In-Process R&D: To Capitalize or Expense?

Zhen Deng[a] and Baruch Lev[b,*]

[a]City University of New York—Baruch College, New York, New York, USA

[b]New York University, New York, New York, USA

Abstract

The FASB recently proposed the capitalization of acquired in-process R&D costs to replace the current practice of expensing this item. This proposal will likely be strongly opposed by corporate executives. We examine whether in-process R&D is an asset worthy of capitalization or an expense, and, if it is an asset, how reliable is its estimate. We find a significant association between the values of in-process R&D and acquiring firms' cash flows during the three years subsequent to acquisition, thereby supporting the FASB's proposal to recognize in-process R&D as an asset. Preliminary tests are positive for the reliability/objectivity of in-process R&D estimates.

Keywords: R&D, capitalization, cashflows, intangibles.

*Baruch Lev, Stern School of Business, New York University, 44 West Fourth Street, Suite 10-92, Kaufman Management Center, New York, NY 10012. Tel: (212)998–0028, Fax: (212)995-4001, blev@stern.nyu.edu
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I. Introduction

The in-process research and development (IPRD) phenomenon came to the public's attention in the mid-1990s, when a substantial number of leading companies, particularly in the high tech and science-based sectors, announced corporate acquisitions in which incomplete R&D projects constituted the major asset acquired. What raised eyebrows and triggered the media's attention was the fact that, following an arcane accounting rule, the acquiring firms immediately expensed the just-recognized value of IPRD, thereby writing off most of the value of the acquired entity. IBM's acquisition of the Lotus Development Corp in July 1995 was among the first large cases in which IPRD played a prominent role. The total price paid for Lotus was $3.2 billion. Following the "purchase accounting" method, IBM estimated the fair value of Lotus' tangible net assets (primarily, cash, accounts receivable, land and buildings) at $305 million, and the fair value of identifiable intangible assets (trademarks, assembled workforce, leasehold improvements) at $542 million. Current software products were valued at $290 million, and deferred tax liabilities were estimated at $305 million. And here comes the crown jewel: IBM estimated the fair value of Lotus' IPRD—new products and services in the process of research and development—at $1.84 billion, constituting almost 60% of Lotus' acquisition price. This meant that the acquisition's goodwill—the difference between acquisition price and the total fair value of net assets—was $564 million.

The consequences of the immediate expensing of IPRD and the means for managing (manipulating) earnings they create attracted the media attention.[1] As indicated by the above example of Lotus' acquisition, the higher the valuation of IPRD—a very soft and subjective value—the lower is the residual value of goodwill, and in turn the lower the hits to future earnings from goodwill amortization.[2] The immediate expensing of IPRD also obviated the future amortization of this asset had it been capitalized, further contributing to future reported earnings. Finally, the immediate expensing of IPRD substantially reduced the asset and equity bases of the acquiring company, thereby inflating widely used profitability measures, such as the return on assets or equity. No wonder, then, that managers strongly support the expensing of IPRD. And no wonder that, when the Financial Accounting Standards Board (FASB) in the late 1990s announced its intention to consider the capitalization of IPRD, it met with a strong opposition of managers, particularly those of high tech companies.[3]

A major unintended, yet expected, consequence of the expensing of IPRD was the inflation of IPRD values by managers of acquiring companies; a tempting proposition, given the considerable uncertainty and subjectivity of estimating the value of incomplete R&D projects. Moreover, this inflationary temptation was exacerbated by the absence of comparable market prices—there are no markets in R&D—that could serve as value benchmarks. In the first systematic study of IPRD comprising of 375 cases, Deng and Lev (1997) reported that the mean and median ratios of IPRD to total acquisition price were both 72%, and that the mean ratio of IPRD to the equity (net worth) of the acquiring firms was 41%. These high ratios demonstrate

[1] For example, in August 1998, a Wall Street Journal article reported on the SEC concerns that companies were abusing the IPRD charges (MacDonald, 1998). In March, 1999, another Wall Street Journal article reported the impact of the SEC crackdown on the size of IPRD write-offs (MacDonald, 1999).
[2] Until 2001, goodwill had to be amortized over a period of up to 40 years. SFAS No. 142 abolished the amortization of goodwill and replaced it with an annual impairment test.
[3] The FASB subsequently decided not to pursue the reconsideration of the IPRD issue.

the significant effects of IPRD expensing on key financial variables of acquiring companies. The high values of IPRD expensed by acquiring firms led the Securities and Exchange Commission (SEC) to clamp down on these valuations, forcing numerous companies to restate downward the valuation of previously reported IPRD, and to significant decreases in the subsequent valuations of this asset.[4] The bursting of the technology stock price bubble in 2000 and the ensuing recession significantly decreased the number of corporate acquisitions, and with it the economic impact of the IPRD phenomenon. Recently, however, along with the economic and stock market recovery, the mergers and acquisition activity picked up, bringing back to the forefront the questionable accounting treatment of IPRD.

This is the background for the current reconsideration of the accounting treatment of IPRD by the FASB, which motivates our study. Specifically, the FASB—the accounting rule-making body in the United States—now proposes that IPRD shall be capitalized and amortized, or tested periodically for impairment (see Section II for elaboration). This proposed change of accounting treatment raises several important issues, foremost of which are the following two: Is IPRD an asset worthy of capitalization, and what is the typical life (amortization period) of IPRD? Below, we examine these questions empirically, and we conclude that IPRD contributes to future cash flows and thus is indeed an asset, and, moreover, that the life of the typical IPRD is at least three years.

