RESEARCH NOTES AND COMMENTARIES

THE IMPACTS OF PERFORMANCE RELATIVE TO ANALYST FORECASTS AND ANALYST COVERAGE ON FIRM R&D INTENSITY

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Taking an agency theory perspective of managers as risk averse and self-interest seeking and focusing on externally generated analyst forecasts as the performance target, we propose that managers tend to cut R&D expenses when they are under pressure to meet analyst forecasts, especially when they face an increase in employment risk after missing the forecasts. We further argue that analyst coverage can serve as an external monitoring mechanism to help contain this agency problem. We test these arguments with data from a sample of U.S. manufacturing firms during the period of 1979 to 2005. Copyright © 2012 John Wiley & Sons, Ltd.

INTRODUCTION

Research and development (R&D) activities are important to organizational learning, innovation, and long-term firm success (Cohen and Levinthal, 1990). Recent studies (e.g., Chen, 2008; Chen and Miller, 2007; Greve, 2003a) find that firms tend to increase R&D intensity when performance falls below organizational aspirations and reduce it when performance exceeds organizational aspirations. From an agency theory perspective, we attempt to further enhance the understanding of firm R&D intensity in response to performance relative to a target by focusing on two related issues that have not been addressed in prior studies. The first concerns externally generated short-term performance targets, and the second concerns managerial incentives.

Publicly traded corporations generally confront externally generated targets, such as security analysts' earnings forecasts, that have important implications for the employment and personal wealth of corporate managers (Bartov, Givoly, and Hayn, 2002; Burgstahler and Dichev, 1997; Puffer and Weintrop, 1991). Taking an agency theory perspective of managers as risk averse and self-interest seeking (Amihud and Lev, 1981), we argue that there is an agency problem in managerial decisions related to R&D intensity in response to performance relative to analyst forecasts. Specifically, acting out of self-interest, corporate managers use reductions in R&D intensity as a means

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to increase the chance of meeting analyst forecasts, especially when performance misses analyst forecasts in the prior year. Further, managers' tendency to reduce R&D intensity when performance misses forecasts is weakened by the level of analyst coverage. We test these arguments with data from a sample of U.S. manufacturing firms during the period of 1979 to 2005 and find empirical support. Our study contributes to the R&D literature by showing not only the presence of an agency problem in firm R&D decisions in response to performance relative to analyst forecasts but also the function of analyst coverage as an external monitoring mechanism that helps to contain this problem.

THEORY AND HYPOTHESES

Agency theory proposes that corporate managers are more concerned with their personal interests than the interests of the firm and shareholders (Jensen and Meckling, 1976). Moreover, managers are not risk neutral but risk averse in strategic decision making because much of their wealth, status, and careers are tied to the performance of their firms (Amihud and Lev, 1981).[1] Acting out of self-interest, managers may undertake actions that can lower their employment risk even though these actions may run counter to the preference of shareholders. Although R&D investment is important to long-term firm success (Cohen and Levinthal, 1990), there is risk involved because the benefits of R&D investment tend to be distant and most R&D projects have a low likelihood of success (Scherer and Ross, 1990). Because of the risk, firms have been found to cut R&D investment when managers are not closely monitored by the board (Kor, 2006).

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[1] Lane, Cannella, and Lubatkin (1998) challenge Amihud and Lev's (1981) argument that unrelated diversification represents a case in which the interests of managers and shareholders diverge, but not the argument of managerial risk aversion that is central to our study. In fact, they acknowledge that managers are concerned about firm-specific risk (558) and that managers will act in self-serving and opportunistic ways when their interests are clearly and directly at stake (559). Because missing analyst forecast has a significant impact on the employment of top managers (Farrell and Whidbee, 2003; Puffer and Weintrop, 1991), our study focuses on a situation in which managers' interests are clearly and directly at stake. We thus expect agency problems to emerge in the context of our study.

