MARKETS IN INTANGIBLES:

PATENT LICENSING

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Abstract

The absence of organized markets in intangibles has been a major hindrance to their recognition as assets in financial reports. Economic conditions, however, change fast and markets in intangibles, particularly in patents and know-how, are operating both off and on-line (Internet). We examine various valuation and disclosure aspects of the most active of these markets — the licensing of patents and know-how — which has grown substantially in recent years.

Our findings indicate that: (a) a significant nonuniformity exists in the financial reporting of royalty (licensing) income across firms, (b) royalty income is a highly relevant variable to investors, (c) in addition to being an important source of income, the intensity of patent royalties provides investors with a strong signal concerning the value and potential of R&D expenditures, and (d) given both the direct and indirect (signaling) valuation implications of royalty income, and the heightened public concern about the adequacy of information concerning intangibles, accounting standard-setters should reevaluate firms' disclosure of various aspects of patents, technology, and know-how.

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I. Introduction

Common wisdom has it that intangibles are not traded (exchanged) in active markets and hence cannot be reliably valued and recognized as assets in financial statements. Thus, writes Walter Schuetze, a former SEC Chief Accountant and FASB member, in opposition to the recognition of R&D as an asset (1993, p. 68):

> It is the same line of reasoning, that a cost can be an asset, that leads some people to suggest that the FASB should reconsider FASB statement No. 2 and allow for recognition of research and development costs as an asset. Note that in none of the cases is the asset [proposed to be] represented on the balance sheet exchangeable [traded in a market].[1]

To be sure, the absence of markets, denying owners of intangibles liquidity and investors access to comparable valuations, weakens the case for recognition of these assets in financial statements.[2] Recent developments, however, call for a reconsideration of the intangibles' marketability issue. A growing number of Internet-based exchanges in technology and know-how have been recently established, providing markets in patents, processes and even non-patented technology.[3] Most of the supply to these markets is expected to be provided by large, innovative companies (e.g., Sony, Dow Chemicals) which are placing parts of their patent and know-how portfolios for trade on the websites.

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1 The nontradability of R&D as a source of uncertainty was also noted by Griliches, the pioneer economic researcher on R&D (1995, p.77): "A piece of equipment is sold and can be resold at a market price. The results of research and development investments are by and large not sold directly… the lack of direct measures of research and development output introduces an inescapable layer of inexactitude and randomness into our formulation."

2 Strickly speaking, though, marketability is not an absolute condition for asset recognition: "assets may be acquired without cost, they may be intangible and although not exchangeable they may be usable by the entity in producing or distributing other goods or services." (FASB, Statement of Financial Accounting Concepts No. 6, Par. 26). Nevertheless, the absence of comparable market prices reduces the reliability of value estimates of nontradable assets.

3 Examples of such exchanges are Yet2.com and pl-x.com. On the latter, see Stroud (2000).

While Internet-based exchanges in intangibles are in infancy, their off-line progenitor— patent licensing — is active and fast-growing. Revenues (royalties) from patent licensing have increased in the U.S. from $15 billion in 1990 to more than $110 billion in 1999 (Rivette and Kline, 2000, p. 59). Many companies (e.g., IBM, Lucent Technologies, and Dow Chemicals) established independent divisions dedicated to the licensing of patents and know-how, and an increasing number of consultants provide specialized services in the valuation of patents and identification of potential licensees. The patents market, both off and on-line is expected to grow fast: a 1998 survey by the technology licensing firm BTG International found that 67% of U.S. companies own identified technology assets that they do not exploit in either internal development or licensing—hence the large potential for trade (Rivette and Kline, 2000, p. 58-59).[4]

Most of the patent licensing transactions are concentrated in the chemicals, software, electrical and non-electrical machinery, engineering and professional services, semiconductor, and pharmaceuticals and biotech sectors. Among the leading licensors are Intel, IBM, Lucent Technologies, Hewlett-Packard, Merck, Monsanto and DuPont, along with many smaller companies. In semiconductors there has been a significant growth in "fabless" or "chipless" companies, which specialize in the design of chip modules and sell or license the designs to other manufacturing companies (Linden and Somaya,1999). The patent and know-how licensing market is thus fast increasing in volume and expanding across economic sectors.

[4] IBM is a case in point. While among the top patent holders in the world, its licensing revenues until 1993 amounted to approximately $300 million a year. This changed drastically when under the newly appointed (1993) CEO Lou Gerstner, IBM embarked on an aggressive licensing program expected to yield $1.4 - 1.5 billion in 2000 (Salomon Smith Barney report on IBM, June 22, 1999). Given the substantially higher gross margin on licensing revenues than on other kinds of IBM revenues, the contribution to the bottom line of patent royalties is considerably larger than those of other revenue sources. Thus, while IBM's royalty revenues represent about 1.5% of its 2000 total revenues, royalty income accounts for about 13% of IBM's pretax net income.

