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## Record: 1

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| **Title:** | The effect on cash flows and security returns of an allocation of R&D costs between ... |
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| **Source:** | Journal of Financial Statement Analysis; Fall97, Vol. 3 Issue 1, p5, 10p, 2 charts |
| **Document Type:** | Article |
| **Subject Terms:** | *CASH flow<br>*RESEARCH & development tax credit<br>*AUDITING<br>*VALUATION |
| **Geographic Terms:!** | UNITED States |
| | NAICS/Industry Codes541990 All Other Professional, Scientific, and Technical Services |
| **Abstract:** | Presents a study examining the security valuation relevance of cash flow information when Research and Development (R&D) is required to be expensed in the United States. Explanation of the linear regression model employed for testing the reconstructed decomposed cash flow model; Statement of the three hypothesis; Selection of the cross-sectional sample for the study and presentation of the results of the test on the hypotheses; Conclusion. |
| **Full Text Word Count:** | 5577 |
| **ISSN:** | 1085-3464 |
| **Accession Number:** | 9711130181 |
| **Persistent link to this record (Permalink):** | http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=9711130181&site=ehost-live |
| **Cut and Paste:** | <A href="http://search.ebscohost.com/login.aspx? |

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## THE EFFECT ON CASH FLOWS AND SECURITY RETURNS OF AN ALLOCATION OF R&D COSTS BETWEEN CAPITALIZATION AND EXPENSE

Evaluation of the usefulness of the accounting model has a long history. Most recently, strong concern about the adequacy of financial reporting has been expressed by the AICPA Special Committee on Financial Reporting [1994]. The committee notes the dramatic changes in business operations that have increased the prominence of service providers compared to manufacturers of products. It contends that the current accounting model in the U.S. was developed mainly to account for industrial and manufacturing companies.

The assets that drive a modern company are human resources, information and data, research and development and the capacity for innovation. Financial reporting must come up-to-date...to be [a] vital component of wealth creation (Report of the AICPA Committee... [1994,p. 5]).

In response, the Securities and Exchange Commission (SEC) last year organized a symposium to discuss whether disclosure of "soft assets" should be required in financial statements or whether information about "soft assets" should be provided as supplemental information on a voluntary basis ("SEC Sponsors Discussions..." [1996,p. 15]). The Financial Accounting Standards Board (FASB) also agreed to review the current U.S. accounting treatment of intangible assets both in connection with business combinations and more generally (FASB [1996]).

A major soft assets category is research and development (R&D) expenditures. In the U.S. R&D outlays are regarded as sufficiently soft as not to warrant placement on the balance sheet. Today's circumstances, however, call for a re-examination of this accounting treatment. In certain high-technology industries--electronics and pharmaceuticals, for example--R&D expenditures are becoming an increasing proportion of sales, exceeding 20% at a growing number of companies. The International Accounting Standards Committee in IAS 9 [1993] currently mandates the capitalization of development costs when certain conditions are met. Other countries' standards either allow or require the capitalization of development outlays. In the U.S., almost alone among the developed GAAP mandates the expensing of all R&D outlays when development outlays have become an increasing proportion of R&D expenditures.

That R&D, written off as an expense, does indeed have an asset value is clear in the increasing number of acquisitions in the U.S. where acquiring firms are assigning values to acquired firms' in-process R&D and including them in the first year's consolidated expenses (Briloff [1996], "Some High-Tech Firms' Profits..." [1997]).

Different accounting treatment of R&D across countries reflects the trade-off between relevance and reliability. The litigation risk related to non-reliability also is a factor.(n2) Sophisticated users of financial statements, understanding the need for the expensing of R&D as a safe harbor for auditors, likely divide R&D outlays between an investment portion, having expected future associated sales, and an expense portion that is matched with current sales because future benefits are not anticipated.

The issue can be stated in terms of cash flow. Do investors recognize that reported cash flow from operations and cash flow from investments, major parts of the cash flow statements, are imprecise because of the expensing mandate, and do they make a correction or division between operating and investing cash flows that is incorporated into security returns?

