The Stock Market Valuation of R&D Leaders

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Abstract

We examine future excess returns, earnings variability and stock volatility of R&D Leaders and Followers. Drawing on the business strategy literature, which makes a clear distinction between R&D Leaders and Followers, we show that R&D Leaders do earn significant future excess returns, while R&D Followers just earn average returns. We further document that R&D Leaders generate higher future sales growth, and return-on-assets than Followers. We also tackle the perennial question of whether the excess returns subsequent to R&D are due to mispricing or risk, and show that only a small part of the returns can be attributed to risk compensation. Finally, it has been documented that R&D expenditures are strongly associated with future earnings volatility, suggesting that R&D is less reliable (verifiable) an asset than physical capital. We show that the association between R&D intensity and future earnings volatility of R&D Leaders is not lower than that of R&D Followers. Thus, penetrating the population of R&D firms to distinguish between R&D Leaders and Followers, we bridge the chasm between the major findings of the economics/finance strand and the accounting body of R&D research.

I. Introduction

Research and development (R&D) expenditures and their consequences have been extensively investigated in the economics, finance, and accounting literatures. There appears, however, to be a wide chasm between the major findings of the economics/finance strand and the accounting body of R&D research: Whereas most economics/finance studies conclude that the returns on R&D are "average," namely do not exceed the normal returns of non-R&D firms, accounting studies consistently indicate that R&D intensity is positively associated with both contemporaneous and future excess stock returns.

Drawing on the business strategy literature, which makes a clear distinction between R&D "leaders" and "followers," we show that leaders do earn future significant excess returns, while R&D followers just earn average returns. We further document that R&D leaders generate higher future sales growth, and return-on-assets than followers. We also tackle the perennial question of whether the excess returns subsequent to R&D are due to mispricing or risk, and show that only a small part of the returns can be attributed to risk compensation. Finally, it has been documented that R&D expenditures are strongly associated with future earnings volatility, suggesting that R&D is less reliable (verifiable) an asset than physical capital. We show that this is driven mainly by R&D followers. The association between R&D intensity and future earnings volatility of leaders is lower than that of followers. Collectively, the findings suggest that R&D leaders' are mispriced by investors due to lack of information. Thus, penetrating the

population of R&D firms to distinguish between R&D leaders and followers, we bring closure to several key empirical issues which were unresolved so far.

The evidence with respect to R&D activity and future performance especially in terms of subsequent stock returns is mixed. Chan et al. (2001) show that firms engaging in R&D earn similar stock returns to firms that do not engage in R&D; and, R&D intensive firms as measured by R&D to sales ratio do not earn future excess stock returns. Hall et al. (1993) shows that the stock market overvalues R&D; and Hall et al. (2005) shows that the valuation multiplier on R&D is lower in recent years. A recent study by Booz Allen Hamilton finds that the performance of large R&D firms is similar to that of small R&D firms (see Jaruzelski et al., 2005). On the other hand, a number of studies have shown the association of R&D activity with contemporaneous market value and future excess stock returns (for example, see Lev and Sougiannis, 1996, Lev et al., 2005). Chan et al. (2001) show a positive association between R&D intensity as measured by R&D to market value and abnormal future returns.[1] This association of R&D activity and future excess stock returns could be due to delayed reaction by the stock market or inadequate adjustment for risk (see, Lev and Sougiannis, 1996 and Chambers et al., 2002).

We examine the relationship between future performance and R&D by recognizing that not all R&D activities are similar. Firms strategically choose to be R&D Leaders or Followers (see Porter, 1979, 1980, 1985): some R&D firms are Leaders who introduce new and innovative products while others are Followers who mimic or react to

[1] Other studies show the positive association between future stock returns and changes in R&D investments (see Penman and Zhang, 2002; Eberhart, Maxwell and Siddique, 2004).

the products of the Leaders. For example, in the pharmaceutical industry, firms such as Merck, Eli Lilly and Pfizer are R&D Leaders while generic drug makers such as Chattem, Mylan, Natures Sunshine, Igi and Icn are Followers. Research in strategy and economics suggests that R&D Leaders have sustained future profitability as well as lower business dissolution risk. Thus, in a strategic sense the nature and focus of R&D efforts could be different across firms.

Firms with R&D intensity measure greater than (lesser than or equal to) that of the industry are classified as Leaders (Followers). R&D intensity is measured using two proxies: the R&D expenditure to sales ratio and the R&D expenditure to market value ratio.[2] Examining some characteristics of R&D Leaders and Followers we find the following: Leaders have lower book-to-market ratio, higher market value of equity, higher sales growth, lower earnings-to-price ratio, lower return-on-equity and lower dividend yield than Followers. These characteristics suggest that book value of equity and earnings are biased downwards for R&D Leaders due to conservative accounting (see Lev et al., 2005). Leaders' future market share, future sales growth and future return on assets are higher than that of Followers. These characteristics suggest that Leaders have sustained future profitability.

We then examine the stock market valuation of R&D activity. Recognizing the strategic differences in R&D activity enables us to interpret the future excess returns in terms of delayed reaction by investors and inadequate adjustment for risk. First, if R&D

[2] We also use the R&D intensity measures using R&D capital instead of R&D expenditures and consider an R&D Leader to be following an innovation strategy when the firm is considered a Leader in two and three consecutive years. The results are qualitatively similar and much stronger than the results reported in the paper.

is equally risky for Leaders and Followers, then we expect the future excess returns to be similar for both. Second, if R&D is considered more risky for Leaders than Followers, then we expect the difference in future excess returns to be constant. We find that the difference in future annual excess returns between Leaders and Followers are 0.99%, 7.58%, 3.93% and 2.44% in the first, second, third and fourth years, respectively. This suggests that even though some of the excess returns (about 2.50% excess returns in the fourth year) may be due to incomplete risk adjustment, the majority of the second and third year excess returns are due to delayed reaction by investors. These differences in future annual excess returns are exacerbated when a firm is a Leader/Follower for two consecutive years: an alternative measure of innovation strategy. We find that the future excess returns of R&D Followers is zero on average, thus suggesting that innovation activity by itself is not a contributor to future excess returns: the nature of R&D in terms of innovation strategy drives the delayed market reaction. This positive association of R&D Leaders and future excess stock returns is attributable to delayed market reaction for one important reason: the future excess returns is positive and high in the second and third years and decreases substantially in the fourth year (a reversal).

To examine whether the positive future excess returns of R&D Leaders' are due to innovation strategy being more risky, we examine two measures of risk across Leaders and Followers: stock returns volatility and future earnings variability. The strategy and economics literature argues that R&D Leaders should have lower business risk (see Caves and Porter, 1977; Caves and Ghemawat, 1992). Kothari et al. (2002) find that R&D expenditures are more strongly associated with future earnings variability than

capital expenditures, suggesting that R&D expenditures are more risky. These arguments/findings emphasize again the chasm between the two streams of literature: finance/economics and accounting. Stock returns volatility and earnings variability are measures of perceived risk (See Bushee and Noe, 2000; Beaver et al. 1970). We regress stock returns volatility on R&D expenditures and an interaction between Leaders and R&D expenditures controlling for other factors (see Bushee and Noe, 2000). We find that while stock returns volatility is positively associated with R&D expenditures, stock returns volatility of Leaders is significantly smaller than that of Followers. This is consistent with the argument that the perceived risk of Leaders is lower than that of Followers. We regress future earnings variability on R&D expenditure and an interaction between Leaders and R&D expenditure controlling for other factors (see Kothari et al., 2002). We find that the association of R&D expenditure with future earnings variability of Leaders is lower than that of Followers. This suggests that R&D expenditures of Leaders do not induce higher earnings variability. Thus, we conclude that the incomplete risk control argument for the future excess returns of Leaders is not a plausible reason for such a phenomenon.

To summarize, we find that R&D Leaders exhibit higher future profitability and lower risk than Followers, but the investors reaction appears to be delayed. This delay could occur due to behavioral aspects or lack of information. We shed some light on the possibility of investors' delayed reaction due to lack of information. For this purpose, we examine whether financial analysts' (an important information intermediary) incorporate the potential higher future profitability of Leaders in their long-term earnings growth

forecasts. We find that the long-term growth forecasts are on average 5% higher for Leaders than Followers. This shows that financial analysts on average appear to understand that the Leaders have higher future earnings potential than Followers. However, examining the revision in long-term growth estimates we find that the Leaders' long-term growth estimates are revised downwards about 3.3% on average, while the Follower's long-term growth estimates are revised downwards about 1.6%, which suggests that analysts appear to react to current earnings or stock price movements and hence, penalize Leaders more in their long-term outlook. Alternatively, the lack of information on R&D productivity seeps into the analysts' earnings forecasts through their revisions. We also find that the standard deviation of the long-term growth forecasts is higher for Leaders than Followers, which suggests that the disagreement among analysts for Leaders is more than Followers. Such disagreements across sophisticated financial intermediaries on R&D productivity are most likely to occur due to lack of information. The change in standard deviation across Leaders and Followers is not statistically significant showing that the differences appear to persist.

We contribute to the literature on R&D stock valuation in three ways. First, we establish a connection between innovation strategy and stock valuation; thus, emphasizing the importance of considering the nature of R&D in terms of the firms' innovation strategy for stock valuation. We show that innovation strategy enhances stock value in the long-run.[3] Second, we show that investors do not appear to get information in

[3] This is similar in spirit of recent papers such as Chen et al. (2005), Gaur et al. (2005) and Hendricks and Singhal (2005) who examine the association between the nature of operations-related strategies and stock market valuation.

a timely fashion leading to a delayed reaction by investors for firms following an innovation strategy. Chan et al. (2001) show that the future excess returns for R&D intensive firms are driven by lower stock price valuation in the current year due to R&D firm's earnings being depressed. Lev et al. (2005) find that investors do not appear to undo the bias created by the conservative treatment of R&D in the financial statement. These findings could be driven by behavioral reasons or lack of information. Our evidence suggests that lack of information is the more likely cause for the delayed reaction, because stock returns volatility and future earnings variability of R&D Leaders is lower than that of Followers. Even sophisticated financial analysts revise their long-term growth estimates downwards, which potentially suggests lack of information. Collectively, these findings imply that firms following an innovation strategy need to establish effective communications with investors so as to reduce the information schism (see Coyne and Witter 2002).