Performance relative to analyst forecasts and R&D intensity

Security analysts' earnings forecasts represent an important externally generated short-term performance target that publicly traded firms are expected to meet and that have important implications for their top managers (Bartov *et al.*, 2002; Puffer and Weintrop, 1991). Investors tend to assign higher values to firms that meet analyst forecasts (Bartov *et al.*, 2002; Kasznik and McNichols, 2002). Good performance in the stock market not only increases managers' personal wealth but also lowers their employment risk (Finkelstein, Hambrick, and Cannella, 2008). In contrast, missing analyst forecasts can result in a decrease of firm market value (Bartov *et al.*, 2002) and an increase of top managers' employment risk (Farrell and Whidbee, 2003; Puffer and Weintrop, 1991). Concerned with their personal interests, top managers treat analyst forecasts as an important target to meet (Burgstahler and Dichev, 1997).

However, they are unlikely to treat analyst forecasts in the same way as organizational aspirations. Organizational aspirations are targets firms consciously set for the purpose of self-assessment (March, 1994). In setting aspirations, firms choose referents that are comparable to themselves, such as industry peers, so that they can assess their performance more accurately (Greve, 1998). Analyst forecasts are not the performance of real referents; instead, they are the projections of security analysts who are constrained by the information available and their own experiences and cognitive capacities (Hunton and McEwen, 1997). Managers treat these forecasts as an important target to meet merely because of the consequences for their personal wealth and employment risk (Kasznik and McNichols, 2002; Puffer and Weintrop, 1991).

Taking the agency theory perspective of managers as risk averse and self-interest seeking (Amihud and Lev, 1981; Jensen and Meckling, 1976), we predict that managers are likely to use reductions in R&D intensity as a means to eliminate performance discrepancy when performance misses analyst forecasts. Because missing analyst forecasts increases their employment risk (Puffer and Weintrop, 1991), managers are under great pressure to meet analyst forecasts in the following year (Kasznik and McNichols, 2002). Given that returns to R&D investments tend to be distant and uncertain (Scherer and Ross, 1990), an increase in

R&D intensity does not have an immediate positive impact on firm performance. It can actually make firm performance look worse because of the increase in firm expenses.

To boost short-term performance, managers are likely to search for opportunities to reduce expenses that do not have an immediate negative impact on revenues. R&D expenses are a likely candidate because their impact on revenues tends to be distant. There is evidence that firms use reductions in R&D expenses to boost earnings after a leveraged buyout (Long and Ravenscraft, 1993). We thus argue that managers may also use reductions in R&D expenses to increase the chance of meeting analyst forecasts after missing the forecasts in the prior year. The further performance misses analyst forecasts, the more R&D expenses managers will likely cut.

> *Hypothesis 1: When performance misses analyst forecasts, there is a negative relationship between the performance gap relative to forecasts and firm R&D intensity in the following year.*

When performance meets or exceeds security analysts' earnings forecasts, managers do not face an increase in employment risk, but they are still under pressure to meet analyst forecasts in the following year. Firms that exceed current analyst forecasts tend to face significantly higher future forecasts (Kasznick and McNichols, 2002). Being risk averse and self-interest seeking (Amihud and Lev, 1981), they may have little incentive to increase R&D investments in this situation. To have a higher chance of meeting the expected higher analyst forecasts in the following year, they may tighten R&D expenses so that they can reduce costs to hedge against the expected increase in analyst forecasts and/or potential downward fluctuations in revenues. The further performance exceeds analyst forecasts, the higher are the analyst forecasts that managers can expect to face in the following year, and the more R&D expenses they are likely to cut.

> *Hypothesis 2: When performance meets analyst forecast, there is a negative relationship between the performance gap relative to forecast and firm R&D intensity in the following year.*

The impact of analyst coverage

Firms vary in the number of security analysts who track and issue earnings forecasts for them. Firms that receive coverage from more security analysts generally receive a higher level of publicity, which makes them receive greater attention and scrutiny from investors (Jensen and Meckling, 1976; Johnson *et al*., 2005). There is evidence that the impact of firm performance on CEO turnover is stronger when a large number of analysts follow the firm (Farrell and Whidbee, 2003). We thus argue that analyst coverage can function as an external monitoring mechanism to help contain agency problems—firms that receive greater analyst coverage are more closely monitored by security analysts and investors and thus experience less of an agency problem.