The previous research mainly investigates the investment nature of R&D costs from an income statement approach (Grabowski and Mueller [1978], Hirschey and Weygandt [1985], Bublitz and Ettredge [1989], Majumdar and Nagarajan [1994], Sougiannis [1994]) or uses both income and balance sheet variables (Lev and Sougiannis [1996]). The latter two researchers have succeeded in estimating the size of the R&D capital asset and the amount of amortization using a lag regression model. No study has so far examined the security valuation relevance of cash flow information when R&D is required to be expensed.

SFAS 95 [1988], as amended by SFAS 117 [1995], requires a statement of cash flows as part of the full financial statements of all business entities (both publicly and privately held) and not-for-profit organizations. Since efficient market theory defines security returns as the market's measure of a firm's expected cash streams, an understanding of the cash flow aspect of R&D as an investment is as important as its effect on current earnings.

This study estimates the value relevance of R&D reporting from a cash flow perspective by applying an algorithm to two types of cash flow models of security returns to estimate an "optimal" allocation of R&D outlays between expensing (operating cash flow) and capitalization (investing cash flow). The sample includes U.S. companies having significant amounts of R&D expenditures. "Optimal" is defined here as 1) a range where there is an increase of the adjusted $R^2$ of the returns' regression after the divisions of R&D outlays are assumed, and in which 2) a new variable, gross R&D stock change, included in revised cash flow models for the sample of firms, continues to be statistically significant.

The findings of the earnings-based studies (particularly Lev and Sougiannis [1996]) are corroborated by the reported results of this study. Investors partially adjust for the mandated R&D expensing in terms of cash cows, which lends support to the contention that improved disclosure of the nature of R&D outlays will enable users to make better estimates of asset values.

## RESEARCH DESIGN

The requirement for decomposed cash flow statements using either the direct or indirect method has generated research on the three refined components of cash flow: operations, investing activities, and financing activities. Livnat and Zarowin [1990] find that disaggregation of total cash flow from operations into operating receipts and payments increases the association with unexpected returns. Surprisingly, the least significant t-statistic is for the investing activity variable. To explain this, Livnat and Zarowin suggest that the market anticipates capital investment.

An alternative explanation is that, to the extent that a sample includes companies that are R&D intensive, the operating and investing cash flow components may be misspecified if the market makes a division of R&D between the investment portion, where future sales or reduced costs are expected, and the expense portion that is different from their division according to GAAP. Other studies on cash flows (e.g., Bowen, Burgstahler, and Daley [1987]) have argued that the research inadequately defines cash flow, but they do not consider alternative measures of operating cash flow where R&D is not considered by the market to be fully expensed. Therefore, not treating all R&D outlays as a cash outflow in the cash flow from operations section, and including some portion of them in the investment section, will likely improve the explanatory power of the independent variables of revised cash flow statements.

In this study, stock price performance is used to determine whether the market adjusts the cash flow statement components into a division of R&D between operating and investment activities. If so, there should be a significant improvement in the association of stock prices, the decomposed cash flow components of cash flow statements, and reconstructed earnings. This would provide additional evidence supporting the research results of Lev and Sougiannis [1996], who use an earnings and book value model to conclude that investors do capitalize some portion of R&D outlays, ignoring the highly conservative (prudent) accounting treatment of R&D under U.S. accounting standards.(n3)

Our cash flow model differs from the Livnat and Zarowin (LZ) model [1990] in several respects. First, cash flow from operations (CFO) is computed using the indirect instead of the direct method; thus there are no inflow or outflow components of CFO. Although the FASB encourages, but does not require, use of the direct method, under either method a reconciliation of income and operating cash Flow using the indirect method is required to be reported. As a result, to avoid dual reporting, almost all firms prepare their cash flow statements using the indirect format. Therefore, it is more realistic to analyze operating cash flow using the indirect method.(n4)

Second, the financing and investing cash flow components in the LZ model (not found statistically significant) are each aggregated here to make the model more parsimonious.

