Capitalization versus Expensing: Evidence on the Uncertainty of Future Earnings from Capital Expenditures versus R&D Outlays

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I. INTRODUCTION

We present evidence on the relation between R&D costs and the uncertainty of future benefits from those investments using financial data from 1972-1997 for a large sample of firms. Existing empirical research focuses mainly on examining the relevance of accounting disclosures about R&D costs (i.e., association of R&D costs with security prices or returns). We believe the evidence from our study on the uncertainty of benefits from R&D costs, combined with the evidence from previous research on the relevance of R&D costs for security prices, will contribute to the on-going debate among academics, practitioners, and regulators on accounting for R&D. However, based on the evidence in the paper, we are unable to make an unambiguous policy recommendation as to whether R&D costs should be expensed or capitalized.

An important issue facing U.S. and international accounting standard setters is the financial reporting of corporate R&D expenditures. U.S GAAP (Statement of Financial Accounting Standards, SFAS, No. 2, 1974, and Proposed Statement of Position dated April 22, 1997) requires corporations to immediately expense their R&D expenditures. By contrast, International Accounting Standard No. 9 (1978) and the International Accounting Standards Committee's Exposure Draft E60 (1997) on intangible assets allow corporations to capitalize development expenditures and require expensing only research outlays.

The U.S. standard on the accounting treatment of R&D expenditures (i.e., SFAS No. 2) is likely influenced by the standard setters' perceived degree of uncertainty about future economic benefits from current research and development outlays. Paragraphs 48, 49, and 50 of SFAS No. 2 summarize FASB's rationale for requiring immediate expensing of R&D costs. FASB applied the principles for recognizing costs as expenses as set forth in Accounting Principles Board Statement No. 4, paragraphs 156-160. FASB states "…there is often a high degree of uncertainty about whether research and development expenditures will provide any future benefits" (paragraph 49). In paragraph 50 it states "…the relationship between current research and development costs and the amount of resultant future benefits to an enterprise is so uncertain that capitalization of any research and development costs is not useful in assessing the earnings potential of the enterprise." The significant consideration of the uncertainty of future benefits from R&D costs in the standard-setting process suggests standard setters consider the usefulness of a balance sheet in credit (or lending) decisions to be an important factor.

FASB continues to employ the degree of uncertainty of future benefits as a criterion in determining whether a given cost should be capitalized or expensed. This is seen from FASB's definition of assets as "probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events" (Statement of Financial Accounting Concepts No. 6, 1980). Thus, the greater the uncertainty of future economic benefits from R&D expenditures, the weaker would be the case in favor of capitalization (i.e., recognition of R&D as an asset on the balance sheet) even if *on average* the future benefits are positive.

The current debate among academics and practitioners on capitalization versus expensing of R&D expenditures has been without direct empirical evidence on the uncertainty of future earnings and cash flows attributable to current R&D outlays. Bierman and Dukes (1975) is the only study to our knowledge that comes close to examining the relation between R&D and the uncertainty of future benefits. They survey the literature at the time and conclude that FASB overestimates the risk of future benefits from R&D investments. They argue that when looking at a company's R&D investment portfolio, the risks are lower than for an individual project.[1] However, no direct evidence is offered on the degree of risk of future benefits (e.g., earnings or cash flows) associated with R&D investments.

[1] SFAS No. 2 deems "not appropriate to consider accounting for research and development activities on an aggregate or total-enterprise basis" (paragraph 52). The reason is that "For accounting purposes the expectation of future benefits generally is not evaluated in relation to broad categories of expenditures on an enterprise-wide basis but rather in relation to individual or related transactions or projects" (paragraph 52).

Recent research on the accounting treatment of R&D expenditures (e.g., Chambers, Jennings, and Thompson, 1998, Deng and Lev, 1997, and Lev and Sougiannis, 1996, and Sougiannis, 1994) provides compelling evidence that *on average* the market assigns a statistically and economically significant valuation to corporate R&D activity. This is interpreted as R&D costs meeting the relevance criterion underlying accounting standard setting. The evidence, however, does not shed light directly on the degree of uncertainty of the economic benefits to R&D activity compared to other expenditures that corporations typically capitalize. Our objective in this study is to provide direct evidence on the relative degree of uncertainty of future earnings attributable to current R&D investments and to current capital expenditures. The motivation stems from the fact that, whereas existing evidence is largely on the relevance of R&D, standard setting is guided by a trade-off between relevance and uncertainty of future benefits.

The trade-off between relevance and uncertainty of future benefits is in the spirit of the relevance-reliability trade-off that is often discussed in the context of accounting standards (e.g., SFAC No. 2, 1980, Watts and Zimmerman, 1986, pp. 205-206, and Revsine, Collins, and Johnson, 1998, p. 17). We, however, use the phrase "uncertainty of future benefits," not reliability. Accounting information is deemed to be reliable if it "is free of error and bias, is factual, verifiable, and neutral" (Weygandt, Kieso, and Kell, 1996, p. 496, and SFAC No. 2). We believe R&D costs would meet the above definition of reliability because the R&D costs incurred by a firm in a fiscal period can be reasonably accurately established. However, standard setters are also concerned about the likelihood that future benefits will be realized. If the definition of reliability is broadened to include uncertainty of future benefits from costs incurred currently, then our study provides evidence on the reliability component of the relevance-reliability trade-off in the context of R&D accounting. Interestingly, most readers of our study at least initially interpret uncertainty of future benefits to be synonymous with reliability.

Summary of results. The empirical analysis compares the relative contributions of current R&D and capital expenditures to future earnings variability. We use the standard deviation of realized future earnings as a proxy for the uncertainty of future benefits. We perform a simulation analysis to demonstrate the suitability of using realized future earnings' variability to draw inferences about the ex ante relation between the expected variability of future earnings and current period R&D costs. We analyze a sample of over 50,000 firm-year observations from 1972 to 1992 with data on R&D and capital expenditures and estimates of future earnings variability. Evidence is consistent with the hypothesis that R&D investments generate more uncertain future benefits. Specifically, in a regression of future earnings variability on R&D, capital expenditures, and other economic determinants of earnings variability like leverage, firm size, industry membership, growth, and return variability, the coefficient on R&D is about three times as large as that on capital expenditures.

The paper's findings are robust to a variety of sensitivity checks. These include (1) control for cross-industry variation in R&D expenditure levels and cross-sectional variation in growth; (2) alternative variable definitions of future benefits, including earnings, operating cash flows, and earnings plus R&D and depreciation; (3) exclusion of all firms that report zero R&D expense; and (4) research design variations like annual cross-sectional regression analysis versus pooled time-series and cross-sectional regressions. Consistently we find that future benefits from R&D investments are significantly more uncertain than from capital expenditures. This finding, together with the evidence from previous research on the value relevance of R&D, will hopefully be useful in the current discussion on accounting for R&D. However, based on the evidence in this paper alone we are unable to offer any policy prescription because we have no knowledge of the weights to be assigned to relevance and to benefit uncertainty in trading-off one against the other. This is a task left to standard setters who would, hopefully, take into account the evidence on both relevance and benefit uncertainty.

Outline of the paper. Section II surveys the arguments in the literature for and against R&D capitalization. It also summarizes research on the relevance of R&D cost information in financial statements. Section III describes the simulation and research design we use to test the hypothesis that R&D investments produce more uncertain future benefits than capital expenditures. Section IV presents details of data, sample selection, and descriptive statistics. Section V contains the results of empirical analysis and sensitivity tests. We conclude in section VI.

II. ACCOUNTING FOR R&D AND RELATED RESEARCH

This section briefly reviews the arguments that regulators, academics and practitioners often make for and against expensing R&D costs. We also summarize findings of the accounting research on R&D expensing versus capitalizing. Almost invariably previous studies focus on evaluating the relevance of R&D costs. We are unaware of scientific evidence on the relative degree of uncertainty of benefits from R&D costs versus capital expenditures.

Rationale for expensing R&D expenditures. Some favor immediate expensing of R&D costs on the grounds that reliable evidence of future economic benefits from current R&D activity is lacking. For example, the Association for Investment Management and Research (AIMR) (1993) concurs with the FASB's expensing of R&D because "it usually is next to impossible to determine in any sensible or codifiable manner exactly which costs provide future benefit and which do not" (pp. 50-51). While *on average* R&D expenditures might generate future economic benefits, the standard setters' concern appears to be the lack of compelling evidence of future benefits to each firm and in each instance to justify R&D capitalization (see SFAS No. 2, paragraph 52). Moreover, not impressed by the existence of future benefits, AIMR concludes that the future benefits are so unrelated to costs incurred that the information in the capitalized amount of R&D costs is largely "irrelevant to the investment valuation process" (1993, pp. 50-51). This can be interpreted as neither capitalization nor expensing is particularly helpful or harmful in investors' valuation of corporations for their investment decisions.

