More than Numbers: R&D-related Disclosure and Firm Performance

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ABSTRACT

This study examines the relation between reported financial performance and qualitative disclosure in the R&D disclosure setting. Prior disclosure research focuses largely on firms' decisions to provide stakeholders with quantitative financial information that directly summarizes financial performance. However, a significant amount of disclosure is not directly captured in the financial statements (e.g., narratives or text). This information is important to help market participants understand the economics underlying firms' operations. Specifically, I investigate whether current performance influences firms' incentives to disclose qualitative R&D-related information. Based on a detailed analysis of R&D-related disclosures, I find that current performance is negatively related to qualitative disclosure. This relation is more pronounced for firms that place more importance on R&D and for firms with higher outside monitoring. In contrast to my main results, I find that firms' decisions to provide earnings guidance, a more quantitative type of disclosure, are positively related to current performance. These findings highlight the complexity of firms' disclosure strategies and suggest that performance influences different types of disclosures in different ways.

1. Introduction

This study examines how firms' reported performance influences their decisions regarding the level of disclosure detail in their 10-K reports. Specifically, I examine firms' decisions to provide disclosures related to their investments in research and development (R&D). In general, prior empirical disclosure research typically focuses on how performance influences quantitative financial disclosures (e.g., earnings, earnings guidance or accounting segment data) that directly summarize financial performance and are available in large financial databases.[1] However, a comparatively large amount of disclosure information that is more qualitative in nature is not directly incorporated in the financial statements. Prior research focuses less on this type of disclosure, perhaps because it is difficult to measure and quantify. Qualitative disclosure is important because it helps market participants bridge the gap between the financial statements and the economic reality of firms' operations (Glassman 2003). This study seeks to provide new insights related to disclosure decisions and to increase our understanding of the role of qualitative disclosure in firms' overall disclosure strategies.

Recent empirical studies find that the textual characteristics (e.g., readability and tone) of qualitative disclosures have information content beyond that contained in quantitative accounting disclosures and are associated with important economic consequences such as equity mispricing and the characteristics of firms' information environments (Davis et al. 2008; Li 2008, 2010; Feldman et al. 2009; Brown and Tucker 2010; Lehavy, Li, and Merkley 2010). However, less is known about the determinants of firms' decisions to provide specific types of qualitative disclosure content and, importantly, how the influence of performance on these disclosures differs from more quantitative disclosures. To address these limitations, I examine the relation

[1] For examples, see Patell (1976), Grossman and Hart (1980), Penman (1980), Grossman (1981), Milgrom (1981), Verrecchia (1983), Ajinkya and Gift (1984), Dye (1985), Lev and Penman (1990), Skinner (1994), Kasznik and Lev (1995), Healy and Palepu (2001), Miller (2002), and Kothari, Shu, and Wysocki. (2009).

between reported performance and qualitative disclosure in the context of R&D-related disclosures.

The R&D setting offers several features that highlight the value of qualitative disclosure to market participants. First, R&D investments are associated with significantly high levels of risk and information asymmetry with respect to their potential outcomes (Aboody and Lev 2000). Second, information about these outcomes is especially important to investors because R&D has a significant impact on firm value and economic growth.[2] Third, prior research suggests that financial statements do not communicate effectively the value of R&D investments, especially when financial performance is low (Hayn 1995; Lev 1999; Lev and Zarowin 1999; Franzen et al 2007). The combination of investors' need for R&D-related information and the limitations of financial statements to convey it provides managers an important disclosure opportunity. They can provide qualitative disclosure to improve investors' understanding of firms' fundamental business activities as well as influence investors' interpretations of changes in financial performance and their assessment of future prospects.

Because R&D-related disclosures can have an important influence on investors' decisions, I investigate how reported financial performance influences R&D-related disclosure. A large body of literature finds that financial performance is important to capital market participants (see Kothari 2001 for a review of this literature). Investors' interest in performance provides incentives for firms to provide R&D-related disclosure in conjunction with their mandatory financial reports. Theoretical work on the interaction between mandatory and voluntary disclosure examines how variation in reported performance affects disclosure decisions (Hughes and Pae 2004; Einhorn 2005; Bagnoli and Watts 2007). However, there is little empirical evidence related to these theories. Thus, I examine how R&D-related disclosure

[2] See Griliches (1981, 1998), Jaffe (1986), Romer (1986, 1990), Lucas (1988), Hall (1993), Aghion and Tirole (1994), Sougiannis (1994), Lev and Sougiannis (1996), Chan et al. (2001), and Lev (2001).

varies based on performance and I develop hypotheses based on investors' evaluations of reported firm performance.

To identify R&D-related disclosures, I construct a measure based on the number of R&D-related sentences provided in 10-K filings. I categorize a sentence as R&D-related if it contains specific R&D-related keywords or phrases (see Appendix A). To identify the content of R&D-related disclosures, I classify R&D-related sentences into subjects, such as progress, competition, and facilities, based on the words provided in each sentence (see Appendix B for examples).[3] Using a sample of 20,990 10-K filings of firms that invest in R&D from 1996-2007, I find that firms disclose, on average, about 31 R&D-related sentences per 10-K.

I predict a negative relation between R&D-related disclosure and concurrent financial performance. This prediction is based on how the costs and benefits of disclosure change with performance. As firms' performance decreases, firms provide more R&D-related disclosure in response to the demands of investors who seek more information to evaluate current performance and assess the amount and uncertainty of future cash flows. As performance increases, firms face lower cash flow concerns and lower uncertainty; however, the costs of disclosure (e.g., proprietary costs) potentially increase because success invites increased competition.

Consistent with this prediction, I find that firms reporting lower (higher) financial performance, measured by concurrent earnings performance and a market-based measure of R&D payoff, provide more (less) R&D-related disclosure. This relation holds in analyses employing both firm-fixed effect and changes methodologies after controlling for a variety of disclosure determinants such as information environment, type of operations, uncertainty, and

[3] I use 10-K disclosures to measure firms' qualitative R&D-related disclosures because they are provided concurrently with the audited financial statements. However, the main inferences of this study continue to hold using the number of R&D-related press releases for a reduced sample of R&D intensive firms.

financing-related incentives. It also holds for samples of firms with both increasing and decreasing earnings performance.

I further investigate the role of performance on R&D-related disclosure by examining when the relation between year-to-year changes in R&D-related disclosure and changes in current performance is most pronounced. I predict a stronger negative relation between changes in firm performance and changes in R&D-related disclosure for firms that place more importance on R&D. I measure the importance that firms place on R&D using the intensity of R&D investments and the level of industry competition. I posit this relation because investors in these firms have greater interest in this information as performance decreases and, thus, firms have stronger incentives to provide R&D-related disclosure to help investors evaluate changes in performance. My findings are consistent with this prediction.

I also predict that the relation between changes in performance and changes in disclosure is more negative for firms with higher outside monitoring because outside monitors can mitigate managers' incentives to withhold information by pressuring firms to increase disclosure when performance is poor (Nagar 1999; Berger and Hann 2007; Kothari, Shu, and Wysocki 2009). These incentives are likely lower when performance is high. I measure the amount of outside monitoring based on analyst following and institutional ownership. I find a significantly stronger negative relation between changes in performance and changes in R&D-related disclosure for firms with higher outside monitoring, consistent with the prediction.

Overall, these results suggest that current performance influences firms' qualitative disclosure decisions. However, qualitative and quantitative disclosures can serve different purposes and could respond differently to performance. For example, qualitative disclosure can help investors understand firms' operations in light of current performance, while quantitative disclosure, such as earnings guidance, directly informs investors about performance. In addition, prior research suggests that firms are more willing to provide timely disclosures of good news

(Verrecchia 1983; Miller 2002; Kothari et al. 2009). Knowing whether performance influences qualitative and quantitative disclosures differently improves our understanding of firms' overall disclosure strategies. In contrast to my main findings, I find that current performance is *positively* associated with the likelihood that firms provide earnings guidance, a more quantitative type of disclosure. This finding highlights the complexity of disclosure strategies and suggests that performance influences different types of disclosures in different ways.

This study contributes to the disclosure literature in several ways. First, prior research focuses largely on how performance influences the disclosure of *quantitative* financial information or the release of a particular type of disclosure.[4] In contrast, this study addresses management's decisions to provide *qualitative* disclosure. Understanding how performance influences firms' qualitative disclosure decisions is particularly important because of the proportionately large amount of this information and its role in informing investors about firms' activities.

Second, while many studies control for firms' disclosure policies using measures of management earnings forecasts, the findings of this study suggest that this approach could over-generalize firms' disclosures and that researchers should also consider qualitative disclosures when studying or controlling for disclosure. Finally, this study also contributes to prior work investigating the textual features (e.g., readability and tone) of qualitative disclosures by focusing on firms' decisions to provide different amounts of R&D-related information and by providing a methodology for empirically quantifying such disclosures.

Section 2 reviews prior literature and develops my hypotheses. Section 3 describes the data and sample, and section 4 presents my empirical results. Section 5 concludes.

[4] For example, studies have examined conference calls (Frankel et al. 1999; Tasker 1999; Bowen et al. 2002), press releases (Miller 2002), and analyst disclosure ratings (Lang and Lundholm 1993). However, these studies have generally focused on the existence of specific disclosures or overall disclosure quality, rather than managements' decisions regarding the level of disclosure in a particular content area.

2. Prior Literature and Hypothesis Development

In this section, I review the related disclosure and R&D literatures and develop hypotheses about the relation between R&D-related disclosure and reported financial performance as well as about the determinants of the cross-sectional variation in this relation.

2.1 Forms of Voluntary Disclosure

The separation of ownership and control in modern corporations motivates the need for managers to disclose relevant information to obtain financing from outside investors and to help current investors evaluate managerial actions. To obtain access to the public U.S. capital markets, firms must also agree to be subject to securities regulations, created and enforced by the Securities and Exchange Commission (SEC). These regulations make the disclosure of certain financial information mandatory, such as the audited financial statements (see Schipper [2007] for a discussion of required disclosures in financial reports). Nevertheless, firms continue to exercise considerable discretion regarding the amount and content of disclosure within their mandatory reports.