Functioning as an external monitoring mechanism, analyst coverage can influence firm R&D intensity. Managers generally are less likely to engage in opportunistic behavior when they are closely monitored (Fama and Jensen, 1983). Unlike managers who tend to have a less favorable attitude toward R&D activities because of the uncertainty in their financial returns (Baysinger and Hoskisson, 1989), investors have a favorable attitude toward R&D investments (Chauvin and Hirschey, 1993). When firms receive greater analyst coverage, their managers are more closely monitored by analysts and investors.

Thus, analyst coverage may help contain the agency problem in R&D decisions when firm performance misses analyst forecasts. A reduction in R&D intensity, once discovered by security analysts and investors, can have a significantly negative impact on firm market value (Chauvin and Hirschey, 1993). To lower the risk of being discovered and getting another strong negative reaction from investors, corporate managers are likely less aggressive in cutting R&D intensity if their firms receive greater analyst coverage. For firms that receive coverage from a large number of analysts, their managers may even increase rather than reduce R&D intensity because of the strong monitoring from analysts and investors. Thus, we predict that analyst coverage weakens the negative relationship between performance gap and firm R&D intensity when performance misses analyst forecasts.

> *Hypothesis 3: When performance misses analyst forecasts, the interaction of the performance gap*

relative to forecasts and analyst coverage is positively related to firm R&D intensity in the following year.

We do not expect a moderating effect of analyst coverage when performance meets analyst forecasts for two reasons. First, because managers do not face an increase in employment risk when performance meets analyst forecasts, the reduction in R&D intensity is likely to be smaller and thus less noticeable. Second, even if the reduction in R&D intensity is noticed by analysts and investors, managers are in a better position to justify it because meeting analyst forecasts gives them more credibility (Shen and Cannella, 2002). Given the low risk of negative investor reactions, managers may not be as concerned with investor reactions in cutting R&D expenses in this situation.

METHODS

Our initial sample included all manufacturing companies (SIC [Standard Industrial Classification] codes from 2000 to 3999) listed in the COMPUSTAT that reported more than $10 million in sales and total assets each year from 1979 to 2005. To reduce the influence of a single firm on the estimate of industry-level variables, we excluded small industries with fewer than five firms at the four-digit SIC level (Chen and Miller, 2007). We also excluded firms that reported R&D expenses greater than sales because they were most likely research companies. After this procedure, our sample consists of 3,904 firms and 25,251 firm-year observations, covering 195 industries at the four-digit SIC level. We used this sample to calculate the industry-level variables, including industry performance, industry R&D intensity, and industry growth. We then used the I/B/E/S database to collect data on analysts' earnings forecasts and matched them with the COMPUSTAT data. Our final sample consists of 2,539 firms and 14,729 firm-year observations.

Dependent, independent, and control variables

R&D intensity. Consistent with prior studies (e.g., Chen and Miller, 2007; Cohen and Levinthal, 1990), we measured *R&D intensity* as the percentage of firm R&D expenses over sales during each fiscal year. Firms are not required to break out

R&D expenses from sales and general administrative (SG&A) expenses if they are less than 10 percent of SG&A (*SEC Regulation 5-03.2*). About 25 percent of our observations have missing values in R&D expenses. We replaced the missing values with zero, on the assumption that these firms invested very little (less than 10% of SG&A) in R&D. In separate analyses, we ran the analysis using only observations that reported R&D expenses and obtained essentially the same results.

Performance relative to forecast. We measured analyst forecast as the average of security analysts' forecasts of the firm's earnings per share (EPS). Although different analysts often make different earnings forecasts for the same firm around the same time (Hunton and McEwen, 1997), research shows that the 'consensus,' or the average of the forecasts, is the target that investors generally expect the firm to meet (Kasznik and McNichols, 2002). Analysts normally revise their forecasts on an ongoing basis during the course of the year as they gain more information. Bartov *et al.* (2002) show that investors react strongly to earnings surprises over the last forecast preceding earnings release by the firm. We thus used each analyst's last forecast before the end of the fiscal year to calculate the 'consensus' of the EPS forecasts. We then calculated the size of the performance gap relative to analyst forecast as the following:

$$\text{Performance gap relative to forecast}_{it}$$
$$= |(\text{actual EPS}_{it} - \text{EPS forecast}_{it})/$$
$$(\text{EPS forecast}_{it})|$$

Compared with a dollar value-based difference measure, our ratio-based measure takes into account the difference in the size of analyst forecasts across firms and thus better reflects firm performance relative to analyst forecast (Puffer and Weintrop, 1991). We took the absolute value to correct for the problem of sign-switching when the forecast is negative.