We provide a brief review of related research before proceeding with our analysis: Deng and Lev (1997) documented a significant positive association between expensed IPRD values and quarterly excess (market-adjusted) stock returns in the quarter of acquisition, as well as with market-to-book ratios at the end of the quarter, implying that investors consider IPRD as a value-

[4] In a follow up study, Deng and Lev (1999) report that the average size of in-process R&D charges as a percentage of purchase price dropped to 45%, from 72%, for mergers that occurred after the SEC started to scrutinize IPRD.

enhancing asset, rather than an expense. An alternative, cynical explanation to these findings cannot be ruled out: Investors' positive response to IPRD is due to the latter's potential for inflating future reported earnings. We overcome this reasoning in the current study by relating IPRD to subsequent cash flows.

In an experimental setting, Hopkins et al. (2000) examined whether different methods of accounting for business acquisitions affect analysts' stock price estimates. Responses from 113 buy-side analysts and portfolio managers show that they assign a higher value to acquiring firm's common stock when the acquisition premium is immediately expensed as IPRD rather than capitalized as goodwill and subsequently amortized.

Dowdell and Press (2001) examined the impact of the SEC's scrutiny of IPRD write-offs on the financial reports of a sample of firms in the software and computer services industry during 1996–1998. They found that inspection by the SEC significantly reduced the size of IPRD write-offs following the SEC action and that this also led to material downward revisions of previously reported IPRD write-offs. The authors also documented that firms with high profit expectations by investors (measured by price-to-earnings or price-to-book ratios) wrote off more IPRD than did low-expectations firms, which they interpreted as inconsistent with the income-smoothing and "big-bath" hypotheses of earnings management. They also indicated that IPRD restatement announcements were negatively associated with abnormal stock returns (i.e., investors reacted negatively to IPRD restatements).

Clem et al. (2004) documented the market reactions to a series of regulatory events related to IPRD during 1998–1999. They noted that the sample firms' stock prices reacted negatively, on average, to announcements of SEC scrutiny of IPRD charges. They also found a positive price reaction to the FASB's decision in the late 1990s that it would defer its plan to

require the capitalization of IPRD (see footnote 3). The authors interpreted these findings as evidence that investors "viewed the potential for increased regulation of IPRD charges as detrimental to the value of R&D intensive firms."

The order of our discussion is as follows: Section II elaborates on the difference between expensing and capitalizing R&D. Section III presents the proposed accounting change concerning IPRD. Section IV discusses the empirical tests and findings, while Section V reports on a preliminary reliability test. Section VI concludes the paper.

II. R&D Expensing vs. Capitalization

Accounting rules in the United States (generally accepted accounting principles—GAAP) require public companies to expense all internal R&D outlays. Expensing means that quarterly and annual R&D expenditures are subtracted from revenues (sales) in the process of calculating net income (earnings). The major characteristic of an expense that distinguishes it from an asset (capital) is that it is not expected to generate future benefits. Thus, for example, wages and salaries are expenses because they are paid for past employee performance, and rent is paid for past plant occupancy. This asset–expense distinction clarifies the major controversy concerning R&D expensing: There is no doubt that R&D activities are expected to generate future benefits, such as from sales of drugs or software products. Indeed, extensive empirical evidence documents significant statistical associations between current and past R&D expenditures by companies, and future growth in sales, earnings, and stock prices (see Lev, 2001, Ch.3). Why then expense R&D? Accounting rule makers claim that while, *on average*, R&D is associated with future benefits, individual R&D projects developed by specific companies are highly

uncertain. Many projects are discontinued or fail to provide reasonable return on development costs. Accounting conservatism, it is claimed, calls for the expensing of such uncertain R&D.

The alternative to R&D expensing is capitalization—that is, the recognition that R&D expenditures constitute an asset that is expected to provide future benefits, like plant, machinery, or inventories. The impact of R&D capitalization on reported financial data is two-fold: The accumulated R&D expenditures appear on the balance sheet among the firm's assets, rather than as expenses, and the quarterly or annual amortization of the R&D capital, which reflects the decrease over time in the asset's benefits, is considered an expense and is subtracted from revenues in the determination of net income. Thus, under capitalization, amortization replaces the R&D actual expenditure, which is currently being fully expensed. Note, that such capitalization of R&D is not permitted under U.S. accounting rules. The proposed change—the subject of this study—pertains only to *acquired* in-process R&D, namely the R&D included in mergers and acquisitions, and not to internal R&D.

So much for accounting rules. But who is right? Accounting rule makers who claim that R&D is too uncertain to deserve the coveted status of an asset (capital), or the challengers (e.g., Lev and Zarowin, 1999) who claim that while individual R&D projects may be uncertain most public companies engage in the development of portfolios (bundles) of projects (e.g., drugs or software programs under development) that exhibit a combined level of uncertainty that is relatively low? Such a level of R&D uncertainty, claim the challengers, is not significantly higher than the uncertainty of other corporate investments, such as real estate, stocks, or bonds, which are recognized by accountants as assets.