The expensing of R&D is consistent with the usefulness of a balance sheet in credit decisions (i.e., in lending and in writing debt contracts) being an important factor in the standard-setting process. The high degree of uncertainty of future benefits from R&D costs and the generally negligible collateral value of R&D investments make R&D less attractive for capitalization. R&D expenditures have low collateral value in part because there typically are few alternative uses for them or the liquidation value in the event of project failure is not substantial. This is unlike the collateral value of tangible assets like buildings, plant, and equipment. Therefore, the agency cost of borrowing against intangible R&D assets is high and the debt capacity of R&D costs (intangible assets) is low. Empirical evidence bears out this prediction. For example, Barclay, Smith, and Watts (1995) show that R&D intensive industries like biotechnology, pharmaceuticals, and computers and software (which are also industries with growth options or investment opportunities) finance their businesses mostly with equity.[2]

Rationale for capitalizing R&D expenditures. Proponents of R&D capitalization point to the evidence that (as if) earnings that reflect the effects of R&D capitalization and amortization are significantly more highly associated with stock prices and returns than GAAP earnings with immediate R&D expensing. This is interpreted as "the R&D capitalization process yields value-relevant information to investors" (Lev and Sougiannis, 1996, p. 134) and as contradicting FASB's objection to R&D capitalization in SFAS No. 2 that direct evidence of R&D costs and specific future benefits does not exist. The proponents therefore argue that it behooves standard setters to issue a new standard allowing corporations to capitalize R&D costs.

Previous research. A large body of previous research examines issues surrounding the accounting treatment of R&D costs. Early research following the promulgation of SFAS 2 in 1974 focuses on the standard's economic consequences. Economic consequences are estimated

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[2] We are aware that there are alternative theories and explanations for cross-sectional variation in leverage. For example, pecking order and static tradeoff are alternative theories of capital structure (see Shyam-Sunder and Myers, 1999, for a discussion and empirical evidence). Our objective in discussing the agency-cost based theory of capital structure is merely to state that the expensing treatment of R&D is consistent with that theory, but we acknowledge that it might be consistent with other theories as well.

from security price changes and from the standard's effect on corporate R&D expenditures (e.g., Dukes, Dyckman, and Elliott, 1980, Horwitz and Kolodny, 1980, Elliott, Richardson, Dyckman, and Dukes, 1984, and Wasley and Linsmeier, 1992). This research produces mixed evidence in part because it lacks power to detect effects on R&D activity in the presence of confounding economic events like the energy crisis and recession in the mid-1970s (Ball, 1980).

Much of the recent research on this topic focuses on examining the value relevance of R&D costs. Lev and Sougiannis (1996) and Chambers, Jennings, and Thompson (1998) show that financial statements restated to reflect economically plausible rates of amortization applied to hypothetically capitalized R&D investments are more highly associated with security prices than with financial-statement numbers based on immediate expensing of R&D. Chambers et al. (1998) find that in a price level regression the estimated coefficient on capitalized R&D costs is indistinguishable from that on property, plant, and equipment (PP&E). The equality of the two coefficients is, however, not a sufficient condition to conclude that future benefits from R&D and PP&E are equally uncertain. The reason is that the market's pricing is based on the amount, timing, and systematic uncertainty of future cash flows, whereas our focus is only on the (systematic and unsystematic) uncertainty of future cash flows, which cannot be unambiguously inferred from the price-level regression coefficients. Other research shows that advertising and R&D expenditures have positive impacts on the market value of a firm (Hirschey and Weygandt, 1985, Woolridge, 1988, and Chan, Martin, and Kensinger, 1990). Collectively, these studies argue that because R&D investments are on average associated with stock prices or because they are on average value enhancing, they should be capitalized and amortized rather than immediately expensed.

Unlike Lev and Sougiannis (1996) and Chambers et al. (1998), for at least two reasons we do not restate financial statements as if R&D were capitalized to examine whether the uncertainty of the resulting restated earnings series is more sensitive to R&D than capital expenditures. First, regardless of capitalizing or expensing, the current investment in R&D or capital expenditure would be the same, so the independent variable in the analysis that regresses future earnings variability on current R&D and capital expenditures will be unaffected. Second, the variable of interest is the uncertainty of future benefits from current investments (in R&D or capital assets). Future benefits as estimated using future earnings are indeed affected by the choice between capitalization and expensing treatments of the investments. To overcome this problem, we also summarize results using future earnings plus future R&D and depreciation. This gross earnings measure is a relatively clean proxy for future benefits compared to future earnings calculated according to GAAP. Evidence in section V shows that the tenor of the results is similar using the two measures.

III. SIMULATION AND RESEARCH DESIGN

The main hypothesis we test is whether the ex ante expected variability of future earnings due to R&D investments is greater than that due to capital expenditures. Since expected variability of future earnings is not observable, we use the standard deviation of realized future annual earnings for five years. We regress the standard deviation of future earnings on current R&D, capital expenditures, and other economic determinants of earnings variability, which are included as control variables in the regression. A comparison of the coefficients on R&D and capital expenditures provides an indication of the relative sensitivity of earnings variability to R&D and capital expenditures. The above regression approach using realized earnings variability uncovers a relation between ex ante expected variability and current investments for at least two reasons.

First, we perform a simulation, described in detail below, which shows that, if the *ex ante* uncertainty of cash flows from R&D exceeds that from capital expenditures, then in a regression to explain *realized* earnings variability, the coefficient on R&D will be greater than that on capital expenditures.

Second, use of realized variables to test for an ex ante relation, as in the case of our hypothesis, is a standard practice in financial economics and accounting. For example, the ex ante risk-return relation is tested using cross-sectional regressions of realized returns on beta risk (Fama and MacBeth, 1973, Fama and French, 1992, and Kothari, Shanken, and Sloan, 1995) and the effect of risk (or discount rates) on earnings response coefficients is examined in regressions of realized returns on realized earnings (e.g., Easton and Zmijewski, 1989, and Collins and Kothari, 1989).

Simulation

The simulation is designed to formalize the intuition that the more uncertain the future benefit, the larger is the coefficient on current investment in a regression of the variance of future benefits on the investment. The simulation makes apparent the properties of the coefficients from the regressions. This facilitates the interpretation of the empirical results using data for real-life firms later in the paper.

The simulation has two parts: (1) simulate R&D, capital expenditure, and future earnings observations; and (2) estimate a regression of standard deviation of realized future earnings on current R&D and capital expenditures. For each simulated firm we generate R&D, capital expenditure, and future earnings data as follows. We begin by assuming that the levels of R&D and capital expenditures depend on firm size. We randomly select a level of R&D for each firm to be distributed uniformly between 1 and 5. We then generate the actual R&D outlay over time to be up to 25% above or below the randomly selected level of R&D for the firm. The level of capital expenditures is assumed to be on average twice that of R&D, which is comparable to the Compustat data that we examine later in the paper. Like R&D, actual capital expenditures over time are assumed to vary randomly around the mean level of capital expenditures for the firm.

Each year's R&D and capital expenditures produce uncertain future benefits for T_R and T_C years. If the current year's R&D expenditure is RDI, then it yields an actual benefit in each of the future T_R years equal to a random variable that is distributed $N[RDI/ T_R, \sigma^2(RD)]$. Thus, for each simulated firm and the entire simulation sample the expected future benefit from the current year's R&D expenditure is simulated to be exactly equal to the R&D expenditure. Of course, the actual benefit for a simulated firm will almost invariably be different from the expected benefit and the absolute difference will be increasing in the variance parameter, σ^2(RD) and the amount of R&D investment, RDI. If the discount rate is zero, then the simulations assume that the R&D expenditure is, on average, a zero net present value investment. The σ^2(RD) parameter determines the level of uncertainty of future benefit realizations per dollar of R&D investment. The larger the σ^2(RD) parameter value, the more uncertain are future benefits for every dollar invested in R&D. Thus, the simulations, by construction, ensure a positive relation between the ex ante expected variability of future benefits and R&D expenditures. Future benefits from current year's capital expenditure, CI, are similarly simulated over the future T_C years.

Earnings are defined as the sum of realized benefits from R&D and capital expenditures in the past T_R and T_C years.[3] For example, assume T_R = 10 years and T_C = 5 years, which implies R&D benefits are realized over a longer period than benefits from capital expenditures. Earnings in year 11 would then be the sum of random realizations of benefits from R&D investments in years 1 to 10 and from capital expenditures in years 6 to 10. We roll the window forward one year at a time and calculate earnings for five years, i.e., years 11 to 15, for each firm. We calculate the standard deviation of earnings using realized earnings for the five years. We repeat the above procedure to obtain a sample of 1,000 observations.

The objective of the simulation is to examine whether the standard deviation of realized future earnings for years 11 to 15 is related to R&D and capital expenditures in the current year, year 10. We therefore regress the standard deviation of earnings on R&D and capital

[3] Unlike historical cost GAAP earnings, earnings as we define in the simulation analysis do not deduct the R&D outlay or depreciation of current and past capital expenditures from the realized future benefits. However, results are qualitatively similar if earnings were calculated net of these expenses.

expenditures for year 10. We repeat the entire simulation 100 times and examine the average coefficient on R&D and capital expenditure. We also repeat the analysis by changing the parameter values for the number of years of future benefit from R&D and capital expenditures, i.e., T_R and T_C, the level of capital expenditures relative to R&D, the number of future years used to calculate the standard deviation of earnings, and the variance of future benefits from R&D and capital expenditures, i.e., $\sigma^2(RD)$ in $N[RDI/T_R, \sigma^2(RD)]$ and similarly $\sigma^2(C)$ for capital expenditure.

We draw the following conclusions from the simulation regressions of the standard deviation of future earnings on R&D and capital expenditures:

(1) The coefficients on current R&D and capital expenditures increase in the variance of future benefits from those expenditures, i.e., in the $\sigma^2(RD)$ and $\sigma^2(C)$ parameters.

(2) Other things equal, the sensitivity of future earnings variability (i.e., the regression slope coefficient) does not depend on the level of R&D and capital expenditures. Obviously, the larger the investment in R&D or capital expenditure, the larger the variability of future earnings. However, the marginal impact of an additional dollar of investment in R&D or capital expenditures depends only of the $\sigma^2(RD)$ and $\sigma^2(C)$ parameters, not on the level or size of the investment in R&D or capital expenditures.