In general, the information firms voluntarily disclose can be classified into two forms: (1) direct financial information (frequently quantitative) and (2) qualitative disclosure (i.e., narrative information of a more qualitative nature). Prior studies sometimes refer to these two forms of information as hard and soft information (Petersen 2004; Engelberg 2008; Demers and Vega 2010; Minnis 2010). A large body of analytical and empirical research examines the voluntary disclosure of direct financial information. Theoretical studies model a firm's decision to disclose a noisy signal of firm value based on whether the news in the signal exceeds a certain threshold. The threshold is determined in a rational expectations framework based on either the costs of disclosure or investors' uncertainty about management's information (Verrecchia 1983; Dye 1985). Related empirical studies focus largely on the disclosure of quantitative financial metrics,

such as earnings guidance or segment accounting data based on the news (good vs. bad news) of the disclosure (Patell 1976; Penman 1980; Ajinkya and Gift 1984; Lev and Penman 1990; Skinner 1994; Kasznik and Lev 1995; Harris 1998; Leuz 2004; Botosan and Stanford 2005; Berger and Hann 2007).

This stream of research typically does not directly consider the role of more qualitative disclosures or the interaction of these disclosures with the performance information in firms' mandatory reports. One potential reason that qualitative disclosure receive less attention is that it is not generally available in machine-readable format and thus, researchers incur higher costs to study it. Recent empirical studies examine the textual characteristics (readability or tone) of qualitative disclosures provided in conjunction with firms' mandatory disclosures and the economic consequences associated with this information. In general, these studies find that qualitative information is important and useful to market participants (Guo et al. 2004; Davis et al. 2008; Li 2008, 2010; Feldman et al. 2009; Brown and Tucker 2010; Lehavy et al. 2010; Sun 2010). However, this research has only begun to examine the importance of qualitative disclosure, and does not provide a complete picture of when and why firms disclose such qualitative information.

Analytical work suggests that the likelihood that firms disclose supplementary information increases as reported performance differs from expectations, i.e., increasing in either good or bad news (Bagnoli and Watts 2007). However, it is important to acknowledge that this result is based on particular assumptions regarding the costs and benefits of disclosure, which can, in themselves, depend on the news in the mandatory accounting reports. For example, it is possible that under certain conditions firms will produce disclosures only if the reported

performance is poor because the costs and benefits of disclosure are not necessarily symmetric for both good and bad news reports and can, in fact, be asymmetric.[5]

One example of such asymmetric costs is the influence of firm performance on information uncertainty. Theoretical work modeling performance as a normally distributed random variable finds no relation between firm performance and information uncertainty (i.e., variance of performance) because the mean and variance of normally distributed variables are independent (Ng et al. 2009). Empirical evidence suggests that firm performance is negatively associated with information uncertainty (Brown et al. 2009; Ng et al. 2009; Rogers et al. 2009). Given the potential for asymmetric costs and benefits, empirical research should examine the specific circumstances of the disclosure setting when making predictions about the relation between performance and disclosure.

2.2 R&D-related Disclosure

This study specifically examines the relation between qualitative R&D-related disclosure and reported financial performance. The R&D setting has several specific institutional features that make it an interesting area to study disclosure. R&D investment is associated with higher information asymmetry and uncertainty than more tangible investments. The unique and risky nature of R&D projects, the limited usefulness of information obtained from other firms, and the lack of well-developed markets for R&D-type assets reinforces the importance of R&D-related disclosure to investors (Aboody and Lev 2000; Boone and Raman 2001; Chan, Lakonishok, and Sougiannis 2001; Kothari, Laguerre, and Leone 2002).[6] Moreover, R&D investment is economically important. Public corporations invest hundreds of billions of dollars annually in

[5] One related stream of research from the managerial accounting literature is the variance investigation models. For example, the information obtained in a variance investigation can be thought of as producing a disclosure. Under certain conditions, a variance investigation takes place only when poor performance is sufficiently low due to differences in the costs and benefits of an investigation (Duvall 1967; Baiman and Demski 1980).

[6] In recent years, intellectual property auction firms such as Ocean Tomo have started to appear; however, the recent economic downturn and a lack of broad interest have limited the liquidity and size of these groups.

R&D projects to create valuable products, services, and processes (Wolfe 2010). A large literature across many disciplines examines R&D funding, performance, and valuation. R&D is of particular relevance to investors, because R&D investments affect performance, expected profits, and cash flows (Grandi et al. 2009; see Lev 2001 for a synthesis of prior research).

Accounting rules treat R&D differently than other investments. While firms periodically evaluate the values of financial and physical assets through impairment, depreciation, or mark-to-market procedures, firms must immediately expense R&D investments and are essentially not required to disclose much more.[7] Consequently, financial statements fail to communicate effectively the value and performance of R&D investments (Lev 1999; Aboody and Lev 2000; Lev and Zarowin 1999). Thus, qualitative R&D-related disclosures have the potential to provide information that is critical to investors' understanding of the performance information contained in the financial statements.

Despite the importance of R&D, prior research that directly examines firms' communication of R&D information within the mandatory disclosure context (i.e., within firms' financial reports) is limited to a small number of studies based on limited samples and industries. Entwistle (1999) examines the R&D disclosure environment of 113 technology-intensive firms listed on the Toronto Stock Exchange. He performs both field interviews with executives and analysts, as well as a content analysis of the R&D-related disclosures in annual reports. His field interviews suggest that managers make cost/benefit analyses for their R&D-related disclosure decisions and that there is large variation across firms in the importance of capital and product market concerns. In addition, his content analysis suggests that R&D-related disclosure varies by industry and the amount of R&D spending.

[7] It is important to note that this generalization can depend on the presence of R&D arrangements. Current regulations require that firms disclose (1) the total R&D expenses for each income statement period presented (SFAS 2), (2) the amount of any in-process R&D acquired through acquisitions (SFAS 141 and 142), and (3) the terms of any R&D arrangements accounted for as a contract to perform R&D for others (SFAS 68).

Similarly, Jones (2007) examines the amount of R&D information provided by firms using a sample of 119 U.S. firms in four R&D-related industries. She finds that R&D-related disclosure is associated with lower analyst forecast errors for both earnings and sales. Guo et al. (2004) focus on the competitive costs of disclosure by examining the product-related disclosures in the IPO prospectuses of 49 biotech companies. They find that the stage of product development, the availability of patent protection, and the presence of venture capital backing influence biotech firms' R&D-related disclosures. They also find that the amount of R&D-related disclosure is negatively associated with measures of information asymmetry.

While the generalizability of these studies is limited by their small samples and respective sample selection criteria, these studies suggest that managers can use their reporting discretion to provide important information about many different aspects of their R&D investments such as inputs (e.g., expenditure amounts, facilities, scientists, collaborations), progress of projects, outputs, and sources of funding. I extend prior research on R&D-related disclosure by examining the relation between disclosure and reported financial performance. In addition, I examine R&D-related disclosures using a large sample of firms across many different industries and base my tests on within-firm variation as well as changes in disclosure and performance.[8]

2.3 R&D-related Disclosure and Financial Performance

Motivated by theoretical models (Einhorn 2005; Bagnoli and Watts 2007), I study firms' decisions to provide qualitative R&D-related disclosure in the framework of performance evaluation. External stakeholders (e.g., investors, competitors, or suppliers) evaluate R&D firms'

[8] Two concurrent working papers examine firms' disclosure of R&D-related information outside of the firms' formal financial reporting. James and Shaver (2009) examine the disclosures of 302 firms in the communications and pharmaceutical industries. Their evidence suggests that firms with stronger strategic positions are more likely to provide press releases regarding R&D accomplishments. Nichols (2009) examines the disclosure of product-related and business expansion announcements. His evidence suggests that these announcements trigger positive returns that are increasing in proprietary costs.

reported current financial performance, relative to industry peers and prior period reports, to estimate firm value and to consider potential investment opportunities. Variation in reported performance relative to these benchmarks influences stakeholders' demands for R&D information to complement the financial statements and influences firms' willingness to supply this information.

Firms that invest in R&D bear significant risks and have a high probability of failure (i.e., skewed payoff distribution). Poor current performance raises considerable concern about the amount and uncertainty of future cash flows and increases investors' and suppliers' demand for additional information. These stakeholders could use this information in an attempt to better understand the implications of performance for the future, in light of firms' R&D investments. For example, prior research asserts that investors consider the causes and nature of poor performance with particular attention to R&D investments in forming expectations about firms' long-term prospects (Joos and Plesko 2005). Thus, poor performance can prompt managers to supply additional R&D-related disclosure to explain current poor performance or to help investors properly assess its importance. These issues are compounded by the fact that R&D investments are associated with higher information asymmetry and that the financial statements of poorly performing R&D firms are less useful to investors (Hayn 1995; Lev and Zarowin 1999; Franzen et al. 2007).[9]

Better current financial performance suggests that prior R&D investments have been successful and alleviates investors' concerns about the amount and uncertainty of firms' future cash flows. As performance increases, information asymmetry decreases and investors incentives to conduct information searches decreases (Brown et al. 2009). In addition, strong performance

[9] For example, one pharmaceutical controller commented that his firm recently increased R&D disclosure significantly in an effort to obtain investment capital. This was because investors needed to understand the firm's R&D in light of the firm's recent poor performance. Similarly, several investor relations professionals from technology firms suggested that they provide additional R&D information when performance is down to keep investors on-board with their firms' longer-term strategies.

invites competition and influences the behavior of competitors and suppliers who seek opportunities to increase their own performance (Dontoh 1989, Sadka 2004). The costs of disclosure (e.g., proprietary costs) could potentially increase with performance because higher performing firms could have more to lose in terms of competitive advantage. Information asymmetry between management and competing firms about the cause of higher performance and its relation to the firm's current R&D activities provides an important block to imitation and factor mobility (Lippman and Rumelt 1982, Barney 1991). Thus, providing less R&D-related disclosure when current performance is high could limit the ability of other firms to fully adjust important aspects of their operations such as pricing, production, research, advertising, or strategy. This suggests investors could demand less R&D-related disclosure when performance is higher and that managers could be less willingly to supply it.[10] Based on this analysis of both high and low performance, I offer the following hypothesis:[11]

H_1: Current financial performance is negatively associated with R&D-related disclosure.