Ultimately, the R&D expensing vs. capitalization controversy should be settled on empirical grounds. Indeed, various studies were aimed at resolving this issue. Here are two

examples. The only exception to the R&D expensing rule in the U.S. is software development costs. The FASB ruled in 1985 that the R&D (development costs) of software projects that successfully passed technological feasibility tests, such as a beta site, should be capitalized and amortized. This allowed Aboody and Lev (1998) to examine whether the extent of software development costs that were capitalized and reported on the balance sheets of software companies as assets are: (1) recognized by investors as such (i.e., reflected as assets in stock prices), and (2) associated statistically with the future earnings of the companies as expected from assets. The empirical answers to these two questions were affirmative: The capitalized software development costs were indeed assets.

The second example of an empirical study on the merits of R&D capitalization deals with regular R&D. Lev and Sougiannis (1996) used reported financial data of public companies to determine the values of firms' R&D capital and its amortization rate (that is, to undo the required expensing of R&D). This was statistically performed by relating a firm's earning in a given year to its R&D expenditures in the same and prior ten years. The annual amortization rates of R&D were derived from the pattern of statistical association between earnings (the benefits) and the lagged values of R&D expenditures (the costs). Deriving R&D capital and amortization rates, enabled Lev and Sougiannis to statistically determine whether investors consider R&D an expense (as accountants claim) or an asset when pricing securities. The evidence, once more, indicated that, on average, R&D is considered by investors an amortizable asset rather than an expense.[5] On the other hand, Kothari et al. (2002) provided evidence that the contribution of R&D to the future volatility of earnings—a measure of risk—is higher than the contribution of capital expenditures (physical assets) to earnings volatility.

[5] Note, however, that the findings of these and other empirical studies hold *on average*. Thus, accountants' argument that in certain specific cases R&D does not qualify as an asset is not completely invalidated by the empirical findings.

Under what circumstances would R&D capitalization and amortization result in significantly different financial information (earnings, asset values) released to investors relative to R&D expensing? The determining factor is the *growth rate* of the firm's R&D expenditures. When a firm's R&D does not grow over time, the annual R&D expenditures (in steady state) will equal the annual amortization of the R&D capital, had R&D been capitalized and amortized, and therefore earnings will be the same under expensing and capitalization. However, when the growth rate of R&D is positive, typical to most companies in a growing economy, R&D expenditures (the current accounting expense) are higher than R&D amortization, leading to earnings under R&D capitalization being higher than earnings under expensing. The higher the R&D growth rate, the higher the gap in earnings. Corporate assets and equity values reported on the balance sheet will always be higher under capitalization than under expensing, since even with a zero R&D growth rate, R&D capitalization will result in a positive (and unchanging) R&D asset reported on the balance sheet.

Finally, a sensitive issue: A frequently voiced argument against R&D capitalization is that it provides managers with a means to manipulate reported earnings and asset values. Since the amount of R&D to be capitalized is subjective, managers, it is argued, can play with the capitalized amount to report earnings figures that fit their purposes (e.g., to surpass earnings forecasts by financial analysts). When capitalization is increased, reported earnings will generally rise. While there is undoubtedly some validity to the manipulation-via-capitalization argument, two things should be kept in mind. First, the evidence supporting capitalization (discussed above), though limited, suggests that at least on average the capitalized values provide information relevant to investors. They are not all bad. Second, and more important, the expensing of R&D—the current accounting rule—also affords managers a potent manipulation

tool, arguably more damaging than the manipulation via capitalization. Specifically, when R&D is fully expensed and managers wish to increase reported earnings, they can simply cut the actual R&D expenditure (outlay). This, of course, will adversely affect the future growth of the company; hence the adverse effect. In contrast, when R&D is capitalized, a real cut in R&D expenditures will have a small immediate effect on earnings, because the lower R&D expenditure is first capitalized, and it only gradually affects current and future earnings through the lower R&D amortization. Thus, R&D capitalization provides a certain safeguard against short-sighted decreases in the level of R&D activities aimed at inflating reported earnings.

III. Regulatory Considerations

Current Generally Accepted Accounting Principles (GAAP) mandate the immediate expensing of in-process R&D (IPRD). However, the widespread criticism of this procedure—particularly in stripping the balance sheet of the values of major acquired assets, and in distorting profitability measures—led those who set accounting standards to reconsider the expensing of IPRD. In 2003, the FASB issued the following statement:

> To further the IASB's [International Accounting Standards Board] and the FASB's objective of converging the International Financial Reporting Standards (IFRS) and U.S. GAAP, the Board decided to eliminate the requirement in FASB Interpretation No. 4, *Applicability of FASB Statement No. 2 to Business Combinations Accounted for by the Purchase Method,* to charge to expense certain IPR&D assets acquired in a business combination. Those acquired IPR&D assets would be recognized as intangible assets; however, research and development expenditures related to those assets incurred subsequent to the date of acquisition would not be capitalized. The Board also decided to amend Statement 142 to clarify that for purposes of applying that Statement, acquired IPR&D assets that are recognized as intangible assets as part of a business combination should be considered *indefinite-lived* until the completion or abandonment of the associated research and development efforts. At the point of completion, the reporting entity would make a separate determination of the useful life of the completed assets. Accordingly, prior to completion or abandonment, the acquired IPR&D assets would not be amortized and would be

> subject to the impairment review and testing provisions for indefinite-lived assets.

During 2004, the FASB intends to issue an exposure draft that discusses the proposal to capitalize IPRD and subject it to a periodic impairment test. A final standard for IPRD is expected in 2005.