The research questions we examine in this study are manifested by the following case of a specific technology recently licensed by IBM from LSI Logic corp.:[5]

> IBM Corp. said it will license a design for a communications chip from LSI Logic Corp., giving a major boost to LSI's efforts to create an industry standard in the fast-growing field of digital-signal processors. LSI has pushed its "open standard" chip as an alternative to the industry-leading designs of Texas Instruments, Inc. The chips are used to convert radio waves and other natural signals into digital forms, and are used in communications devices from cellular phones to sophisticated switching systems.
>
> IBM and LSI declined to discuss terms of their licensing deal. "This will certainly help IBM and it gives more credibility to LSI's chip," said Tony Massimini, chief of technology for Semico Research Corp. "The fact that IBM is our principal competitor is a benchmark for how open we are," Mr. Corrigan [LSI chairman] added.

The IBM-LSI licensing deal, one of thousands executed every year, demonstrates the depth of issues calling for research. In the accounting area (as distinct from strategy, public policy, etc.), these issues fall into two main categories: valuation and disclosure.

1. Valuation: Licensing revenues are, of course, a source of income which should be valued as such by investors. Since licensing contracts generally extend over several years (generating relatively "permanent income"), licensing revenues are probably accorded a higher multiple by investors than more transitory components of income. More intriguing, as the IBM-LSI deal indicates, is the question whether the valuation implications of technology trades extend beyond the direct revenue stream. As stated in the above news release: "This [IBM licensing] gives more credibility to LSI's chip." Thus, the fact that a firm's technology (as distinct from its final products) is actively traded may enhance investors' perceptions of its innovation capabilities and positively impact its market value. In particular, the intensity of royalty income may assist investors in assessing the uncertain prospects of the firm's R&D activities.

[5] The Wall Street Journal interactive edition, January 22, 2001, ("IBM will License LSI Chip Design to Help Boost Industry Standard").

We accordingly examine both the direct (licensing revenues) and indirect (signaling) valuation implications of patent licensing.

2. Disclosure: Companies are often tight lipped about their licensing activities: "IBM and LSI declined to discuss terms of their licensing deal," said the Wall Street Journal. Furthermore, there are no specific disclosure regulations concerning licensing revenues and trade in intangibles (as there are, for example, for R&D expenditures). Given the fast increase in the aggregate volume of licensing revenues and the possible broad valuation implications of this income source (to be examined below), a consideration of disclosure issues is warranted. Particularly intriguing is the apparent reluctance of several large companies known to generate considerable licensing revenues (e.g., IBM, Texas Instruments) to disclose this source of income. We, therefore consider licensing disclosure issues, in light of our valuation findings.

Our main conclusions are: (a) royalty income is highly valued by investors — a dollar of such income has a market multiple roughly twice that of a dollar of earnings, (b) the intensity of royalty income provides investors with an important signal about the "quality" of firms' R&D and technological capabilities, and (c) given the above valuation attributes of royalty income, the growing volume of patent licensing, and the increasing public concerns with the adequacy of investors' information about intangibles, our findings suggest, we believe, a consideration by standard-setters of the disclosure of key issues concerning the management of patents and know-how.[6]

[6] The recent public concern with the disclosure of information about intangibles is manifested by the Senate hearing on "Adapting a 1930's Financial Reporting Model to the 21st Century," July 19, 2000; by an SEC appointed committee which has recently (May 2001) released its report concerning the question — "Do Investors Have the Information they Need?" — putting special emphasis on intangibles; and by a recent (April 2001) FASB special report titled "Business and Financial Reporting, Challenges from the New Economy," which focuses on intangibles. More on this in Section V.

Section II presents data on our sample, while Section III reports on the valuation relevance of royalty income. Section IV analyzes the signaling attributes of royalty income concerning the quality of firms' R&D activities, and Section V surveys the increasing concerns of regulatory bodies regarding the adequacy of information on intangibles, and the potential role of royalty income in a proposed framework (by the SEC Task Force) for supplemental information on intangible assets. Section VI concludes the study.

II. Sample and Summary Statistics

We obtained our sample by conducting an automated keyword search of "royalty," "licensing income," and similar terms in firms' annual reports and 10K filings available on NEXIS during the period 1990-1998. A sample of 198 companies was identified as reporting the amount of royalty income from the licensing of technology.[7] The number of firms that disclosed royalty income in each year varies, with the highest in 1996 (188 firms) and the lowest in 1990 (94 firms). Financial statement data for our tests were retrieved from COMPUSTAT, and stock price and return information was obtained form the CRSP monthly files.

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[7] Examples of royalty income reporting:

1. Dupont	1998	1997	1996	
($ millions)	$132	$64	$72	
2. Genome Therapeutics	1998	1997	1996	
($ millions)	$21	$647	$127	

Royalty revenues in 1996 and 1997 were primarily derived from rennin patent which was assigned (sold) to Pfizer in 1998.