The rest of the paper is organized as follows: Section II provides the characteristics of Leaders and Followers; Section III examines the stock market valuation of Leaders and Followers; Section IV examines the association of risk measures of Leaders and Followers; Section V examines the financial analysts' long-term earnings growth forecasts; and Section VI contains some concluding remarks.

II. Characteristics of Leaders and Followers

Research in economics provides insights into the interactions between strategy, competition and innovation activities. Caves and Porter (1977) develop a framework for

intra-industry profit differentials based on pre-commitment to specialized resources such as R&D. Caves and Ghemawat (1992) examine the factors that sustain profit differentials across firms within an industry and find that differentiation-related strategies which includes R&D, play a more important role than cost-related strategies. Differentiation-related strategies are indicative of innovative leadership in the product market, i.e., new products/services, brands, etc. while cost-related strategies include higher capacity and cost structure advantages. Gruber (1992) shows that in a vertically differentiated product market where fixed costs of innovation decline over time, innovation leaders are persistent. For example, in the Erasable Programmable Read Only Memories (EPROM) market, Intel which invented the memory chip has persistently held leadership in innovative activity. Klette (1996) shows that R&D could help improve future profitability due to knowledge-spillovers across lines of business: R&D could have a lasting impact on performance due to knowledge-spillovers. Cardinal and Opler (1995) show that diversified firms are at least as efficient as non-diversified firms with respect to R&D expenditures, which is likely due to economies of scope. In summary, the evidence on interaction between business strategy, competition and innovation suggests that R&D leadership provides sustained future performance through a combination of (a) knowledge-spillovers, (b) provision of differentiated products, and (c) economies of scope.

The innovation race literature provides some intuition on who could be considered R&D Leaders. One of the most contentious issues has been the capacity for innovation activities to sustain monopoly power, i.e., interaction between strategy and

innovation races. On the one hand, Reinganum (1985) shows that incumbent firms have less incentives to invest in R&D and hence entrants overtake incumbents, even though incumbents make more profits in the short-term: the driving force in this model is diminishing returns to R&D investment. On the other hand, Gilbert and Newbery (1982) examine a setting where incremental innovations are awarded with certainty to the firm that spends the most on R&D and show that the incumbent firm continues to earn monopoly rents. Lerner (1997) empirically examines the interactions between strategy, competition and innovation activities in the disk drive industry and finds support for Reinganum's theoretical insights, i.e., the entrant firm shows a higher propensity to innovate and ends-up with higher profits in the long-run. Banbury and Mitchell (1995) show that incremental product innovation in the cardiac pacemaker industry helps the incumbent sustain and increase profits, by increasing their market share as well as decrease the likelihood of business dissolution, providing some degree of support for Gilbert and Newbery's insight. Intuitively, both the cases are characterized by the firm spending the most in R&D, having a higher performance in the future. Zahra and Covin (1993) provide evidence that suggests that high-performing companies adopt a coherent set of technological choices that, taken together, create a competitive advantage; especially in mature sectors where technology plays a prominent role.

Based on the insights from the strategy and economics literature we use R&D expenditure to classify Leaders and Followers: Specifically, we use industry adjusted R&D intensity measures to classify R&D Leaders and Followers. Two proxies are used for R&D intensity: R&D expenditure to sales ratio and R&D expenditure to market value

of equity ratio. We use industry benchmarks to classify Leaders and Followers for two reasons. First, for industries such as chemicals or pharmaceuticals where the same firm continues to wield Leadership in product innovations (such as, DuPont, Dow Chemical, Merck, Pfizer), the R&D intensity of such firms compared with others in the industry should be higher (such as Chattem Inc., Mylan Laboratories, Natures Sunshine, Igi Inc. and Icn. Pharmaceutical). Second, the industry adjusted R&D intensity calibrates for the competitive forces operating within the industry. For instance, even a Follower in the pharmaceutical industry could have a higher R&D intensity than that of a Leader in the food products industry.

The benchmark R&D intensity for the industry is the value-weighted R&D expenditure to sales of all firms in the industry group, as well as the value-weighted R&D expenditure to market value of equity of all firms in the industry group; where the value-weights are computed using sales and market value of equity, respectively. For the industry groups, we use the mapping of the four-digit SIC to the 48 industry group as in Fama-French (1997).[4] Firms whose R&D intensity is greater than (less than or equal to) that of the benchmark R&D intensity for the industry are classified as R&D Leaders (Followers).

The sample includes all firms with positive R&D expenditures from 1975 through 2002 with financial information available in the Compustat annual database. We delete firms with either sales less than $10 million or total assets less than $5 million so as to include reasonably sized firms. We obtain R&D expenditures (data item # 46) and sales

[4] The mapping was obtained from Ken French's website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html .

(data item # 12) from the Compustat annual database; data on stock price and number of shares outstanding to compute market value of equity are obtained from the CRSP database.

Table 1, Panel A contains some characteristics of Leaders and Followers. There are about 550 (400) firms each year that are classified as R&D Leaders, while 717 (867) firms are classified as Followers, when R&D to sales (R&D to market value) ratio is used as the R&D intensity measure. The percentage of Leaders has been increasing over time: 37% of the companies are Leaders in 1975 as compared to about 50% in 1997, which shows the importance of innovation in recent years.

Panels B and C of Table 1 provide evidence on the persistence of our classification of R&D Leaders and Followers, respectively. Examining the persistence of our classification is important to assess whether the R&D intensity measures capture innovation as a strategy: if innovation is a strategic choice and strategic choices are difficult to change in the short-run, then our classification should exhibit some degree of persistence. Panel B shows whether firms classified as Leaders in year t continue to be Leaders in subsequent years. About 54% of the firms classified as Leaders in year t continue to be classified as Leaders, while 26% of the firms classified as Leaders in year t are classified as Followers and 20% of the firms do not survive in year t+4. Panel C shows the classification in years t+1, t+2, t+3 and t+4 of Followers. About 58% of the firms classified as Followers in year t continue to be classified as Followers, while 17% of the firms classified as Followers in year t are classified as Leaders and 25% of the firms do not survive in year t+4. This shows that the survival rate of Leaders is higher

than the survival rate of Followers. Furthermore, the misclassification of a Leader as a Follower appears to be higher than the misclassification of a Follower as a Leader, i.e., fewer Followers become Leaders in subsequent years, while more Leaders become Followers. Overall, the classification of Leaders and Followers exhibit a certain degree of persistence.

Examining the Pharmaceutical industry we find that the following firms are classified as Leaders: Eli Lilly in 19 of the 19 years; Pfizer in 18 of the 23 years; Merck in 19 of 23 years; while generic drug manufacturers are classified as R&D Followers: Chattem Inc. in 23 of the 23 years; Mylan Labs in 21 out of 22; Natures Sunshine in 17 out of 17 years; Igi Inc. in 15 out of 15 years; Icn Pharmaceutical in 13 out of 14 years. Similarly, in the chemical industry the R&D Leaders are: Dow Chemical in 21 out of 23 years; Dupont in 15 out of 23 years, Rohm & Haas in 23 out of 23 years and Rogers Co. in 23 out of 23 years. While the R&D Followers are: Lawter International in 23 out of 23 years, Crompton in 20 out of 21 years and Sun Coast Industries in 10 out of 10 years are classified as Followers. This also provides some degree of validation on the classification scheme.

Table 2, Panel A provides some descriptive statistics of Leaders' and Followers' performance when R&D to sales ratio for classification. The R&D to sales ratio of Leaders is on average 5½ times that of Followers: the mean (median) R&D to sales of Leaders is 11.57 (7.71) while that of Followers is 2.09 (1.41). The R&D to market value of equity is on average 2½ times higher for the Leaders than the Followers, indicating that investors appear to impute some of the benefits of R&D in stock prices. Similarly,

the book-to-market, sales-to-market and earnings-to-price ratios of Leaders are much lower than that of Followers, indicating that investors recognize that the Leaders are more intangible intensive. The return on equity of Leaders is negative while that of Followers is positive, which could be due to the accounting convention/rule of writing-off R&D expenditures. The mean (median) dividend yield computed as dividends (data item #21) divided by market value of firm is 1.22% (zero%) for Leaders and 1.97% (1.05%) for Followers, i.e., on average the Leaders appear to retain more of the earnings possibly due to better investment opportunities. The sales growth as well as the industry-adjusted sales growth of Leaders is 33% higher than that of Followers, but Followers have a higher market share. The mean (median) accounting information based measures of size such as sales, total assets and book value of equity of Leaders are $1167m ($80m), $1173m ($77m) and $456m ($46m), respectively; while the corresponding mean (median) of Followers are $1304m ($131m), $1309m ($98m) and $473m ($48m). This suggests that Followers are in general larger sized companies with larger brick and mortar operations. However, the mean (median) market value of equity of Leaders is $1009m ($94m) and that of Followers is $948m ($68m), which shows that the investors recognize at least a portion of the intangible intensity (R&D intensity) in their valuations. The mean (median) net income for Leaders is 57.16 (3.18) and for Followers 61.38 (4.48). Although the difference in mean is not statistically significant, the median income of Leaders is statistically smaller than that of Followers. Overall, the results indicate that Leaders' earnings are depressed in the short-run possibly due to conservative accounting treatment

of R&D expenditures. Table 1, Panel B shows similar characteristics across Leaders and Followers, when R&D to market value of equity is used for classification.