Analyst coverage. We measured the *analyst coverage* each firm received using the number of analysts who issued earnings forecasts for it during the year (Farrell and Whidbee, 2003). A higher value of this measure indicates a higher level of analyst coverage.

Performance relative to aspirations. Research shows that firm performance relative to historical and social aspirations, measured by return

on assets (ROA), influences firm R&D intensity (Chen and Miller, 2007; Greve, 2003a). Following Chen and Miller (2007), we included separate measures of performance relative to historical and social aspirations as controls. We calculated ROA as the ratio of net income before extraordinary items to the average of total assets at the beginning and the end of the fiscal year. We measured historical aspiration as firm ROA during the prior year and social aspiration as the median ROA of all the other firms within the same industry at the four-digit SIC level during that year. Performance relative to historical aspiration was the difference between firm ROA and historical aspiration, and performance relative to social aspiration was the difference between firm ROA and social aspiration.

Past R&D intensity. Because the allocation of resources to R&D activities remains relatively stable over time due to 'institutionalized' organizational search (Chen and Miller, 2007; Greve, 2003b), we included R&D intensity during the prior year as a control. The inclusion of a lagged dependent variable in the model also provides a solution for first-order autocorrelations in panel data analysis, which were present in our data as suggested by a Wooldridge (2002) test ($F = 297.01$, p < 0.001).

Other control variables. Firms with more slack resources are more active in R&D and can release these resources during adverse times (Greve, 2003b). We measured *available slack* as the ratio of current assets to current liabilities, *potential slack* as the ratio of long-term debt to shareholder equity, and *recoverable slack* as the ratio of SG&A to sales (Palmer and Wiseman, 1999). The threat of bankruptcy affects firm behavior, including R&D activities (Chen and Miller, 2007). We used *Altman's Z* as a measure of the firm's distance from bankruptcy. A higher value of this measure indicates a lower risk of bankruptcy.

We included *firm size* to control for its impact on R&D intensity and measured it as the logarithm of sales. We included two industry-level variables at the four-digit SIC level. One is *industry R&D intensity*, measured by the average of firm R&D intensity in the industry. This measure was to control for the difference in R&D intensity across industries. The other, *industry growth*, was measured by the percentage increase in industry sales relative to the prior year. This measure was to control for the impact of growth in the product markets (Chen and Miller, 2007).

Statistical analysis

Our hypotheses focus on the impact of the performance gap relative to analyst forecast on firm R&D intensity under different performance contexts (whether performance meets or misses analyst forecasts). Because firms tend to behave differently depending on whether they miss or meet their performance target (March, 1994), we split our sample on the basis of whether firm performance meets analyst forecasts to test our hypotheses. This approach generates regression coefficients for all of our variables under performance meeting analyst forecasts and under performance missing analyst forecasts separately and enables us to examine their impacts on firm R&D intensity under different performance contexts. We ran all analysis using firm fixed-effects panel regression models. These models enable us to control for both firm effects and time effects in analysis. All of our independent variables and control variables lag the dependent variable by one year.

RESULTS, DISCUSSION, AND CONCLUSIONS

Table 1 reports descriptive statistics and correlations of the variables. Table 2 reports results of our split-sample regression analysis. We mean-centered performance relative to analyst forecasts and analyst coverage in the analysis to aid the interpretation of the interaction effects and reduce the potential for multicolinearity (Aiken and West, 1991). Models 1 to 3 report results for the subsample in which performance missed analyst forecasts. In Model 2 the coefficient for *performance to forecast$_{t-1}$* is negative ($b = -0.31$, p < 0.01), providing support for Hypothesis 1. In Model 3 the coefficient for *performance to forecast$_{t-1}$* is still negative ($b = -0.30$, p < 0.05) and the coefficient for its interaction with *analyst coverage$_{t-1}$* is positive ($b = 0.03$, p < 0.01), providing support for Hypothesis 3.