(3) The longer the period of future benefits, i.e., T_R and T_C, the larger the coefficient on R&D and capital expenditure. The intuition is as follows. If T_R is large, then any given year's earnings are the sum of T_R random benefit realizations corresponding to R&D investments in the past T_R years. Since the variance of a sum of independent random variables is the sum of the variances of the individual random variables, the larger the T_R parameter, the larger the variance, and thus the larger the coefficient on R&D expenditure.

(4) The tenor of the results is not changed if the standard deviation of future earnings is calculated using more than five observations. (We experimented using up to 8 observations.)

In summary, the simulations provide a reasonable basis to regress the standard deviation of realized future earnings on current R&D and capital expenditures to test the hypothesis that the ex ante expected variability of earnings is more sensitive to a firm's R&D outlays than to capital expenditures.

Research design using actual data

To test the hypothesis that future earnings variability is more sensitive to R&D expenditures than capital expenditures, we estimate the following annual cross-sectional model (firm subscript i is suppressed) that includes additional determinants of earnings variability as control variables:

$$SD(E_{t+1,t+5}) = \alpha + \beta_{1t}\,CapEx_t + \beta_{2t}\,R\&D_t + \beta_{3t}\,MV_t + \beta_{4t}\,Leverage_t + error_{t+1,t+5} \qquad (1)$$

where

$SD(E_{t+1,t+5})$ is the standard deviation of earnings before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5; each earnings observation is deflated either by the book value of equity, BVE, or by stock price, P, at the beginning of the period t;

$R\&D_t$ is research and development per share, deflated by BVE or P;

$CapEx_t$ is the capital expenditure per share, deflated by BVE or P;

MV_t is the natural logarithm of the market capitalization of equity at the end of year t; and

$Leverage_t$ is the ratio of long-term debt to the market value of equity plus long-term debt, both at the end of year t.[4]

Since future benefits from risky investments like R&D are generally presumed to be more uncertain than from relatively safe capital expenditures, we expect the coefficient on R&D investment in the regression to exceed that on capital expenditures. While this may not be apparent in any one cross-section examined, by aggregating the coefficients from several annual cross-sectional regressions, we hope to estimate the sensitivity of earnings variability to investments with considerable precision. However, we do not have a rigorous theoretical prediction about the relative magnitudes of the coefficients on R&D and capital expenditures. Nor do we believe financial accounting standard setters have in mind a particular cut-off magnitude of the sensitivity of earnings variability to R&D that would lead them to conclude

[4] The data section offers detailed definitions of the variables (e.g., Compustat data item information).

whether R&D capitalization should be permitted. Nevertheless, the evidence should be of interest because the relative impact of R&D and capital expenditures on future earnings variability appears to be an important consideration in the current debate on R&D capitalization versus expensing.

In most of the empirical analysis, we augment model (1) to include advertising expense as an explanatory variable. The motivation is that advertising costs represent an economically important outlay as seen from the descriptive statistics in the next section and because advertising is deemed to be an investment in an intangible asset. Advertising costs thus are expected to explain future earnings variability, which would mitigate the standard error of the coefficient estimates from model (1) and also reduce the correlated-omitted variable bias. In addition to including advertising expense, we also employ other specifications of the regression model. For example, we discuss results of estimating the model controlling for industry effects in earnings variability and controlling for growth as determinants of earnings variability. Furthermore, we summarize results using variance instead of the standard deviation of future earnings, and deflated change in earnings instead of the deflated level of earnings in calculating the standard deviation. The tenor of the results is the same for every specification, which suggests the inference that earnings variability stemming from R&D investments is significantly greater than that from capital expenditures is robust.

Leverage and size as control variables. The regression model (1) includes financial leverage and market value of equity as economic determinants of earnings variability. Finance theory predicts that, other things equal, earnings variability increases in financial leverage (see Beaver, Kettler, and Scholes, 1970, and White, Sondhi, and Fried, 1994, pp. 987-991, for theory and evidence).[5] Earnings variability is expected to decrease in firm size for at least two reasons. First, small firms are more likely to be single-project or less diversified firms whereas large firms are expected to have multiple projects, divisions, or operating segments. To the extent operating earnings from the projects, divisions, or segments are less than perfectly correlated, diversification leads to a less volatile earnings stream for the large firms than small firms.

Second, Beaver, Kettler, and Scholes (1970) and others show that earnings variability and a market measure of risk, the CAPM beta, are positively correlated. We use size instead of beta as a determinant of earnings variability. There exists compelling evidence that firm size is at least as good as, and frequently better than, an historical estimate of beta as a measure of equity risk (e.g., Banz, 1981, Fama and French, 1992, and Kothari, Shanken, and Sloan, 1995). Empirically an historical estimate of beta is a noisy proxy for risk because (1) there is sampling error in a regression estimate, and (2) an historical beta, typically estimated using past five years of monthly returns, often reflects stale, not current, economic conditions affecting the firm's beta. In addition to the historical beta estimate reflecting stale information, its estimation would require imposing additional data availability for a firm to be included in the analysis. Typically, researchers use five years of monthly return data to estimate relatively precise and unbiased betas (e.g., Fama and French, 1992). This would imply a continuous data availability requirement for 10 years (five years to estimate beta and five years to estimate future earnings variability) for a security to be included in the empirical analysis. Overall, we believe that, when market capitalization is included as an independent variable, the incremental benefit of including a highly correlated variable like the historical beta estimate is small, if any, for the reasons described above.

Additional control variables. In addition to size and leverage, the empirical analysis summarizes findings when the model also includes industry membership as a determinant of earnings variability and controls for the effect of growth in earnings on earnings variability. If R&D investments are simply a proxy for industry membership that is driving the variability of future earnings then, in the absence of a control for industry membership, the sensitivity of earnings variability to R&D would be biased upward. A control for earnings growth makes

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[5] If interest charges are fixed, then the variability of earnings before and after interest charges would be identical,

sense for the following reason. R&D intensive firms are often high growth and investment opportunity firms. Their R&D success produces high positive earnings growth and failure might translate into high negative earnings growth. Suppose both are predictable. In this case, even though there is not a high degree of uncertainty about future benefits, the estimated standard deviation of future earnings will be high because of earnings growth. Either de-trending the time series of earnings and/or using first differences in earnings are two means of controlling the effect of growth on standard deviation. We undertake both the methods to mitigate the potential upward bias due to growth in the estimated relation between R&D and uncertainty of future benefits.

As we increase the number of controls, the marginal benefit of an additional control diminishes rapidly because most of the control variables are highly correlated with each other. Moreover, there is also a danger that we might potentially remove the treatment effect of R&D and capital expenditures on earnings variability, which is the main objective of this study. This appears to be the case when we include stock-return variability as a control variable. Stock return variability reflects the market's assessment of a firm's cash flow uncertainty and therefore it in itself is a market-based measure of risk and earnings variability (see Beaver et al., 1970, for theory and evidence). When we include stock return variability in the regression model (1), the coefficient on R&D remains significant and the point estimate is almost 50% greater than that on capital expenditures. However, the difference between the coefficients on R&D and capital expenditures is no longer statistically significant at 5% level.

Future years' earnings data availability. Since model (1) regresses future earnings variability on current investments, in order to calculate earnings variability, several future years' observations are needed. This data requirement is not innocuous in testing our hypothesis. Firms making risky R&D investments are more likely to experience extreme performance and thus experience financial distress. Therefore, they might not survive the future five years.

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which means leverage will not affect earnings variability. However, empirically we find a strong relation.

Mergers and acquisitions might also affect their survival rate. If non-surviving firms are excluded from the analysis, earnings variability calculated using earnings of *ex post* surviving, successful firms might not be an unbiased *ex ante* forecast of a firm's earnings variability. The realized earnings volatility of a surviving firm might understate the market's *ex ante* estimate of earnings volatility at time t. This is expected to bias the results against our hypothesis that R&D investments generate more variable future earnings than capital expenditures.

In order to maintain both surviving and non-surviving firms in our sample and thus mitigate a potential sample-selection bias, we adopt the following approach. We calculate Altman's (1968) Z-score as a proxy for a firm's financial health for all stocks at time t. We rank the firms according to their Z-scores and assign each observation a decile rank. Next, we calculate earnings variability for each firm with data available for five years beyond year t. We then calculate the average earnings variability for each Z-score decile. We assign the mean earnings variability of the Z-score decile to which a firm with missing future earnings data belongs. For example, if a firm is delisted in year t+3 and belonged to Z-score decile two at time t, then it is assigned the mean earnings variability of all the decile two Z-score firms for which earnings variability can be calculated. This approach likely mitigates the bias in estimated earnings variability that arises if data only on surviving firms are used. However, as it turns out the tenor of the results is unchanged whether or not we exclude non-surviving firms from the analysis. We recognize that the survivor bias problem is not entirely circumvented. The decile portfolio average earnings variability is after all calculated using data for surviving firms only.