In Panels A and B of Table 2, Followers have higher profitability ratios like return on equity (ROE), return on assets (ROA) and earnings-to-price (EP) than Leaders when these ratios are computed based on net income. To assess the impact of R&D expenditures on these profitability ratios, we add back R&D expenditures to net income. We find that the adjusted profitability ratios of Leaders are higher than that of Followers showing that the Leaders' bottom line earnings are significantly impacted by R&D spending.

Overall, the evidence in Table 2 shows that Leaders are more intangible intensive firms with higher sales growth; but financial information in annual reports show them as poor performers which could be due to the conservative treatment of R&D expenditures. This is consistent with the arguments and findings of Chan et al. (2003), Lev (2003) and Lev and Sougiannis (1996).

Table 3 contains some future performance metrics for Leaders and Followers, i.e., we track the performance of firms classified as Leaders in year t over subsequent years t+1, t+2, t+3 and t+4. We do this to assess whether Leaders have higher future performance in terms of sales growth, return on assets and market share than Followers. Conversely, if Leaders do not exhibit future performance similar to that of Followers, then this could provide one reason for why R&D firms earn returns similar to that of non-R&D firms. Panels A and B provide the industry-adjusted and the levels of sales growth and return on assets for Leaders and Followers. In general, Leaders exhibit higher sales

growth and return on assets over the four subsequent years. Panel C shows that although Followers have a slightly higher market share in year t, starting from year t+1 Leaders have a higher market share. These results indicate that Leaders' strategic choice pays off in terms of future performance.

Overall, the evidence in Table 3 suggests that R&D expenditures help Leaders achieve higher performance in future years. Combined with the evidence in Table 2, these results indicate that although Leaders show a lower performance with respect to accounting net income, their strategic decision of being a Leader in their industry pays off in the future with higher ROA and higher sales growth.

In the next section we examine the stock market valuation of the Leaders and Followers.

III. Stock Valuation of Leaders and Followers

In the previous section we find that R&D Leaders have lower performance in the contemporaneous year, but sustained higher performance for at least the next four years. In this section, we examine the future excess returns of Leaders and Followers to gain insights into mispricing or inadequate control for risk. Following CLS (Chan et al. 2003) each firm in the sample is assigned to a companion portfolio based on its ranking by size and book-to-market. For the companion portfolio the book-to-market ratios are classified into five equal groups at the end of April each year; the size breakpoints are determined by classifying the NYSE companies into five equal groups in April each year. The group representing the smallest size is further divided into two equal groups. Thus, we have

five groups for the book-to-market ratio and six groups for size to determine the companion portfolio of book-to-market and size that each company belongs. The monthly risk-adjusted excess returns are then computed as the difference the firm's monthly return minus the companion portfolio's value-weighted monthly return. The annual excess returns are obtained by cumulating the monthly excess returns. Similar to CLS, we track the Leaders' and Followers' excess returns for four subsequent years.

If the nature of both Leaders' and Followers' R&D activity are similar then, we expect to find similar excess returns for both. In other words, if risk-adjusted excess returns for both Leaders and Followers are similar and positive then our risk adjustments may not be adequate. Of course this could also suggest that the investors do not understand all types of R&D activity.

Table 4, Panel A provides the risk-adjusted excess returns for Leaders and Followers in the four years subsequent to the year in which firms are classified as Leaders and Followers using R&D to sales ratio. For Followers the excess returns in years t+1, t+2, t+3 and t+4 are 0.79%, 0.01%, 0.07% and 0.34%, respectively; none of which is statistically different from zero. This suggests that investors understand and appropriately value the R&D activity of Followers. On the other hand, for Leaders the excess returns in years t+1, t+2, t+3 and t+4 are 1.78%, 7.59%, 4.00% and 2.78%, respectively; all of which are statistically different from zero. This suggests that investors do not understand and appropriately value the R&D activity of the Leaders. Note that the R&D Leaders' current profitability is low but the future profitability is high. More

importantly, the R&D Leaders' future profitability is higher than that of Followers (see Section II), which is not recognized by the market till the profits are realized.

An alternative argument would be that investors' perceive R&D activity of Leaders to be more risky and our risk adjustments are not complete. To shed light on this, we examine the hedge portfolio returns. The hedge portfolio returns is the difference between the Leaders and the Followers returns in the subsequent years. The idea here is that if the investors perceive the R&D activity of the Leaders to be more risky, then the difference in the excess returns across Leaders and Followers should be a constant. The hedge portfolio returns are t+1, t+2, t+3 and t+4 are 0.99%, 7.58%, 3.93% and 2.44%, which suggests that at least a portion of the excess returns in years t+2 and t+3 are due investors' under-valuation of the R&D activity of Leaders.

Table 4, Panel B provides the risk-adjusted excess returns for Leaders and Followers in the four years subsequent to the year in which firms are classified as Leaders and Followers based on R&D to market value of equity ratio. The results are similar and more striking than the results when R&D to sales ratio is used. When R&D to market value of equity is used to classify firms into Leaders and Followers, if the investors have valued the future profit prospects of R&D correctly, then they are more likely to be classified as a Follower. Alternatively, if the market has undervalued the innovation activity of the firm such that the prior market value of equity is much lower, then the firm is more likely to be classified as a Leader. Thus, if the investors do not value the R&D activity appropriately for want of good information pertaining to intangible activity, the results in Panel B are expected to be more striking.

Table 5 provides the risk-adjusted excess returns for Leaders and Followers in the four years subsequent to the year in which portfolios are formed. In Panel A (B) the portfolios are based on whether the firm is a Leader or Follower in years t and t-1 based on R&D to sales (market value of equity) ratio. Here we examine whether the investors value the R&D activity of firms that are consistently Leaders. The results are similar to that reported in Table 4.

Table 6 provides the results using an alternative risk adjustment procedure following Fama and French (1993, 1996). The model is estimated using monthly returns from each of the three years following portfolio formation for Leaders and Followers. Specifically, we estimate the following model.

$$R_{it} - R_{ft} = b_{0i} + b_{1i} [R_{mt} - R_{ft}] + b_{2i} SMB_t + b_{3i} HML_t + b_{4i} UMD_t + e_{it} \quad (1)$$

where R_{it} is the value-weighted monthly return of portfolio i in month t, R_{ft} is the treasury bill rate in month t, R_{mt} is the value-weighted monthly market index, SMB_t and HML_t are the returns on the Fama and French (1993) factor-mimicking portfolios for size and book-to-market, respectively, UMD_t is the momentum returns on a portfolio of past winners (top quintile) and past losers (bottom quintile).

Table 6 provides the estimates of equation (1) for Leaders and Followers in the four years subsequent to the year in which firms are classified as Leaders and Followers based on R&D to sales ratio. The difference in the monthly risk-adjusted returns captured by the intercept (b_0) across Leaders and Followers in years t+1, t+2, t+3 and t+4 are 0.11%, 0.32%, 0.34% and 0.21%, respectively, which corresponds to risk-adjusted annual

returns of 1.32%, 3.84%, 4.08% and 2.52% in the corresponding years. These findings are consistent with those in Tables 4 and 5.

Other sensitivity tests

First, the mean risk-adjusted returns for years t+1, t+2, t+3 and t+4 is computed for Leaders and Followers in year t and the difference in average returns is compared each year. When R&D to sales is used to classify Leaders and Followers, Leaders have a significantly higher average four year ahead risk-adjusted returns in 8 out of 23 years, and most of these belong to the 1990s. On the other hand, Followers have significantly higher average four year ahead risk-adjusted returns in 2 out of the 23 years. When R&D to market value of equity is used to classify Leaders and Followers we find that Leaders have a significantly higher average four year ahead risk-adjusted returns in 13 out of the 23 years, while Followers do not have significantly higher average four year ahead risk-adjusted returns in any of the years. This provides further corroboration of our earlier conclusion.

Second, we define the top (bottom) quartile of the industry-adjusted R&D expenditure to sales firms as Leaders (Followers). The difference between the average four year ahead risk-adjusted excess returns across Leaders and Followers increases to 4.38% as against 3.74% (see Panel A of Table 4) in the original classification. Similarly, we define the top (bottom) quartile of the industry-adjusted R&D expenditure to market value of equity firms as Leaders (Followers). The results show that a finer classification criterion increases the future risk-adjusted excess returns and shows that the result is not driven by marginal Leaders.

To summarize the evidence presented we find that (a) Leaders have lower earnings, and return on equity in the year of portfolio formation as compared to Followers, (b) Leaders have higher sales growth and return on equity than Followers in four years following portfolio formation, (c) Leaders have a positive risk-adjusted excess returns in four years following portfolio formation; while the Followers have zero future risk-adjusted excess returns, and (d) the difference in risk-adjusted excess returns between R&D Leaders and Followers declines over time. All of these indicate that investors' do not appear to value the R&D Leaders appropriately, because of lack of information on the nature of R&D. In the next section we examine whether measures of risk such as stock return volatility and future earnings variability is higher or lower for Leaders than Followers.

IV. Stock Returns and Future Earnings Volatility of Leaders and Followers

In this section we examine the association between R&D expenditures of Leaders and Followers and (a) future stock return volatility, which is a measure of investors' perceived risk (see Froot et al. 1992) and (b) future earnings variability, which is an ex post measure that indicates whether R&D leads to more volatile earnings stream and thus increased risk (see Beaver et al. 1970).

Stock returns volatility and R&D Leaders

Froot et al. (1992) argue that high stock return volatility can increase a firm's perceived risk, thereby raising its cost of capital. Following this argument, if investors

perceive Leaders to be more risky than Followers, we expect the stock return volatility of Leaders to be higher than that of Followers.