Models 4 to 6 report results for the subsample in which performance met or exceeded analyst forecasts. In Model 5 the coefficient for *performance to forecast$_{t-1}$* is negative ($b = -0.16$, p < 0.05), providing support for Hypothesis 2. Compared with the results in Model 3, the magnitude of the impact of performance gap relative to analyst forecasts is smaller when performance exceeded forecasts

Table 1.   Variable means, standard deviations, and correlation coefficients

Variable	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12
1 R&D intensity$_t$	5.59	8.72	0.00	98.99												
2 (Performance to forecast)$_{t-1}$	0.73	0.71	0.00	4.47	0.09*											
3 Analyst coverage$_{t-1}$	8.10	7.81	1.00	64.00	0.10*	0.05*										
4 (Performance - historical performance)$_{t-1}$	−0.01	0.13	−5.06	4.43	−0.02*	−0.15*	−0.01									
5 (Performance - socail aspiration)$_{t-1}$	0.00	0.12	−5.06	2.10	−0.21*	−0.26*	0.07*	0.56*								
6 R&D intensity$_{t-1}$	5.71	9.90	0.00	43.83	0.88*	0.12*	0.09*	−0.05*	−0.29*							
7 Available slack$_{t-1}$	1.88	1.97	0.00	34.92	0.40*	−0.03*	−0.03*	0.01*	0.10*	0.35*						
8 Potential slack$_{t-1}$	0.33	0.65	0.00	5.00	−0.19*	0.12*	−0.08*	−0.04*	−0.14*	−0.17*	−0.20*					
9 Recoverable slack$_{t-1}$	27.04	17.24	0.42	93.52	0.66*	0.09*	0.00	−0.04*	−0.26*	0.67*	0.29*	−0.23*				
10 Altman Z$_{t-1}$	5.48	7.32	−27.26	34.72	0.18*	−0.05*	0.03*	0.07*	0.30*	0.13*	0.55*	−0.24*	0.13*			
11 Log(revenue)$_{t-1}$	6.03	1.59	2.31	10.55	−0.28*	−0.02*	0.59*	0.03*	0.14*	−0.25*	−0.34*	0.11*	−0.35*	−0.16*		
12 Industry R&D intensity$_{t-1}$	4.20	4.68	0.00	45.72	0.54*	0.07*	0.06*	0.00	−0.02*	0.50*	0.30*	−0.19*	0.45*	0.21*	−0.24*	
13 Industry growth$_{t-1}$	8.49	33.89	−94.71	70.38	0.00	−0.02*	0.00	0.01	0.01*	−0.01	0.00	0.00	−0.02	0.00	0.01	−0.01

* $p < 0.05$. Panel data. N = 14, 729.

Table 2. Firm fixed-effect panel regression of the impacts of performance relative to analyst forecast on R&D intensity: split-sample analysis