My first hypothesis is consistent with the notion that as performance decreases (increases), investors demand more (less) information to better evaluate their current or potential investments. However, there is likely considerable variation in the importance of this relation across firms. For example, this relation likely varies in the cross-section based on the relative importance of R&D investments and the amount of outside monitoring.

[10] While it not completely clear whether 10-K information benefits firms' competitors, the author's discussions with competitive intelligence experts and industry professionals suggest that many firms are very concerned about this problem in their 10-K disclosures and that competitors read this information. For example, in one 10-K filing Medivation, a pharmaceutical firm, indicated for the first time that it was expediting its stage three trials of an Alzheimer drug. Subsequent to this release, Elan and Wyeth, working in the same area, revealed that it would expedite the trials for its own Alzheimer drug.

[11] Note that this prediction is opposite to that of the literature on more quantitative disclosures (e.g., Verrecchia 1983). The key issue is that qualitative and quantitative disclosures are different and serve different purposes. For example, I assume that qualitative R&D disclosure is used to "estimate the value implication of the content of firms' financial reports" (Bagnoli and Watts 2007, 886) as opposed to providing a direct signal about firm value.

My second hypothesis addresses how the relative importance of R&D investment to firms' business strategies influences the relation between performance and disclosure. On the one hand, as performance decreases, R&D-related information is likely to be more important to investors in firms that place a greater emphasis on R&D. I specifically refer to these firms as having high R&D priorities. On the other hand, as performance increases, R&D-related information could be more important to the competitors of firms with high R&D priorities (i.e., proprietary costs) to help them to adjust their own operations. I classify firms' R&D priorities (i.e., low or high) based on the proportion of their budget invested in R&D and the level of competition in their respective industries (i.e., industry concentration). My second hypothesis is as follows:

H_2: The negative association between current financial performance and R&D-related disclosure is more pronounced for firms with high R&D priorities as compared with firms with low R&D priorities.

Finally, I examine how the relation between R&D-related disclosure and financial performance varies based on outside monitoring. Agency concerns increase as firm performance decreases because managers seek to withhold information that could reveal poor managerial action or ability (Nagar 1999; Bushee and Leuz 2005; Berger and Hann 2007). In the case of R&D, poorly performing firms could be hesitant to provide R&D-related disclosure because investors could conclude that management is making poor R&D investments or lacks competence. However, outside monitors such as institutional shareholders could pressure management to make decisions that are more aligned with shareholders' interests (e.g., Bushee 1998). Thus, outside monitors can strengthen managements' response to investors when performance is poor by encouraging higher R&D-related disclosure. However, there is likely less incentive for them to do so when performance is high. Based on this reasoning, I make the following hypothesis:

H_3: The negative association between current financial performance and R&D-related disclosure is more pronounced for firms with high outside monitoring as compared with firms with low outside monitoring.

3. Sample and Variable Definitions

3.1 Sample Selection

My initial sample is based on firm/year observations for fiscal years 1996-2007 with financial data available on the Compustat Fundamental Annual table and pricing data available from the Center for Research in Security Prices (CRSP). In addition, I require that each observation have at least one million dollars of assets, report non-zero R&D expense, and have 10-K data available from the SEC's Electronic Data Gathering, Analysis, and Retrieval system (EDGAR). I link my sample observations to EDGAR filings based on the SEC's Central Index Key (CIK). I drop firms without matches from the sample. Further, I require that each firm-year observation be a member of an industry with sufficient data to compute a measure of industry R&D payoff as well as to calculate my control variables. I provide specific details about these measures later in this section. My final sample is composed of 20,990 firm-year observations from firms that invest in R&D.

3.2 Measuring R&D-related Disclosure

I measure R&D-related disclosure based on a content analysis of 10-K filings. This measure has several advantages. First, it allows me to sample from a broad range of industries and firms that make R&D investments. This is an improvement over prior empirical work on R&D-related disclosure that is limited to small samples and select industries. Second, this measure allows me to focus on qualitative disclosures that firms provide concurrently with accounting performance measures and reduces selection concerns because all firms with material R&D investments must provide a minimum level of disclosure in the 10-K filing. Third, prior research and private conversations with competitive intelligence professionals suggest that 10-K

filings are an important source of information for market participants (e.g., Previts et al. 1994; Rogers and Grant 1997; Choudhary et al. 2010; Lehavy et al. 2010; Brown and Tucker 2010). It is important to note, however, that some firms' 10-K filings have little within-firm variation (i.e., sticky disclosure) and can contain previously disclosed information (i.e., lack of timeliness).[12]

To measure the R&D-related disclosure in 10-K filings I first develop an R&D disclosure dictionary of keywords and phrases after carefully examining by hand a random selection of over one hundred and fifty 10-K filings of firms included in my sample. In particular, I focus on keywords and phrases common across different firms' disclosures. To ensure that my keywords list is reasonable I consulted industry personnel on R&D-related disclosure topics and compared my list with examples used in Entwistle (1999) and James and Shaver (2009). Appendix A contains the keywords that provide the basis for this dictionary approach to content analysis.[13]

I use this list of keywords and phrases along with their common variants to identify R&D-related disclosures at the sentence level using a computerized algorithm. This algorithm uses the Perl programming language's "regular expression" routines to search each 10-Ks for variations of the keywords and phrases found in Appendix A. Because it is difficult to construct measures based on subjective assessments of specific information items, I measure R&D-related disclosure ($R\&D_{DISC}$) as the number of R&D-related sentences in firm's 10-K filings.[14] Table 1

[12] These drawbacks should work against my ability to find results. Another potential medium for R&D disclosure is firms' press releases; however, collection of this data for a large sample of firms is very costly (e.g., data collection time and copyright/legal issues with data vendors). In addition, press releases can be subject to greater selection issues because firms are generally not obligated to issue R&D-related press releases, but are required to provide minimum R&D disclosures in the 10-K. I verify that my main results are similar in direction and significance in a reduced sample of firms using the number of R&D-related press releases as a measure of R&D disclosure. In addition, using a small hand-collected sample, I find that much of the specific information in firms' R&D-related press releases is contained in 10-K filings, but that the two disclosures have some differential information.

[13] Because any list of keywords is subjective, it is important to note that my main results continue hold in both direction and significance when using only the bolded words in Appendix A to calculate R&D disclosure. The standard errors are slightly larger, however, consistent with the notion of greater measurement error.

[14] Using this procedure, I likely measure R&D disclosure with error. Because my disclosure measure is a dependent variable in this paper, it will not bias my estimates if the error is random, but it could lead to larger standard errors. It is difficult to objectively determine whether these errors are biased. If they are, it seems reasonable to argue that this bias is most likely associated with the levels of the independent variables (i.e., firm characteristics) and not with

provides descriptive statistics of this measure. As shown in Panel A, the average firm discloses 30.99 R&D-related sentences. This number is likely higher than what would be anticipated if firms only disclose the minimum requirements.[15] As a benchmark, I examine the number of earnings and revenue related disclosures. As expected, the average number of R&D-related disclosures is lower than that of these other disclosure areas. However, it is still a significant amount of R&D-related disclosure given critics' contention that firms provide this information only for compliance purposes.

Panel B provides the descriptive statistics of firms' R&D-related disclosure based on industries using the Fama-French 48 classification. Consistent with prior R&D studies (Entwistle 1999), pharmaceutical firms provide the greatest amount of R&D-related disclosure, averaging about 82 R&D-sentences per 10-K. Firms in industries that create high-tech/computer products (Medical Equipment, Business Services, Electronic Equipment, Measuring and Control Equipment, and Computers) provide about 24 to 30 R&D-related sentences, on average. The remaining industries produce somewhat less R&D-related disclosure, averaging between 11 to 18 sentences.

Panel C provides statistics of the percentage of a firm's R&D-related disclosures that address specific R&D subjects. I assign a subject to an R&D-related disclosure if it contains words or phrases that relate to that particular subject. For example, an R&D-related sentence from a pharmaceutical firm could discuss the progress of current projects. I also examine the sentences directly following an R&D-related disclosure to determine its subject because these sentences often explain or elaborate on the R&D-related sentence. Appendix B provides examples of R&D-related disclosures pertaining to each subject category. I also examine

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their changes. The levels are more likely to be related to differences in the structure (i.e., word choice and syntax) of the text of firms' R&D-related disclosures.

[15] This assumes a strict interpretation of the rules and it is difficult to ascertain what the SEC would consider mandatory. For example, some firms receive comment letters from the SEC asking for additional R&D information. In general, firms respond to these requests by asserting that the information in question is proprietary and its disclosure would put the firm at a competitive disadvantage.

whether R&D-related disclosure relates to risk (R&D Risk) or contains forward-looking statements (R&D FLS).[16]

On average, 19% of firms' R&D-related disclosure is related to explaining the risks and uncertainties associated with R&D investment. A large portion of R&D-related disclosure is about forward-looking information (17%, mostly risk-related), prior R&D expenditures (14%), competition (12%), facilities (12%), and strategy (11%). Firms provide less information, on average, about topics such as R&D progress (5%), employees (3%), and funding (2%). Overall, these data are consistent with firms providing important information to help alleviate information asymmetry concerns, however, areas associated with information that could be valuable to competitors, such as R&D progress, receive less discussion.

3.3 Variable Definitions

Performance

I measure performance using current earnings performance and industry R&D payoff. I measure current earnings performance as the adjusted return-on-assets (adjROA), defined as operating earnings before R&D and advertising expense scaled by ending total assets, similar to Sougiannis (1994). I choose current earnings, in particular, because of the large body of evidence regarding its role as an important performance measure to investors and financial analysts. It is also important to managers either directly as a component of their compensation contract or indirectly through its relation to stock prices.