To examine this, we augment Bushee and Noe's (2000) model and estimate the following equation.

$$\begin{aligned} STDRET_{t+1} = \; & [\text{Fixed year effects}] + \beta_1 RNDM_t + \beta_{L1} LEADER_t \, RNDM_t + \beta_2 AR_t + \beta_3 VOL_t \\ & + \beta_4 LMV_t + \beta_5 LEV_t + \beta_6 DM_t + \beta_7 EP_t + \beta_8 BM_t + \beta_9 SG_t + \beta_{10} GROWTH_t \\ & + \beta_{11} STDGR_t + \beta_{12} NUMEST_t + \beta_{13} CHGR_t + \beta_{14} CHSTD_t + error \end{aligned} \quad (2)$$

where STDRET is the stock return volatility computed as the log of standard deviation of daily stock returns measured from May of year t+1 to April of year t+2 (see Bushee and Noe, 2000); RNDM is the R&D expenditure to market value of equity in year t; LEADER is a dummy variable that takes on a value of one if the industry-adjusted R&D intensity is greater than zero in year t; AR is the size and book-to-market adjusted excess returns cumulated from May of year t to April of year t+1; VOLS is the mean monthly trading volume divided by the number of shares outstanding at the end of the month computed from May of year t to April of year t+1; LMV is the log of market value of equity on December 31st of year t; EP is the earnings to price ratio computed as the income before extraordinary items divided by the market value; DM is the dividend yield; LEV is the leverage computed as long-term debt divided by total assets; BM is the book-to-market ratio; SG is the sales growth from year t-1 to year t; GROWTH is the average of analysts' mean long-term earnings growth forecast from May of year t to April of year t+1; STDGR is the average of the standard deviation of the analysts' long-term growth forecasts from May of year t to April of year t+1; NUMEST is the average

number of analysts following the firm in year t; CHGR and CHSTD are the change in mean and standard deviation of analysts' long-term growth forecasts from year t-1 to t.

The main difference between equation (2) and Bushee and Noe (2000) is the inclusion of the test variables: RNDM and the interaction of Leaders and RNDM. Consistent with observations made in earlier, if investors react to R&D efforts by considering R&D to be more risky due to behavioral reasons, we expect stock return volatility to be positively associated with RNDM (see Lang and Lundholm, 1993). On the other hand if investors understand that Leaders have adopted an innovation strategy, then the perceived risk should be lower for them. Hence, we expect the interaction between Leaders and RNDM to be negative. In other words, we expect the Leaders to have less stock return volatility, i.e., less perceived risk.

AR, VOL, LMV, LEV, EP, BM, DM and SG are control variables (see Bushee and Noe, 2000). In addition to these variables, we include variables related to the information environment as captured by the analysts' long-term growth estimates, and the corresponding standard deviation. Previous research on firm's disclosure practices and stock return volatility documents a positive association between the two; indicating that better information environment is positively associated with stock return volatility (see Lang and Lundholm, 1993). GROWTH, STD and NUMEST are the controls for the information environment.

Consistent with our earlier sample selection criteria, we consider only firms with both sales greater than $10 million and total assets greater than $5 million. Furthermore, we require that at least three analysts provide long-term growth forecasts such that the

standard deviation of long term growth forecasts is a meaningful measure. The sample for estimating equation (2) contains 5,536 firm-year observations.

Table 7, Panel B contains the results of estimating equation (2) without RNDM and the interaction between RNDM and LEADERS, i.e., a replication of Bushee and Noe (2000) so as to establish a benchmark for our sample. The coefficient estimates on the control variables are similar to that of Bushee and Noe (2000). The coefficient estimates on the information environment variables are positive suggesting that Lang and Lundholm's (1993) conjecture that firms facing more information asymmetry (as proxied by stock return volatility) are the ones for whom there is a demand for better disclosure environments (as proxied by financial intermediaries).

The last two columns of Table 7, Panel B contain the results of estimating equation (2) including our test variables. RNDM is positively associated with future stock return volatility and the interaction between Leaders and RNDM, is negatively associated with future stock return volatility. This broadly supports the conjecture that the future excess returns for Leaders documented in the previous section is not due to risk.

Future earnings variability and R&D Leaders

We examine whether the nature of R&D of Leaders is such that it results in increased future earnings variability compared to that of Followers. Kothari et al. (2002) hereafter referred to as KLL; develop a research design that relates ex post variability of earnings to R&D expenditures and capital expenditures. The premise of examining future earnings variability is based on Beaver et al.'s (1970) findings that earnings variability and the systematic risk measured by beta obtained from the CAPM model are positively

associated. The motivation for their study is to provide evidence on whether the nature of research activity is similar or different than capital expenditures in inducing earnings variability. We augment KLL's model and estimate the marginal difference on the R&D coefficient between the Leaders and the Followers as follows:

$$SD(EPS_{t+1,\,t+5}) = [\text{Industry Fixed Effects}] + \beta_{1t}\, RNDM_t + \beta_{L2t}\, LEADER_t\, RNDM_t + \beta_{2t}\, CapEx_t + \beta_{L1t}\, LEADER_t\, CapEx_t + \beta_{3t}\, LMV_t + \beta_{4t}\, LEV_t + error_{t+1,t+5} \quad (3)$$

where $SD(E_{t+1,t+5})$ is the standard deviation of earnings per share before extraordinary items and discontinued operations (data item # 58); the standard deviation is calculated using five annual earnings observations for years t+1 through t+5 and each earnings observation is deflated by the stock price, P, at the beginning of the period t; RNDM is the R&D expenditure (data item # 46) to market value of equity (data item # 199 times data item # 54) in year t; LEADER is a dummy variable that takes on a value of one if the industry adjusted R&D intensity computed based on R&D to sales of the firm is greater than zero in year t; $CapEx_t$ is the capital expenditure per share (data item # 128), deflated by P; LMV_t is the natural logarithm of the market value of equity at the end of year t; and LEV_t is the ratio of long-term debt (data item # 9 plus data item # 34) to the market value of equity plus long-term debt, both at the end of year t. We estimate regression model (3) for only the non-zero R&D firms, while KLL consider both firms with and without R&D.

The main difference between our regression model (3) and KLL's model is the inclusion of the two interaction terms of R&D expenditures with Leaders and capital expenditures with Leaders. We allow for the coefficient on capital expenditures to be different across R&D Leaders and Followers, to allow for the possibility that the sustained competitive advantage could lead to higher utilization of the facilities. Note that

while KLL's focus was on the relative weights on RNDM and CapEx in inducing earnings variability our focus is on the differential impact of R&D across Leaders and Followers. The intuition behind this research design is that if Leaders earnings variability is similar or lower than that of the Followers, then the earlier evidence of stock market valuation wherein the Follower firms do not exhibit risk-adjusted excess returns, while the Leader firms do, is likely driven by the investor's lack of information. Thus, we expect β_{L1t}, β_{L2t} to be negative or zero. LMV and LEV are the control variables for our purpose (see KLL).

We obtain financial data from the Compustat Annual Industrial and Annual Research files for the period 1975-2002 with all available data. For all the variables except P, the values are for fiscal year t or at the end of fiscal year t. In contrast, P is measured at the end of fiscal year t-1 because they are used as deflators. Per share values of P and future earnings, EPS_{t+1} to EPS_{t+5}, are adjusted for stock splits and stock dividends using the cumulative adjustment factor, Compustat data #27, so that they are comparable to the per share values of the remaining variables for year t. Since earnings variability is calculated using data for five years following year t, the last year of the sample period is 1997. Even though earnings variability is calculated using five years of future earnings data, to avoid survivor bias, we do not require earnings data availability for years t+1 to t+5 for a firm year to be included in the data. In cases where earnings data are missing in any of the periods from t+1 through t+5, the standard deviation of earnings, $SD(EPS_{t+1,t+5})$ is set equal to the mean of $SD(EPS_{t+1,t+5})$ for the firms in the same Altman Z-Score decile portfolio in year t (see KLL). Consistent with our earlier

sample selection criteria we delete firms with sales revenue less than $10 million and Total Assets less than $5 million. The sample contains 27,458 firm-year observations. Note that the definition of LEV and LMV are different from that used for estimating equation (2). This is because we keep the definitions consistent with that of KLL.

Table 8, Panel A reports descriptive statistics for estimating equation (3). Firms on average spend 11.46% of the stock price on capital expenditures and 6.97% of the stock price on R&D expenditures indicating that the outlays are substantial. The mean (median) standard deviation of earnings deflated by stock price is 4.17% (3.33%), ranging from 0.14% to 45.96%. In unreported analysis we find that on average the standard deviation of earnings vary considerably through time.

Table 8, Panel B provides the mean of the annual cross-section estimates of regression model (3) for the whole sample, i.e., replication of KLL. We do this to establish a benchmark since we consider only R&D firms. Similar to KLL we find that the coefficient on R&D expenditure is 0.0760 while the coefficient estimate on CapEx is 0.0169. That is R&D expenditures contribute about 4.5 times more than CapEx to earnings variability indicating that the nature of R&D activity is more "risky" as opposed to traditional "brick and mortar" expenditures.

The estimates of equation (3) are contained in the last two columns of Table 8, Panel B. The coefficient estimate on the interaction between Leaders and R&D expenditures is negative and significantly different from zero, the mean β_{L2t} over the 23 years is -0.0321. The results indicate that the R&D spending for Leaders are less risky than that of the Followers' R&D spending, showing that R&D Leaders have more

effective R&D which decreases future earnings variability. Also, the future earnings variability induced by capital expenditures is lower for the Leaders as evidenced by the negative coefficient on the interaction between Leaders and CapEx (-0.0171). This suggests that R&D activity of Leaders on average is geared towards improving the manufacturing and delivery processes, i.e., process R&D which in turn results in decreasing the risk of capital expenditures.

Overall, the evidence suggests that the nature of R&D activity of Leaders does not induce additional future earnings variability; and that the nature of R&D activity is such that it mitigates future earnings variability induced by capital expenditures. More importantly, this evidence does not support the incomplete risk adjustment argument for the risk-adjusted excess returns of R&D Leaders. In addition, the evidence also suggests that information on the nature of R&D activity in terms of product versus process oriented R&D would enhance the information available to investors, essentially because some of the R&D activity could have indirect benefits by improving the effectiveness of brick and mortar operations.