3. Texas Instruments	1993	1992	1991	1990
($millions)	$521	$391	$256	$172

Texas Instruments did not report royalty revenues after 1993, although it continues to stress that it "expects a significant ongoing stream of royalty revenue into the next century." In 1995, Texas Instruments reported that royalty revenues were record high without disclosing the amount of royalty. Similarly, IBM, perhaps the largest generator of patent royalties does not disclose quantitative data from this income source in its financial report.

Companies generally don't report costs associated with royalty income.

Table 1 presents the industry composition of the sample firms. Dominating the sample are typical R&D-intensive industries such as pharmaceutics, computers and electronics, medical and scientific instruments, and software. Pharmaceutical and chemical companies account for the largest concentration of the sample — 31.8 percent. The preponderance of patent licensing among pharmaceutics and biotech companies is related to the ability of inventors in these industries to appropriate the benefits of patents and defend ownership against infringement, a major concern of patent owners and licencees. Specifically, the exact molecular construct of most pharmaceutics and biotech patents facilitates the establishment of property rights over such patents and substantiates claims concerning infringement, in contrast with the relatively vague and easy to "invent around" patents in other sectors, such as food products, transportation equipment, or durable goods. The most difficult to defend and establish property rights are the recently popular "process patents," such as Internet and managerial processes patents. Trade in active markets requires a clear delineation of property rights on the goods traded, hence the popularity of trade in pharmaceutics and biotech patents.

[Insert Table 1 About Here]

Summary statistics of the sample are reported in Table 2. Each ratio in Panels A and B of Table 2 is calculated by dividing the sum of the numerators by the sum of the denominators, across all firms with data on royalty income. R&D capital (reported in Panel B) is estimated by the procedure in Chan, et al. (1999), which assumes a uniform 20% annual amortization rate of R&D capital:[8]

[8] Empirical estimates of annual R&D amortization generally range between 15% and 20%, see Nakamura (2001).

R&D capital in year t = R&D Expenditure of year t + 0.8 x R&D Expenditure of year t-1 + 0.6x R&D Expenditure of year t-2 + 0.4x R&D Expenditure of year t-3 + 0.2x R&D Expenditure of year t-4.

[Insert Table 2 About Here]

The large differences between the mean and median values of the variables in Table 2, Panel A (e.g., mean total assets $3,420 million; median $47 million) indicate the existence of some very large companies in the sample.[9] The slight decrease in the number of sample firms in 1997 and 1998 (Panel A) suggests, perhaps, a tendency in recent years to refrain from disclosing royalty income data (see Texas Instruments and IBM cases in footnote 7). The royalty share in net earnings (Panel B) is quite substantial, amounting to 14%, on average, as a result of the low costs (high margins) of royalty revenues. The correlation matrix in Panel C of Table 2 indicates that royalty income is, as expected, positively related to R&D intensity (extensive R&D activities increase, on average, the inventory of licensable patents), but negatively related to firm size (total assets).[10]

How representative is our sample of all companies engaged in R&D (potential licensors of patents and know-how)? A relevant benchmark is obviously the group of R&D firms not reporting royalty income. From the comprehensive data on R&D companies in Chan et al. (1999), we conclude that licensing firms in our sample are more R&D intensive than the population of R&D firms: 4.4% R&D intensity in our sample (Table 2, panel A) vs. 3.5% in Chan et al. Thus, a higher intensity of R&D creates more licensing opportunities. Also, the sample firms are more profitable, on average, than other R&D firms (ROE of the sample firms

[9] However, our analysis (not reported in detail) indicates that firm size does not significantly affect the valuation estimates reported in Sections III and IV.

[10] The absence from the sample of some large licensors, such as IBM, may have contributed to the negative correlation between royalty intensity and firm size.

— 14% (Table 2) vs. 9% -10% for all R&D firms (Chan et al., 1999 Table IV)), which may be to some extent a reflection of royalty income.

The question of how representative is our sample of the population of patent licensing enterprises is more difficult, if not impossible to answer. Research (e.g., Arora et al. 2000) and anecdotal evidence (Rivette and Kline, 2000a) indicate the existence of several large licensors (e.g., IBM, Apple, Sun Microsystems, Eli Lilly) which are absent from our sample, due to non-reporting of patent royalties. Given such non-reporting, we obviously cannot fully document the frequency of non-reporters, and the extent, if any, of biases in our sample vis a vis the population of patent licensors.