One important limitation of adjROA is that current earnings describe past performance which might not be indicative of future performance. In fact, my hypotheses suggest that this is part of the reason that investors demand qualitative information to be able to better evaluate

[16] I define a sentence to be risk related if it contains the following phrases or common variations: "risk," "uncertain," "could significantly affect," "may adversely affect," "success depends," "subject to," "variability," "fluctuations," "may delay," "cannot provide assurance," and "no assurance." I define a sentence to be forward-looking if it contains the future tense of words such as "will," "could", "should," "expect," "anticipate," "plan," "hope," "believe," "can," "may," "might," "intend" "project," "forecast," "objective," or "goal."

current performance and assess the firms' future. While prior research shows that earnings are persistent, earnings could provide information on R&D firms investments with a lag. Thus, a measure of current performance that incorporates market expectations of firms' R&D would be a useful compliment to earnings performance in examining my research question.

As such, I also perform my tests on a market-based measure of industry R&D payoff examined in Grandi, Hall, and Oriani (2009) that is well established in the economics literature.[17] This measure estimates the payoff to R&D investment by examining how a firm's R&D capital maps into Tobin's Q based on an empirical model. To compute this measure I estimate the value of γ ($R\&D_{PAYOFF}$) in the following equation using nonlinear least squares for each industry and year:[18]

$$\ln\left(\frac{V_{i,t}}{A_{i,t}}\right) = \ln b + \ln(1 + \frac{\gamma K_{i,t}}{A_{i,t}}) \quad (1)$$

where *V* is a firm's market value three months after the fiscal period end, *A* is a firm's tangible assets (PP&E and inventories), and *K* is a firm's R&D capital based on the capitalization and amortization of R&D expenditures at a rate of 20% following Lev and Sougiannis (1996) and Chen, Lakonishok, and Sougiannis (2001). The estimate of γ is interpreted as the differential valuation of R&D capital relative to tangible assets.

Control Variables

I control for firms' information and disclosure environments, investment mix, information uncertainty, and financing incentives. Prior research suggests that firms with better

[17] See Griliches 1981; Jaffe 1986; Cockburn and Griliches 1988; Hall 1993; Hall, Jaffe, and Trajtenberg 2005; Hall and Oriani 2006 for examples of this measure. While stock returns also provide a measure of market performance, they can be particularly noisy and long window returns may not relate well to firms' disclosure choices at a particular moment in time. Consistent with this assertion, I find no evidence of an association between current annual returns and firms' R&D disclosure.

[18] See Grandi, Hall, and Oriani (2009) for specific details regarding the derivation of the empirical model. I require at least 20 observations for each industry-year regression. Note that I estimate the measure by industry-year because a firm specific measure would lack variation across time and this variation is important for identification purposes in my empirical tests.

information and disclosure environments (i.e., the amount and quality of information available to outsiders about the firm) provide higher levels of disclosure because these firms bear lower information production costs, have better information systems, greater expertise, and better monitoring (Lang and Lundholm 1993). I employ a variety of proxies to capture this construct. I measure SIZE as the logarithm of total assets, ANALYSTS as the number of analysts following the firm at the beginning of the fiscal period, and %INST as the percentage of institutional ownership at the beginning of the fiscal period. All of these variables have been found to be positively associated with firm disclosure. In addition, I control for the overall quality of firm's disclosures with the number of management forecasts issued during the reporting period (MFCOUNT) (Nagar et al. 2003; Lehavy et al. 2011).[19]

I control for investment mix (intangibles vs. fixed assets), because the type of investment could influence the importance of capital and product market considerations to a firm. Entwistle (1999) finds that firms with higher R&D expenditures provide higher R&D-related disclosure. Similarly, I measure the extent of a R&D investment as the ratio of R&D expense to total operating expense (R&D/OPX). I also include the market-to-book ratio (MB) as a measure of the extent of intangible assets; however, this variable could also capture aspects of proprietary cost. In addition, I include the capital intensity ratio (CAPINT) defined as the ratio of tangible assets (PP&E and inventories) to total assets. Firms with more tangible investments could have less incentive to provide R&D-related disclosures because they have higher collateral in the form of physical assets.

I also include controls for information uncertainty. Prior literature provides mixed evidence regarding the effect of information uncertainty on disclosure (Lang and Lundholm

[19] Li (2008) provides evidence that firms with lower performance can obfuscate their performance by providing less readable disclosures. I do not control for readability in my reported results because of concerns that such measures are endogenous to the R&D disclosure decision. However, in untabulated results I find that my results are consistent (e.g., similar direction and significance) after the inclusion of measures of 10-K readability.

1993). While investors prefer more disclosure when uncertainty is high, managers could be less able to provide accurate information and could have higher disclosure costs. I control for information uncertainty using the standard deviation of monthly stock returns over the reporting period (RETVOL) and the standard deviation of earnings over the prior 3 years. These measures capture information uncertainty relating to both general performance and to the uncertainty surrounding the payoffs to R&D investments.

I include controls for financing incentives. Due to the uncertain nature of R&D investments, R&D performing firms rely on equity financing more than debt. Differences between debt and equity interests could create demands for different R&D-related disclosure information. Also, prior research suggests that firms could alter their disclosure behavior prior to issuing additional stock. As such, I include controls for leverage (LEVERAGE), measured as ratio of debt to total assets, and stock issuance (STOCK_ISS), measured as an indicator variable which equals one if the firm had a positive net equity issuance in the current year.[20]

In addition to the controls described, I also include industry or firm-fixed effects to control for unobserved constant factors that relate to both performance and R&D-related disclosure but are not accounted for in my other control variables. Industry-fixed effects are particularly important because it is likely that unobservable industry factors relate to both firms' disclosure behavior and their performance. Similarly, firm-fixed effects are important because firms' disclosure policies and their performance could be related to other unobservable characteristics and could confound my inferences.

[20] Results are unchanged if I expand this variable to include the two future years as in Lang and Lundholm (1993), however, it does result in a smaller sample size and increases selection bias.

4. Empirical Results

4.1 Summary Statistics

Table 2 presents descriptive statistics for the sample of firm-year observations. Consistent with prior research, the distribution of the size of firms that invest in R&D measured by total sales and total assets is right skewed with means (medians) of $1,200 (92) million and $1,300 (119) million, respectively. The average (median) adjusted return-on-assets is 0.07 (0.11). The average (median) value of the R&D payoff measure ($R\&D_{PAYOFF}$) is 1.92 (1.2) suggesting that the market values R&D assets almost 92% higher than tangible assets, on average. This is consistent with the results of prior economic research that R&D investments produce value (Grandi, Hall, and Oriani 2009).

The average (median) firm in my sample is followed by 4.2 (2) analysts and institutional investors own 38% (34%) of its outstanding shares. These averages are smaller than more general samples because a number of firms that invest in R&D tend to be smaller, less profitable firms. Importantly, the average (median) sample firm spends 18% (10%) of its operating budget on R&D (measured as the ratio of R&D expense to total operating expense), has a market-to-book ratio of 4.44 (2.58), and relies heavily on equity financing. The mean (median) debt-to-asset ratio is only 16% (8%) and over 55% of sample firms had net stock issues during the fiscal year.

4.2 Performance and R&D-related Disclosure

My first hypothesis concerns whether performance negatively influences firms' decisions to provide concurrent R&D-related disclosure. To test this hypothesis I first examine the univariate correlation of current performance with firms' R&D-related disclosures. Panel A of Table 3 presents the spearman correlations of earnings (adjROA) and R&D payoff ($R\&D_{PAYOFF}$)

with total R&D-related disclosures and also with the respective number of R&D-related disclosures on specific subjects.

Consistent with my main hypothesis, I find that both measures of current firm performance correlate negatively with total R&D-related disclosure as well as with almost all of the individual R&D subject disclosure measures. With few exceptions, these correlations range from -3% to -28%. Further, as might be expected from its construction at the industry-year level, $R\&D_{PAYOFF}$ is more strongly negatively correlated with the disclosure of R&D-related market and industry issues such as market conditions (R&D Market), regulation, R&D collaborations, and competition. In contrast, earnings performance (adjROA) is more negatively associated with more firm specific disclosure issues such as R&D progress, discussions of R&D as a part of a firms' operations (R&D to Operations), and R&D employees.[21]

To further examine the common variation in the various R&D-related disclosure subjects, I perform a factor analysis on these measures, rather than examining them individually in a multivariate setting. Consistent with the previous correlation results, standard diagnostic tests (e.g., eigenvalues, percentage of variation, and scree plots) suggest the presence of a single general factor. Panel B of Table 3 provides the coefficient estimates of the factor loadings and standardized factor scores. In particular, the higher factor loadings on R&D subjects that are important to investors, such as R&D projects, collaborations, competition, and strategy, suggests that these disclosures share significant common variation (i.e., they move together). This is important because individual R&D subject disclosures do not capture the entirety of firms' R&D-related disclosures and firms do not provide this information in isolation. Interestingly, I find that the factor produced by this analysis is highly correlated ($p > .90$) with the total number of R&D sentences. Thus, in all subsequent multivariate tests, I use the number of R&D-related

[21] Note that adjROA is positively associated with the disclosure of R&D tax credit information. This is likely because firms' with higher earnings are more able to take such credits. For example, one telecommunications firm hired a Big 4 auditor to calculate its R&D tax credit after it became profitable.

sentences, rather than the factor, as my R&D-related disclosure measure for ease of interpretation.