Third, two new cash outflow variables are added to the model: 1) an assumed capitalized portion of R&D outlays (R&D stock, which relates to the balance sheet), and 2) a revised definition of operating cash flow, including the assumed amount of R&D outlays that is expensed. Since the LZ model, using risk-adjusted returns, does not find significant associations between the cumulative return and the components of cash flow from investing activities, our reclassification of expected successful R&D from operating to investing cash flow is hypothesized as likely to improve the association, assuming that analysts make a similar reclassification. In addition, our models use raw returns.

Studies on the relative informativeness of cash flow versus earnings have concentrated on determining whether the unexpected components of earnings or cash flows can incrementally explain abnormal stock returns (e.g., Neil, Schaefer, and Bahnson [1991]). The results generally find that both variables provide complementary information (Rayburn [1986], Wilson [1986,1987]).(n5)

All the studies using cash flow from operations, however, measure that variable using GAAP principles, the basis for the firm's definition of operating cash flow. We reconstruct the GAAP measurement of R&D as it affects both the cash flow and earnings statements simultaneously to determine whether the restated earnings and cash flow numbers include additional information content for the sample firms investigated.

A reclassification algorithm is used here to allocate the sample firms' R&D outlays between expensing and capitalization. The decomposed variables are then incorporated into the earnings and cash flow models. Depending on the reclassification results, it will then be possible to estimate whether there is a fractional range of R&D that the market implicitly capitalizes on average for the given time period, and, if so, to suggest how this information may best be presented in the financial statements. A comparison of the results of the two models, one with and the other without the R&D division, should also shed light on whether cash flow and earnings data of the two models provide incremental information content beyond that in the GAAP-based financial reports.

## HYPOTHESES AND MODELS

The first testable hypothesis is that the reclassification of a portion of R&D costs from operating to investing cash flow will 1) increase the explanatory power of the cash flow decomposition model for security returns, and 2) change the differentiated association between cash flows and security returns.

A reconstructed decomposed cash flow model can be tested to see if it has incremental information content over a similar U.S. GAAP model. The model decomposes total net cash flow into net cash flow from operating, financing, and investing activities under U.S. GAAP, with an added variable to represent imputed R&D investment. The linear regression model employed for this test is:

(1) $R = a + b_1 OCF + b_2 FCF + b_3 ICF + b_4 RI + e$

where

R = cumulative market return;

OCF = unexpected change in operating cash flow;

FCF = unexpected change in financing cash flow;

ICF = unexpected change in investing cash flow, excluding R&D;

RI = unexpected change in gross R&D stock (unexpected R&D investment); and

e = error term.

Following the random walk assumption of other researchers (Rayburn [1986], Bowen, Burgstahler, and Daley [1987], and LZ [1990]), first differences between period 1 and period 0 for the independent variables are used as the unexpected components of cash flow. Likewise, the cumulative return is computed as the change from the previous year's market value (the difference of fiscal year stock prices plus dividends for period -1 and period 0). The book value of total assets (unadjusted for any R&D capitalization) is used as a deflator to minimize any heteroscedasticity caused by firm variances. (Market value was also applied as a deflator, with no statistically significant difference in the result.)

While operating and financing cash flows can immediately affect a firm's performance within one fiscal year, there is usually a lag of several years between some R&D outlays and their results (Griliches [1984]). Therefore, an R&D stock variable, RI, is used instead of a direct cash outflow for the investing portion of R&D. RI is measured by assuming an R&D stock of four times the firm's R&D expenditure in the beginning year (1989) of the time series.(n6)

The R&D stock serves the same purpose as the lag regression used in earnings-based studies to estimate the investment value of R&D over its life cycle. The first difference of the R&D stock is identical with that of the R&D investment flow, and changes according to the assumed proportion of capitalization. For example, 5% of the initially estimated R&D stock is assumed when a 5% capitalization rate is set, and to this amount is added the capitalized portion (5%) of each subsequent year's R&D outlays.