III **Valuation Implications of Royalties**

We use the "Residual Earnings" (RE) model for examination of the valuation implications of patent royalties. The RE model postulate the market value of the firm as a linear function of its book value (equity) and the present value of expected residual (abnormal) earnings. The latter are earnings (generally before extraordinary and other one-time items) minus a charge for the cost of equity capital.[11] We use IBES consensus analysts' forecasts of earnings for obtaining five-years ahead estimates of firms' earnings. Analysts generally predict two-three years ahead, and provide long-term growth rates for up to five years.[12] We use two versions of the RE model, with and without a terminal value. In the former, the residual earnings in year five are assumed to grow in perpetuity by either zero, or 3 percent per year (the latter is generally the expected long-term growth of the economy). In the latter (no terminal value) RE model, only the five years ahead residual earnings are included in the model. The empirical

[11] The residual earnings model is frequently used by researchers for valuation purposes (e.g., Lee et al., 1999; Palepu et al., 1996). The RE model resembles the Ohlson (1995) model, but does not rely on the specific information dynamics of the latter. Residual earnings are often referred to as "economic value added" in the management literature.

estimates we obtained were very similar across the two RE versions, and the one reported in Sections III and IV is the model with a terminal value. We used two alternative rates for the cost of equity capital: 10% and 12%, without appreciable effects on the results. The findings reported below are based on a 12 percent discount rate.

Given scale (size of firm) concerns in the levels RE model (e.g., Brown et al., 1999), we estimate two versions of this model: a per-share levels model (dependent and independent variables are per share), and an RE model scaled by book value (the dependent variable: market-to-book ratio). As will be seen below, the estimates derived from the two versions are very close. For the interested reader, we also report estimates based on a stock return model (in footnote 14).

Given our focus on royalty income, we single out this item in the RE model. This is done by subtracting from expected (consensus forecast) earnings an estimate of future royalty income. Since royalty income is not explicitly predicted by analysts, we subtract from each of the five annual earnings forecasts: (a) the current year reported royalty income, (implicitly assuming zero growth in this item), and alternatively (b) an expected royalty income which grows, starting with the current year, by 5% annually. The present value (at 12% discount rate) of the series of royalty income is incorporated as an additional independent variable in the RE model.

Finally, the RE model is estimated by pooling the sample observations cross-sectionally and over time (1990-1998). Since sample firms appear in the data several times, thereby detracting from the independence of observations, we also run year-by-year regressions and report the appropriate estimates and significance tests.

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[12] It is most likely that analysts' forecasts abstract from extraordinary and nonrecurring items.

The valuation of royalty income

Table 3 presents estimates of the RE model in levels of per-share figures. Two sets of estimates are reported, one based on the assumption of 5% growth in royalty income over the subsequent five years, and the other on 0% annual growth in royalty income.

[Insert Table 3 About Here]

It is evident from the estimates that the coefficient of the present value of royalty income is positive and highly statistically significant (t-values of 8.06 and 8.22, for the two growth versions of royalty income). The coefficient of royalty income is double the size of the coefficient of residual earnings, probably reflecting the relative permanence of royalty income—patent licensing contracts typically range over 4-5 years.[13] The large coefficient of royalty income appears also to reflect the positive implications of such income with respect to the innovation capabilities of licensing companies, an issue examined in next section. One should be careful, of course, comparing the estimated coefficient on royalty income with that of residual earnings, given that earnings typically include a considerable number of one-time items. Our residual earnings, however, are derived from consensus analysts' forecasts of earnings. While analysts are rarely specific about their definition of earnings, it is generally believed that they abstract from extraordinary and other one-time items.

The year-by-year regressions reported in the bottom panel of Table 3 indicate that the estimated regression coefficients of royalty income were positive in each of the nine regressions, and statistically significant in eight of them. The average of the nine royalty coefficients (1.427) is, once more, twice as large as the average coefficient of residual earnings (0.623). This indicates that our estimates are not adversely affected by pooling observations over time.

[13] Statistical tests of the significance of difference between the coefficients of earnings and royalties reject the null hypothesis at the 0.001 level.

Table 4 presents estimates for the scaled (by book value) RE model. The dependent variable is the price-to-book ratio. Given, the relative permanence of royalty income, we expect an estimated regression coefficient around 1. Table 4 estimates are consistent with this conjecture and with the levels (Table 3) results: the coefficient of the present value of royalties is 1.087, it is highly significant, and about 2-3 times the size of the coefficient of residual earnings. Here too, the individual year regressions (bottom panel of Table 4) are consistent with the pooled regression.[14]

[Insert Table 4 About Here]

We conclude, therefore, that royalty income is highly valued by investors. However, except for the relatively (to residual earnings) large coefficient of royalty income (a large "bang for the buck"), the finding that this income is an important source of value is not surprising. The intriguing question is whether royalty income provides additional (indirect) signals to investors concerning the all-important innovation capabilities of companies and the prospects of their R&D. As will be seen below, the answer to this question is in the affirmative.