V. Do Financial Analysts Incorporate the Future Profitability of R&D Leaders?

In this section, we examine whether financial analysts incorporate the future profitability potential of Leaders into their earnings forecasts. Financial analysts typically provide up to two years ahead earnings forecasts as well as a long-term growth estimate of earnings applicable to three to five years ahead (i.e., medium-term) horizon. If the

financial analysts mitigate the information schism between the investors and the firm, which is one of their main roles, they must incorporate the increased potential of future profits of Leaders in their long-term growth estimates.

Table 9, Panel A provides the results of comparing the financial analysts' long-term forecasts across Leaders and Followers. The number of analysts following the Leaders and Followers are similar with about 7 analysts following the firms. The mean (median) R&D expenditure to market value of equity for Leaders and Followers are 8% (6%) and 3% (2%), respectively, which is consistent with the observations in Table 2.

The mean (median) long-term growth forecast for Leaders and Followers are 19% (17%) and 14% (13%), respectively; which constitutes on average a 5% higher long-term growth forecast for Leaders than Followers. This shows that financial analysts on average incorporate the higher earnings potential of Leaders into their long-term earnings forecasts. However, examining the revision in long-term growth estimates we find that the Leaders' long-term growth estimates are revised downwards about 3.3% on average, while the Follower's long-term growth estimates are revised downwards about 1.6%, which suggests that analysts appear to react to current earnings or stock price movements and hence, penalize Leaders more in their long-term outlook. Alternatively, the lack of information on R&D productivity appears to seep into analysts' earnings forecasts.

The mean (median) standard deviation of long-term growth forecasts for Leaders and Followers are 4.5 (3.8) and 3.6 (2.8), respectively, which suggests that the disagreements among analysts for Leaders is more than that for Followers. Such disagreements across sophisticated financial intermediaries on R&D productivity are

most likely to occur due to lack of information. The change in standard deviation across Leaders and Followers is not statistically significant showing that the differences appear to persist.

In Table 9, Panels B and C we repeat the analysis contained in Table 4 by partitioning the sample into firms with greater than three analysts following and all the rest. Table 9, Panel B provides the risk-adjusted excess returns for Leaders and Followers in the subsequent four years for firms with more than two analysts. For Followers, the excess returns in years t+1, t+2, t+3 and t+4 are 0.72%, -0.50%, 0.07% and 1.34%, respectively. This suggests that analysts help investors understand and appropriately value the R&D activity of Followers. On the other hand, for Leaders the excess returns in years t+1, t+2, t+3 and t+4 are 4.08%, 10.83%, 6.09% and 4.17%, respectively. This suggests that analysts do not help to mitigate the information schism with respect to R&D Leaders.

Table 9, Panel C provides the risk-adjusted excess returns for Leaders and Followers in the subsequent four years with less than three analysts. For Followers the excess returns in years t+1, t+2, t+3 and t+4 are 0.81%, 0.13%, 0.08% and 0.11%, respectively. This suggests that even without the help of analysts, investors understand and appropriately value the R&D activity of the Followers. On the other hand, for the Leaders the excess returns in years t+1, t+2, t+3 and t+4 are 1.09%, 6.63%, 3.38% and 2.36%, respectively; all of which are statistically significant. This pattern is similar to what we observed in Panel B.

The results in Panels B and C of Table 9 suggest that financial intermediaries do not play a role in mitigating or alleviating the lack of information. This could be due to lack of uniform information that is provided to them, which can be used to compare, analyze and evaluate the prospects of Leaders such that investors can make informed decisions.

VI. Concluding Remarks

In this paper, we examined the future excess returns of R&D intensive firms. Firms with R&D intensity measure greater than (lesser than or equal to) that of the industry are classified as Leaders (Followers). We show that Leaders have sustained future profitability. However, the future risk-adjusted excess returns are higher for Leaders than Followers, suggesting that the stock price does not incorporate the R&D relevant information in a timely fashion. We then directly examine the difference across Leaders and Followers of two risk measures: stock return volatility and future earnings variability. We find that Leaders have lower stock return volatility and earnings variability, ceteris paribus. We then examine whether the financial analysts' help mitigate the apparent lack of information with respect to R&D, and find that even though the long-term earnings growth estimates for Leaders is high, they revise these estimates downwards perhaps as a reaction to short-term earnings. Overall, it appears that the stock market does not incorporate the Leaders' potential for sustained future profits as argued in the strategy and economics literatures.

These findings have several important implications. First, collectively the results demonstrate the need for firms to establish effective communications strategies with investors so as to reduce the information schism, especially for firms pursuing innovation strategies (see Coyne and Witter 2002). Secondly, the results demonstrate the importance of incorporating additional disclosures of research and development activities of firms in the annual reports. This information could be in the form of disclosures in footnotes and need not be incorporated in the financial statements themselves. Future research on whether improved disclosure of R&D activity enables investors to value R&D firms more appropriately will provide insights into effective communication strategy to help investors' value firms with innovation strategy.

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TABLE 1: Classification of R&D Leaders and Followers

PANEL A: Number of firms classified as Leaders and Followers

	R&D Intensity: R&D to Sales			R&D Intensity: R&D to Market Value		
Year	Leaders	Followers	Leaders as % of Total	Leaders	Followers	Leaders as % of Total
1975	439	746	37.05	502	683	42.36
1976	461	716	39.17	469	708	39.85
1977	449	680	39.77	416	713	36.85
1978	419	661	38.80	332	748	30.74
1979	412	651	38.76	319	744	30.01
1980	419	616	40.48	343	692	33.14
1981	421	623	40.33	344	700	32.95
1982	431	629	40.66	330	730	31.13
1983	436	670	39.42	264	842	23.87
1984	478	711	40.20	270	919	22.71
1985	494	679	42.11	271	902	23.10
1986	486	680	41.68	278	888	23.84
1987	484	688	41.30	295	877	25.17
1988	512	688	42.67	333	867	27.75
1989	518	674	43.46	360	832	30.20
1990	551	667	45.24	384	834	31.53
1991	554	688	44.61	407	835	32.77
1992	621	725	46.14	422	924	31.35
1993	652	788	45.28	457	983	31.74
1994	754	823	47.81	498	1079	31.58
1995	787	844	48.25	525	1106	32.19
1996	913	896	50.47	569	1240	31.45
1997	950	959	49.76	821	1088	43.01
Average number of firms	550	717	43.37	400	867	31.60

PANEL B: Persistence of Leaders

	Number of firms				As percentage of Leaders in year (t)			
	Followers	Leaders	Not in sample	Total	Followers	Leaders	Not in sample	Total
Current year, year (t)	0	12,641	0	12,641	0.00	100.00	0.00	100.00
One year after, year (t+1)	1,254	10,722	665	12,641	9.92	84.82	5.26	100.00
Two years after, year (t+2)	2,110	9,164	1,367	12,641	16.69	72.49	10.81	100.00
Three years after, year (t+3)	2,763	7,873	2,005	12,641	21.86	62.28	15.86	100.00
Four years after, year (t+4)	3,282	6,799	2,560	12,641	25.96	53.79	20.25	100.00

PANEL C: Persistence of Followers

	Number of firms				As percentage of Followers in year (t)			
	Followers	Leaders	Not in sample	Total	Followers	Leaders	Not in sample	Total
Current year, year (t)	16,502	0	0	16,502	100.00	0.00	0.00	100.00
One year after, year (t+1)	14,180	1,125	1,197	16,502	85.93	6.82	7.25	100.00
Two years after, year (t+2)	12,285	1,854	2,363	16,502	74.45	11.24	14.32	100.00
Three years after, year (t+3)	10,819	2,368	3,315	16,502	65.56	14.35	20.09	100.00
Four years after, year (t+4)	9,648	2,756	4,098	16,502	58.47	16.70	24.83	100.00

Notes:

1. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, Sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.
2. In Panels B and C the classification of Leaders and Followers is based on R&D expenditures to Sales.

Variable Definitions:

A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as (a) R&D expenditures in year t to sales in year t, and (b) R&D expenditures in year t to market value of equity four months subsequent to the fiscal year-end of year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry-adjusted R&D expenditure to market value of equity is computed as the difference between the firm's R&D expenditure to market value of equity minus the industry's R&D to market value of equity for the corresponding year. The industry's R&D expenditure to market value of equity is computed as the value-weighted R&D expenditure to market value of equity with market value of equity as value-weight. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997).