No amortization rate is assumed for the R&D stock, in order to simplify the model. The theoretical justification for this decision is that economic research has concluded that the choice of a decay rate for private R&D stock is irrelevant to production function estimates (Griliches and Mairesse [1984,p. 341]). Because the purpose of the study is to examine the different effects of the association between the investing cash flow of R&D and security returns attributable to the assumed portions of R&D

capitalized, any amortization rate should lead to essentially the same conclusion.(n7)

Moreover, the study is concerned primarily with determining whether any incremental information is added beyond the U.S. GAAP requirement of no capitalization when cash flow statements are the basis of the models. Elimination of amortization is warranted since the algorithm adjusts cash flow from both operations and investing activities for the assumed amounts of outlays that are expensed or capitalized.

The first hypothesis can be tested by gradually reclassifying R&D expenditures from operating to investing cash flow in increments of 5%. Classification of 100% of R&D as operating and 0% as investing cash flow is equivalent to the current U.S. GAAP model. The reclassification starts with expensing 95% and capitalizing 5% of R&D outlays, and continues to increase the capitalized portion until 100% is reached.

The U.S. GAAP model and the series of reconstructed models are then compared in terms of their adjusted $R^2$ and t-statistics for each of the independent variables. The "optimal" portion or range of portions of R&D to be capitalized can be located by a trade-off between the overall explanatory power of the returns model and the significance of the individual independent variables in Equation (1).

The first hypothesis is stated as follows.

H1: The adjusted $R^2$ and significance of RI remain the same for all levels of R&D capitalization in the reclassified components of the cash flow model.

Because cash flow and net income have differential information content (Neil, Schaefer, and Bahnson [1991]), security returns do not respond to unexpected cash flows alone. Therefore, the second test is a model that includes both 1) the reconstructed cash flow, and 2) net income adjusted for the assumed allocation of R&D costs between capitalization and expense. These variables together should produce a better association with security returns than that found using GAAP-based reports.

The simultaneous reconstruction of operating cash flow and net income will further highlight whether and to what extent the market capitalizes R&D investment. In other words, the association between cash flow/net income and security returns should move in the same direction as that between reconstructed cash flow and security returns when a portion of R&D is capitalized, and may exhibit a narrower "optimal" range because of the dual constraints.

The second hypothesis is a test of the effect of the capitalization of R&D on the informativeness of operating cash flow and net income, holding every other parameter constant. The second linear regression model is:

(2) $R = a + b_1 \, OCF + b_2 \, NI + b_3 \, RI + e$

where

NI = unexpected change in net income. The other variables are as defined before.

As in Equation (1), the first difference is used as the measure of unexpected change for all the variables. When 100% of R&D costs are expensed and 0% capitalized, the unexpected operating cash flow and unexpected net income are U.S. GAAP figures, and RI is equal to zero. With the increasing capitalization of R&D, operating cash flow, RI, and net income are all adjusted for the decrease in expensed R&D.(n8) For Equation (2), a reclassification by increments of 5% in the portion of R&D capitalized, as performed for Equation (1), would be expected to lead to the same result.

Two separate hypotheses are developed for this test.

H2: The adjusted $R^2$ and significance of RI remain the same for all levels of R&D capitalization in the operating cash flow and net income model.

H3: The significance is the same for both models.

**SAMPLE DESCRIPTION AND TEST RESULTS**

Three criteria are applied in selection of the cross-sectional sample. First, companies must have reported annual R&D expenditures in their 10-Ks for 1989-1993. Second, complete cash flow information must have been available for the same period. Third, all companies must have had a positive net income during this period in order to avoid the potential complicating effect of opposite signs for OCF and net income.(n9) The year 1989 is selected as the initial year because this was the first full year all companies were required to report cash flow information in accordance with SFAS 95.(n10)

In the Compustat data base, 327 U.S. companies meet all three requirements. The total R&D expenditures of the sample companies constitute approximately 22% of the total corporate R&D outlays reported in the data base for the entire period. Although the SEC mandates the reporting of R&D expenditures only when they exceed 1% of net sales, the sample includes several companies whose it&D/net sales ratio is less than 1%. (This fact suggests that some firms perceive a benefit from the voluntary release of R&D information to the market.)