IV. SAMPLE SELECTION, DATA, AND DESCRIPTIVE STATISTICS

We obtain financial data from the 1997 Compustat Annual Industrial and Annual Research files for the period 1972-1997. For each year t from 1972 to 1992, we retain all observations with non-missing data for the following:

$CapEx_t$ is capital expenditures, Compustat data #128,

$R\&D_t$ is research and development expense, data #46, with a zero reported amount not treated as a missing value,

$AdvEx_t$ is advertising expenditures, data #45, with a zero reported amount not treated as a missing value,

MV_t is the market value of equity, measured as the natural logarithm of the product of the fiscal-year closing price and common shares outstanding [log(data #199*data #54)],

$Leverage_t$ is the sum of long-term debt, data #9, and debt in current liabilities, data #34, divided by the sum of long-term debt and the market value of equity,

E_t is the primary earnings per share before extraordinary items and discontinued operations, data #58,

P is share price, data #199, and

BVE is the stockholders' equity, data #216, divided by the number of common shares outstanding, and we exclude negative BE firms when BE is used as the deflator.

For all the variables except P and BVE, the values are for fiscal year t or at the end of fiscal year t. In contrast, P and BVE are measured at the end of fiscal year t-1 because they are used as deflators. Per share values of P, BVE, and future earnings, E_{t+1} to E_{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 1992. The earliest year is set at 1972 because prior to that year relatively few firms on Compustat report information on R&D outlays.

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. As described in the previous section, in cases where earnings data are missing in any of the periods from t+1 through t+5, the standard deviation of earnings, $SD(E_{t+1,t+5})$ is set equal to the mean of $SD(E_{t+1,t+5})$ for the firms in the same Altman Z-Score decile portfolio.

The sample-selection criteria yield a total of 55,073 firm-year observations when book-value of equity is used as the deflator and 52,046 observations using price as the deflator. The use of deflated variables mitigates heteroscedasticity in the regressions. Since no single deflator is likely to be perfect in controlling heteroscedasticity, we report results using both BVE and price as deflators. The results are robust to deflator choice.

The number of non-missing firm-year observations on advertising expense is lower at 42,776 using book value as the deflator and at 40,569 using price as the deflator. We report regression results later in the paper with and without advertising expense as an independent variable to permit the use of the larger sample with R&D and capital expenditure data and to ascertain whether results are sensitive to the inclusion of advertising expenditures. Using book value of equity as the deflator, the number of observations each year ranges from a minimum of 2,003 in 1972 to a maximum of 2,899 in 1992. Using price as the deflator, the numbers range from a minimum of 1,909 in 1972 to a maximum of 2,680 in 1988. The number of firm-year observations with one or more of the future years' data missing is 16,107 using book value as the deflator and 15,733 using price as the deflator.

Descriptive statistics. Table 1, panel A reports descriptive statistics for variables deflated by the beginning of the period book value of equity, BVE, and panel B for variables deflated by the beginning of the period price, P. MV and Leverage variables are not deflated. To mitigate the impact of outliers on regression coefficients, we winsorize $CapEx_t$, $R\&D_t$, $AdvEx_t$, MV_t, and $Leverage_t$ variables by setting the values in the bottom and top one percentiles to the highest values of the 1st and 99th percentiles. We winsorize observations with deflated E_t values of less than -1 or greater than 1 at -1 and +1. We obtain qualitatively similar results when extreme 1% observations are excluded, instead of winsorized, from the analysis.

Average outlays for capital expenditures, R&D, and advertising are substantial. Firms on average spend 19.8% of the book value of equity on capital expenditures and the corresponding expenditures on R&D and advertising are 10.8% and 5.7%. The averages, however, exceed the median capital expenditures, R&D, and advertising, which are 7.1%, 1.1%, and 0.8% of the book value of equity. Moreover, more than a fourth of the sample firms do not report any spending on advertising or R&D. These firms either did not incur such expenditures or they bundled them with other expenses for reasons of materiality. The distributions of capital expenditures, R&D, and advertising are all highly right skewed. This is likely due to the existence of a few high-growth, high-tech firms that invest heavily in capital assets and/or R&D. It might also result from a low denominator (P and/or BVE) that is often encountered in relatively young firms.

[Table 1]

The average standard deviation of earnings deflated by the book value of equity is 11.5% and it is 10% using share price as the deflator. Both the distributions are only moderately right skewed. Based on the average standard deviation magnitudes, publicly traded corporations' earnings vary considerably through time.

Univariate cross-correlations. Table 2, panels A and B report 21-year averages of the annual cross-sectional Pearson correlation coefficients among size, leverage, and the remaining variables, which are scaled by the book value of equity or share price. The pattern of correlations is unaffected by the choice of the scaling variable. In both panels A and B, all the correlations are statistically significant at the 1% level. We infer significance from a t-test on the mean of the 21 annual cross-correlations estimated for each pair of variables. In calculating the t-test, we assume the 21 estimated annual cross-correlations are mutually uncorrelated. The positive correlations among firms' R&D and capital expenditures, and advertising are consistent with these investments being complements, not substitutes, in a typical firm's operations. Because of non-zero cross-correlations among various investment and control variables, these variables' univariate correlations with future earnings variability cannot be unambiguously interpreted as these investments' marginal effects on earnings variability. Nevertheless, we find that earnings variability is positively correlated with R&D, capital expenditures, and advertising.

This is also consistent with growth, as proxied for by investments, being positively correlated with earnings variability, which is a measure of cash flow uncertainty.

[Table 2]

V. EMPIRICAL RESULTS

This section reports results of annual cross-sectional regressions of future earnings variability on current capital expenditures and R&D costs, advertising expense, and control variables, firm size and leverage [see equation (1) in section 2]. We report results using four measures of earnings variability. We estimate earnings variability using either earnings level or earnings change deflated by either book value of equity or share price. We report regression results with and without certain independent variables. For each regression specification, we report sample statistics of the 21 intercept and slope coefficient estimates. The t-statistic is calculated using the sample mean and standard deviation of the sample of 21 annual coefficient estimates. The standard deviation of the sample of 21 estimates, however, is likely to understate the true standard deviation because these estimates are not independent. The likely source of dependence is twofold.

First, we calculate the standard deviation of future earnings using a five-year rolling window, so that successive annual estimates of earnings variability (the dependent variable in the regression) are serially correlated. A portion of this serial dependence might persist in the regression residuals. In that case successive cross-sections of the annual regression residuals would be correlated and so the coefficient estimates would also be correlated through time. Second, even apart from dependence due to the use of overlapping earnings data, true earnings variability itself is likely highly positively autocorrelated. Earnings variability is a risk characteristic and firms' risk characteristics generally are positively serially correlated. For example, risks of the firms in the gas and electric utility industry have been low for long periods and high technology, high growth firms tend to be risky year after year.

To incorporate the effect of serial correlation in the estmated coefficients on the standard error of the mean of the 21 annual coefficients, we report results using standard errors adjusted for the dependence using the Newey and West (1987) procedure. We correct for serial dependence in the coefficients by estimating autocorrelations up to five lags. The choice of five lags is logical because we use a five-year overlapping window to estimate earnings variability and also because empirically we find that autocorrelations beyond the fifth lag are fairly small. In addition, since we have only 21 annual observations, adjustment for dependence beyond five lags is not warranted (see Andrews, 1991 and Newey and West, 1994). In any case, the tenor of our results is unchanged upon using standard errors corrected for autocorrelations for greater or fewer than five lags.

Regression results

Table 3 reports the main results of the paper. Panel A reports results using the standard deviation of future earnings as the earnings variability measure and the book value of equity as the deflator for the dependent variable and all the independent variables except MV and Leverage. The average coefficient on R&D is 0.067 and statistically significant with a t-statistic of 3.41. Every one of the 21 annual regression coefficient estimates on R&D is positive and the median is 0.052. Thus, the mean and the median are close to one another, which suggests the distribution of coefficients is not particularly right skewed. The average coefficient on capital expenditures is only 0.021 (t-statistic = 3.47) or less than one-third as large as the average coefficient on R&D. A t-test of the difference in means indicates that the average coefficient on R&D is staistically significantly greater than that on capital expenditures at a p-value less than 0.01.[6] The evidence is consistent with R&D investments generating significantly more uncertain future earnings than investments in capital assets.

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[6] The t-statistic that we calculate accounts for the dependence in the time series of estimated coefficients on R&D and capital expenditures. To estimate the dependence, we correlate the time series of estimated coefficients on R&D with the coefficients on capital expenditures. The estimated correlation is positive when book value is the deflator and negative when price is the deflator. This correlation is used in adjusting the standard error of the difference in the means of the coefficients on R&D and capital expenditures. If the t-test were to ignore this dependence, the

[Table 3]

Results in panel A also reveal that the average coefficient on advertising expense, 0.025 (t-statistic = 8.52) is approximately of the same magnitude as that on capital expenditures, but much smaller than that on R&D. There are at least two explanations consistent with this result. First, benefits from advertising are about as uncertain as those from capital expenditures, perhaps because most corporate advertising is about products that corporations have already introduced in the market.

Second, advertising yields fairly short-lived future benefits. Clarke (1976, p. 355) concludes that "advertising's effect on sales lasts for months rather than years is strongly supported." Batra, Myers, and Aaker (1996, p. 567) in a popular textbook on advertising management also conclude that "the immediate and carryover effect of advertising usually occurs in months, not years." A similar inference can be drawn from Assmus, Farley, and Lehmann (1984, table 1). Lodish et al. (1996) perform a statistical analysis summarizing the findings in 389 academic research studies on the effect of advertising on sales. Somewhat surprisingly to us, their analysis susgests "no obvious relationship" between advertising and sales. On average the sensitivity of sales to advertising is statistically significantly greater than zero, but economically modest (see Lodish et al., 1996, pp. 128-129 and table 3). The short-lived nature of the benefits from advertising is relevant to interpreting the coefficient on advertising in our regression model. Recall that the simulations demonstrate that, other things equal, the shorter the future period of benefits from current investments, the smaller the sensitivity of earnings variability to that investment.