TABLE 2: Characteristics of Leaders and Followers

PANEL A: Descriptive statistics for Leaders and Followers when R&D intensity is R&D expenditure to sales

	Mean				Median			
			Difference				Difference	
Variables	**Leaders**	**Followers**	**t-stat**	**p-value**	**Leaders**	**Followers**	**z-stat**	**p-value**
R&D expenditure to sales (%)	11.57	2.09	27.85	0.00	7.71	1.41	106.68	0.00
R&D expenditure to market value of equity (%)	10.24	4.32	74.44	0.00	7.05	2.71	75.02	0.00
Book-to-market value of equity	0.69	0.87	-23.50	0.00	0.53	0.71	-31.41	0.00
Sales-to-market value of equity	1.73	2.97	-37.66	0.00	1.05	1.99	-52.42	0.00
Earnings-to-stock price (%)	1.44	6.10	-7.63	0.00	5.03	7.47	-31.95	0.00
Return on equity (%)	-16.01	1.23	-2.04	0.04	10.17	12.03	-17.04	0.00
Dividend yield (%)	1.22	1.97	-23.53	0.00	0.00	1.05	-32.75	0.00
Sales growth (%)	34.09	22.34	2.05	0.04	12.82	10.24	9.25	0.00
Industry-adjusted sales growth (%)	25.90	16.90	2.33	0.02	4.00	2.00	11.65	0.00
Market share (%)	2.05	2.11	-0.71	0.47	0.13	0.20	-14.15	0.00
Market value of equity ($ millions)	1009.13	947.46	1.10	0.27	93.58	68.18	12.37	0.00
Sales ($ millions)	1166.82	1304.25	-2.06	0.04	80.45	130.73	-20.35	0.00
Net income ($ millions)	57.56	61.38	-0.85	0.39	3.18	4.48	-14.28	0.00
Total asset ($ millions)	1173.00	1309.00	-1.55	0.12	76.81	97.66	-7.69	0.00
Book value of equity ($ millions)	455.70	473.20	-0.73	0.46	46.22	47.76	-0.68	0.24

PANEL B: Descriptive statistics for Leaders and Followers when R&D intensity is R&D expenditure to market value of equity

	Mean				Median			
			Difference				Difference	
Variables	**Leaders**	**Followers**	**t-stat**	**p-value**	**Leaders**	**Followers**	**z-stat**	**p-value**
R&D expenditure to sales (%)	10.78	4.09	21.85	0.00	5.36	1.99	56.55	0.00
R&D expenditure to market value of equity (%)	13.54	3.82	71.13	0.00	10.17	2.74	104.09	0.00
Book-to-market value of equity	0.70	1.00	30.34	0.00	0.57	0.80	36.30	0.00
Sales-to-market value of equity	3.24	2.06	26.98	0.00	2.10	1.35	34.81	0.00
Earnings-to-stock price (%)	1.38	5.33	-4.07	0.00	6.09	6.50	-8.83	0.00
Return on equity (%)	-28.50	4.03	-2.81	0.01	7.92	12.72	-36.34	0.00
Dividend yield (%)	1.46	1.73	-7.65	0.00	0.00	0.56	-17.49	0.00
Sales growth (%)	25.97	28.12	-2.03	0.04	9.21	12.15	-13.61	0.00
Industry-adjusted sales growth (%)	19.09	21.77	-2.35	0.02	1.43	4.48	-9.45	0.00
Market share (%)	2.07	2.10	-0.35	0.72	0.17	0.17	-1.20	0.22
Market value of equity ($ millions)	474.20	1205.00	-15.62	0.00	46.24	103.20	-33.34	0.00
Sales ($ millions)	830.70	1435.00	-10.25	0.00	80.40	121.40	-16.77	0.00
Net income ($ millions)	23.39	76.51	-14.06	0.00	1.63	5.50	-35.88	0.00
Total asset ($ millions)	767.60	1473.00	-9.90	0.00	67.19	100.10	-16.78	0.00
Book value of equity ($ millions)	291.30	546.10	-12.11	0.00	34.06	54.72	-21.59	0.00

Notes:

1. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.
2. In Panel A firms are classified as Leaders for the year if the industry-adjusted R&D expenditure to sales is greater than zero; and as Followers otherwise.
3. In Panel B firms are classified as Leaders for the year if the industry-adjusted R&D expenditure to market value of equity is greater than zero; and as Followers otherwise.
4. The difference in the mean and median across the Leaders and Followers are based on the cross-section, pooled data.

Variable Definitions:

A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as (a) R&D expenditures in year t to sales in year t, and (b) R&D expenditures in year t to market value of equity four months subsequent to the fiscal year-end of year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry-adjusted R&D expenditure to market value of equity is computed as the difference between the firm's R&D expenditure to market value of equity minus the industry's R&D to market value of equity for the corresponding year. The industry's R&D expenditure to market value of equity is computed as the value-weighted R&D expenditure to market value of equity with market value of equity as value-weight. Market value is calculated as

share outstanding times price at the end of April. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to sales is R&D expenditure (Compustat data item # 46) divided by sales revenue (Compustat data item # 12). R&D expenditure to market value of equity is R&D expenditure divided by market value of equity. Book-to-market ratio is book value of equity (Compustat data item # 60) divided by market value of equity. Return on equity is net income (Compustat data item # 172) divided by book value of equity. Sales-to-market value of equity is sales (Compustat data item # 12) divided by market value of equity. Earning-to-Stock Price ratio is Net income (Compustat data item # 172) divided by market value of equity. Dividend yield is dividend (Compustat data item # 21) divided by market value of equity. Sales growth is change in sales between year (t) and year-(t-1) divided by sales in year (t-1). The industry market share for a firm is the firm's sales divided by the total sales of the all firms in the same industry for that year. Total asset is (Compustat data item # 6).

TABLE 3: Leaders and Followers Future Performance

PANEL A: Sales growth

	Industry-adjusted				Level			
			Difference				Difference	
	Leaders	Followers	t-stat	p-value	Leaders	Followers	t-stat	p-value
One year after, year (t+1)	8.81	4.14	11.45	0.00	15.88	11.17	11.96	0.00
Two years after, year (t+2)	8.87	4.03	12.89	0.00	15.21	10.59	3.77	0.00
Three years after, year (t+3)	8.67	3.94	15.26	0.00	14.57	10.34	3.39	0.00
Four years after, year (t+4)	12.00	4.23	15.00	0.00	17.36	9.89	3.88	0.00

PANEL B: Return on asset

	Industry-adjusted				Level			
			Difference				Difference	
	Leaders	Followers	t-stat	p-value	Leaders	Followers	t-stat	p-value
One year after, year (t+1)	1.80	-2.17	22.38	0.00	20.38	16.64	22.05	0.00
Two years after, year (t+2)	1.36	-2.54	20.67	0.00	19.67	16.20	21.96	0.00
Three years after, year (t+3)	0.90	-2.80	18.60	0.00	18.98	15.87	18.52	0.00
Four years after, year (t+4)	0.03	-2.99	5.45	0.00	17.82	15.42	5.52	0.00

PANEL C: Industry market share

			Difference	
	Leaders	**Followers**	**t-stat**	**p-value**
One year after, year (t+1)	1.70	1.46	3.79	0.00
Two years after, year (t+2)	1.81	1.51	4.51	0.00
Three years after, year (t+3)	1.95	1.57	5.32	0.00
Four years after, year (t+4)	2.09	1.63	6.03	0.00

Notes:

1. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.
2. Firms are classified as Leaders in year (t) if the industry-adjusted R&D expenditure to sales is greater than zero; and Followers otherwise. The sales growth, return on assets and industry market share of the firms classified as Leaders and Followers in year (t) is tracked in the subsequent years.
3. Industry-adjusted columns in Panel A is the mean of the difference between the firm's sales growth in year (t+i) and the value-weighted industry sales growth in year (t+i) to which the firm belongs with sales in year (t+i) as the value-weights.
4. Industry-adjusted columns in Panel B is the mean of the difference between the firm's return on assets in year (t+i) and the value-weighted industry return on assets in year (t+i) to which the firm belongs, with return on assets in year (t+i) as value-weights.
5. In Panel A, if level of sales growth data are missing in any of the years from t+1 through t+4, it is set equal to mean sales growth of the firms in the same Altman Z-Score decile portfolio.
6. Similarly in Panel B, if level of ROA data are missing in any of the years from t+1 through t+4, it is set equal to mean sales growth of the firms in the same Altman Z-score decile portfolio.
7. All the ratios in all panels, sales, sales growth, industry-adjusted sales growth, ROA, industry-adjusted return on asset are multiplied by 100 to represent them in percentage.

Variable Definitions:

A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as R&D expenditures (data#46) in year t to sales (data#12) in year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to sales is R&D expenditure (Compustat data item # 46) divided by sales (Compustat data item # 12). Sales growth is change in sales between year (t) and year-(t-1) divided by sales in year (t-1). Return on assets is operating income divided by total asset (Compustat data item # 6) where operating income is {sales(#12) - cost of goods sold (#41) - sales and general administrative expenses(#189) + R&D expense}. The industry market share for a firm is the firm's sales divided by the total sales of the all firms in the same industry for that year.

TABLE 4: Stock Valuation of Leaders and Followers

PANEL A: Annual excess returns when classification is based on R&D expenditure to sales

	Leaders		Followers		Difference	
	Excess returns	t-stat	Excess returns	t-stat	t-stat	p-value
One year after, year (t+1)	0.0178	3.17	0.0079	1.89	1.39	0.15
Two years after, year (t+2)	0.0759	9.32	0.0001	0.01	8.10	0.00
Three years after, year (t+3)	0.0400	5.75	0.0007	0.15	4.58	0.00
Four years after, year (t+4)	0.0278	3.88	0.0034	0.78	2.91	0.00
Average over (t+1) to (t+4)	0.0404		0.0030			

PANEL B: Annual excess returns when classification is based on R&D expenditure to market value of equity

	Leaders		Followers		Difference	
	Excess returns	t-stat	Excess returns	t-stat	t-stat	p-value
One year after, year (t+1)	0.0447	6.27	-0.0027	-0.73	5.91	0.00
Two years after, year (t+2)	0.0877	8.79	0.0077	1.72	7.31	0.00
Three years after, year (t+3)	0.0324	4.15	0.0110	2.28	2.46	0.01
Four years after, year (t+4)	0.0380	4.30	0.0029	0.71	3.59	0.00
Average over (t+1) to (t+4)	0.0507		0.0047			

Notes:

1. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, Sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.
2. In Panel A, firms are classified as Leaders in year (t) if the industry adjusted R&D expenditure to Sales is greater than zero; and Followers otherwise. The mean excess returns for each of the four subsequent years for the portfolio of firms classified as Leaders and Followers in year (t) is reported. The difference column shows t-stat and p-value of t-stat for the difference in the annual excess returns of the Leaders minus the annual excess returns of the Followers (i.e., hedge portfolio returns).
3. In Panel B, firms are classified as Leaders in year (t) if the industry-adjusted R&D expenditure to market value of equity is greater than zero; and Followers otherwise. The mean excess returns for each of the four subsequent years for the portfolio of firms classified as Leaders and Followers in year (t) is reported. The difference column shows t-stat and p-value of t-stat for the difference in the annual excess returns of the Leaders minus the annual excess returns of the Followers (i.e., hedge portfolio returns).