This diverse sample includes companies of different sizes and in different industries with varying degrees of R&D intensity (R&D/net sales), from a minimum intensity of 0.001 to a maximum of 0.64. A large majority fall between 0.01 and 0.10. As noted earlier, all the sample cash flow variables are extracted from statements prepared following the indirect method.

The result of the first test, based on the whole cross-sectional sample, is presented in Exhibit 1. A 25% increase in adjusted $R^2$ from the GAAP model to the adjusted model at 5% capitalization of R&D is evidenced. The adjusted $R^2$ continues to increase with the increased capitalization of R&D; it is almost 50% higher at 100% capitalization than at 0% capitalization. All the coefficients of the independent variables have the expected signs.

Of special interest is that both ICF (unexpected change in investing cash flow excluding R&D) and RI (unexpected R&D investment) have positive signs, reflecting the market's recognition of the capital value of investment in intangible as well as tangible assets. This reinforces the fact that an expected increase in future cash flow enhances a firm's market value.

It should be noted that the t-statistic for RI remains significant at the 5% level when the capitalization assumption is between 5% and 75%. Its loss of significance beyond 75% capitalization suggests that the market capitalizes only part of the R&D outlays, according to some estimate of expected successful versus unsuccessful R&D. While it has an overall positive response to a firm's commitment to R&D, the market expects a declining rate of return for R&D investment once it exceeds an "optimal" portion.

In other words, the market recognizes, on average, the capital asset value of a firm's R&D expenditure at a less significant level after it goes beyond 75% capitalized. The range of 5% to 75% may be regarded as the "optimal" capitalization in aggregate for all companies in all industries included in the sample. On the basis of this analysis, H1 is rejected.

Exhibit 2 presents the results of the test for hypotheses 2 and 3. There is an almost 20% increase in the adjusted $R^2$ when R&D capitalization changes from 0% to 100%. However, RI (unexpected R&D investment) in the second model, carries less weight than in the first model, because part of the information is also embedded in NI (unexpected change in net income). The range within which the market implicitly capitalizes R&D is narrower here than in the first model because of the dual constraints of reclassified cash flows and net income.

To compare the significance of the two models, a partial F-test is applied to the common variables of OCF (unexpected change in operating cash flow) and RI (unexpected R&D investment). The result, at the 1% significance level, indicates that Equation (2) with variables OCF and net income is superior to Equation (1) with only OCF, which is consistent with the conclusions of several studies that both cash flow and earnings provide complementary information. Consequently, hypotheses 2 and 3 are rejected.

## CONCLUSION

We have addressed whether the market recognizes the investment nature of R&D outlays by treating at least a portion as investing, rather than operating, cash flow despite the conservative (prudent) requirement of U.S. GAAP. With the growing emphasis and importance of R&D investment, and the extensive use of decision support tools for R&D planning and control, it is reasonable to see expense only accounting for R&D as not representative of the way the market actually judges R&D outlays.

Other research has documented a significant positive association between R&D outlays and security returns based on earnings studies, suggesting that the market to some extent treats R&D outlays at least partially as an asset expected to produce future benefits much like other tangible investments. Kanodia and Mukherji [1996] also show that the division of a firm's cash flows between operations and investments is an important accounting practice, and where such division is "noisy," there are distortions of firms' equilibrium investments. Our results indicate that the market does regard a good amount of R&D outlays as investments, even though these outlays are actually classified as operations expenses under U.S. GAAP.

Perhaps analysts and sophisticated users have access to non-accounting sources of information, including meetings with managers, management earnings forecasts, and independent analysis, that provide less "noisy" information about the investment nature of firms' R&D outlays than the information reported in GAAP-based statements. This may explain why broad band assumptions about the investment nature of R&D produce better correlations of operating cash flows, earnings, and investments with security returns than GAAP-based reports do.

The results of this study, supporting previous earnings-based research, suggest that GAAP cash flow variables when adjusted by an assumed division between R&D expense and R&D assets provide value-relevant information. As R&D becomes more significant in our increasingly technological economy, a reexamination of the costs and benefits of mandated R&D expensing and its relation to the relevance/reliability trade-off seems to be warranted.

