummy variable, which the chairman of the board served as chief executive officer (CEO) equal one and otherwise equal zero. Size measured by nature logarithm of the market value of equity. The industry R&D intensity (IRI) is the ratio of industry R&D expenditures to industry sales in fiscal year -1. Relative firm R&D Intensity (FRI) is the ratio of firm R&D expenditure to sales in fiscal year -1. Industry concentration (IC) is measured by the Herfindahl index, which is equal to the sum of squares of the financial market shares of all firms with the same primary four-digit SIC industry code in Compustat. Q is pseudo q dummy variable; if firms with pseudo q above median, then Q equal one and otherwise equal zero. Pseudo q is estimated as the ratio of the market value of the firm's assets to the book value of the firm's assets for the fiscal years before the announcement, where the market value of assets is estimated as the book value of assets minus the book value of common equity plus the market value of common equity. The number in the parentheses presents *t-value*. "***" represents a 1% significance level; "**" represents a 5% significance level; "*" represents a 10% significance level.

	Model 1	**Model 2**	**Model 3**	**Model 4**
Intercept	-8.028	0.969	0.873	1.766
	(-3.30)***	(0.47)	(0.52)	(0.93)
Board Size	3.847			
	(4.64)***			
Blockholder Ownership		4.071		
		(2.26)**		
Insider Ownership			4.016	
			(1.93)*	
Duality				-1.559
				(-2.25)**
Size	-0.249	-0.308	-0.175	-0.223
	(-1.12)	(-1.54)	(-1.01)	(-1.19)
IRI	1.694	9.191	-1.484	0.220
	(0.34)	(1.79)*	(-0.34)	(0.05)
FRI	0.055	0.051	0.047	0.084
	(1.28)	(1.36)	(1.35)	(2.24)**
IC	0.193	0.517	0.905	1.170
	(0.11)	(0.30)	(0.60)	(0.73)
Q	2.451	1.800	1.254	2.186
	(2.90)***	(2.24)**	(1.71)*	(2.90)***
N	212	209	193	227
Adjusted R^2	0.097	0.135	0.051	0.073
F-value	4.77***	6.40***	2.71**	3.98***

Table 6
Cross-Sectional Impact of Pseudo Q and Internal Governance on Cumulative Abnormal Return (CAR)

The dependent variable is two-day (-1, 0) cumulative abnormal return (CAR). Two-day announcement period abnormal returns are estimated using the standard market model procedure with parameters estimated for the period 200 days to 60 days before the announcement. Board size is number of the board of directors in the fiscal year -1. 5% blockholder ownership is the total percentage of company's stock held by shareholder owning more 5% or more of the company's stock. Insider ownership is the total percentage of company's stock held by directors and officers owning. Duality is a dummy variable, which the chairman of the board served as chief executive officer equal one and otherwise equal zero. Q*IG_H indicate high-q and high-governance firms; Q*IG_L indicate low-q and low-governance firms. High Q firms are firms with pseudo q above median. In Model 1 to 3, high internal governance firms are proxy variables above median; in Model 4, high internal governance firms indicate that chairman of the board didn't served as CEO. And then, In Model 1 to 3, low internal governance firms are proxy variables below median; in Model 4, low internal governance firms indicate that chairman of the board served as CEO. Size measured by nature logarithm of the market value of equity. The industry R&D intensity (IRI) is ratio of industry R&D expenditures to industry sales in fiscal year -1. Relative firm R&D Intensity (FRI) is ratio of firm R&D expenditure to sales in fiscal year -1. Industry concentration (IC) is measured by the Herfindahl index, which is equal to the sum of squares of the financial market shares of all firms with the same primary four-digit SIC industry code in Compustat. Q is Pseudo q dummy variable; if firms with pseudo q above median, then Q is 1 and otherwise is 0. Pseudo q is estimated as the ratio of the market value of the firm's assets to the book value of the firm's assets for the fiscal years before the announcement, where the market value of assets is estimated as the book value of assets minus the book value of common equity plus the market value of common equity. The number in the parentheses presents *t-value*. "***" represents a 1% significance level; "**" represents a 5% significance level; "*" represents a 10% significance level.

	Model 1	**Model 2**	**Model 3**	**Model 4**
Intercept	1.815	2.576	1.790	1.538
	(0.80)	(1.41)	(1.12)	(0.79)
Q*IG-H	2.714	1.960	2.017	2.444
	(2.75)***	(2.42)**	(2.84)***	(2.73)***
Q*IG-L	-2.982	-1.442	-1.514	-1.383
	(-2.73)***	(-1.66)*	(-2.01)**	(-1.82)*
Size	-0.196	-0.333	-0.173	-0.201
	(-0.85)	(-1.92)*	(-1.17)	(-1.08)
IRI	-0.230	8.832	-3.663	1.666
	(-0.05)	(1.79)*	(-0.85)	(0.40)
FRI	0.048	0.053	0.045	0.087
	(1.10)	(1.43)	(1.31)	(2.34)**
IC	0.010	0.416	1.274	0.930
	(0.01)	(0.25)	(0.88)	(0.59)
N	212	209	193	227
Adjusted R^2	0.058	0.138	0.082	0.075
F-value	3.18***	6.55***	3.86***	4.03***