Variable Definitions:
A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as (a) R&D expenditures in year t to sales in year t, and (b) R&D expenditures in year t to market value of equity four months subsequent to the fiscal year-end of year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to

sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry-adjusted R&D expenditure to market value of equity is computed as the difference between the firm's R&D expenditure to market value of equity minus the industry's R&D to market value of equity for the corresponding year. The industry's R&D expenditure to market value of equity is computed as the value-weighted R&D expenditure to market value of equity with market value of equity as value-weight. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to Sales is R&D expenditure (Compustat data item # 46) divided by sales revenue (Compustat data item # 12). R&D expenditure to market value of equity is R&D expenditure divided by market value of equity. Market value is calculated as share outstanding times price at the end of April. The excess returns is computed using the companion portfolio approach where the companion portfolio for each firm is determined based on the book-to-market ratio and the market value of equity (see CLS).

TABLE 5: Robustness test of Stock Valuation of R&D Leaders and Followers

PANEL A: Annual excess returns when classification is based on R&D expenditure to sales

	Leaders in years (t-1) and (t)		Followers in years (t-1) and (t)		Difference	
	Excess returns	t-stat	Excess returns	t-stat	t-stat	p value
One year after, year (t+1)	0.0202	3.42	0.0082	1.91	1.75	0.08
Two years after, year (t+2)	0.0747	9.34	-0.0024	-0.50	7.95	0.00
Three years after, year (t+3)	0.0423	5.64	-0.0019	-0.43	5.11	0.00
Four years after, year (t+4)	0.0316	4.08	0.0039	0.88	2.32	0.01
Average over (t+1) to (t+4)	0.0422		0.0020			

PANEL B: Annual excess returns when classification is based on R&D expenditure to market value of equity

	Leaders in years (t-1) and (t)		Followers in years (t-1) and (t)		Difference	
	Excess returns	t-stat	Excess returns	Excess returns	t-stat	p value
One year after, year (t+1)	0.0392	5.16	-0.0031	-0.79	3.99	0.00
Two years after, year (t+2)	0.0668	6.70	0.0073	1.58	6.75	0.00
Three years after, year (t+3)	0.0462	4.96	0.0047	1.02	4.75	0.00
Four years after, year (t+4)	0.0429	4.29	0.0030	0.71	4.11	0.00
Average over (t+1) to (t+4)	0.0488		0.0030			

Notes:

1. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.
2. In Panel A, firms are classified as Leaders in year (t) if the industry adjusted R&D expenditure to sales is greater than zero; and Followers otherwise. The mean excess returns for each of the four subsequent years for the portfolio of firms classified as Leaders and Followers in year (t) is reported. The difference column shows t-stat and p-value of t-stat for the difference in the annual excess returns of the Leaders minus the annual excess returns of the Followers (i.e., hedge portfolio returns).
3. In Panel B, firms are classified as Leaders in year (t) if the industry-adjusted R&D expenditure to market value of equity is greater than zero; and Followers otherwise. The mean excess returns for each of the four subsequent years for the portfolio of firms classified as Leaders and Followers in year (t) is reported. The difference column is the difference in the annual excess returns of the Leaders minus the annual excess returns of the Followers (i.e., hedge portfolio returns).

Variable Definitions:

A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as (a) R&D expenditures in year t to sales in year t, and (b) R&D expenditures in year t to market value of equity four months subsequent to the fiscal year-end of

year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry-adjusted R&D expenditure to market value of equity is computed as the difference between the firm's R&D expenditure to market value of equity minus the industry's R&D to market value of equity for the corresponding year. The industry's R&D expenditure to market value of equity is computed as the value-weighted R&D expenditure to market value of equity with market value of equity as value-weight. Market value is calculated as share outstanding times price at the end of April. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to sales is R&D expenditure (Compustat data item # 46) divided by sales revenue (Compustat data item # 12). R&D expenditure to market value of equity is R&D expenditure divided by market value of equity. The excess returns is computed using the companion portfolio approach where the companion portfolio for each firm is determined based on the book-to-market ratio and the market value of equity (see CLS).

Table 6: Stock Return Valuation of Leaders and Followers, Equation (1)

	Portfolio	b_0	t-stat	b_1	t-stat	b_2	t-stat	b_3	t-stat	b_4	t-stat	R^2
One year after, year (t+1)	Followers	0.0022	2.89	0.9953	52.85	0.9095	32.67	0.0911	2.84	-0.0899	-4.00	0.95
	Leaders	0.0033	2.98	1.0451	37.27	1.0400	25.09	-0.3014	-6.31	-0.1816	-5.43	0.93
Two years after, year (t+2)	Followers	0.0023	2.71	1.0265	49.42	0.7304	26.69	0.1682	4.70	-0.1528	-6.25	0.94
	Leaders	0.0055	4.51	1.0110	34.41	0.9619	24.85	-0.2940	-5.80	-0.1453	-4.20	0.92
Three years after, year (t+3)	Followers	0.0027	3.30	1.0174	50.03	0.6753	25.74	0.1754	5.69	-0.1693	-8.80	0.94
	Leaders	0.0061	5.40	1.0199	36.59	0.8668	24.10	-0.2441	-5.78	-0.2002	-7.59	0.93
Four years after, year (t+4)	Followers	0.0031	3.84	0.9907	50.51	0.5749	23.05	0.1616	5.51	-0.1434	-8.10	0.94
	Leaders	0.0052	5.08	1.0150	40.31	0.7534	23.53	-0.1874	-4.97	-0.1736	-7.63	0.94

1. Equation (1): $R_{it} - R_{ft} = b_{0i} + b_{1i} [R_{mt} - R_{ft}] + b_{2i} SMB_t + b_{3i} HML_t + b_{4i} UMD_t + e_{it}$.
2. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.

Variable Definitions:

A firm is classified as a Leader in year t, if the industry adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as R&D expenditures (data#46) in year t to sales (data#12) in year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to sales is R&D expenditure (Compustat data item # 46) divided by sales revenue (Compustat data item # 12). R_{it} is the monthly return of the portfolio for portfolio i in month t, R_{ft} is the treasury bill rate in month t, R_{mt} is the value-weighted market index, SMB_t and HML_t are the returns on the Fama and French (1993) factor-mimicking portfolios for size and book-to-market, respectively, UMD_t is the momentum returns on a portfolio of past winners (top quintile) and past losers (bottom quintile) beginning seven months ago and ending one month ago.

TABLE 7: Future Stock Return Volatility of Leaders and Followers

PANEL A: Descriptive statistics

Variable	Mean	Std	Min	Q1	Median	Q3	Max
STDRET	-3.8139	0.3954	-4.8878	-4.1259	-3.8395	-3.5093	-2.5790
RNDM	0.0562	0.0635	0.0001	0.0172	0.0367	0.0722	0.9574
LEADER	0.4337	0.4956	nm	nm	nm	nm	nm
AR	0.0205	0.4244	-1.2534	-0.2175	-0.0255	0.1820	5.7622
VOL	1.2164	1.3238	0.0514	0.4611	0.7279	1.3879	12.5500
LMV	6.8557	1.4943	2.6018	5.7569	6.7372	7.7910	12.1121
LEV	0.1750	0.1313	0.0000	0.0597	0.1685	0.2639	0.5900
DM	0.0177	0.0188	0.0000	0.0000	0.0143	0.0295	0.1147
EP	0.0475	0.0720	-0.5080	0.0347	0.0577	0.0793	0.3216
BM	0.5221	0.3005	0.0581	0.3096	0.4581	0.6687	2.3259
SG	0.1584	0.2623	-0.3694	0.0213	0.1036	0.2214	2.3170
GROWTH	0.1674	0.0771	0.4756	0.1142	0.1448	0.2009	0.5572
STDGR	0.0407	0.0374	0.0000	0.0220	0.0326	0.0496	0.0941
NUMEST	8.1463	4.8311	3.0000	4.3333	6.5833	10.6667	30.2500
CHGR	-0.0240	0.1451	-0.5910	-0.1006	-0.0241	0.0439	1.6207
CHSTD	-0.0069	0.0008	-0.0100	-0.0073	-0.0067	-0.0064	-0.0061

PANEL B: Estimating equation (2)

	Equation (2) without RNDM		Equation (2)	
	Coefficient Estimate	t-stat	Coefficient Estimate	t-stat
Intercept	-3.93	-90.92	-3.97	-92.36
RNDM (β_1)			0.7498	9.81
LEADER RNDM (β_{L1})			-0.1032	-2.43
AR (β_2)	0.0021	0.27	-0.0022	-0.29
VOL (β_3)	0.0987	31.64	0.0938	30.05
LMV ((β_4)	-0.0674	-17.52	-0.0651	-17.03
LEV (β_5)	-0.0541	-1.94	-0.053	-1.92
DM (β_6)	-6.1497	-24.48	-5.6417	-22.27
EP (β_7)	-0.4059	-8.19	-0.2848	-5.6
BM (β_8)	0.1627	10.84	0.0999	6.24
SG (β_9)	-0.0285	-1.69	-0.0264	-1.58
GROWTH (β_{10})	0.0113	13.93	0.0119	14.75
STDGR (β_{11})	0.0022	1.96	0.0021	1.9
NUMEST (β_{12})	0.0048	4.57	0.0039	3.69
CHGR (β_{13})	-0.1572	-6.56	-0.1512	-6.37
CHSTD (β_{14})	-0.3982	-8.43	-0.4063	-8.69
Adjusted R^2 (%)	61.09%		61.87%	

Notes:

1. Equation (2): $STDRET_{t+1}$ =[Fixed year effects] + $\beta_1 RNDM_t + \beta_{L1} LEADER_t\ RNDM_t + \beta_2 AR_t + \beta_3 VOLS_t + \beta_4 LMV_t + \beta_5 LEV_t + \beta_6 DM_t$ + $\beta_7 EP_t + \beta_8 BM_t + \beta_9 SG_t + \beta_{10} GROWTH_t + \beta_{11} STDGR_t + \beta_{12} NUMEST_t + \beta_{13} CHGR_t + \beta_{14} CHSTD_t$ + error
3. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million, total assets greater than $5 million and followed by at least two analysts for the period 1982 to 1997.
4. The sample contains 5,536 observations spanning 1982 to 1997.
5. DM, LEV, BM, GROWTH, STDGR, CHGR, and CHSTD are winsorized at 1% and 99% of the distribution.
6. nm in Panel A indicates the statistics are not meaningful.