While the univariate results provide useful descriptive information, they do not control for a variety of important factors that can confound inferences regarding the relation of current performance and R&D-related disclosure. Thus, I provide further evidence by estimating the following multivariate regression that includes controls for a variety of disclosure determinants examined in prior disclosure literature:

$$\mathbf{LN(R\&D_{DISC}) = \beta_0 + \beta_1 PERF\_VAR + \beta_2 SIZE + \beta_3 ANALYSTS + \beta_4 \%INST + \beta_5 MFCOUNT + \beta_6 R\&D/OPX + \beta_7 MB + \beta_8 CAPINT + \beta_9 RETVOL + \beta_{10} EARNVOL + \beta_{11} LEVERAGE + \beta_{12} STOCK\_ISS + fixed\ effects + \varepsilon\ (2),}$$

where PERF_VAR represents either adjROA or $R\&D_{PAYOFF}$ as specified in the results. The estimation is performed using ordinary least squares regression with industry or firm fixed effects. T-statistics, presented in brackets, are based on standard errors that are clustered by firm and year. Columns 1 and 2 of Table 4 report the results of the estimation using adjROA and $R\&D_{PAYOFF}$, respectively, as the measure of performance with industry fixed effects. Consistent with my hypothesis, the coefficients on both of these variables are negative and significant, suggesting that firms with lower performance provide higher R&D-related disclosure.[22] The coefficient on estimates adjROA and $R\&D_{PAYOFF}$ are -0.216 and -0.021, respectively. A one standard deviation decrease in adjROA is associated with about a 5% increase in R&D-related disclosure. A one standard deviation decrease in $R\&D_{PAYOFF}$ produces a result of similar magnitude. These results are consistent with the notion that firms provide more R&D-related

[22] I cluster on time and firm following Gow et al. (2010) who find that this procedure produces more reliable rejection rates than other methods even with as few as 10 time clusters. However, given concerns about the finite sample properties of this procedure I also verify that my results remain significant at $p < .05$ based on bootstrap corrections (Cameron et al. 2008). In addition, the coefficient on adjROA continues to be negative and significant ($p < 0.01$) after the inclusion of time fixed effects in addition to industry fixed effects. I do not include time fixed effects because $R\&D_{PAYOFF}$ is based only on time and industry variation. If I replace industry fixed effects with time fixed effects, the coefficient on $R\&D_{PAYOFF}$ remains negative and significant at the 0.01 level. The same applies to the use of both firm and time fixed effects for both measures of performance and the inclusion of no fixed effects. In addition, the results remain significant at the $p < 0.05$ level regardless of the method of clustering.

disclosure as performance decreases in response to the demands of investors, but less disclosure as performance increases potentially due to proprietary costs.

The signs of the coefficients on the control variables are similar to those reported in prior disclosure literature. Firms with better information environments as measured by SIZE, %INST, and MFCOUNT provide more R&D-related disclosure (however, the coefficients on ANALYSTS is insignificant). I also find that firms with higher investment in innovation (as measured by R&D/OPX and MB) and lower amounts of fixed capital provide more R&D-related disclosure. Finally, less leveraged firms and firms with recent net stock issuances provide more R&D-related disclosure.[23]

While the evidence in columns 1 and 2 suggests performance is negatively associated with R&D-related disclosure, it is possible that these variables are correlated with time invariant factors that have not been properly controlled for. To help mitigate this possibility, I estimate the previous regression model with firm fixed effects. As shown in columns 3 and 4, the sign and significance of the coefficients on the performance variables are largely unchanged. These results based on within-firm variation provide stronger evidence that firms provide R&D-related disclosure in response to the demands of investors based on current performance.

While my results based on within-firm variation support the prediction of a negative relation between R&D-related disclosure and performance, the firm-fixed effect approach assumes that the influence of current performance on firms' R&D-related disclosure varies based on firm averages. In other words, the firm fixed effect results address the question of how firms use R&D-related disclosure to respond to performance as it differs from their average performance. However, it is also important to consider how R&D-related disclosure varies as

[23] I continue to find a negative and statistically significant relation ($p < 0.05$) when using alternative measures of performance such as the return from net income or cash flow from operations. In addition, the sign and significance of my results are unchanged if I include additional controls for in-process R&D expenditures or general acquisition costs. Similarly, my inferences are unchanged if I limit the sample to firm-years with zero in-process R&D or firm-years without mergers and acquisitions.

performance *changes* relative to prior year performance. In fact, the relation between changes in performance and changes in R&D-related disclosure relates more strongly to idea that managers provide R&D-related disclosure in response to changes in performance. Thus, I estimate the following changes regression:

$$\Delta R\&D_{DISC} = \beta_0 + \beta_1 \Delta PERF\_VAR + \beta_2 \Delta SIZE + \beta_3 \Delta ANALYSTS + \beta_4 \Delta \%INST + \beta_5 \Delta MFCOUNT + \beta_6 \Delta(R\&D/OPX) + \beta_7 \Delta CAPINT + \beta_8 \Delta RETVOL + \beta_9 \Delta EARNVOL + \beta_{10} \Delta LEVERAGE + \beta_{11} STOCK\_ISS + \varepsilon \quad (3).$$

I perform this estimation using ordinary least squares. T-statistics, presented in brackets, are based on standard errors that are clustered on firm and year.[24] Columns 1 and 2 of Table 5 report the results of the regression estimation using changes in adjROA and $R\&D_{PAYOFF}$, respectively, as the measure of performance. The coefficients on these variables are both negative, consistent with the previous regression results.

Next, I examine whether the results based on changes in earnings performance (adjROA, in Table 5 column 1) differ based on the sign of the earnings change to determine whether the relationship between R&D-related disclosure and earnings performance is different for samples with increasing or decreasing performance. Table 6 provides the estimation of equation 3 for samples of earnings increases and earnings decreases, separately. I find that the negative relation between changes in earnings performance and changes in R&D-related disclosure is significant for both samples. While the coefficient on adjROA is more negative for the sample of earnings decreases, I find no evidence that the relation is statistically different for earnings increases or decreases in a fully interacted model. Overall, my evidence is consistent with the assertion that

[24] While the changes regression model differences out the levels effects of individual years, I continue to cluster my estimates by year to account for changes associated with effects common to individual years. My inferences do not change if I cluster only at the firm level or use bootstrapping techniques. In addition, the coefficient on ΔadjROA continues to be negative and significant after the inclusion of year fixed effects. However, similar to the previous regressions, I do not include year fixed effects because the $\Delta R\&D_{PAYOFF}$ measure is based only on time variation and the industry variation is differenced out in the changes.

firms respond to changes in investors' demands for R&D-related information based on changes in reported performance.

4.3 Tests of Variation in the Relation between Performance and R&D Disclosure

My second and third hypotheses suggest that the strength of the negative relation between changes in performance and changes in R&D-related disclosure differs based on cross-sectional firm characteristics. The second hypothesis states that the negative relation between changes in current performance and changes in R&D-related disclosure is stronger for firms that place more importance on R&D investment, that is, high R&D priority firms. To identify firms with high R&D priorities, I partition my sample based on specific firm and industry characteristics. First, I measure the importance of a firm's R&D based on the percentage of its operating budget spent on R&D investment. Second, prior research suggests that firms in more concentrated industries face more intense competition. Thus, I measure industry competition using the four-firm concentration ratios provided by the U.S. data based on three digit NAICS codes (Ali, Klasa, and Yeung 2008).

I partition my sample firms into high and low R&D priority groups based on whether they are above or below the sample medians of both of these measures. I then estimate separate regressions for each group based on the changes regression model from equation 3. I present the estimation results for each group separately because the coefficient estimates of the groups likely differ considerably for both changes in performance and changes in the control variables. I determine the statistical significance of the coefficients across the two groups using a fully-interacted model. Table 7 reports the results from this analysis for changes in adjROA and $R\&D_{PAYOFF}$. Consistent with my hypothesis, I find that the relation between changes in performance and changes in R&D-related disclosure is significantly more negative for the high R&D priority group for both performance measures. In fact, a given change in adjROA for the

high R&D priority group is associated with change in R&D-related disclosure that is more than three times greater than that of the low priority group. This evidence suggests that the importance of R&D to firms' operations plays an important role in how firms provide R&D-related disclosure in response to reported performance.

My third hypothesis asserts that outside monitoring affects the relation between changes in performance and changes in R&D-related disclosure by pressuring managers to disclose more when performance is lower. Specifically, I predict that the negative relation between changes in current performance and changes in R&D-related disclosure is stronger for firms with higher outside monitoring. Using analyst following and the percentage of institutional ownership as measures of external monitoring (Bushee 1998), I partition my sample into high and low outside monitoring groups. I denote observations with above the median analyst following and institutional ownership as the high monitoring group and those below as the low monitoring group. I then estimate separate regressions for each group based on the changes regression model from equation 3.

Table 8 presents the results from this analysis for both changes in adjROA and $R\&D_{PAYOFF}$ separately.[25] Consistent with my prediction, I find that the relation between changes in earnings performance and changes in R&D-related disclosure is more negative for the high monitoring group. In particular, the influence of a change in adjROA on R&D-related disclosure for firms in the high outside monitoring group is almost twice that of the low group. The significance of this difference is based on a fully interacted regression between the two groups. While the negative relation is only significant for the high monitoring group when performance is measured using changes in $R\&D_{PAYOFF}$, I find no statistical difference between the two groups when performance is measured using changes in $R\&D_{PAYOFF}$. The difference in results between

[25] The high and low groups for each table are based on two independent splits using a different set of variables for each table. Thus, the number of observations in Tables 6 and 7 are different.

the two performance measures can be explained by the fact that managers directly report earnings performance about their firm, while the R&D payoff measure is based on a firm's industry (i.e., firm specific agency or investor considerations could be less relevant).

I perform additional cross-sectional tests by examining the sensitivity of the negative relation between current performance and R&D-related disclosure based on financing incentives. Lang and Lundholm (1993) suggest that firms provide better disclosure prior to seasoned equity offerings. Thus, a negative relation between performance and R&D-related disclosure may be the result of poor performing firms seeking additional financing. I partition my sample into two groups based on whether a firm had a positive net stock issuance in the two years following the 10-K filing. While the relation between current performance and R&D-related disclosure is more negative in the sample of firms without net stock issuances, this difference is not statistically significant. I also find similar results for partitions of my sample based on net debt issuance, negative cash flow from operations, and changes in total cash holdings. In the interest of brevity, I do not tabulate these results.