	Performance missed forecasts			Performance met/exceeded forecasts		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(Performance to forecast)$_{t-1}$ (H1: −; H2: −)		−0.31** (0.10)	−0.30* (0.13)		−0.16* (0.08)	−0.23* (0.11)
X Analyst coverage$_{t-1}$ (H3: +)			0.03** (0.01)			0.01 (0.01)
Analyst coverage$_{t-1}$		0.10*** (0.02)	0.05** (0.02)		0.08*** (0.01)	0.08*** (0.01)
(Performance - historical aspiration)$_{t-1}$	−2.38* (0.95)	−2.16* (0.95)	−2.28† (1.27)	−1.31 (1.13)	−0.80 (1.14)	−0.76 (1.21)
(Performance - social aspiration)$_{t-1}$	4.56* (1.81)	3.55* (1.80)	3.39 (2.42)	3.05† (1.66)	2.66 (1.67)	2.44 (1.68)
R&D intensity$_{t-1}$	0.25*** (0.03)	0.25*** (0.03)	0.23*** (0.04)	0.37*** (0.06)	0.36*** (0.06)	0.36*** (0.06)
Available slack$_{t-1}$	0.45*** (0.06)	0.41*** (0.06)	0.42*** (0.07)	0.12 (0.08)	0.10 (0.08)	0.07 (0.09)
Potential slack$_{t-1}$	−0.09 (0.06)	0.03 (0.06)	−0.01 (0.07)	0.00 (0.09)	0.07 (0.09)	0.09 (0.10)
Recoverable slack$_{t-1}$	0.06** (0.02)	0.06** (0.02)	0.07** (0.02)	0.03 (0.02)	0.03 (0.02)	0.03 (0.02)
Altman Z$_{t-1}$	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
Log(revenue)$_{t-1}$	−1.80*** (0.26)	−2.24*** (0.27)	−1.84*** (0.26)	−0.75*** (0.16)	−1.16*** (0.17)	−1.20*** (0.17)
Industry R&D intensity$_{t-1}$	0.02 (0.05)	0.01 (0.05)	0.02 (0.05)	−0.05 (0.03)	−0.04 (0.03)	−0.04 (0.03)
Industry growth$_{t-1}$	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Constant	13.41*** (1.78)	16.21*** (1.85)	11.43*** (1.63)	6.29*** (1.11)	8.69*** (1.11)	8.86*** (1.11)
Model F	14.88**	16.77**	13.43**	7.85**	8.27**	8.34**
R^2	0.29	0.31	0.32	0.20	0.21	0.22
ΔR^2		0.02***	0.01**		0.01***	0.01***
Number of firms	2176	2176	2176	1917	1917	1917
N	7165	7165	7165	7564	7564	7564

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Two-tailed tests, robust standard errors are in parentheses.
Coefficients for year indicator variables are not reported.

than when performance missed forecasts, suggesting that managers were more aggressive in cutting R&D expenses when performance missed forecasts. Our further analysis using the full sample confirms this finding—it shows that a dummy variable indicating performance below forecasts has a significant negative impact on firm R&D intensity above and beyond the negative impact of performance gap relative to analyst forecasts. Model 6 adds the interaction of performance to forecast and analyst coverage and shows that it has no effect on R&D intensity. In all analyses, the coefficients for *analyst coverage* are consistently positive, consistent with our argument that firms invest more in

R&D when they receive greater coverage by security analysts.

To better illustrate the above results, we present them graphically in Figure 1 below. Figure 1a presents the main effects of performance relative to analyst forecasts on firm R&D intensity. It shows that firm R&D intensity decreases as the performance gap relative to analyst forecasts increases and that the decrease is faster when firm performance is below forecasts. Figure 1b presents the moderating effect of analyst coverage when performance misses analyst forecasts. Following Aiken and West (1991), we present the relationship between the performance gap relative to analyst

(a)

(b)

— High analyst coverage
- - - Low analyst coverage
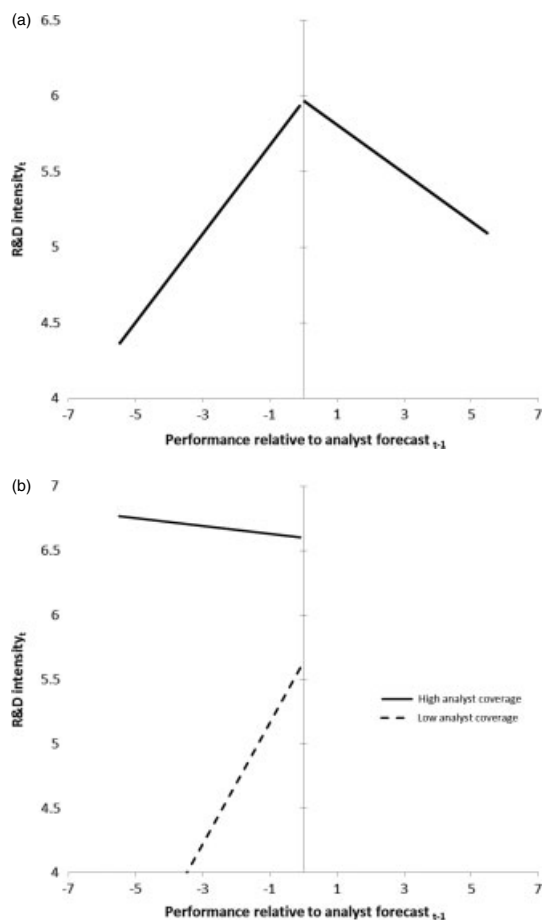
[a]Performance relative to analyst forecast is mean-centered. In Figure 1b, high and low analyst coverage is one standard deviation below and above the mean respectively.