Variable Definitions: STDRET is the stock return volatility computed the log of standard deviation of daily stock returns measured over from May of year t+1 to April of year t+2 (see Bushee and Noe, 2000). RNDM is the R&D expenditure (data#46) to market value of equity in year t. LEADER is a dummy variable that takes on a value of one if the industry-adjusted R&D intensity computed based on R&D to sales of the firm is greater than zero in year t. A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as R&D expenditures (data#46) in year t to sales (data#12) in year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. AR is the size and book-to-market adjusted excess returns in year t corresponding to the STDRET. VOL is annual mean of monthly trading volume relative to shares outstanding at the end of each month. LMV is log of market value of equity where market value is computed as share outstanding times price at the end of April. LEV is leverage ratio computed as long term debt (data#9) plus current debt (data#34) divided by total asset is (data#6). EP is Earning-to-price ratio computed as income before extraordinary items (data#18) divided by market value of equity. BM is book-to-market ratio computed as book value of equity (data#60) divided by market value of equity. DM is dividend yield computed as dividend (data#21) divided by market value of equity. SG is sales growth measured as change in sales revenue (data#12) between year t and year (t-1) divided by sales revenue in year (t-1). GROWTH is the annual (from May to April) mean of analyst monthly consensus long-term growth forecast in year t obtained from IBES summary database. STDGR is the annual (from May to April) mean of monthly standard deviation of analyst long-term growth forecast obtained from IBES summary database. NUMEST is the annual (from May to April) mean of number of forecast in a month obtained from IBES summary database. CHGR and CHSTD are the change in GROWTH and STDGR from one year to the next scaled by previous year's GROWTH and STDGR, respectively.

TABLE 8: Future Earnings Variability of Leaders and Followers

PANEL A: Descriptive statistics

Variable	Mean	Std	Min	Q1	Median	Q3	Max
EPS	0.0534	0.1676	-1.0000	0.0198	0.0672	0.1172	1.0000
$SD(EPS_{t+1, +5})$	0.0417	0.0453	0.0014	0.0113	0.0333	0.0529	0.4596
RNDM	0.0697	0.0769	0.0000	0.0201	0.0445	0.0902	0.6863
CapEx	0.1146	0.1328	0.0000	0.0355	0.0728	0.1436	2.2293
LMV	-2.2439	1.9833	-8.1311	-3.7200	-2.4743	-0.9405	3.6855
LEV	0.2605	0.2884	0.0000	0.0437	0.1796	0.3826	3.1493

PANEL B: Estimating equation (3)

	Equation (3) without interaction		Equation (3)	
Variable	Coefficient Estimate	t-stat	Coefficient Estimate	t-stat
RNDM (β_{1t})	0.0760	7.50	0.1186	11.44
LEADERS RNDM (β_{L1t})			-0.0321	-2.29
CapEx (β_{2t})	0.0169	3.66	0.0166	3.20
LEADERS CapEx (β_{L2t})			-0.0171	-2.67
LMV (β_{3t})	-0.0081	-25.47	-0.0083	-25.18
LEV (β_{4t})	0.0225	13.28	0.0209	12.61

Notes:

1. Equation (3) : $SD(E_{t+1,t+5})$=[Industry Fixed Effects]+ β_{1t} $RNDM_t$ +β_{L2t} $LEADER_t$ $RNDM_t$ + β_{2t} $CapEx_t$ +$\beta_{L1t}$$LEADER_t$ $CapEx_t$ +$\beta_{3t}$$LMV_t$+$\beta_{4t}$$LEV_t$+$error_{t+1,t+5}$
2. The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million and total assets greater than $5 million for the period 1975 to 1997.

3. The sample contains 27,458 firm-year observations spanning 1975 to 1997.
4. The coefficient estimates in Panel B are the mean of the annual coefficient estimates of equation (3).
5. The t-statistics in Panel B are the t-statistics of the annual coefficient estimates of equation (3).
6. All variables except EPS are winsorized at 1% and 99% of the annual distributions. EPS values greater than +1 or less than -1 are winsorized at +1 and -1.

Variable Definitions:

A firm is classified as a Leader in year t, if the industry-adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as R&D expenditures in year t to sales in year t. The industry-adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to sales is R&D expenditure (data#46) divided by sales revenue (data#12). RNDM is R&D expenditure (data#46) divided by market value of equity. Market value of equity is price (data #199) times shares outstanding (data #54). CapEx is capital expenditures per share (data #128) deflated by number of shares outstanding (data #54). LMV is the natural log of market value of equity at the end of fiscal year. LEV is the sum of long-term debt, (data#9) and debt in current liabilities, (data #34), divided by sum of long-term debt and market value of equity. EPS is earnings per share before extraordinary times and discontinued operations (data#58). STD is standard deviation of earnings per share. STD is calculated using five annual earnings observations for years t+1 through t+5. When EPS data are missing in any of the years from t+1 through t+5 STD is set equal to mean STD of the firms in the same Altman Z-Score decile portfolio.

TABLE 9: Role of Financial Analysts for Leaders and Followers

PANEL A: Descriptive statistics

	Mean				Median			
			Difference				Difference	
	Leaders	Followers	t-stat	p-value	Leaders	Followers	z-stat	p-value
NUMEST	8.11	7.91	1.67	0.09	6.58	6.42	0.60	0.54
GROWTH	0.1941	0.1451	25.43	0.00	0.1748	0.1314	24.60	0.00
STDGR	0.0456	0.0362	9.74	0.00	0.0383	0.0286	16.92	0.00
RNDM	0.0811	0.0297	19.65	0.00	0.0645	0.0191	11.55	0.00
CHGR	-0.0332	-0.0161	4.52	0.00	-0.0329	0.0159	-5.18	0.00
CHSTD	-0.0069	-0.0070	1.37	0.17	-0.0067	-0.0067	0.61	0.57

PANEL B: The Excess returns for firms with three or more analysts

	Leaders		Followers		Difference	
	Excess returns	t-stat	Abnormal Returns	t-stat	t-stat	p-value
One year after, year (t+1)	0.0408	4.35	0.0072	1.14	2.51	0.01
Two years after, year (t+2)	0.1083	6.51	-0.0050	-0.72	5.77	0.00
Three years after, year (t+3)	0.0609	4.14	0.0007	0.11	3.18	0.00
Four years after, year (t+4)	0.0417	3.10	0.0134	1.96	1.78	0.08
Average over (t+1) to (t+4)	0.0629		0.0041			

PANEL C: The Excess returns for firm with less than three analysts

	Leaders		Followers		Difference	
	Excess returns	t-stat	Excess returns	t-stat	t-stat	p-value
One year after, year (t+1)	0.0109	0.89	0.0081	0.79	0.01	0.96
Two years after, year (t+2)	0.0663	3.88	0.0013	0.11	5.64	0.00
Three years after, year (t+3)	0.0338	2.34	0.0008	0.06	2.54	0.01
Four years after, year (t+4)	0.0236	1.54	0.0011	0.10	2.32	0.02
Average over (t+1) to (t+4)	0.0337		0.0028			

Notes:

1 The sample contains all domestic NYSE, AMEX and Nasdaq firms covered in CRSP, IBES and COMPUSTAT with non-zero R&D expenditures, sales greater than $10 million and total assets greater than $5 million for the period 1982 to 1997.

2 The mean excess returns for each of the four subsequent years for the portfolio of firms classified as Leaders and Followers in year (t) is reported. The difference column in Panel B and Panel C is the difference in the annual excess returns of the Leaders minus the annual excess returns of the Followers (i.e., hedge portfolio returns).

3 GROWTH, STDGR, CHGR, and CHSTD are winsorized at the top and bottom one percent.

4 The difference columns in Panel A show the p-value of difference between Leaders and Followers.

Variable Definitions:
A firm is classified as a Leader in year t, if the industry adjusted R&D intensity is greater than zero, and as a Follower otherwise. R&D intensity of each firm in year t is measured as R&D expenditures in year t to Sales in year t. The industry adjusted R&D expenditure to sales is computed as the difference between the firm's R&D expenditure to sales and the industry's R&D to sales for the corresponding year. The industry's R&D expenditure to sales is computed as the value-weighted R&D expenditure to sales with sales as value-weight. The industry R&D intensity is computed using the 48 industry groups as in Fama and French (1997). R&D expenditure to Sales is R&D expenditure (Campustat data item # 46) divided by sales revenue (Campustat data item # 12). market value of equity is calculated as share outstanding times price at the end of April. R&D expenditure to market value of equity is R&D expenditure divided by market value of equity. GROWTH is the annual mean of analyst monthly consensus long term growth forecast in year t. (from May to April). STDGR is the annual mean of monthly standard deviation of analyst long term growth forecast. NUMEST is the annual mean of number of forecast in a month. CHGR is the change in GROWTH in a given year scaled by lagged GROWTH. CHSTD is the change in STDGR scaled by lagged STDGR. RNDM is R&D to market value is R&D expenditure divided by market value of equity. The excess returns is computed using the companion portfolio approach where the companion portfolio for each firm is determined based on the book-to-market ratio and the market value of equity (see CLS).