There are two major reasons for the FASB's change of heart regarding IPRD: convergence of accounting principles with the International Financial Reporting Standards, and the application of one of the main working principles that underpins the business combination standard (FASB Statement No. 141), namely the recognition at fair value of all acquired assets, including intangibles. We elaborate on these reasons thus.

The International Financial Reporting Standard No. 3 on business combinations (IFRS 3, issued in 2004) requires an acquirer to recognize at the acquisition date all the acquired intangible assets that meet the definition of intangibles in IAS 38, and to do so separately from goodwill. This definition states that the intangible be "identifiable," namely arises from contractual or other legal rights, and "separable," that is "capable of being separated or divided from the entity and sold, transferred, licensed, rented, or exchanged." The fair value of the recognized intangible should also be subject to a reliable measurement. The International Standards Board concluded that IPRD should be included among the acquired intangibles that are required to be recognized separately from goodwill. Thus, convergence of U.S. GAAP with the international standards calls for the capitalization of IPRD in the U.S.

The second reason for the change in the FASB's attitude toward IPRD is the application of a major principle that underlies the recognition of assets acquired in a business combination under FASB Statements Nos. 141 and 142. Specifically, those statements call for the separation

from goodwill of identifiable intangible assets and their valuation at fair values. According to these statements, IPRD appears to qualify as an intangible asset to be capitalized.

It should be made clear that the FASB's proposed capitalization of IPRD does not extend to IPRD acquired outside of a business combination. Accordingly, even if the FASB's proposal passes, serious inconsistencies regarding the recognition of IPRD in financial reports will remain. It should also be noted that the proposed capitalization of IPRD does not extend beyond the acquisition date: Research and development expenditures related to the acquired projects and incurred subsequent to the date of acquisition will be expensed. One wonders about the relevance of financial information when one part of an asset is capitalized and another part is expensed, where the dividing line between the two parts (the date of acquisition) is arbitrary with respect to the economic and technological processes of the products under development. Thus, while the FASB's proposed capitalization of acquired IPRD, if passed, will probably improve financial information, such improvement falls short of the ideal of disclosing comparable, value-relevant information.

IV. Sample, Tests, and Results

Our initial sample consists of all firms that have IPRD data in Compustat (data item 388) during the period 1993–2000. We require stock market price data in Compustat at the beginning of the year in which the IPRD write-off occurred. The initial sample consists of 551 firm-years. We exclude transactions that occurred after 2000, because we require up to three years of future financial and stock price data for our predictive analysis in order to draw inferences on the association between the reported IPRD figure and subsequent cash flows. By excluding transactions that occurred after 2000, we also avoid the confounding impact of FASB Statement

Nos. 141 and SFAS 142 implementation, which eliminate the pooling method and goodwill amortization. The initial sample did not include transactions that occurred before 1993, because Compustat reports no cases of IPRD charges prior to 1993. To supplement the sample for the pre-1993 period, we collected additional data for IPRD write-offs by searching the LexisNexis database and thereby added observations for 27 firm-years to the initial sample and extending the sample period to 1986–2000. From this sample of 578 firm-years, we remove 7 observations that do not have data on operating cash flows (Compustat data 308) or accruals (data 123 minus data 308). We further remove 49 observations that do not have at least nine monthly CRSP returns data for the calculation of annual abnormal returns. Thus, our regressions that require current-year stock price and financial data are based on a sample of 522 observations. We lose an additional two observations in the regressions that require two years (at least 18 monthly returns) of CRSP returns data after the IPRD write-off year. To reduce the impact of outliers, we exclude annual abnormal returns in excess of 100% along with the top and bottom 1% of the financial variables (scaled by beginning-of-the-year market value).

To motivate our tests and provide intuition to the data, Table 1 presents information for three sample cases. The first example is Adobe's acquisition of LaserTools and Compumation in 1994. The IPRD expense in 1994 ($15.5 million) constituted 91% percent of the total acquisition price ($17.0 million). The proportions of IRPD expense relative to acquisition price were lower in the other two examples: 49% in Sun Microsystems and 58% in IBM's case (mentioned in the Introduction). The remaining data in Table 1 demonstrate the principal variables used in our analysis: They include sales, earnings, cash flows, and size-adjusted stock returns, in the year of acquisition (and IPRD expensing), as well as the values of these variables

in each of the three years subsequent to the IPRD expensing[6]. The data indicate some differences in patterns. For example, while the earnings of all three companies increased subsequent to acquisition, the cash flows of IBM decreased. Stock returns, which reflect multiple factors and variables, do not always conform with the patterns of earnings and cash flows. Thus, for example, while Adobe's sales, earnings, and cash flows increased continuously subsequent to acquisition, its relative stock price actually decreased (negative size-adjusted returns) in years $t + 1$ and $t + 3$ after acquisition. The regression results reported below reflect, of course, the general patterns in the sample data, rather than individual idiosyncrasies.