## ENDNOTES

The authors gratefully acknowledge the financial support of the Faculty of Business of the City

University of Hong Kong, and the computer assistance of Joe Lee in the university's computer service center.

(n1) The American Accounting Association's Committee on Accounting and Auditing Measurement earlier expressed a similar concern: "With the decline in smoke-stack industries and the growing importance of service industries and of high-tech industries dependent on research, the gap left in financial statements by the omission of internally generated intangibles is becoming increasingly serious" (Report of the American Accounting Association Committee [1991,p. 85]).

(n2) A concern among auditors that capitalizing R&D will increase suits against accounting firms is aptly expressed by a former chief accountant of the SEC and member of the FASB: "It seems to me that, from the standpoint of auditors protecting themselves from the risks of litigation, they too should welcome simple and unambiguous accounting standards that produce financial statements that can be easily understood by reasonable investors and by the courts. Simple and straightforward standards may be the only way to end costly legal debates over the reasonableness of judgment calls [made years ago]..." (Schuetze [1993]).

(n3) Our study differs from the Lev and Sougiannis [1996] study. They show a statistically significant association of risk-adjusted security returns and prices with net earnings and book values adjusted-for their estimated firm-specific R&D stock net of amortization expense. We focus on cash flow and adjust the GAAP operating cash flow and investing cash flow for incremental divisions of R&D outlays to estimate their significance in explaining raw security returns.

(n4) SFAS No. 95, par. 27, says: "In reporting cash flows from operating activities, enterprises are encouraged to report major classes of gross receipts and gross cash payments..." (emphasis added). It should be noted that the standards-setting authorities of other countries having a cash flow statement requirement (the IASC, U.K., and Hong Kong, for example) also "encourage" the use of the direct method, but few if any companies choose it, using instead the indirect method to prepare the statement.

(n5) Bernard and Stober [1989] show that their relative importance depends upon macroeconomic conditions.

(n6) Its determination is based on a standard perpetual inventory equation with a declining balance constant amortization rate of 15% and a growth rate of 8% in Griliches (Hall [1990]). This is consistent with Nadiri and Prucha [1992], who estimate the useful life of R&D to range on average between seven and nine years.

(n7) Amortization rates of 10%, 15%, and 20% were tested with essentially similar results. The Durbin-Watson test statistics are always above the upper bound, indicating an absence of autocorrelation of the error terms, which include the imputed R&D amortization expenses.

(n8) No amortization expense is assumed for the adjustment of NI. Amortization rats of 10%, 15%, and 20% were tested, with essentially the same results.

(n9) A subsample of companies with negative net income, often high-tech companies with relatively high levels of R&D, was also tested. The overall association is even more pronounced than for companies with positive net income. Sometimes the coefficient of RI is negative, however, suggesting that the market may negatively, instead of positively, evaluate loss companies' R&D. The exclusion of the loss firms explains the non-coverage of a large percentage of R&D.

(n10) We have no reason to believe that the results would differ for subsequent years.