The regressions in panel A of table 3 include two control variables; the natural logarithm of the market value of equity and leverage (defined as the ratio of the book value of long-term debt to the sum of the market value of equity and long-term debt). The average coefficients on

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standard error of the difference in the coefficients is too large when the dependence is positive and too small when the dependence is negative.

both the variables are highly significant and have predicted signs. Earnings variability declines in firm size and it increases in leverage.

Results in panel B of table 3 use earnings variability measured as the standard deviation of earnings scaled by the beginning of the period price. The results are qualitatively similar to those in panel A using the book value of equity as the deflator. The average coefficient magnitudes on all the variables are slightly larger than, but similar in their pattern to, those in panel A. In contrast, the t-statistics are considerably higher on R&D, capital expenditure and leverage, implying the coefficients are estimated more precisely. The lower standard errors are a result of a narrower range in the coefficient estimates, as seen from the minimum and maximum values of the coefficient estimates, and a smaller Newey-West adjustment for dependence in the coefficient estimates compared to that in panel A. Price deflation appears to reduce the degree of serial correlation in the residuals and therefore also in the coefficient estimates. The t-statistic for the difference between the mean coefficients on R&D and capital expenditures is 4.83 with a p-value of less than 0.01.

We find that the similarity in the results using the book value of equity and price as deflators is also observed in all of the tests we discuss below. Since no new insight is gained by reporting the results using both the deflators, in the rest of the paper we only present results using the book value of equity as the deflator. Interested readers can obtain results using price as the deflator from us.

Symmetric treatment of capital expenditures and R&D. U.S. GAAP earnings in period t are net of R&D expenditures incurred in period t but not net of capital expenditures incurred in period t. Instead, only a fraction of past capital expenditures is deducted as depreciation in calculating earnings. It is possible that annual earnings of periods t+1 to t+5 are more variable simply because of variation in these periods' R&D outlays and therefore the results in table 3 might be a mechanical consequence of the accounting treatment of R&D expenditures. Compared to R&D, depreciation expense is less likely to impart large variability in future earnings because only a fraction of the average capital expenditure over past several years is deducted in calculating earnings. That is, the time series of depreciation expense is relatively smooth.

To control for the potential variability in future earnings induced by the accounting treatment of R&D, we gross up future earnings by adding back both future R&D and depreciation. The resulting numbers represent future benefits of current and past R&D and capital expenditures and are less influenced by future R&D and capital expenditures. Untabulated regression results using the standard deviation of the grossed-up earnings numbers yield an average coefficient of 0.114 (t-stat = 5.13) on R&D, 0.022 (t-stat = 7.18) on capital expenditures, and 0.013 (t-stat = 2.02) on advertising expense. The average coefficient on R&D is significantly greater than that on capital expenditures.

Results excluding zero R&D observations. We observe from the sample descriptive statistics that more than a fourth of the sample firm-year observations report zero R&D expense, probably because their R&D outlays are not a material expense to be reported as a separate line item. A concentration of a large fraction of observations with a zero value for the independent variable (R&D) might potentially bias upwards the slope coefficient on the independent variable. We therefore report regression results similar to those in table 3 except that we now exclude all firm-year observations with zero R&D expense. The results reported in table 4 reveal little change relative to those in table 3. The average coefficient on R&D is 0.069 (t-statistic = 3.28), which is more than three times the average coefficient on capital expenditures, 0.018 (t-statistic = 3.04). Once again, the difference is statistically significant at the 1% level of sigificance. Other coefficients and the model's explanatory power remain similar using both book value of equity and price as deflators.

[Table 4]

Results excluding advertising expense. We next discuss regression results for the model that excludes advertising expense as one of the independent variables. The motivation is that data for advertising expense is reported considerably less frequently than for R&D and capital expenditures (see descriptive statistics in table 1). Table 5 shows that the tenor of the results is unaffected when a larger sample without requiring data for advertising is analyzed. The average coefficient on R&D is 0.072 (t-statistic = 3.21) compared to the average coefficient of 0.024 (t-statistic = 3.83) on capital expenditure and the average difference between the two coefficints is significantly positive at a p-value less than 0.01.

[Table 5]

Results using standard deviation of the change in earnings as the variability measure. So far we have reported regression results using the standard deviation of the earnings level deflated by the book value of equity or price as the earnings variability measure. While we believe that variability in deflated earnings is an economically sensible measure, an equally sensible alternative measure is the standard deviation of the change in earnings deflated by the book value of equity or share price. If the time series properties of earnings suggest they are largely permanent, then the standard deviation of earnings changes is likely a better measure of earnings variability, whereas if there are considerably temporary components to earnings, then the standard deviation of earnings levels would be a better measure of earnings variability. Since earnings contain both permanent and transitory components and because previous research documents both cross-sectional and temporal variation in these components, the standard deviation of neither the level nor the change in earnings is unambiguously a superior measure of earnings variability. One advantage of using the standard deviation of earnings changes is that if there is substantial growth (or decline) in earnings over the estimation period, then the standard deviation of first differences is largely unaffected by growth. In contrast, *ceteris paribus*, the standard deviation of the earnings level is increasing in absolute growth. To control for this effect on the standard deviation of earnings, either an explicit control for growth is needed or the earnings series should be detrended (see section 4.2). Empirically we find the standard deviation of earnings level and differences to be highly correlated in our sample.

Table 6 shows that results using the variability of deflated change in earnings more strongly favor the hypothesis that R&D investments produce future benefits that are more uncertain than those from capital expenditures. The average explanatory power of the regression model is similar to that reported in the previous tables.

[Table 6]

Additional robustness checks

We perform the following empirical tests to ascertain whether our results are sensitive to alternative research design choices and variable definitions. The tests include a control for industry effects and growth, an analysis with a symmetric treatment of both capital expenditures and R&D costs in calculating future earnings (benefits), pooled data analysis, and other robustness checks. In every single case the results are similar to those described so far in the paper.

Control for industry effects. We begin by providing descriptive evidence on the average investment in R&D and capital expenditures and the standard deviation of earnings by two-digit SIC code industries in table 7 and figure 1. The table presents industries in the ascending order of their R&D investment. Figure 1 graphs the level of R&D investment and the standard deviation of earnings by industry where industry SIC codes on the horizontal axis are in the ascending order of R&D investment. The descriptive statistics are striking in that there is little variation in earnings variability across industries, whereas both capital expenditures and R&D exhibit substantial cross-industry variation. This is consistent with firms' choices of other determinants of earnings variability are such that univariate industry analysis is ineffective in teasing out R&D's contribution to earnings variability. The descriptive statistics also reveal that there is considerable within industry variation in both investment intensities and earnings variability, which might explain the relation between investments and earnings uncertainty. Therefore, industry membership by itself does not seem to drive the relation between R&D and earnings variability seen earlier. A formal test to examine this issue follows.

[Table 7 and figure 1]

We augment the regression model (1) to include industry dummies. Industry dummies control for the variation in the level of earnings variability across industries. Without industry dummies, it is possible that we document a positive relation between earnings variability and R&D intensity that is due to industry membership rather than such a relation due to variation in R&D intensity both within and across industries. The inclusion of industry dummies in the regression model, however, does not change the result that R&D costs influence earnings variability more so than capital expenditures. The average coefficient is 0.071 (t-stat = 6.11) on R&D, 0.027 (t-stat = 6.27) on capital expenditures, and 0.044 (t-stat = 8.06) on advertising expense. The average coefficient on R&D significantly exceeds that on capital expenditures at the 1% significance level.

Control for Growth. The standard deviation of earnings estimated using future earnings in levels can be a misleading indication of earnings uncertainty if growth is predictable. Since R&D intensive firms are typically high growth firms, it is possible that the more steeply-sloped relation between the standard deviation of earnings and R&D than capital expenditures is due to growth as a correlated-omitted variable. We therefore calculate future earnings net of *ex post* earnings growth over the estimation period (five years). We regress future earnings on time to capture growth and reestimate the standard deviation using earnings minus average realized growth for each firm. Regression analysis using the standard deviation of growth-adjusted earnings, deflated by the book value, yields an average coefficient of 0.052 (t-statistic = 3.34) on R&D and 0.015 (t-statistic = 3.22) on capital expenditures, with the difference between the two average coefficients being significant at a p-value of 0.01.

Earnings growth can also be controlled for using changes in earnings instead of earnings levels. The mean earnings change over the five-year estimation period represents realized earnings growth, which does not affect the standard deviation estimated from the five earnings change observations. Analysts' growth forecast and past growth are two other growth proxies that can potentially be employed in the analysis here. Lack of the availability of long-term analysts' forecasts in machine-readable form for the entire sample period for the large sample that we use is the primary reason we do not use analysts' growth forecasts. The use of past earnings growth requires substantial additional data availability and previous research suggests that past earnings growth is a poor proxy for future growth because a random walk is a good description of the time-series property of annual earnings. For these reasons, we do not use past earnings growth as a proxy for long-term future earnings growth.

Pooled cross-sectional analysis. We estimate a pooled time-series cross-sectional regression instead of annual cross-sectional regressions. Once again, the results are similar to those reported earlier. For example, using price as the deflator, the coefficient on R&D is 0.067 (t-statistic = 20.08) and that on capital expenditures is 0.020 (t-statistic = 12.31).

Other robustness checks. First, we examine the effect that replacing firms' missing values of earnings variability with the mean earnings variability of their respective Z-score decile portfolios has on the results. Recall that we substitute decile portfolio mean earnings variability in approximately a third of the sample. Both pooled regression results and annual cross-sectional regression results reveal that the exclusion of missing earnings variability observations does not alter the tenor of the results.