4.4 Differences between Qualitative and Quantitative Disclosure

The primary results indicate that as performance decreases, firms provide more R&D-related disclosure. In contrast, prior research suggests that firms with higher performance are more likely to provide quantitative disclosures such as annual earnings guidance to communicate performance to market participants (e.g., Patel 1976; Penman 1980; Waymire 1984; Lev and Penman 1990; Miller 2002; Houston, Lev, and Tucker 2010). However, qualitative and quantitative disclosures can serve different purposes and performance could influence them differently. For example, quantitative disclosures such as earnings guidance directly inform investors about performance, while qualitative disclosures can help investors understand firms' fundamental operations. In addition, performance can also relate to investors demand for

different types of disclosure through its influence on the quality of managers' information. In the case of earnings guidance, it is increasingly difficult for management to provide useful and accurate earnings projections as performance decreases due to increased uncertainty (Chen et al. 2010). Thus, qualitative disclosure provides a useful disclosure alternative as performance decreases to meet investors information demands. Specifically, I examine the relation between firms' performance and their decisions to provide earnings guidance in my sample.

Following prior research, I estimate a logistic regression based on the disclosure determinants previously explained for my sample of R&D performing firms. I also estimate this regression using OLS with firm fixed effects. Table 9 provides the results of this estimation. Consistent with prior research, I find that my measures of performance are positively associated with the likelihood that a firm provides earnings guidance in the coming year. Thus, while my two measures of performance are negatively associated with R&D-related disclosures, they are positively associated with firms' decisions to provide earnings guidance. This result is consistent with the notion that qualitative R&D-related disclosure and earnings guidance relate to performance differently. While some studies measure disclosure based solely on whether a firm provides earnings guidance, my results suggest that this approach likely over-generalizes disclosure policies to only the more quantitative aspects of disclosure and overlooks the significant amount of disclosure that is more qualitative in nature.

5. Summary and Conclusions

This study emphasizes the role of qualitative disclosure as an important mechanism to help bridge the gap between more direct financial information, such as financial statements or earnings guidance, and the economic reality of firms' operations (Glassman 2003). In particular, the results provide new empirical evidence on the relation between reported performance and qualitative disclosures in a specific setting – firms' R&D-related disclosures. The R&D setting is

provides an particularly informative research area because it emphasizes the importance of qualitative disclosure to external stakeholders, who need to evaluate the levels of risk and information asymmetry associated with the outcome of R&D investments. In addition, the limitations of financial statements to capture the value of R&D investments provides additional impetus to gain better insight into firms' qualitative disclosure decisions.

Using measures of earnings performance and R&D-market payoff, I find that current reported performance is negatively related to concurrent R&D-related disclosure in both firm-fixed effect and changes regression analyses. I also find that this negative relation is a function of both the importance of R&D to the firm and the degree of outside monitoring. In contrast to my main results, I find that firms' decisions to provide earnings guidance are positively related to current performance. These findings highlight the complexity of firms' disclosure strategies and suggest that performance influences can influence the way firms' disclosure different types of differently. While there are certainly limitations in the empirical measures and design common to this literature, my study provides important evidence regarding how managers use qualitative disclosure based on changes in performance to respond to investors.

Additionally, this study provides relevant empirical evidence regarding the complimentary relation between mandatory disclosure (e.g., financial statements) and voluntary disclosure and builds on the predictions of prior disclosure theory (Hughes and Pae 2004; Einhorn 2005; Bagnoli and Watts 2007). Prior empirical evidence suggests that mandatory disclosure serves a confirmatory role and increases the credibility of voluntary disclosure (e.g., earnings guidance) because audited financial statements will subsequently be released (Beniluz 2004; Ball et al. 2010). This study examines a different complimentary relation, namely how the information in mandatory reports relates to firms' decision to provide more or less qualitative disclosure. The results suggest that the importance of qualitative information as a compliment to the financial statements depends on concurrently reported performance.

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Appendix A: R&D-related Disclosure Key Words

This appendix provides the list of R&D-related keywords and phrases used to classify a sentence as an R&D-related disclosure. I developed the list through a careful review of over one hundred and fifty 10-K filings of firms included in my sample. To ensure that my keywords list is reasonable I consulted industry personnel on R&D-related disclosure topics and compared my list with examples used in Entwistle (1999) and James and Shaver (2009). In addition, the results of this study are similar when R&D-related disclosure is calculated using only the bolded key words.

research and development
R&D
product development
research, development
research, engineering, and development
research and product development
research development
research project
research and evaluation project
research program
research collaboration
research facility
research facilities
research initiative
research venture
research center
conduct research
new technology
joint research
develop technology
entering development
developing new products
development of new products
research operations
research pipeline
product engineering
technology development
technical development
technology milestone
technology breakthrough
technological breakthrough
breakthrough innovation
clinical candidate
product candidate
drug candidate
breakthrough in
developing new technologies
development of proprietary technology
established a collaboration
projects in development
completion of key milestones
continuing development of
preclinical development
preclinical data
evaluating the potential of
clinical data
clinical development
clinical program
clinical study
safety study
pilot study
announced a collaboration
joint venture to develop
collaborative initiative
research collaboration
collaborative research
research collaborative
new patent
applied for patent
claims in this patent
filed patent
granted a patent
issued a patent
new patent
received a patent
patent was awarded
key patent
important patent
patents pending
applications pending

Appendix B: Examples of R&D-related Subject Disclosure

R&D Progress	We have initiated a clinical development plan which we believe will allow us to begin global Phase3 clinical studies in Alzheimers disease in 2008 and, if those studies are positive, to apply for U.S. and European marketing approval for Alzheimers disease in 2010. However, we caution you that these are forward-looking statements, and as such are subject to significant risk and uncertainty.
R&D Collaboration	In February 1999, we entered into a four-antibody corporate collaboration with MedImmune. The agreement covers the licensing of Vitaxin to MedImmune as well as the optimization of three additional antibodies, including Synagis and an antibody against IL-9. Licenses granted under this agreement are exclusive and worldwide covering the right to research, develop, sell and sublicense. The business terms of the agreement includes research and development support, potential milestone payments, royalties on the sales of products resulting from the collaboration and an equity investment. The duration of the research and development aspect of this agreement has been extended through February 2003.
R&D Competition	The Company intends to make further investments in people and equipment in subsequent years in order to increase new product development. The semiconductor industry is highly competitive and the Company expects competitive pressures to continue. The Company is in direct and active competition, as to one or more of its product families, with at least thirty manufacturers of such products, of varying financial size and strength.
R&D Strategy	This strategy is designed to align our product development initiatives with our manufacturing processes and manufacturing cost structure, and to reduce our exposure to more commodity-type product applications that are prone to unpredictable demand and fluctuating pricing. Our focus is primarily on higher-margin products that possess design features that take optimal advantage of our existing and developing manufacturing technology and that command a price commensurate with the performance advantages of our alloys. In addition to our focus on products with higher gross margins, we will continue to engage in prototype manufacturing, both for internally manufactured products and for products that will ultimately be licensed to or manufactured by third parties.

Patents	As of December 31, 2007, we had 95 granted patents in the United States from 58 families as well as 75 patent families with pending patent applications. We intend to file additional patent applications when appropriate, and to aggressively prosecute, enforce, and defend our patents and other proprietary technology.
R&D Funding	In August 2003, we signed a new $3.0 million research and development contract with the U.S. Army for the development of KEPs, which was later supplemented by additional $2.7 million. Our strategy is to orient the KEP program toward future systems such as the Joint Strike Fighter program and the Armys Future Combat System. We also continue to work with a number of defense-related research and development agencies and large defense companies to identify additional military applications that may benefit from using Liquidmetal alloys.
R&D to Operations	Our losses have resulted principally from expenses incurred in research and development of our technology and products and from selling, general and administrative expenses that we have incurred while building our business infrastructure. We expect to continue to incur significant operating losses in the future as we continue our research and development efforts and seek to obtain regulatory approval of our products. Our ability to achieve profitability depends on our ability to raise additional capital, complete development of our products, obtain regulatory approvals and market our products.
R&D Facilities	The Company's business units maintain product development and engineering departments whose activities are focused on improving existing products and services and developing new technologies to meet customer demands for improved drilling performance and environmental-based solutions for drilling and completion operations. The Company's primary research facilities are located in Houston, Texas; Stavanger, Norway; and Aberdeen, Scotland. The Company also maintains a drill bit database which records the performance of substantially all drill bits used in the United States over the last 16 years, including those manufactured by competitors.

R&D to Prior Periods	Research and development expenses in fiscal 2004 decreased $0.7 million to $14.6 million from $15.3 million in fiscal 2003 due to our reduced silicon development efforts in 2004. Research and development expenses in fiscal 2003 decreased $0.1 million to $15.3 million from $15.4 million. In fiscal 2002 research and development expenditures were constant due to managements dedication to the development of new and enhanced products, such as the next generation quartz automotive gyro sensor, NCAPS torque sensors and improvements to other existing product families.
Regulation	Governmental and regulatory authorities may approve a product candidate for fewer indications or narrower circumstances than requested or may condition approval on the performance of post-marketing studies for a product candidate. Even if a product receives regulatory approval and clearance, it may later exhibit adverse side effects that limit or prevent its widespread use or that force us to withdraw the product from the market. Any marketed product and its manufacturer will continue to be subject to strict regulation after approval.
R&D Employees	The Company employs approximately 18 people in its research and development department, including seven PhDs with specialties in the fields of molecular biology, protein chemistry, vascular physiology, and biochemistry.
R&D Tax Credit	We also have research and development tax credit carry forwards of approximately $1.9 million that begin to expire in 2005, if not previously utilized. Utilization of our net operating loss carry forwards will be subject to limitations due to the change in ownership provisions of the Internal Revenue Code of 1996, as amended, as a result of our prior issuances of equity securities. These carry forwards, therefore, may expire prior to being fully utilized.
In-process R&D	The acquired in-process research and development projects are in various stages of development, had not reached technological feasibility at the time of acquisition and had no known alternative uses. The efforts required to develop the acquired in-process research and development into commercially viable products include completion of the development stages of the commercially viable products, clinical-trial testing, FDA approval and commercialization. Due to the nature of the pharmaceutical development process, the Company anticipates incurring additional costs to develop these products.