IV. **The Signaling Effect of Royalty Income**

Recall the IBM-LSI Logic licensing deal mentioned in the introduction. The chief technology officer of Semico Research is quoted saying: "This [licensing agreement] will certainly help IBM, and it gives more credibility to LSI's chip" (emphasis ours). This statement highlights the possible role of patent and technology licensing in enhancing the credibility of the

[14] To probe further the data, we ran a returns regression: annual stock return (from 9 months before fiscal year end through 3 months after it) regressed on levels and changes in operating income (minus royalty income), and the level and changes in royalty income. All independent variables are scaled by beginning of year market value. Regression estimates indicate that both the level and change of royalty income coefficients are statistically significant at the 0.01 and 0.05, level respectively. The combined (levels and changes) coefficient of royalty income (5.64) is over four times the size of the combined coefficient of operating income (1.25). The stock returns estimates are thus consistent with those of the residual earnings model.

licensor's technological capabilities, and reducing investors' uncertainty concerning its R&D activities.[15]

Specifically, technological (innovation) capabilities—a key to the success of many business enterprise—are acquired primarily through investments in intangibles, such as R&D, information technology and human resources (e.g., employee training, specific incentive systems). Firms' technological capabilities, however, are unobserved. New products or services can be observed, of course, but their impact in generating revenues and earnings cannot be separated from that of established products. The only publicly available proxy for technological and innovation capabilities is R&D expenditures, but it's a noisy proxy. Some R&D expenditures turn out to be very successful, leading to major products and services, while, other R&D efforts come to naught. AT&T's (through Bell Labs) development of the cellular phone technology in the 1970s, didn't yield AT&T any returns, since the company decided not to pursue the development.[16] More recently, Motorola and partners' $5 billion investment in the development of the Iridium (communications satellites) project is virtually lost, as Iridium is in chapter 11. Indeed, empirical research (e.g., Kothari et al., 1999) confirms that the variability of earnings associated with R&D is substantially higher than the variability of earnings associated with physical assets.[17]

Given the substantial uncertainty associated with R&D, investors in R&D-intensive companies can be expected to search for signals concerning the quality (prospects) of firms' R&D and, broadly, with the assessment of firms' technological capabilities. The existence and

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15 The signaling effect (externality) of licensing is also demonstrated by The Wall Street Journal (August 8, 2000, p. A14) report on Palm's licensing agreements with Nokia and Sony, which quotes the CEO of Indigo saying: "Those licensing deals made it clear to us that Palm was a company with legs."

16 This was decided by AT&T in the late 1970s, after a major consulting firm concluded that cellular (wireless) communication is not commercially viable.

17 This variability, of course, is related to accountants' concern with the reliability of capitalized R&D.

volume of royalty income (from patent and technology licensing) may provide such signals. Generalizing from LSI's credibility gained by licensing technology to IBM mentioned above, firms which are able to license their patents on a substantial scale will probably be perceived by investors as having outstanding technological capabilities. Royalty income may thus serve as a "good housekeeping seal" for the firm's R&D expenditures and technological capabilities.

The direction of the above signaling conjecture goes from royalties to R&D. It may also operate in the reverse direction: a large investment in R&D promises a continuous supply of new technology, patents, and know-how, in turn, assuring investors of a continued, perhaps even increasing stream of royalty revenues.[18] We, therefore, expect a positive and statistically significant interaction term between the intensity of royalty income and R&D.

Tables 5 and 6 present tests of the signaling hypothesis of royalty income. As before (Tables 3 and 4), we incorporate in the RE model the present value of expected royalty income as an independent variable, in addition to book value and the present value of residual earnings. Given our present focus on R&D, we add to the RE model an independent variable representing the present value of five years ahead R&D expenditures, PVFRD. This variable is constructed for each firm by extrapolating its R&D expenditures over the next five years, assuming continuation of the R&D growth rate over the last three years. Expected R&D values are discounted by 12 percent (the same rate used for residual earnings and royalty income). This RE model thus postulates a relationship between price (or price-to-book), and the following independent variables: book value, and the present value of: (1) expected residual earnings, (2) expected royalty income, and (3) expected R&D expenditures (see equation in Table 5).

[18] We are indebted to Erik Brynjolfsson for this insight. Texas Instruments' 1992 10-K includes the following supporting comment: "Research and development success in the form of new products, services and intellectual property contributes importantly to TI shareholder value. Royalty revenues have helped us make the R&D and other investments necessary for our strategic transitions and to support future growth."

[Insert Table 5 About Here]

The top regressions in Tables 5 (price levels) and 6 (price-to-book) indicate that R&D is positively and significantly valued by investors.[19] The coefficients of R&D, however (0.195 and 0.037), are small, relative to earnings or royalties, apparently reflecting the generally high uncertainty associated with the commercialization prospects of R&D expenditures. The bottom regressions in Tables 5 and 6 <u>interact</u> the present value of R&D with the intensity of royalty income (the ratio of royalty income to sales), to test our conjecture that the latter provides a credibility signal for the former. Indeed, we find that the interaction coefficient is positive and statistically significant in both versions of the residual earnings model. Moreover, the estimated coefficients of royalty income in the regressions with interaction term (1.033 and 0.972) are smaller than the royalty coefficients without interaction (1.201 and 1.032), indicating the relevance of separating the <u>direct</u> valuation of royalties as a source of income from the <u>indirect</u> valuation of royalties as a signal for R&D quality.