Second, instead of winsorizing the extreme 1% observations, which might have an undue influence on the estimated coefficients, we repeat the regression analysis using data that excludes the extreme 1% observations. There is no material effect on the results. Finally, we repeat the entire analysis using variance instead of the standard deviation as a measure of future earnings' variability.

VI. SUMMARY AND CONCLUSIONS

The FASB's statement of Financial Accounting Concepts No. 2 notes that the trade-off between relevance and uncertainty of future benefits is a major consideration in accounting standard setting with respect to capitalization and expensing of investment expenditures. The trade-off suggests balancing the demand for value-relevant information by equity investors, with the demand for reliable information about future benefits, by debt holders and other contracting parties. However, much of the current research on accounting for R&D expenditures focuses on the relevance dimension of this tradeoff (e.g., Dukes, Dyckman, and Elliott, 1980, Horwitz and Kolodny, 1980, Elliott, Richardson, Dyckman, and Dukes, 1984, and Wasley and Linsmeier, 1992). To compliment existing research, we examine the reliability of future benefits of R&D expenditures relative to other investments such as capital expenditures.

Our analysis compares the relative contributions of current investments in R&D and capital expenditures to future earnings variability. We use the standard deviation of future earnings to proxy for future earnings variability. Our sample consists of over 50,000 firm-year observations, obtained from Compustat's Annual Industrial and Research files, from 1972-1992. Our results support the hypothesis that R&D investments generate more uncertain future benefits compared to capital expenditures. Controlling for other economic determinants of earnings variability, we find that the coefficient on current R&D expenditures is about three times that of the coefficient on current capital expenditures. This difference is statistically significant. Our results are robust to many sensitivity checks, including controls for industry effects and growth, alternative variable definitions, and research design variations.

We believe that our study contributes to the current debate over accounting for R&D expenditures. A number of studies report convincing evidence that the capitalization of R&D would aid in making the balance sheet more value relevant for share prices (e.g., Lev and Sougiannis, 1996). These studies provide standard setters with useful information on the relevance dimension of the relevance-reliability tradeoff. Our study provides evidence that the future benefits of R&D expenditures are less certain than those of investments in capital expenditures. Hence, we provide standard setters with a relative measure of the reliability of future benefits component of the relevance-reliability trade-off.

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TABLE 1

Descriptive Statistics

Panel A- Scaled by Book Value of Equity

Variable	Description	N	Mean	Standard Deviation	Min	q1	Median	q3	Max
$R\&D_t$	R&D Expense	55,073	0.108	0.477	0.000	0.000	0.011	0.064	12.694
$CapEx_t$	Capital Expenditures	55,073	0.198	0.577	0.000	0.027	0.071	0.162	13.561
$AdvEx_t$	Advertising Expense	42,776	0.057	0.168	0.000	0.000	0.008	0.045	5.068
MV_t	Log Market Value	55,073	-3.19	2.02	-8.13	-4.68	-3.42	-1.86	3.18
$Leverage_t$	Leverage (Debt/MV+Debt)	55,073	0.289	0.243	0.000	0.070	0.241	0.463	0.955
E_t	EPS	55,073	0.061	0.278	-1.000	0.013	0.106	0.181	1.000
$Var(E_{t+1,t+5})$	Variance of Earnings	55,073	0.028	0.051	0.000	0.002	0.012	0.031	0.512
$SD(E_{t+1,t+5})$	Standard Deviation of Earnings	55,073	0.115	0.095	0.000	0.049	0.097	0.139	0.715

Panel B- Scaled by Price

Variable	Description	N	Mean	Standard Deviation	Min	q1	Median	q3	Max
$R\&D_t$	R&D Expense	52,046	0.045	0.125	0.000	0.000	0.007	0.040	3.382
$CapEx_t$	Capital Expenditures	52,046	0.128	0.261	0.000	0.017	0.051	0.133	6.486
$AdvEx_t$	Advertising Expense	40,569	0.043	0.108	0.000	0.000	0.004	0.033	1.513
MV_t	Log Market Value	52,046	-3.142	2.028	-8.131	-4.637	-3.377	-1.798	3.185
$Leverage_t$	Leverage (Debt/MV+Debt)	52,046	0.294	0.242	0.000	0.078	0.249	0.469	0.955
E_t	EPS	52,046	0.052	0.212	-1.000	0.011	0.074	0.137	1.000
$Var(E_{t+1,t+5})$	Variance of Earnings	52,046	0.024	0.046	0.000	0.002	0.011	0.025	0.512
$SD(E_{t+1,t+5})$	Standard Deviation of Earnings	52,046	0.100	0.089	0.000	0.041	0.085	0.119	0.614

The full sample consists of all firms on the Compustat Annual Industrial and Industrial Research files from 1972-1992 for which $CapEx_t$, $R\&D_t$, MV_t and $Leverage_t$ are available. Each of the following variables except MV_t and $Leverage_t$ is deflated by either the book value of equity (panel A) or the stock price (panel B), at the end of the fiscal year t-1.

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share;

$AdvEx_t$ is advertising expense per share;

MV_t is the natural log of the Market Value at the end of fiscal year t;

$Leverage_t$ is the book value of debt divided by debt plus the market value of equity both at the end of fiscal year t;

E_t is earnings per share;

$SD(E_{t+1,t+5})$ is the standard deviation of earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5.

Variables are winsorized by setting the values in the 1st and 100th percentiles to the minimum and maximum values in the 2nd and 99th percentiles. Observations with deflated EPS values of less than -1 or greater than 1 are winsorized at -1 and +1. In cases where EPS data are absent in any of the years from t+1through t+5, $SD(E_{t+1,t+5})$ is set equal to the mean $SD(E_{t+1,\ t+5})$ of the firms in the same Altman Z-Score decile portfolio (see section 2 for details).

TABLE 2

Mean Correlations Among Independent Variables

Panel A: Pearson Correlation Coefficients - Variables Scaled By Book Value of Equity

Variable	Description	$R\&D_t$	$CapEx_t$	$AdvEx_t$	MV_t	$Leverage_t$	$SD(E_{t+1,t+5})$
$R\&D_t$	R&D Expense	1.000					
$CapEx_t$	Capital Expenditures	0.266	1.000				
$AdvEx_t$	Advertising Expense	0.218	0.257	1.000			
MV_t	Log Market Value	-0.081	-0.068	-0.093	1.000		
$Leverage_t$	Leverage	-0.073	0.087	0.061	-0.173	1.000	
$SD(E_{t+1,t+5})$	Standard Deviation - Earnings	0.166	0.158	0.111	-0.247	0.095	1.000

Panel B: Pearson Correlation Coefficients - Variables Scaled By Price

Variable	Description	$R\&D_t$	$CapEx_t$	$AdvEx_t$	MV_t	$Leverage_t$	$SD(E_{t+1,t+5})$
$R\&D_t$	R&D Expense	1.000					
$CapEx_t$	Capital Expenditures	0.253	1.000				
$AdvEx_t$	Advertising Expense	0.179	0.268	1.000			
MV_t	Log Market Value (Billions)	-0.120	-0.117	-0.153	1.000		
$Leverage_t$	Leverage	0.049	0.284	0.193	-0.173	1.000	
$SD(E_{t+1,t+5})$	Standard Deviation - Earnings	0.140	0.195	0.150	-0.298	0.285	1.000

Above are thet the means of annual Pearson correlations from 1972-1992. Each of the following variables except MV_t and $Leverage_t$ is deflated by either the book value of equity (panel A) or the stock price (panel B), at the end of the fiscal year t-1.

$SD(E_{t+1,t+5})$ is the standard deviation of earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share;

$AdvEx_t$ is advertising expense per share;

MV_t is the natural log of the Market Value at the end of fiscal year t;

$Leverage_t$ is the book value of debt divided by debt plus the market value of equity both at the end of fiscal year t.

We obtain data from the Compustat Annual Industrial and Research files. We winsorize all variables by setting the values in the 1st and 100th percentiles to the minimum and maximum values in the 2nd and 99th percentiles. Observations with deflated EPS values of less than -1 or greater than 1 are winsorized at -1 and +1. In cases where EPS data are absent in any of the years from t+1through t+5, $SD(E_{t+1,t+5})$ is set equal to the mean $SD(E_{t+1, t+5})$ of the firms in the same Altman Z-Score decile portfolio (see section 2 for details).

All the correlations are significant at the 0.01 level using a two-tailed test.