Figure 1. The effects of performance relative to analyst forecast and analyst coverage on firm R&D intensity[a]

forecasts and firm R&D intensity in the following year under high (one standard deviation above mean) and low (one standard deviation below mean) analyst coverage, respectively. The figure shows that an increase in the performance gap relative to analyst forecasts leads to a decrease in R&D intensity when analyst coverage is low and leads to a slight increase in R&D intensity when analyst coverage is high, providing further support for Hypothesis 3.

By taking an agency perspective of managers as risk averse and self-interest seeking and focusing on analyst forecasts as the target, our study complements recent research that focuses on organizational aspirations in the study of the impact of performance targets on firm R&D decisions. When

the target is organizational aspirations, empirical evidence suggests that firms increase R&D intensity when performance falls below it (Chen and Miller, 2007; Greve, 2003b). When the target is externally generated analyst forecasts, our results indicate that firms decrease R&D intensity when performance misses the target unless they receive a high level of analyst coverage. This finding is consistent with our agency perspective of managerial risk taking and the argument of analyst coverage as an external monitoring mechanism.

Our study has two implications for future research and practice. First, it emphasizes the need to pay attention to agency problems when the performance target is externally generated and affects managers' personal interests. Firms often face multiple performance targets that may have different implications for managers. We believe that paying attention to managerial incentives can help us better understand how managers allocate attention and prioritize these targets. Further, investors and the boards of directors probably should de-emphasize meeting analyst forecasts in the assessment of managerial performance so that managers can take a more long-term perspective in R&D decisions. Second, our study shows that analyst coverage can function as an external monitoring mechanism that helps to contain the agency problem in firm R&D decisions in response to performance relative to analyst forecasts. A natural extension is to examine whether analyst coverage can also help contain agency problems in other strategic decisions such as diversification and mergers and acquisitions. Researchers can also investigate factors that may either strengthen or weaken the monitoring function of analyst coverage.

Another noteworthy finding of our study concerns the effects of the control variables of performance relative to organizational aspirations, which are not consistent with Chen and Miller's (2007) finding that both performance below historical aspiration and performance below social aspiration leads to an increase in firm R&D intensity. Our focus on analyst forecasts probably caused the difference. Because we included only firms covered by security analysts, our final sample ($N = 14,729$) is much smaller than Chen and Miller's ($N >= 25,078$). More importantly, all firms in our final sample were under pressure to meet analyst forecasts, while many firms in the Chen and Miller (2007) sample were not because they received

no analyst forecast. When top managers are not under pressure to meet analyst forecasts, they may focus on organizational aspirations in performance assessment. This issue surely deserves further investigation.

A primary limitation of our study is that we did not directly observe the decision making process by top managers to detect agency problems in firm R&D intensity decisions in response to performance differences relative to analyst forecasts. Instead, we inferred its existence by examining the impacts of the performance gap relative to analyst forecasts and analyst coverage on firm R&D intensity using archival data. Although we found firms reduced R&D intensity as performance relative to analyst forecasts increased, we do not know whether firms cut R&D expenses on new projects, on less promising old projects, or on all projects across the board. Future research can investigate how firms choose from the variety of available reductions in R&D investment.

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REFERENCES

Aiken LS, West SG. 1991. *Multiple Regression: Testing and interpreting interactions*. Sage: Newbury Park, CA.

Amihud Y, Lev B. 1981. Risk reduction as a managerial motive for conglomerate mergers. *Bell Journal of Economics* **12**(2): 605–617.