Our tests consist of two principal regression strategies: (a) We regress contemporaneous (same year) and subsequent year size-adjusted *stock returns* on annual earnings, which we break down into three components: cash flows from operations (CFO), accounting accruals adjusted for the expensing of IPRD (i.e., the accruals before the expensing of IPRD), and—the focus of this study—the expensed IPRD. (b) We also regress subsequent *cash flows from operations* (CFO) on current cash flows, adjusted accruals, and IPRD. The first (stock return) tests are aimed at assessing investors' valuation of IPRD, whereas the second set of tests (subsequent cash flows) seeks to determine whether IPRD is an asset or an expense[7]. SFAS No. 142 defines the useful life of an intangible asset as "the period over which the asset is expected to contribute directly or indirectly to the future cash flows of the entity." Given that IPRD can contribute to several future years, we use several intervals of subsequent cash flows: operating cash flows for the year after the write-off (year $t + 1$), the second year after the write-off (year $t + 2$), the third year after the write-off (year $t + 3$), the average of years $t + 2$ and $t + 3$, and the average of years $t + 1$ through $t + 3$. Stock returns are buy-and-hold returns that begin four months after the end of

[6] The size-adjusted stock return is the return on the firm's stock (i.e., annual change in stock price adjusted for dividends), minus the average corresponding return on firms of similar size. This is a measure of "abnormal return."
[7] Recall that the defining characteristic of an asset is that it generates future cash flows.

the write-off year (to make sure that investors have had an opportunity to digest the year t financial report). Size-adjusted (abnormal) returns are calculated by deducting the value-weighted average return for all firms in the same size-matched decile of the sample firm, where size is measured as the firm's market capitalization at the beginning of the return period[8]. To control for size differences across the sample firms, we divide each of the variables in the regressions by the firm's market value at the beginning of the year; stock returns, however, are already scaled (measured in percentages) and are thus excepted from this scaling.

An important note: When an investment—IPRD in our case—is statistically related to subsequent cash flows, one has to account in the regression for subsequent investments, which could also affect future cash flow. Thus, for example, the firm's cash flow two years hence (t + 2) could be affected by capital expenditures and R&D in t + 2, in addition to IPRD in year t. We control for subsequent investments by including the subsequent years' R&D and capital expenditures among the independent variables of the regressions described above. Thus, for example, cash flows of year t + 1 are regressed on year-t cash flows, adjusted accruals, and IPRD, as well as on R&D and capital expenditures from year t + 1; similarly for cash flow regressions for years t + 2 and t + 3.

And now to the data. The summary statistics for the pooled sample, presented in Table 2, indicate that the mean (median) size-adjusted stock return in the year of acquisition (and the IPRD expensing) was negative, –4.32% (–8.10%).[9] Thus, on average, the sample companies were not successful market performers, and likely the firms engaged in corporate acquisitions to boost operating performance and investors' growth perceptions. (Note that such acquisitions

[8] Adjusting returns for size is a preliminary adjustment for risk.
[9] Recall that the annual stock return in the acquisition and subsequent years is measured from the fourth month of the fiscal year through the fourth month of the following year, to include in the return the publication of the annual financial report, which includes the IPRD write-off.

were a common feature of all companies in the sample, although some conducted multiple acquisitions per year and/or over the sample period (1986–2000).) Indeed, the mean size-adjusted stock return in the year following the acquisition was slightly positive, 0.83%, whereas the median was still negative (–7.37%). The cash flows of the sample firms were positive in the year of acquisition as well as in the three subsequent years: Mean (median) cash flows scaled by market value were 4.54%, 3.96%, 3.81%, 4.07% (4.64%, 4.23%, 4.06%, 4.19%), for the year of acquisition and the following three years, respectively. Finally, the IPRD expense amounted to a mean (median) of 3.20% (0.94%) of the market value of the firm at the beginning of the year of acquisition.

Table 3 provides estimates of the regressions of stock returns and subsequent cash flows on current (year-of-acquisition) cash flows, accounting accruals before the expensing of IPRD, and the IPRD expense (as well as on subsequent years' R&D and capital expenditures). The top row in Panel A indicates that the coefficient of each of the three independent variables, in particular that of IPRD, is positive and statistically significant. Thus, in conformity with previous findings for the mid 1990s (Deng and Lev, 1997), investors do consider the acquired IPRD as a value-enhancing proposition, rather than an expense.[10] Panel A, row 2, reports on the regression of next year's size-adjusted return on the current components of earnings and indicates that IPRD is still marginally significant. However, this significance vanishes in the corresponding regression of Panel B, where firms appear only once in the sample. We conclude, therefore, that investors' valuation of IPRD was, on average, efficient, fully reflecting the value of IPRD in the year of acquisition.

[10] In such regressions, the estimated coefficients of real expenses—such as salaries and wages, or rent—are negative.

The remaining rows in Table 3, Panel A, report regression estimates where the dependent variables are annual, mean-value cash flows subsequent to the year of acquisition and IPRD expensing. These regressions probe whether IPRD is an asset (i.e., associated with subsequent cash flows) or an expense. When the subsequent three years are considered individually, IPRD is clearly positively and significantly related to cash flows in each of the three postacquisition years. When we average the cash flows of the following two and three years (bottom two rows in Panel A), the coefficient of IPRD is once again statistically significant at the 1% level. We thus have a clear indication that IPRD is associated with future cash flows, as expected from an asset.