TABLE 3

Summary of 21 Annual Cross-Sectional Regressions From 1972-1992

$$SD(E_{t+1,t+5}) = a + b_{1t} R\&D_t + b_{2t} CapEx_t + b_{3t} AdvEx_t + b_{4t} MV_t + b_{5t} Leverage_t + error_{t+1,t+5}$$

Panel A: Scaled by Book Value of Equity

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.068	6.40	0.024	0.030	0.046	0.072	0.087	0.108
$R\&D_t$	R&D Expense	0.067	3.41	0.047	0.004	0.026	0.052	0.097	0.161
$CapEx_t$	Capital Expenditures	0.021	3.47	0.015	-0.001	0.011	0.015	0.034	0.055
$AdvEx_t$	Advertising Expense	0.025	8.52	0.014	0.002	0.014	0.027	0.034	0.051
MV_t	Log Market Value (Billions)	-0.010	-11.07	0.002	-0.013	-0.011	-0.010	-0.009	-0.006
$Leverage_t$	Debt/(Market Value+Debt)	0.025	5.19	0.016	-0.004	0.013	0.022	0.034	0.058
	Adjusted R^2 in %	10.2		2.2	6.1	8.5	10.0	11.6	14.4

Panel B: Scaled by Price

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.034	8.25	0.010	0.009	0.028	0.034	0.041	0.049
$R\&D_t$	R&D Expense	0.072	6.34	0.039	0.003	0.038	0.070	0.100	0.140
$CapEx_t$	Capital Expenditures	0.028	9.00	0.016	0.004	0.021	0.026	0.035	0.061
$AdvEx_t$	Advertising Expense	0.030	3.81	0.023	-0.020	0.018	0.027	0.048	0.068
MV_t	Log Market Value (Billions)	-0.010	-12.94	0.002	-0.015	-0.012	-0.010	-0.009	-0.007
$Leverage_t$	Leverage	0.086	12.42	0.022	0.040	0.074	0.079	0.099	0.143
	Adjusted R^2 in %	18.4		2.4	15.0	16.8	17.5	20.6	22.4

Each of the following variables except MV_t and Leverage is deflated by either the book value of equity (panel A) or the stock price (panel B), at the end of the fiscal year t-1.

$SD(E_{t+1,t+5})$ is the standard deviation of earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share;

$AdvEx_t$ is advertising expense per share;

MV_t is the natural log of the Market Value at the end of fiscal year t;

$Leverage_t$ is the book value of debt divided by debt plus the market value of equity both at the end of fiscal year t.

We obtain data from the Compustat Annual Industrial and Research files. The sample size is 42,776 in Panel A and 40,569 in panel B. We winsorize all variables by setting the values in the 1st and 100th percentiles to the minimum and maximum values in the 2nd and 99th percentiles. Observations with deflated EPS values of less than -1 or greater than 1 are winsorized at -1 and +1. In cases where EPS data are absent in any of the years from t+1through t+5, $SD(E_{t+1,t+5})$ is set equal to the mean $SD(E_{t+1,t+5})$ of the firms in the same Altman Z-Score decile portfolio (see section 2 for details).

Reported t-tests are adjusted for autocorrelation using the Newey-West correction with 5 lags.

TABLE 4

Summary of 21 Annual Cross-Sectional Regressions From 1972-1992

All Observations Where R&D is Zero are Omitted

$$SD(E_{t+1,t+5}) = a + b_{1t} R\&D_t + b_{2t} CapEx_t + b_{3t} AdvEx_t + b_{4t} MV_t + b_{5t} Leverage_t + error_{t+1,t+5}$$

Panel A: Scaled by Book Value of Equity

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.067	5.77	0.026	0.027	0.041	0.072	0.089	0.111
$R\&D_t$	R&D Expense	0.069	3.28	0.049	0.003	0.025	0.053	0.096	0.163
$CapEx_t$	Capital Expenditures	0.018	3.04	0.015	-0.003	0.007	0.014	0.032	0.053
$AdvEx_t$	Advertising Expense	0.030	6.75	0.020	0.001	0.013	0.030	0.040	0.072
MV_t	Log Market Value (Billions)	-0.010	-10.74	0.002	-0.014	-0.012	-0.010	-0.009	-0.006
$Leverage_t$	Debt/(Market Value+Debt)	0.027	8.98	0.012	0.001	0.017	0.026	0.038	0.046
	Adjusted R^2 in %	11.0		2.0	6.7	10.1	10.8	11.9	14.8

Panel B: Scaled by Price

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.033	7.36	0.011	0.009	0.026	0.034	0.040	0.050
$R\&D_t$	R&D Expense	0.068	5.91	0.040	-0.036	0.039	0.076	0.101	0.125
$CapEx_t$	Capital Expenditures	0.028	7.42	0.018	-0.002	0.015	0.026	0.038	0.058
$AdvEx_t$	Advertising Expense	0.037	4.21	0.036	-0.034	0.017	0.039	0.056	0.127
MV_t	Log Market Value (Billions)	-0.010	-11.89	0.002	-0.016	-0.012	-0.010	-0.009	-0.006
$Leverage_t$	Leverage	0.088	10.44	0.025	0.040	0.073	0.081	0.105	0.145
	Adjusted R^2 in %	19.3		2.5	15.9	17.3	18.0	21.6	23.8

Each of the following variables except MV_t and Leverage is deflated by either the book value of equity (panel A) or the stock price (panel B), at the end of the fiscal year t-1.

$SD(E_{t+1,t+5})$ is the standard deviation of earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share;

$AdvEx_t$ is advertising expense per share;

MV_t is the natural log of the Market Value at the end of fiscal year t;

$Leverage_t$ is the book value of debt divided by debt plus the market value of equity both at the end of fiscal year t.

We obtain data from the Compustat Annual Industrial and Research files. All firm-year observations with a value of zero for $R\&D_t$ are omitted. The sample size is 35,772 in panel A and 34,115 in panel B. We winsorize all variables by setting the values in the 1st and 100th percentiles to the minimum and maximum values in the 2nd and 99th percentiles. Observations with deflated EPS values of less than -1 or greater than 1 are winsorized at -1 and +1. In cases where EPS data are absent in any of the years from t+1through t+5, $SD(E_{t+1,t+5})$ is set equal to the mean $SD(E_{t+1,t+5})$ of the firms in the same Altman Z-Score decile portfolio (see section 2 for details).

Reported t-tests are adjusted for autocorrelation using the Newey-West correction with 5 lags.

TABLE 5

Summary of 21 Annual Cross-Sectional Regressions From 1972-1992

Advertising Expense is Omitted

$$SD(E_{t+1,t+5}) = a + b_{1t} R\&D_t + b_{2t} CapEx_t + b_{3t} MV_t + b_{4t} Leverage_t + error_{t+1,t+5}$$

Panel A: Scaled by Book Value of Equity

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.068	6.42	0.024	0.031	0.044	0.073	0.087	0.110
$R\&D_t$	R&D Expense	0.072	3.21	0.052	0.007	0.026	0.053	0.115	0.178
$CapEx_t$	Capital Expenditures	0.024	3.83	0.017	0.007	0.013	0.016	0.035	0.069
MV_t	Log Market Value (Billions)	-0.010	-9.92	0.002	-0.014	-0.011	-0.011	-0.008	-0.006
$Leverage_t$	Debt/(Market Value+Debt)	0.022	4.92	0.016	-0.007	0.012	0.016	0.034	0.055
	Adjusted R^2 in %	10.1		1.9	6.5	8.6	10.2	11.4	14.0

Panel B: Scaled by Price

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.034	8.18	0.010	0.011	0.028	0.035	0.043	0.048
$R\&D_t$	R&D Expense	0.068	6.26	0.035	-0.003	0.040	0.070	0.082	0.140
$CapEx_t$	Capital Expenditures	0.032	8.78	0.014	0.014	0.026	0.029	0.037	0.064
MV_t	Log Market Value (Billions)	-0.011	-13.32	0.002	-0.015	-0.012	-0.010	-0.009	-0.007
$Leverage_t$	Leverage	0.085	12.97	0.022	0.049	0.073	0.077	0.095	0.146
	Adjusted R^2 in %	17.1		2.6	13.8	15.0	16.3	19.0	21.6

Each of the following variables except MV_t and Leverage is deflated by either the book value of equity (panel A) or the stock price (panel B), at the end of the fiscal year t-1.

$SD(E_{t+1,t+5})$ is the standard deviation of earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share;

MV_t is the natural log of the Market Value at the end of fiscal year t;

$Leverage_t$ is the book value of debt divided by debt plus the market value of equity both at the end of fiscal year t.

We obtain data from the Compustat Annual Industrial and Research files. The sample size is 55,073 in Panel A and 52,046 in panel B. We winsorize all variables by setting the values in the 1st and 100th percentiles to the minimum and maximum values in the 2nd and 99th percentiles. Observations with deflated EPS values of less than -1 or greater than 1 are winsorized at -1 and +1. In cases where EPS data are absent in any of the years from t+1through t+5, $SD(E_{t+1,t+5})$ is set equal to the mean $SD(E_{t+1, t+5})$ of the firms in the same Altman Z-Score decile portfolio (see section 2 for details).

Reported t-tests are adjusted for autocorrelation using the Newey-West correction with 5 lags

TABLE 6

Summary of 21 Annual Cross-Sectional Regressions From 1972-1992

$$SD(\Delta E_{t+1,t+5}) = \alpha + \beta_{1t} R\&D_t + \beta_{2t} CapEx_t + \beta_{3t} AdvEx_t + \beta_{4t} MV_t + \beta_{5t} Leverage_t + error_{t+1,t+5}$$

Panel A: Scaled by Book Value of Equity

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.091	6.62	0.031	0.043	0.064	0.096	0.114	0.149
$R\&D_t$	R&D Expense	0.106	3.49	0.075	0.016	0.044	0.072	0.150	0.315
$CapEx_t$	Capital Expenditures	0.037	3.52	0.028	0.008	0.018	0.023	0.051	0.107
$AdvEx_t$	Advertising Expense	0.035	6.22	0.025	-0.011	0.017	0.034	0.047	0.094
MV_t	Log Market Value (Billions)	-0.013	-7.88	0.004	-0.018	-0.016	-0.013	-0.009	-0.007
$Leverage_t$	Debt/(Market Value+Debt)	0.021	3.45	0.022	-0.028	0.004	0.023	0.031	0.064
	Adjusted R^2 in %	11.9		3.6	7.1	8.9	12.3	14.0	20.1

Panel B: Scaled by Price

Variable	Description	Mean	t-stat	Standard Deviation	Min	q1	Median	q3	Max
Intercept	Intercept	0.037	5.62	0.015	0.006	0.025	0.041	0.049	0.056
$R\&D_t$	R&D Expense	0.148	10.81	0.062	0.069	0.112	0.134	0.175	0.357
$CapEx_t$	Capital Expenditures	0.037	6.61	0.019	0.009	0.028	0.035	0.046	0.090
$AdvEx_t$	Advertising Expense	0.046	4.00	0.037	-0.034	0.034	0.045	0.057	0.125
MV_t	Log Market Value (Billions)	-0.013	-14.48	0.002	-0.017	-0.015	-0.012	-0.011	-0.010
$Leverage_t$	Leverage	0.121	12.44	0.029	0.067	0.105	0.125	0.136	0.194
	Adjusted R^2 in %	20.7		2.1	17.3	19.9	20.0	21.2	27.1

Each of the following variables except MV_t and $Leverage_t$ is deflated by either the book value of equity (panel A) or the stock price (panel B), at the end of the fiscal year t-1.