[Insert Table 6 About Here]

In an attempt to probe deeper the information externalities (signaling) of royalty income, we classified the sample companies to biotechnology and pharmaceutics companies vs. all others. The reason: much of the R&D of biotech and drug companies is in the form of "basic research"—aimed at the discovery of <u>new</u> science and technology, while most of the R&D in other sectors (e.g., electronics, software, cars, oil & gas) is "applied research," aimed at modifying and improving existing technologies. Some of the latter research, particularly prevalent in chemical and oil companies, is in the form of "process R&D," which is aimed at improving the efficiency of production processes. Obviously, the uncertainty associated with

[19] This is consistent with earlier studies, e.g. Lev and Sougiannis (1996).

basic research is substantially higher than that of applied or process R&D. For applied (product modification) R&D, there is generally low technological and commercial uncertainty, given that the related existing products have already passed the market test. For process R&D, there is no commercialization uncertainty, since improvements in production processes are implemented internally, rather than sold to outsiders. We would, therefore, expect the credibility signaling impact of royalty income to be more pronounced for the high uncertainty biotech and drug research, than for R&D in other industrial sectors.

The regressions in Table 7 confirm this conjecture. The coefficient of the interaction between the intensity of royalty income and R&D for biotech and drug companies (3.39) is almost twice as large as the interaction term coefficient of the rest of the sample (1.88). It thus appears that the extent of technology licensing is used by investors particularly where quality signals are needed most—basic research.

[Insert Table 7 About Here]

Our valuation analysis in this and the preceding section thus indicates that: (a) royalty income is a potent source of shareholder value, and (b) the intensity of royalty income serves as a quality signal for the firm's R&D activities. Such considerable valuation relevance of an information item naturally leads to an examination of disclosure issues.

V. **Disclosure Issues**

Despite the above documented value-relevance of royalty income and aggregated data indicating a constant increase in the volume of patent licensing, our sample (Table 2) does not indicate an increase in the number of companies disclosing data on royalty income. In fact, some early disclosers (e.g., Taxes Instruments, Dow Chemicals) stopped reporting royalty income in recent years. In the process of writing this report we have asked via the Web 17 leading companies known to license patents, yet not reporting royalty income to investors, to inform us the amounts of their royalty incomes in the last three years.[20] The uniform answer from all 17 companies was: We don't disclose this item. Motorola provided a typical answer: "Thank you for your interest in Motorola. Motorola does have a revenue stream from royalties, but we do not specifically disclose the amount of royalty income." It is clear from these cases, that some firms intentionally refrain form disclosing this item.[21]

The issue of disclosing royalty income should be viewed within the larger context of the adequacy of financial information about <u>intangible assets</u>. This issue gained considerable momentum in recent years, as evidence on the substantial economic value created by intangible assets accumulates.[22] Indeed, various regulatory bodies have recently conducted extensive examinations of information available to investors, and concluded that information on intangible assets is particularly deficient.

Thus, for example, the main recommendation of the SEC Task Force on "Strengthening Financial Markets: Do Investors Have the Information they Need?" is:

> <u>Create a new framework for supplemental reporting of intangible assets and operating performance measures</u>. We recommend that the SEC…move forward with a framework for voluntary supplemental reporting for intangible assets, operating performance measures and other information that would help investors assess a company's future performance…we anticipate that a dedicated group of experts…would be asked to develop a best practice report for companies interested in adopting enhanced disclosure. (SEC Task Force, 2001, p. 2).

[20] The 17 companies are: IBM, Intel, Texas Instruments, DuPont, Dow Chemicals, Lucent Technologies, Apple Computers, Sun Microsystems, Eli Lily, Motorola, Honeywell, Eastman Kodak, Johnson & Johnson, United Technologies, Human Genome Sciences, and Genzyme Biosurgery. The query website we used is : www.quwire.com.

[21] Given the documented value-relevance of royalty income, the question is: why do some firms refrain from disclosure. We can only speculate about the reasons. Perhaps some managers are concerned that licensing of patents and know-how may be perceived by investors as admitting lack of capabilities to develop internally these patents, or future loss of competitiveness from allowing competitors to use one's technologies. It may also be that some companies experienced a <u>decrease</u> in royalty income and are reluctant to share with investors the "bad news." Finally, it may be that managers are not fully aware of the signaling attribute of royalty income. After all, this is the first study that documents such signaling.

[22] For a review of this evidence, see Lev (2001, ch. 4).

Similarly, the FASB's extensive examination of the voluntary disclosures of six to nine large companies in each of eight industries concluded:

> Although some disclosures were found about unrecognized intangible assets, additional data about those assets would be beneficial because of the importance of intangibles to a company's value. Intangibles include not only those resulting from research and development but also human resources, customer relationships, innovations and others… <u>Companies are encouraged to continue improving their business reporting and to experiment with the types of information disclosed and the manner by which it is disclosed</u> (FASB, 2001 a, p. VI, emphasis ours).