**EXHIBIT 1 RECLASSIFIED CASH FLOW MODEL -- DEPENDENT VARIABLE: CUMULATIVE MARKET RAW RETURNS**

| Parameter | Estimate | T-Statistic | |
|---|---|---|---|
| P = 0.00 | $R^2$ = 0.3286[*] | | F Value = 54.35 |
| Intercept | 0.1658 | 4.358 | |
| OCF | 8.0180 | 10.716 | |
| FCF | 0.9481 | 2.064 | |
| ICF | 0.3850 | 0.805 | |
| RI | 0.0000 | | |
| P = 0.05 | $R^2$ = 0.4048 | | F Value = 56.61 |
| Intercept | -0.0168 | -0.362 | |
| OCF | 6.3223 | 8.414 | |
| FCF | 0.7102 | 1.642 | |
| ICF | 0.3661 | 0.812 | |
| RI | 55.6927 | 5.975 | |
| P = 0.25 | $R^2$ = 0.4248 | | F Value = 61.37 |
| Intercept | -0.0033 | -0.071 | |
| OCF | 6.5307 | 9.189 | |
| FCF | 0.6448 | 1.536 | |
| ICF | 0.3877 | 0.889 | |
| RI | 9.1544 | 4.692 | |
| P = 0.50 | $R^2$ = 0.4473 | | F Value = 67.15 |
| Intercept | 0.0132 | 0.293 | |
| OCF | 6.6438 | 10.051 | |
| FCF | 0.5305 | 1.306 | |
| ICF | 0.3700 | 0.879 | |
| RI | 3.3995 | 3.184 | |
| P = 0.75 | $R^2$ = 0.4667 | | F Value = 72.55 |
| Intercept | 0.0286 | 0.642 | |
| OCF | 6.6296 | 10.794 | |
| FCF | 0.3942 | 0.999 | |
| ICF | 0.3159 | 0.776 | |
| RI | 1.5822 | 2.009 | |
| P = 1.00 | $R^2$ = 0.4832 | | F Value = 77.44 |
| Intercept | 0.0424 | 0.966 | |

| | | |
|---|---|---|
| OCF | 6.5246 | 11.425 |
| FCF | 0.2479 | 0.643 |
| ICF | 0.2381 | 0.602 |
| RI | 0.7724 | 1.185 |

| Parameter | Pr > T | Standard Error |
|---|---|---|
| P = 0.00 | | Pr > F 0.0001 |
| Intercept | 0.0001 | 0.0380 |
| OCF | 0.0001 | 0.7482 |
| FCF | 0.0398 | 0.4593 |
| ICF | 0.4225 | 0.4794 |
| RI | | |
| P = 0.05 | | Pr > F 0.0001 |
| Intercept | 0.7176 | 0.0465 |
| OCF | 0.0001 | 0.7514 |
| FCF | 0.1015 | 0.4324 |
| ICF | 0.4163 | 0.4498 |
| RI | 0.0001[**] | 9.3213 |
| P = 0.25 | | Pr > F 0.0001 |
| Intercept | 0.0458 | 0.0458 |
| OCF | 0.0001 | 0.7107 |
| FCF | 0.1255 | 0.4198 |
| ICF | 0.3747 | 0.4362 |
| RI | 0.0001[**] | 1.9511 |
| P = 0.50 | | Pr > F 0.0001 |
| Intercept | 0.7695 | 0.0451 |
| OCF | 0.0001 | 0.6610 |
| FCF | 0.1923 | 0.4060 |
| ICF | 0.3798 | 0.4207 |
| RI | 0.0016[**] | 1.0676 |
| P = 0.75 | | Pr > F 0.0001 |
| Intercept | 0.5211 | 0.0445 |
| OCF | 0.0001 | 0.6142 |
| FCF | 0.3186 | 0.3946 |
| ICF | 0.4383 | 0.4071 |
| RI | 0.0453[**] | 0.7874 |
| P = 1.00 | | Pr > F 0.0001 |
| Intercept | 0.3349 | 0.0439 |
| OCF | 0.0001 | 0.5711 |

| | | |
|---|---|---|
| FCF | 0.5204 | 0.3854 |
| ICF | 0.5476 | 0.3954 |
| RI | 0.2369 | 0.6518 |

p = percentage of R&D expenditures assumed to be capitalized;
OCF = unexpected change in operating cash flow;
FCF = unexpected change in financing cash flow;
ICF = unexpected change in investing cash flow, excluding R&D; and
RI = unexpected change in gross R&D stock (unexpected R&D investment).

[*] All $R^2$s are adjusted $R^2$s.

[**] Between 5% - 75% capitalization, the t-statistic is significant at the 5% level.

The variance inflation factor (VIF) for the variables has been estimated for both Exhibit 1 and Exhibit 2. Although an increase in VIF for RI can be detected with the increase in the capitalized portion of R&D, it never exceeds 2, demonstrating that the models do not have serious multicollinearity. (A VIF for standardized data greater than 10 indicates harmful collinearity; see Kennedy [1994, p. 183].)