$SD(\Delta E_{t+1,t+5})$ is the standard deviation of the change in earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share;

$AdvEx_t$ is advertising expense per share;

MV_t is the natural log of the Market Value at the end of fiscal year t;

$Leverage_t$ is the book value of debt divided by debt plus the market value of equity both at the end of fiscal year t.

We obtain data from the Compustat Annual Industrial and Research files. The sample size is 42,776 in Panel A and 40,569 in panel B. We winsorize all variables by setting the values in the 1^{st} and 100^{th} percentiles to the minimum and maximum values in the 2^{nd} and 99^{th} percentiles. Observations with deflated EPS values of less than -1 or greater than 1 are winsorized at -1 and +1. In cases where EPS data are absent in any of the years from t+1through t+5, $SD(E_{t+1,t+5})$ is set equal to the mean $SD(E_{t+1, t+5})$ of the firms in the same Altman Z-Score decile portfolio (see section 2 for details).

Reported t-tests are adjusted for autocorrelation using the Newey-West correction with 5 lags.

Table 7
Descriptive Statistics
By 2 Digit SIC Code

2 Digit SIC	Industry	N	SD(Et+1,t+5) Mean	SD(Et+1,t+5) STD	SD(Et+1,t+5) Median	$CapEx_t$ Mean	$CapEx_t$ STD	$CapEx_t$ Median	$R\&D_t$ Mean	$R\&D_t$ STD	$R\&D_t$ Median
53	General Merchandise Stores	898	0.103	0.028	0.105	0.166	0.445	0.073	0.000	0.001	0.000
54	Food Stores	727	0.100	0.028	0.102	0.240	0.495	0.121	0.000	0.003	0.000
56	Apparel and Accessory Stores	653	0.106	0.029	0.107	0.196	0.523	0.073	0.000	0.001	0.000
58	Eating and Drinking Places	1,070	0.151	0.048	0.143	0.462	0.856	0.219	0.031	0.436	0.000
59	Miscellaneous Retail	968	0.109	0.030	0.113	0.157	0.354	0.070	0.005	0.030	0.000
67	Holding, Othr Invest Offices	1,987	0.113	0.027	0.107	0.055	0.389	0.000	0.022	0.183	0.000
13	Oil and Gas Extraction	1,403	0.133	0.043	0.121	0.563	1.132	0.244	0.028	0.209	0.000
51	Nondurable Goods -Wholesale	914	0.111	0.036	0.110	0.182	0.442	0.064	0.055	0.409	0.000
50	Durable Goods-Wholesale	1,654	0.113	0.036	0.113	0.154	0.558	0.049	0.061	0.462	0.000
99	Other	6,280	0.119	0.039	0.113	0.274	0.761	0.089	0.062	0.428	0.000
27	Printing, Publishing and Allied	790	0.101	0.030	0.099	0.117	0.233	0.039	0.016	0.062	0.000
23	Apparel & Other Finished Pds	573	0.088	0.024	0.085	0.081	0.226	0.038	0.015	0.136	0.000
48	Communications	551	0.137	0.046	0.119	0.285	0.429	0.166	0.106	0.582	0.001
20	Food and Kindred Products	1,619	0.103	0.031	0.100	0.136	0.445	0.075	0.024	0.203	0.002
25	Furniture and Fixtures	607	0.099	0.024	0.100	0.083	0.139	0.047	0.015	0.045	0.004
26	Paper and Allied Products	916	0.111	0.030	0.108	0.158	0.560	0.078	0.032	0.219	0.004
29	Pete Refining & Related Inds	588	0.118	0.028	0.114	0.166	0.240	0.116	0.012	0.034	0.005
33	Primary Metal Industries	1,161	0.110	0.032	0.106	0.135	0.235	0.081	0.048	0.408	0.005
32	Stone, Clay, Glass, Concrete Pd	769	0.110	0.032	0.109	0.177	0.325	0.101	0.032	0.142	0.006
22	Textile Mill Products	740	0.094	0.024	0.092	0.109	0.129	0.073	0.023	0.072	0.007
34	Fabr Metal, Ex Machny, Trans Eq	1,869	0.104	0.033	0.102	0.186	0.645	0.068	0.046	0.268	0.010
30	Rubber & Misc Plastics Prods	1,158	0.109	0.034	0.105	0.149	0.275	0.085	0.043	0.182	0.012
39	Misc Manufacturing Industries	900	0.110	0.034	0.109	0.160	0.469	0.065	0.070	0.356	0.014
37	Transportation Equipment	1,901	0.106	0.030	0.103	0.152	0.423	0.067	0.098	0.532	0.023
87	Engr, Acc, Resh, Mgmt, Rel Sevs	649	0.125	0.045	0.119	0.223	0.577	0.065	0.213	0.666	0.030
28	Chemicals & Pharmaceuticals	4,128	0.118	0.036	0.119	0.159	0.518	0.053	0.187	0.648	0.036
35	Indl, Comml Machy, Computer Eq	6,204	0.114	0.035	0.113	0.185	0.563	0.068	0.161	0.525	0.049
36	Electr, Oth Elec Eq, Ex cmp	5,662	0.114	0.034	0.113	0.179	0.533	0.073	0.158	0.492	0.055
38	Meas Instr; Photo Gds; Watches	4,942	0.120	0.037	0.118	0.186	0.545	0.065	0.212	0.597	0.075
73	Business Services (including software)	2,792	0.130	0.037	0.125	0.263	0.683	0.085	0.291	0.840	0.076
	Total	55,073	0.115	0.095	0.097	0.198	0.577	0.071	0.108	0.477	0.011

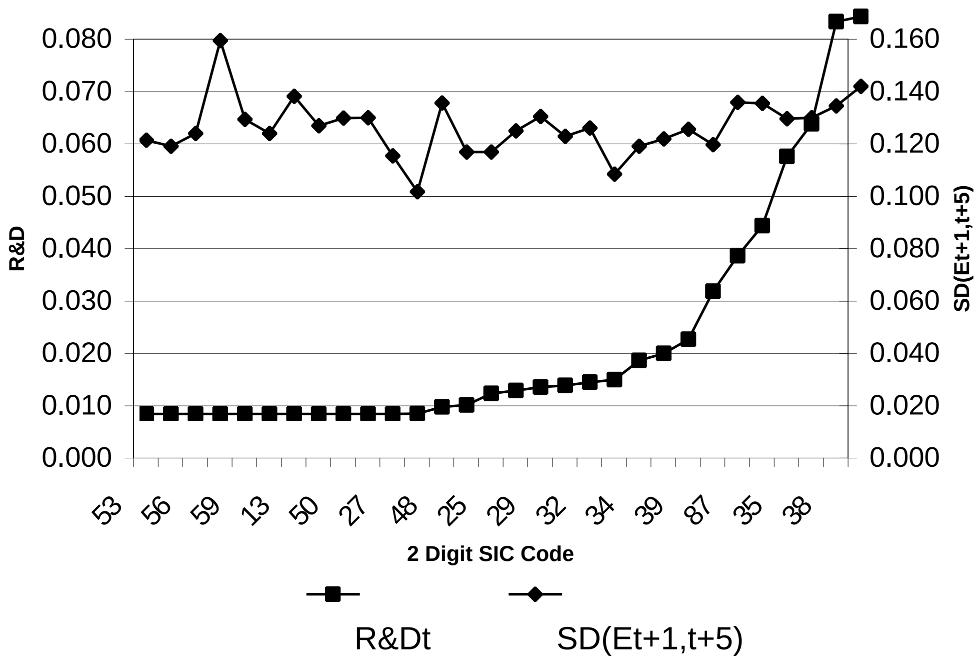
This table reports descriptive statistics by 2-digit industry code. The industries are sorted by mean R&D expenditures scaled by book value of equity ($R\&D_t$).

$SD(\Delta E_{t+1,t+5})$ is the standard deviation of the change in earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share;

$CapEx_t$ is capital expenditures per share.

Figure 1
Plot of R&D and SD(Et+1,t+5)
By 2 Digit SIC Code



From the data reported in Table 8, this figure plots R&D expenditures and the standard deviation of earnings by industry. The industries have been sorted by R&D expenditures.

SD($\Delta E_{t+1,t+5}$) is the standard deviation of the change in earnings per share before extraordinary items and discontinued operations; the standard deviation is calculated using five annual earnings observations for years t+1 through t+5;

$R\&D_t$ is R&D expense per share.