R&D Market	In response to this rapidly growing market, handset original equipment manufacturers, or OEMs, are significantly shortening product development cycles, seeking simplified architectures and streamlining manufacturing processes. Traditional OEMs are shifting to low-cost suppliers around the world. In turn, original design manufacturers, or ODMs, and contract manufacturers, who lack RF and systems-level expertise, are entering the high-volume mobile phone market to support OEMs as well as to develop handset platforms of their own.
R&D to Sales	Net product development expenses as a percentage of revenues were 4.3%, 8.6% and 8.0% in 1996, 1995 and 1994, respectively.

Table 1
Descriptive Information on R&D-related Disclosure

This table provides descriptive information about the R&D-related disclosure measure calculated as the number of 10-K sentences that refer to R&D-related information. A sentence is determined to be R&D-related if it contains a keyword or related phrase from the dictionary of keywords found in Appendix A. Panel A provides statistics on the overall R&D-related disclosure measure and benchmarks it against a comparable score for earnings and revenue disclosures. Panel B provides descriptive information about R&D-related disclosure for selected industries. Industries are based on the Fama and French 48 classification. Panel C provide information regarding the percentage of firms' R&D-related sentences that address specific subjects. Subjects are identified by examining the words contained within each R&D-related sentence.

Panel A. 10-K R&D-related Disclosures (N=20,990)

Variable	Mean	Median	Std Dev
10-K R&D Disclosures	30.99	21	34.38
10-K Earnings Disclosures	51.33	42	33.56
10-K Revenue Disclosures	108.84	98	56.88

Panel B. 10-K R&D-related Disclosure by Industry

Industry	N	Mean	Median	Std Dev
Pharmaceutical Products	2,996	82.40	69.00	55.84
Medical Equipment	1,724	29.80	26.00	19.24
Business Services	3,531	27.94	24.00	23.19
Electronic Equipment	2,824	26.83	24.00	16.79
Measuring and Control Equipment	1,164	26.06	22.00	16.64
Computers	1,948	24.15	22.00	14.81
Chemicals	613	18.54	13.00	20.96
Electrical Equipment	423	16.84	10.00	17.77
Machinery	1,327	15.89	11.00	12.67
Other	3,968	13.99	10.00	14.07
Auto	472	11.46	9.00	10.70

Table 1 - Continued

Panel C. Subject of 10-K R&D-related Disclosures (N=20,990)

Variable	Mean	Median	Std Dev
%R&D RISK	0.19	0.18	0.14
%R&D FLS	0.17	0.17	0.13
%R&D to Prior Periods	0.14	0.1	0.15
%R&D Competition	0.12	0.10	0.11
%R&D Facilities	0.12	0.09	0.11
%R&D Strategy	0.11	0.09	0.11
%R&D to Operations	0.07	0.05	0.08
%R&D to Sales	0.06	0.00	0.10
%R&D Collaboration	0.05	0.00	0.10
%In-process R&D	0.05	0.00	0.11
%Patents	0.05	0.02	0.07
%R&D Progress	0.05	0.00	0.09
%R&D Employees	0.03	0.00	0.06
%R&D Funding	0.02	0.00	0.04
%R&D Tax Credit	0.02	0.00	0.04
%Regulation	0.01	0.00	0.02
%R&D Market	0.00	0.00	0.01

Table 2
Sample Descriptive Statistics

This table provides descriptive statistics for the overall sample of 20,990 firm-year observations. The adjROA is defined as operating income before R&D and advertising expense scaled by ending total assets. $R\&D_{PAYOFF}$ measures how firms' R&D investments relate to market value and is derived based on Grandi, Hall, and Oriani (2009). ANALYSTS is the number of analysts following the firm at the fiscal period end. %INST is the percentage of institutional ownership at the fiscal period end. MFCOUNT is the number of management forecasts issued during the fiscal period. R&D/OPX is the ratio of R&D expense to total operating expense. MB is the market-to-book ratio at the end of the fiscal period. CAPINT is the ratio of PP&E and inventories to total assets. RETVOL is the standard deviation of monthly returns during the fiscal period. EARNVOL is the standard deviation of earnings over the past three years. LEVERAGE is the ratio of total debt to total assets. STOCK_ISS is an indicator variable coded to 1 if the firm had a positive net stock issuance during the fiscal period and zero otherwise.

Variable	Mean	Median	Std Dev
adjROA	0.07	0.11	0.23
$R\&D_{PAYOFF}$	1.92	1.20	2.58
Sales ($mil)	1,200	92	4,100
Total Assets ($mil)	1,400	122	4,500
ANALYSTS	4.46	2.00	6.07
%INST	0.38	0.34	0.32
MFCOUNT	1.50	0.00	2.71
R&D/OPX	0.18	0.10	0.21
MB	4.44	2.58	6.12
CAPINT	0.29	0.26	0.20
RETVOL	0.19	0.15	0.13
EARNVOL	0.14	0.06	0.22
LEVERAGE	0.14	0.07	0.17
STOCK_ISS	0.55	1.00	0.50

Table 3
R&D-related Disclosure Subjects and Performance

This table provides descriptive information about the role of the components of the R&D-related disclosure measure based on the subject matter of individual sentences. The subject matter is identified based on the inclusion of keywords or phrases in each sentence (see Appendix B for examples). Panel A provides spearman correlations for the association of adjROA and $R\&D_{PAYOFF}$ with the total number of sentences for each subject area. Panel B provides the factor loading coefficients from a factor analysis of the common variation contained in the number of sentences provided in each subject area.

Panel A. Correlation of R&D-related Disclosure and Performance

Variable	adjROA	$R\&D_{PAYOFF}$
Total 10-K R&D Disclosures	-0.1184*	-0.2816*
R&D to Prior Periods	-0.0943*	-0.1834*
R&D Competition	-0.0944*	-0.2165*
R&D Facilities	-0.0301*	-0.0495*
R&D Strategy	-0.1278*	-0.0856*
R&D to Operations	-0.1621*	-0.0991*
R&D to Sales	-0.0760*	-0.1433*
R&D Collaboration	-0.0606*	-0.2196*
In-process R&D	-0.1498*	-0.1291*
Patents	0.0857*	-0.1637*
R&D Progress	-0.1921*	-0.1545*
R&D Employees	-0.1531*	-0.1218*
R&D Funding	-0.0524*	-0.1248*
R&D Tax Credit	0.2012*	-0.0637*
Regulation	-0.0957*	-0.2766*
R&D Market	-0.0476*	-0.2137*

* indicates significance at the 0.05 level or lower.

Table 3 - Continued

Panel B. Factor Analysis of R&D-related Disclosure Subject Variables

Variable	Factor Loading	Standardized Factor Score
R&D Progress	0.8363	0.2124
R&D Collaboration	0.8015	0.1661
R&D Competition	0.7899	0.1595
R&D Strategy	0.7513	0.1174
Patents	0.7132	0.1073
R&D Funding	0.7207	0.1017
R&D to Operations	0.6195	0.1005
R&D Facilities	0.6713	0.0945
R&D to Prior Periods	0.5884	0.0865
Regulation	0.5918	0.0597
R&D Employees	0.3429	0.0423
R&D Tax Credit	0.3236	0.0360
In-process R&D	0.1773	0.0235
R&D Market	0.2901	0.0232
R&D to Sales	-0.0061	0.0116

Table 4
R&D-related Disclosure and Current Performance

This table reports the coefficient estimates of a regression of R&D-related disclosure on current performance. The dependent variable is the natural logarithm of the R&D-related disclosure score as defined in Table 1. SIZE is the natural logarithm of total assets. All other variables are defined in Table 2. T-statistics (in brackets) are based on standard errors that are clustered as indicated in the table.

	Variable	(1)	(2)	(3)	(4)
	Intercept	1.962***	2.059***	2.031***	2.054***
		[31.47]	[28.82]	[34.58]	[36.06]
Performance	adjROA	-0.216***		-0.182***	
		[-3.40]		[-4.70]	
	$R\&D_{PAYOFF}$		-0.021***		-0.013**
			[-2.95]		[-3.04]
Information Environment	SIZE	0.033***	0.029***	0.165***	0.161***
		[3.94]	[3.49]	[12.90]	[14.38]
	ANALYSTS	0.001	0.001	-0.008***	-0.008***
		[0.32]	[0.34]	[-3.40]	[-3.36]
	%INST	0.285***	0.265***	0.271***	0.264***
		[5.43]	[5.26]	[6.46]	[5.64]
	MFCOUNT	0.013**	0.013**	0.005**	0.005**
		[2.51]	[2.36]	[2.53]	[2.57]
Investment Type	R&D/OPX	1.935***	1.924***	0.539***	0.506***
		[33.65]	[32.05]	[10.37]	[11.38]
	MB	0.002	0.002**	0.002***	0.002***
		[1.64]	[2.03]	[3.24]	[3.50]
	CAPINT	-0.623***	-0.638***	-0.179**	-0.173**
		[-7.91]	[-7.74]	[-3.03]	[-2.80]
Uncertainty	RETVOL	0.341***	0.417***	-0.099*	-0.057
		[2.92]	[3.81]	[-1.89]	[-1.21]
	EARNVOL	0.028	0.102***	0.061*	0.094***
		[0.95]	[3.82]	[2.08]	[3.14]
Financing	LEVERAGE	-0.273***	-0.244***	-0.013	0.021
		[-4.60]	[-4.04]	[-0.57]	[1.03]
	STOCK_ISS	0.103***	0.102***	0.030***	0.029***
		[6.92]	[6.86]	[4.18]	[4.11]
Fixed Effects		Industry	Industry	Firm	Firm
Standard Error Clustering		Firm and Year	Firm and Year	Year	Year
Observations		20,990	20,990	20,990	20,990
Adjusted R-squared		56.8%	56.6%	87.7%	87.7%

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5
Changes in R&D-related Disclosure and Changes in Performance

This table reports the coefficient estimates of a regression of year-to-year changes in R&D-related disclosure on changes in current performance. The dependent variable is the year-to-year change in the R&D-related disclosure score. All other variables are defined as the current year-to-year changes of the variables used in Table 4. T-statistics (in brackets) are based on standard errors that are clustered on firm and time.