A follow up special report by the FASB (FASB, 2001 b, p. 109) concludes:

> Improved business and financial reporting of the "new economy" will require attention to:
> • Recognition of internally generated intangible assets in financial statements and improved measures of those assets.

This latter report highlights one of the major impediments to improved disclosure about intangibles:

> Companies' inability to identify and inventory intangible assets may be the most significant obstacle to any comprehensive recognition of intangible assets. Managers cannot measure assets they do not, today, identify and manage as assets (FASB, 2001 b, p. XI).

The current concern of regulatory bodies with enhanced disclosure about intangible assets, as well as managers' search for appropriate modes of disclosing properties of intangibles, provide, in our opinion, an opportunity for systematic research on the identification of intangible assets and the measurement of their impact on corporate performance and value, to assist both managers and accounting standard setters. The analysis reported here on patents and technology—major intangible assets in innovative enterprises—and the documented value-relevance of income from the licensing of those assets provides an example of such research. It highlights to managers the importance of royalty income, both as a revenue source and a signal to investors for the strength of the firm's technological capabilities. While managers are undoubtedly aware of the former (the value-relevance of royalties as a source of income), it is doubtful whether they are fully aware of the latter (the signaling aspect of royalties).

For standard setters contemplating improved disclosure about intangibles, our findings suggest a candidate line item in such supplemental disclosure. This is particularly relevant to the SEC—the recipient of the task force report recommending the development of "supplemental reporting for intangible assets." With respect to the FASB's cited above comment that: "Managers cannot measure assets they do not, today, identify and manage as assets," it should be noted that: (a) disclosure of royalty income does not require an asset recognition, and (b) there is no doubt that managers readily have the required information on royalties. We leave open at this stage the question whether firms should be required, or just encouraged to disclose information on royalty income.[23]

VI. **Summary**

The absence of organized markets in intangibles (technology, brands, human resources) has been a major hindrance to their recognition as assets in financial reports, and the disclosure of value-relevant information about these assets. In recent years, however, trade in intellectual property (legally protected intangibles, such as patents and brands) has expanded fast. We have examined in this study various valuation and disclosure issues concerning the major form of intellectual property trade—patent and technology licensing.

Our analyses indicate that: (a) royalties from the licensing of patents are a potent source of shareholder value, and (b) the intensity of royalty income serves as a quality signal for the commercialization potential of the firms' investment in R&D.

[23] The SEC task force (2001) recommends voluntary disclosure, and urges the SEC to create an environment which encourages disclosure about intangibles (e.g., safe-harbor rules for "soft information").

Such broad value-relevance of royalty income should be of interest to managers engaged in the management, valuation and disclosure of intangible assets, and to accounting regulators who are increasingly concerned with the disclosure to investors of information about intangibles.

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Table 1

Industry Composition of Sample Firms [a]

SIC	Industry	Firms	Percent
01	Agricultural Products	2	1.0
10	Metal Mining	1	0.5
13	Oil & Gas Extraction	1	0.5
20	Food & Kindred Products	1	0.5
28	Pharmaceutical or Chemical	63	31.8
30	Rubber & Misc. Plastic	2	1.0
32	Stone, Clay, & Glass Products	5	2.5
33	Primary Metal Industries	2	1.0
34	Fabricated Metal Products	2	1.0
35	Industrial Machinery & Computers	23	11.6
36	Electronic & Other Electrical	28	14.1
37	Transportation Equipment	5	2.5
38	Instruments & Related Products	21	10.6
39	Misc. Manufacturing Industries	2	1.0
48	Communications	1	0.5
50	Wholesale Trade -- Durable Goods	4	2.0
67	Patent Owners & Lessors	11	5.6
73	Software	20	10.1
87	Engineering & Management Services	3	1.5
99	Others	1	0.5
Total		198	100%

a Sample firms were identified by using an automated keyword search of "royalty" and similar terms in annual reports and 10K filings available on *NEXIS* during the period of 1990 – 1998.

Table 2

Sample Summary Statistics

(level variables are in millions of dollars)

Panel A: Firm characteristics [a]

Variable	*All Years*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Number of Firms	198	94	119	139	150	171	180	188	174	152
Mean Sales	1,961	3,063	2,570	2,264	2,099	2,018	1,967	1,442	1,602	1,294
Median Sales	38	94	57	70	62	37	30	28	30	32
Standard deviation	7,844	7,437	7,595	7,249	7,436	7,724	8,259	7,650	8,314	8,777
Mean Total Assets	3,420	4,303	3,683	3,509	3,798	3,175	3,174	2,819	3,204	3,802
Median Total Assets	47	88	70	65	51	34	33	44	45	52
Standard deviation	1,904	13,411	14,260	15,540	19,788	15,646	17,733	20,207	22,758	26,746
Mean Market Capitalization	2,971	2,416	2,750	2,777	2,696	2,705	2,935	2,444	3,289	3,725
Median Market Capitlization	116	68	100	118	140	97	128	148	114	90
Standard deviation	14,784	5,728	7,658	8,726	9,581	9,899	12,319	13,604	19,819	26,088
Return on Equity	0.14	0.16	0.07	0.06	0.03	0.18	0.17	0.21	0.19	0.21
Market-to-Book Ratio	3.87	2.02	2.73	3.06	3.45	3.27	4.15	4.37	5.36	6.29