Bartov E, Givoly D, Hayn C. 2002. The rewards to meeting or beating earnings expectations. *Journal of Accounting and Economics* **33**(2): 173–204.

Baysinger B, Hoskisson RE. 1989. Diversification strategy and R&D intensity in multiproduct firms. *Academy of Management Journal* **32**(2): 310–332.

Burgstahler D, Dichev I. 1997. Earnings management to avoid earnings decreases and losses. *Journal of Accounting and Economics* **24**(1): 99–126.

Chauvin KW, Hirschey M. 1993. Advertising, R&D expenditures and the market value of the firm. *Financial Management* **22**(4): 128–140.

Chen W-R. 2008. Determinants of firms' backward- and forward-looking R&D search behavior. *Organization Science* **19**(4): 609–622.

Chen W-R, Miller KD. 2007. Situational and institutional determinants of firms' R&D search intensity. *Strategic Management Journal* **28**(4): 369–381.

Cohen WM, Levinthal DA. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* **35**(1): 128–152.

Fama EF, Jensen MC. 1983. Separation of ownership and control. *Journal of Law & Economics* **26**(2): 301–325.

Farrell KA, Whidbee DA. 2003. Impact of firm performance expectations on CEO turnover and replacement decisions. *Journal of Accounting and Economics* **36**: 165–196.

Finkelstein S, Hambrick DC, Cannella AA Jr. 2008. *Strategic Leadership: Theory and Research on Executives, Top Management Teams, and Boards*. Oxford University Press: New York.

Greve HR. 1998. Performance, aspirations, and risky organizational change. *Administrative Science Quarterly* **43**(1): 58–86.

Greve HR. 2003a. A behavioral theory of R&D expenditures and innovations: Evidence from shipbuilding. *Academy of Management Journal* **46**(6): 685–702.

Greve HR. 2003b. *Organizational Learning from Performance Feedback: A Behavioral Perspective on Innovation and Change*. Cambridge University Press: New York.

Hunton JE, McEwen RA. 1997. An assessment of the relation between analysts' earnings forecast accuracy, motivational incentives and cognitive information search strategy. *Accounting Review* **72**: 497–515.

Jensen MC, Meckling WH. 1976. Theory of firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* **3**(4): 305–360.

Johnson JL, Ellstrand AE, Dalton DR, Dalton CM. 2005. The influence of the financial press on stockholder wealth: the case of corporate governance. *Strategic Management Journal* **26**(5): 461–471.

Kasznik R, McNichols MF. 2002. Does meeting earnings expectations matter? Evidence from analyst forecast revisions and share prices. *Journal of Accounting Research* **40**: 727–759.

Kor YY. 2006. Direct and interaction effects of top management team and board compositions on R&D investment strategy. *Strategic Management Journal* **27**(11): 1081–1099.

Lane PJ, Cannella AA Jr, Lubatkin MH. 1998. Agency problems as antecedents to unrelated mergers and diversification: Amihud and Lev reconsidered. *Strategic Management Journal* **19**(6): 555–578.

Long WF, Ravenscraft DJ. 1993. LBOs, debt and R&D intensity. *Strategic Management Journal*, Summer Special Issue **14**: 119–135.

March JG. 1994. *A Primer on Decision Making: How Decisions Happen*. Free Press: New York.

Palmer TB, Wiseman RM. 1999. Decoupling risk taking from income stream uncertainty: a holistic model of risk. *Strategic Management Journal* **20**(11): 1037–1062.

Puffer SM, Weintrop JB. 1991. Corporate performance and CEO turnover: the role of performance expectations. *Administrative Science Quarterly* **36**(1): 1–19.

Scherer FM, Ross D. 1990. *Industrial Market Structure and Economic Performance*. Houghton Mifflin: Dallas, TX.

Shen W, Cannella AA Jr. 2002. Power dynamics with top management and their impacts on CEO dismissal followed by inside succession. *Academy of Management Journal* **45**(6): 1195–1206.

Wooldridge JM. 2002. *Econometric Analysis of Cross Section and Panel Data*. MIT Press: Cambridge, MA.