	Variable	(1)	(2)
	Intercept	1.043***	1.079***
		[4.66]	[5.47]
Performance	ΔadjROA	-2.562***	
		[-2.92]	
	$\Delta R\&D_{PAYOFF}$		-0.234*
			[-1.87]
Information Environment	ΔSIZE	2.678***	2.485***
		[7.93]	[8.95]
	ΔANALYSTS	0.068	0.075
		[1.19]	[1.31]
	Δ%INST	-0.318	-0.547
		[-0.33]	[-0.56]
	ΔMFCOUNT	0.024	0.029
		[0.77]	[0.91]
Investment Type	Δ(R&D/OPX)	15.380***	14.284***
		[7.92]	[6.73]
	ΔCAPINT	2.725*	3.147**
		[1.86]	[2.20]
Uncertainty	ΔRETVOL	-0.937	-0.675
		[-0.98]	[-0.79]
	ΔEARNVOL	0.481	0.912
		[0.83]	[1.53]
Financing	ΔLEVERAGE	0.919**	1.308***
		[2.44]	[2.90]
	STOCK_ISS	0.165	0.167
		[1.01]	[1.04]
Observations		18,773	18,773
Adjusted R-squared		2.2%	2.2%

*** p < 0.01, ** p < 0.05, * p < 0.1

Table 6
Changes in R&D-related Disclosure and Changes in Performance
by Sign of Earnings Performance Change

This table reports the coefficient estimates of a regression of year-to-year changes in R&D-related disclosure on changes in current performance for firms with earnings increases and decreases separately. The dependent variable is the year-to-year change in the R&D-related disclosure score. All other variables are defined as the current year-to-year changes of the variables used in Table 4. T-statistics (in brackets) are based on standard errors that are clustered on firm and time.

	Variable	ΔadjROA > 0	ΔadjROA < 0
	Intercept	1.001***	0.878***
		[5.87]	[3.45]
Performance	ΔadjROA	-1.860**	-2.871**
		[-2.25]	[-2.28]
Information Environment	ΔSIZE	2.935***	2.459***
		[6.92]	[4.82]
	ΔANALYSTS	0.081	0.034
		[1.38]	[0.50]
	Δ%INST	-0.609	-0.010
		[-0.66]	[-0.01]
	ΔMFCOUNT	0.000	0.049
		[0.01]	[0.83]
Investment Type	Δ(R&D/OPX)	28.210***	6.583**
		[8.99]	[2.48]
	ΔCAPINT	5.505**	-0.030
		[2.56]	[-0.02]
Uncertainty	ΔRETVOL	-0.613	-1.155*
		[-0.42]	[-1.88]
	ΔEARNVOL	1.143	0.101
		[1.57]	[0.15]
Financing	ΔLEVERAGE	0.807	0.974**
		[0.92]	[2.56]
	STOCK_ISS	0.075	0.232
		[0.30]	[1.31]
Observations		9,138	9,635
Adjusted R-squared		4.8%	1.2%

*** p < 0.01, ** p < 0.05, * p < 0.1

Table 7
The Influence of R&D Priorities

This table examines how the importance that firms' place on R&D influences the relation between changes in performance and changes in R&D-related disclosure. The sample firms are partitioned into high and low R&D priority groups based on the median sample values of the ratio of R&D expenditures to operating expenses and industry four-firm concentration ratios. All variables are the same as in Table 5. T-statistics (in brackets) are based on standard errors that are clustered on firm and time. The statistical significance of the coefficients on changes in the measures of performance is determined by a fully-interacted regression.

	R&D Priorities					
Variable	High	Low	Difference	High	Low	Difference
Intercept	3.282***	0.323**		3.273***	0.336**	
	[4.72]	[2.16]		[6.66]	[2.26]	
ΔadjROA	-4.589**	-1.385*	-3.204**			
	[-2.35]	[-1.82]	[-2.02]			
$\Delta R\&D_{PAYOFF}$				-1.077***	-0.023	-1.054***
				[-3.37]	[-0.45]	[-3.57]
ΔSIZE	3.818***	2.305***		3.341***	2.234***	
	[4.91]	[8.14]		[4.60]	[8.26]	
ΔANALYSTS	0.076	0.014		0.099	0.015	
	[0.38]	[0.28]		[0.50]	[0.31]	
Δ%INST	-0.501	-1.486**		-0.998	-1.562**	
	[-0.26]	[-2.28]		[-0.52]	[-2.32]	
ΔMFCOUNT	0.221	-0.015		0.199	-0.012	
	[1.53]	[-0.41]		[1.38]	[-0.32]	
ΔR&D/OPX	16.426***	20.933***		13.794***	21.053***	
	[6.25]	[3.75]		[5.29]	[3.69]	
ΔCAPINT	5.541	-1.376		5.393	-1.103	
	[1.26]	[-1.03]		[1.26]	[-0.80]	
ΔRETVOL	-2.523	-0.274		-1.044	-0.202	
	[-1.09]	[-0.46]		[-0.63]	[-0.36]	
ΔEARNVOL	1.580	0.976		2.095**	1.248	
	[1.33]	[0.96]		[2.03]	[1.20]	
ΔLEVERAGE	1.524	0.199		2.207**	0.457	
	[1.47]	[0.36]		[2.12]	[0.84]	
STOCK_ISS	0.308	0.146		0.3418	0.1544	
	[0.59]	[0.96]		[0.62]	[1.02]	
Observations	3,939	3,967		3,939	3,967	
Adjusted R-squared	2.1%	2.8%		2.5%	2.7%	

Table 8
The Influence of Outside Monitoring

This table examines how outside monitoring influences the relation between changes in performance and changes in R&D-related disclosure. The sample firms are partitioned into high and low monitoring groups based on the median sample values for analyst following and institutional ownership. All variables are the same as in Table 5. T-statistics (in brackets) are based on standard errors that are clustered on firm and time. The statistical significance of the coefficients on changes in the measures of performance is determined by a fully-interacted regression.

	Outside Monitoring					
Variable	High	Low	Difference	High	Low	Difference
Intercept	1.370***	0.740***		1.381***	0.775***	
	[5.92]	[3.59]		[6.21]	[4.47]	
ΔadjROA	-4.979***	-2.538***	-2.441*			
	[-3.18]	[-2.98]	[-2.27]			
$\Delta R\&D_{PAYOFF}$				-0.254*	-0.215	-0.038
				[-1.85]	[-1.51]	[-0.30]
ΔSIZE	3.641***	2.255***		3.696***	1.935***	
	[5.44]	[5.80]		[5.63]	[5.64]	
ΔANALYSTS	0.026	0.133		0.026	0.135	
	[0.42]	[1.28]		[0.42]	[1.29]	
Δ%INST	-0.708	0.110		-1.163	-0.318	
	[-0.61]	[0.04]		[-1.03]	[-0.12]	
ΔMFCOUNT	0.005	0.023		0.005	0.038	
	[0.15]	[0.39]		[0.15]	[0.64]	
ΔR&D/OPX	21.152***	12.731***		19.392***	11.529***	
	[9.67]	[6.99]		[8.31]	[5.69]	
ΔCAPINT	4.901	1.990		4.597	2.724*	
	[1.45]	[1.23]		[1.42]	[1.71]	
ΔRETVOL	-3.267	-0.833		-2.910	-0.600	
	[-1.55]	[-1.04]		[-1.48]	[-0.85]	
ΔEARNVOL	1.201	0.214		1.508	0.733	
	[0.59]	[0.37]		[0.75]	[1.11]	
ΔLEVERAGE	-0.017	0.980*		0.517	1.336**	
	[-0.01]	[1.73]		[0.25]	[2.33]	
STOCK_ISS	-0.170	0.408*		-0.168	0.415*	
	[-0.63]	[1.69]		[-0.65]	[1.78]	
Observations	7,807	7,721		7,807	7,721	
Adjusted R-squared	2.9%	2.0%		2.8%	2.0%	

Table 9
Decision to Provide Earnings Guidance

This table examines how performance influences the likelihood that a firm that invests in R&D will provide earnings guidance in the coming year. The estimates are obtained using both logistic and OLS regression models. The dependent variable is coded as 1 if the firm issues guidance and zero otherwise. All other variables are defined as in Table 4.

	Variable	Logit Estimation		OLS Estimation	
	Intercept	-2.994***	-2.203**	-0.352***	-0.353***
		[-3.18]	[-2.45]	[-5.76]	[-5.78]
Performance	ROA	1.748***		0.167***	
		[11.26]		[6.02]	
	$R\&D_{PAYOFF}$		0.041***		0.007**
			[2.84]		[2.46]
Information Environment	SIZE	0.423***	0.436***	0.132***	0.133***
		[15.52]	[15.90]	[11.86]	[12.01]
	ANALYSTS	0.012	0.015*	0.008***	0.008***
		[1.44]	[1.80]	[4.07]	[4.13]
	%INST	1.290***	1.386***	0.076**	0.081**
		[9.99]	[10.68]	[2.20]	[2.35]
Investment Type	R&D/OPX	-1.671***	-1.636***	-0.103**	-0.073
		[-8.37]	[-8.03]	[-2.26]	[-1.62]
	MB	-0.005	0.000	0.003***	0.003***
		[-1.24]	[0.10]	[3.65]	[3.83]
	CAPINT	-0.387*	-0.257	0.049	0.041
		[-1.89]	[-1.26]	[0.90]	[0.77]
Uncertainty	RETVOL	1.491***	0.989***	0.169***	0.137***
		[8.13]	[5.69]	[5.18]	[4.19]
	EARNVOL	0.407***	-0.102	0.030	0.002
		[3.18]	[-0.81]	[1.29]	[0.10]
Financing	LEVERAGE	-0.317*	-0.578***	-0.136***	-0.165***
		[-1.66]	[-3.02]	[-3.30]	[-4.03]
	STOCK_ISS	0.167***	0.163***	-0.006	-0.005
		[3.49]	[3.39]	[-0.71]	[-0.56]
Fixed Effects		Industry	Industry	Firm	Firm
Standard Error Clustering		Firm	Firm	Firm	Firm
Observations		17,075	17,075	17,075	17,075
Pseudo (Adjusted) R-squared		22.2%	21.3%	47.6%	47.5%

*** p < 0.01, ** p < 0.05, * p < 0.1