The regressions reported in Table 3, Panel A, include firms that appear more than once in the sample, due to multiple acquisitions during the sample period. This detracts from the reliability of the significance tests of the estimated coefficients. Accordingly, Table 3, Panel B, reports regressions for a subsample (215 firm-years) that features each firm only once (firms with multiple acquisitions in more than one fiscal year are excluded from this sample). It is evident that Panel B estimates are very similar to those of Panel A: With the exception of next-year's cash flows, the IPRD coefficient is significant at the 1% level in all the future cash flow regressions. We therefore conclude that IPRD is, on average, associated with the firm's cash flows over at least three subsequent years. This evidence supports the general recognition of acquired IPRD as an asset.

Finally, most of our sample firms are concentrated in four high tech and science-based industries: 30% in software, (2-digint SIC 73), 13% in pharmaceutics and biotech (SIC Code 28), 15% in computers (SIC Code 35), and 16% in electronics (SIC Code 36). Accordingly, we wish to examine whether our overall sample findings also hold for these industries. Toward this end,

we reran the analyses summarized in Table 3 for each of the four industry groups. The estimates (not reported) indicate that for pharma/biotech and software companies the estimates related to the association between IPRD and subsequent cash flows are similar to those of the total sample. However, the association between IPRD and subsequent cash flows is substantially weaker for the computers and electronics companies, probably indicating that the technology acquisitions made during the 1990s in these industries were not particularly successful (as confirmed later by the burst of the technology bubble in 2000–2001).

IV. But Is It Reliable?

Generally Accepted Accounting Principles (GAAP) and accounting scholars make a distinction between the *relevance* and *reliability* of financial measures and information. Although the dividing line between the two concepts is somewhat hazy, relevance generally refers to the impact of the information on decision makers (e.g., earnings are relevant to investors because their release is generally associated with stock price changes), and reliability refers to the uncertainty properties of the estimates that underlie the information. A frequently used reliability criterion stipulates that close estimates of a given phenomenon should result from several estimators working independently and having access to the same data. Thus, for example, the historical cost of fixed or financial assets is a reliable measure, because independent estimators are likely to arrive at the same cost figure. In contrast, the estimate of an impairment (value loss) of an asset, which often requires the prediction of future cash flows to be generated by the asset, is likely to be substantially less reliable than historical cost figures, because independent estimators of impairment of a given asset are likely to generate widely different

estimates of future cash flows and the consequent impairment, even when using the same available information.

GAAP requires accounting measures, such as assets recognized on the balance sheet, to be both relevant and reliable. The criteria and dividing line for both concepts, however, are not well defined by GAAP. Thus, for example, it is not clear from GAAP what degree of variability of independent estimates will render a certain measure or estimate unreliable.

In empirical research, relevance of financial information is generally validated by an association between the information (e.g., earnings, goodwill estimates) and the consequences of the actions taken by the presumed information users (e.g., stock price changes, trading volume). Due to certain vagueness of the concept, reliability is less amenable to empirical testing. Ijiri and Jaedicke (1966) proposed operational measures for *reliability* and the related attribute—*objectivity*:

> "A measure of objectivity: …We are now concerned with the degree of unanimity or the degree of variability of *x*. One commonly used statistical measure of the variability of a set of observations is the variance. We may, therefore, use this as an indicator of the degree of objectivity of the given measurement system in measuring the given object…. The concept of reliability: …In general, a system is said to be reliable if it works in the way it is supposed to work. For example, a barometer is said to be reliable if it reflects accurately the actual barometric pressure. …However, there is another aspect of reliability which is especially important in dealing with reliability of an accounting information system. Consider the following question about the barometer example given above: "Is the barometer a reliable indicator of tomorrow's weather?" In this case, the question is not whether the barometer indicates the actual barometric air pressure, but rather whether the barometer reading can be used for predicting tomorrow's weather. This type of question is more user-oriented. It is also the type of question which is of importance in evaluating the reliability of accounting measurements." (pp. 477–478).

Thus, Ijiri and Jaedicke propose two operational dimensions for the assessment of reliability/objectivity: variability of estimates, and predictive-ability. We combine these two dimensions in an initial assessment of the reliability/objectivity of IPRD estimates. Specifically, IPRD values, if reliable, are presumably used by investors to assist in the prediction of future

enterprise cash flows. The reliability/objectivity of the IPRD estimates can thus be inferred from the *variance* of associated future cash flows. One way of operationalizing this assessment is to regress the variance of future cash flows (the object of prediction) on current IPRD values (the predictors). Stated differently, if IPRD values are associated with a low variability of future cash flows, the IPRD value can be considered relatively reliable and objective. If, on the other hand, IPRD values are associated with a high variability of future cash flow, then IPRD values cannot be considered reliable predictors of cash flows.[11] To be sure, this test of reliability/objectivity of IPRD values is a limited one, ignoring various aspects of the multifaceted concept of reliability, such as the variance of different estimates of IPRD done by several appraisers (which, of course, is not publicly known).