**EXHIBIT 2 OPERATING CASH FLOW AND NET INCOME MODEL -- DEPENDENT VARIABLE: CUMULATIVE MARKET RAW RETURNS**

| Parameter | Estimate | T-Statistic | |
|---|---|---|---|
| P = 0.00 | $R^2$ = 0.4897 | | F Value = 157.92 |
| Intercept | 0.1545 | 4.675 | |
| OCF | 3.1331 | 4.391 | |
| NI | 8.1851 | 10.441 | |
| RI | 0.0000 | | |
| P = 0.05 | $R^2$ = 0.5281 | | F Value = 122.98 |
| Intercept | 0.0283 | 0.683 | |
| OCF | 2.4066 | 3.422 | |
| NI | 7.2062 | 9.349 | |
| RI | 38.9390 | 4.595 | |
| P = 0.25 | $R^2$ = 0.5432 | | F Value = 130.60 |
| Intercept | 0.0450 | 1.099 | |

| | | | |
|---|---|---|---|
| OCF | 2.5111 | 3.628 | |
| NI | 6.6820 | 9.269 | |
| RI | 5.8952 | 3.419 | |
| P = 0.50 | $R^2$ = 0.5568 | | F Value = 137.97 |
| Intercept | 0.0630 | 1.554 | |
| OCF | 2.5817 | 3.790 | |
| NI | 6.3887 | 9.002 | |
| RI | 1.9325 | 2.193 | |
| P = 0.75 | $R^2$ = 0.5659 | | F Value = 143.11 |
| Intercept | 0.0778 | 1.932 | |
| OCF | 2.6027 | 3.866 | |
| NI | 5.9053 | 8.605 | |
| RI | 0.7300 | 1.216 | |
| P = 1.00 | $R^2$ = 0.5715 | | F Value = 146.39 |
| Intercept | 0.0899 | 2.237 | |
| OCF | 2.5897 | 3.879 | |
| NI | 5.4369 | 8.130 | |
| RI | 0.2071 | 0.451 | |

| Parameter | Pr > T | Standard Error |
|---|---|---|
| P = 0.00 | | Pr > F 0.0001 |
| Intercept | 0.0001 | 0.0330 |
| OCF | 0.0001 | 0.7135 |
| NI | 0.0001 | 0.7839 |
| RI | | |
| P = 0.05 | | Pr > F 0.0001 |
| Intercept | 0.4952 | 0.0414 |
| OCF | 0.0007 | 0.7033 |
| NI | 0.0001 | 0.7708 |
| RI | 0.0001[**] | 8.4746 |
| P = 0.25 | | Pr > F 0.0001 |
| Intercept | 0.2724 | 0.0409 |
| OCF | 0.0003 | 0.6921 |
| NI | 0.0001 | 0.7403 |
| RI | 0.0007[**] | 1.7243 |
| P = 0.50 | | Pr > F 0.0001 |
| Intercept | 0.1212 | 0.0405 |
| OCF | 0.0002 | 0.6812 |

| | | |
|---|---|---|
| NI | 0.0001 | 0.7097 |
| RI | 0.0290[**] | 0.8814 |
| P = 0.75 | | Pr > F 0.0001 |
| Intercept | 0.0543 | 0.0403 |
| OCF | 0.0001 | 0.6732 |
| NI | 0.0001 | 0.6863 |
| RI | 0.2249 | 0.6004 |
| P = 1.00 | | Pr > F 0.0001 |
| Intercept | 0.0259 | 0.0402 |
| OCF | 0.0001 | 0.6677 |
| NI | 0.0001 | 0.6687 |
| RI | 0.6526 | 0.4597 |

p = percentage of R&D expenditures assumed to be capitalized;
OCF = unexpected change in operating cash flow;
NI = unexpected change in net income; and
RI = unexpected change in gross R&D stock (unexpected R&D investment).

[*] All $R^2$s are adjusted $R^2$s.

[**] Between 5% - 50% capitalization, the t-statistic is significant at the 5% level or less.

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