We operationalize the reliability/objectivity assessment of in-process R&D (IPRD), by regressing the four-year (years $t + 1$ through $t + 4$) *standard deviation* of a firm's operating cash flows-per-share on year-t IPRD and on capital expenditures. The two independent variables are also measured per-share. We use capital expenditures—a recognized asset by accountants—as a benchmark for IPRD, since reliability/objectivity are clearly relative terms. Thus, our regressions will indicate the reliability of IPRD relative to that of capital expenditures (physical assets). Alternatively, we use the standard deviation of the *change* in four-year future cash flow as the dependent variable, since investors may be interested in predicting cash flow growth, in addition to the absolute values of cash flows. We add to the regressions two control variables that were shown to be associated with cash flows variability: firm size—the natural logarithm of market value of equity (Compustat item 199 times item 54) at the beginning of the IPRD expensing year (size is negatively associated with cash flow volatility), and financial leverage—

[11] A similar approach to the assessment of reliability of internal R&D (not IPRD) was used by Kothari et al. (2002), using future earnings, rather than cash flows.

the ratio of debt to equity plus debt (leverage is positively associated with cash flow volatility). We scale (deflate) the capital expenditures and IPRD variables by stock price, and alternatively by sales-per-share at the beginning of the year.[12]

Table 4 provides the estimates from several versions of the regressions described above. The pair of columns on the left indicate that when the standard deviation of cash flows is regressed on the two variables—capital expenditures, and IPRD—the variables are positively and significantly associated with cash flow volatility, with the coefficient of IPRD (0.096) substantially lower than that of capital expenditures (0.229). Thus, IPRD is not associated with a higher cash flow variability than capital expenditures. Quite the contrary. When the dependent variable is the standard deviation of cash flow *changes* (two columns on the right), the two variables are highly statistically significant (IPRD, *t*-value = 3.09), and the coefficient of IPRD (0.265) is still smaller than the coefficient of capital expenditures (0.320).[13] Thus, to the extent that association with subsequent volatility of cash flows indicates certain aspects of reliability or objectivity of estimates, our test suggests that the reliability of IPRD is not lower, and indeed perhaps higher, than that of capital expenditures, which are recognized by GAAP as assets.

When firm size and financial leverage are added to the regressions, both are highly significant in the expected direction, but the coefficients of IPRD become insignificant. Accordingly, we conclude that our tentative tests of reliability indicate that IPRD value estimates are not less reliable than estimates of capital expenditures.

[12] To mitigate the impact of outliers, we winsorize observations at the top and bottom one percentile of the variables' distribution.
[13] We obtain similar results when the variables in the regression are scaled by sales.

V. Concluding Remarks

The FASB has tentatively concluded that acquired in-process R&D (IPRD) should be capitalized and tested periodically for impairment. This conclusion is sure to be debated and contested by executives who are comfortable with the current immediate expensing rule for IPRD. It is imperative, therefore, to provide empirical evidence pertinent to the FASB's decision. Our empirical findings, based on sample IPRD cases spanning the years 1986–2000, support the FASB's capitalization decision: We find that IPRD is, on average, significantly associated with future cash flows of at least three years. This evidence also suggests an amortization period for IPRD of at least three years. A preliminary reliability test suggests that the reliability or objectivity of IPRD values are no worse than those of capital expenditures, which are recognized by GAAP as an asset.

It should be borne in mind that our findings concerning IPRD being an asset hold *on average*. Such findings do not rule out specific cases where IPRD fails to generate benefits and should be expensed. Hence the importance of the individual impairment test prescribed by the FASB. Yet, accounting standards are aimed at the average or typical case, similar to our findings, and in this sense our estimates support the current FASB proposal to capitalize IPRD.

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Table 1
Three Examples (Numbers are in $Millions Except Returns)

Acquirer	Target	IPRD Charge	Total Acquisition Price	Year	Sales	Earnings	Cash From Operations	Size-Adjusted Stock Return (%)
Adobe Systems	LaserTools and Compumation	15.5	17	1994	675	15	155	81
				1995	762	93	177	–50
				1996	787	153	198	7
				1997	912	187	209	–23
Sun Microsystems	Integrated Micro Products and Lighthouse Design	57.9	118.2	1996	7,095	477	688	29
				1997	8,598	762	1,105	–14
				1998	9,791	763	1,527	45
				1999	11,726	1,031	2,517	197
IBM	Lotus	1,840	3,200	1995	71,940	4,178	10,708	–12
				1996	75,947	5,249	10,275	24
				1997	78,508	6,093	8,865	3
				1998	81,667	6,328	9,273	51

Table 2

Descriptive Statistics

Variable	Mean	Median	Standard Deviation
Current Return	–0.043	–0.081	0.443
Next Year Return	0.008	–0.074	0.552
Cash Flow from Operations	0.045	0.046	0.077
Next-Year Cash Flow	0.040	0.043	0.086
Second-Year-Ahead Cash Flow	0.038	0.041	0.082
Third-Year-Ahead Cash Flow	0.041	0.042	0.080
Years 2- and 3- Ahead Cash Flow	0.042	0.044	0.066
Three-Years-Ahead Cash Flow	0.045	0.048	0.061
Accruals	–0.100	–0.050	0.169
IPRD	0.032	0.009	0.062

The full sample consists of 522 firm-years with IPRD data during the period 1986–2000. For the period 1993–2000, firms must have IPRD data on annual Compustat industrial and research files. For the pre-1993 period, IPRD data were hand collected from firms' 10K filings. Firms must also have market price data at the beginning of the IPRD write-off year and CRSP returns data. Annual returns in excess of 100% are deleted. Financial variables in excess of the top and bottom one percentiles are winsorized. Contemporaneous Return is the twelve-month buy–hold size-adjusted return for the year of IPRD write-off (year t), measured starting four months after the end of fiscal year $t - 1$. Size-adjusted return is calculated by deducting the value-weighted mean return for all firms in the same size-matched decile, where size is measured as market capitalization at the beginning of the return cumulation period. Next-Year Return is the twelve-month buy–hold size-adjusted return for the year after IPRD write-off. Cash flows from operations (CFO) is Compustat data #308 for the year of the IPRD write-off. Accruals is earnings (data # 123) minus CFO, excluding IPRD write-off (Data# 388). IPRD is as defined above for pre-1993 and 1993–2000. Next-Year Cash Flow is CFO for the year after the write-off (year $t + 1$). Second-Year-Ahead Cash Flow is CFO for year $t + 2$. Third-Year-Ahead Cash Flow is CFO for year $t + 3$. Years 2- and 3- Ahead Cash Flow is the mean CFO for years $t + 2$ and $t + 3$. Three-Years-Ahead Cash Flow is the mean CFO for years $t + 1$ to $t + 3$. All variables except returns are scaled by the market capitalization at the beginning of the period.

Table 3

Estimates from Regressions of Current and Future Stock Returns and Future Cash Flows on Current Cash Flows, Accruals, and In-Process R&D

Panel A: Analysis of Total Sample
(*t*-values in parentheses)

	Independent Variables				
Dependant Variable	Intercept	Cash from Operations	Accruals	IPRD	R^2
Contemporaneous Return	–0.195 (–5.163)	2.059 (6.25)	1.227 (3.08)	3.131 (3.52)	0.09
Next-Year Return	–0.181 (–4.92)	1.889 (5.55)	0.497 (1.28)	1.500 (1.73)	0.06
Next-Year Cash Flow from Operations	0.007 (1.42)	0.689 (15.29)	0.189 (3.80)	0.272 (2.45)	0.38
Second-Year-Ahead Cash Flow	0.009 (1.89)	0.505 (11.18)	0.267 (5.51)	0.520 (4.68)	0.31
Third-Year-Ahead Cash Flow	0.022 (2.77)	0.668 (8.54)	0.245 (2.88)	0.431 (2.25)	0.24
Years 2- and 3-Ahead Cash Flow	0.029 (4.35)	0.608 (9.88)	0.261 (3.84)	0.490 (3.16)	0.26
Three-Years-Ahead Cash Flow	0.021 (3.61)	0.668 (13.32)	0.287 (5.36)	0.536 (4.41)	0.35

See Table 1 note for variable definitions. To conserve space, the coefficients of subsequent years' R&D and capital expenditures in the cash flow regressions are not reported.

Panel B: Analysis of Single Sample Representation of Each Firm
(*t*-values in parentheses)

	Independent Variables				
Dependant Variable	Intercept	Cash from Operations	Accruals	IPRD	R^2
Contemporaneous Return	–0.305 (–5.27)	2.195 (3.93)	1.420 (3.31)	2.992 (2.55)	0.16
Next-Year Return	–0.171 (–2.77)	0.846 (1.59)	0.291 (0.43)	0.618 (0.40)	0.00
Next Year Cash Flow from Operations	0.009 (0.88)	0.677 (7.57)	0.197 (2.48)	0.156 (0.76)	0.38
Second-Year-Ahead Cash Flow	0.003 (0.27)	0.665 (7.77)	0.476 (6.58)	0.930 (4.95)	0.42
Third-Year-Ahead Cash Flow	0.054 (2.59)	1.024 (5.87)	0.477 (2.54)	1.023 (2.30)	0.42
Years 2- and 3-Ahead Cash Flow	0.027 (1.55)	0.894 (6.37)	0.497 (3.34)	1.051 (2.99)	0.35
Three-Years-Ahead Cash Flow	0.008 (0.51)	0.904 (7.51)	0.506 (4.09)	0.958 (3.30)	0.37

See Panel A for variable definition. This table is based a subsample of 215 firms that appear only once in the sample.

Table 4

Estimates of Regressions of Cash Flow Variability on Capital Expenditures, IPRD, and Control Variables

(t-values in parentheses)

Independent Variables	Standard Deviation of Cash Flows		Standard Deviation of Cash Flow Changes	
Intercept	0.036 (10.13)	0.084 (7.38)	0.038 (6.57)	0.110 (5.89)
Capital expenditures	0.229 (3.54)	0.147 (2.20)	0.320 (3.05)	0.153 (1.41)
IPRD	0.096 (1.89)	–0.024 (–0.45)	0.265 (3.09)	0.060 (0.67)
Firm size	—	–0.006 (–4.56)	—	–0.010 (–4.18)
Leverage	—	0.083 (4.07)	—	0.150 (4.69)
N	337	337	337	337
Adjusted R^2	0.04	0.13	0.05	0.14

Standard Deviation of Cash Flows is cash flows from operations (CFO; Compustat data #308) per share, calculated using four annual cash flows for years $t + 1$ through $t + 4$. Standard Deviation of Cash Flow Changes is changes in operating cash flows per share for years $t + 1$ through $t + 4$. Capital Expenditures is Compustat data #128 divided by the weighted average number of shares outstanding during year t (Compustat data # 54). IPRD is in-process R&D (data # 388) divided by the weighted average number of shares outstanding during year t. All of the per share variables above are scaled by the beginning-of-year-t stock price. Firm Size is the natural logarithm of market value of equity (Compustat data #199 × data #54). Leverage is the sum of long-term debt (data #9) and current portion of long-term debt (data #34), divided by the sum of long-term debt and the market value of equity. Observations in excess of the top and bottom one percentiles are deleted.