Panel B: R&D and Royalty Income [a]

Variable	*All Years*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
R&D Expenditure / Sales	0.044	0.041	0.045	0.046	0.046	0.041	0.042	0.040	0.047	0.054
R&D Capital / Book Value [b]	0.331	0.322	0.332	0.354	0.380	0.340	0.353	0.288	0.308	0.297
Royalty / Sales	0.008	0.005	0.006	0.008	0.008	0.006	0.007	0.009	0.009	0.011
Royalty / Earnings	0.140	0.093	0.243	0.314	0.609	0.093	0.114	0.111	0.120	0.114
Royalty / R&D Expenditure	0.170	0.129	0.143	0.164	0.168	0.143	0.158	0.231	0.188	0.209
Royalty / R&D Capital [b]	0.062	0.047	0.052	0.059	0.061	0.050	0.057	0.085	0.077	0.082

Panel C: Spearman [Pearson] Correlation Coefficients [c]

Variable	Royalty Income / Sales		Total Assets		Return on Equity (ROE)	
R&D Intensity	0.356	[0.269]	-0.272	[-0.024]	-0.137	[0.091]
	(0.0001)	(0.0001)	(0.0001)	(0.3503)	(0.0001)	(0.0040)
Royalty Income / Sales			-0.239	[-0.069]	0.019	[-0.002]
			(0.0001)	(0.0453)	(0.6671)	(0.9664)
Total Assets					0.130	[-0.006]
					(0.0001)	(0.8476)

[a] All ratios in Panels A and B are derived by the sum of the corresponding numerator divided by the sum of the corresponding denominator, across all firms with data on royalty income.

[b] Following Chan et al. (1999), R&D capital of year t is estimated as: $\Sigma_{j = 0 \text{ to } 4}$ R&D Expenditure $_{t-j}$ x (1 - 0.2 x j).

[c] The p-value is listed below each correlation coefficient.

Table 3

The Value Relevance of Patent Royalty

Regression Estimates of Stock Price on Book Value, Future Residual Earnings, and Future Royalty Income

(t-values in parentheses)

Panel A: Pooled Sample (1990 - 1998)

Model: $P_{it} = \gamma_0 + \gamma_1 BV_{it} + \gamma_2 PVFAE_{it} + \gamma_3 PVFROY_{it} + \psi_{it}$

	Intercept	BV_{it}	$PVFAE_{it}$	$PVFROY_{it}$	Adj. R^2
5% per annum growth of royalty income	7.685 (9.816)	1.484 (13.67)	0.542 (5.832)	1.226 (8.064)	0.54
H_0: $PVFROY_{it} = PVFAE_{it}$		Chi-square statistic = 27.023 (significance level = 0.001)			
0% per annum growth of royalty income	7.777 (10.009)	1.482 (13.849)	0.544 (5.851)	1.348 (8.222)	0.54
H_0: $PVFROY_{it} = PVFAE_{it}$		Chi-square statistic = 32.993 (significance level = 0.001)			

Panel B: Nine Separate Year Regressions (1990 - 1998) [a]

	Intercept	BV_{it}	$PVFAE_{it}$	$PVFROY_{it}$
Mean Coefficient	6.765	1.543	0.623	1.427
Number of Coefficient > 0	9	9	9	9
Number of t-Statistics > 1.65	9	9	9	8
Z_1	9.454	16.776	8.531	10.431
Z_2	8.632	8.592	10.788	6.065

[a] Results in this panel are based on the regression assuming an annual growth rate of 0% for future patent royalty.

P_{it} is the stock price three months after fiscal year-end of year t, BV_{it} is the book value of equity at fiscal year-end, $PVFAE_{it}$ is the present value of future residual earnings, minus expected patent royalty, and $PVFROY_{it}$ is the present value of expected royalty income (calculated by using reported patent royalty of year t and an assumed future growth rate of 5% and 0%, respectively). All independent variables are deflated by the number of shares outstanding at the end of fiscal year. Reported t-statistics are based on White (1980) standard errors.

$$Z_1 = (1/\sqrt{T}) \sum_{j=1}^{T} (t_j / \sqrt{k_j/(k_j - 2)}).$$

$$Z_2 = \text{mean t-statistic} / (\text{standard deviation of t-statistics} / \sqrt{T-1}).$$

Table 4

The Value Relevance of Patent Royalty

Regression Estimates of Price-to-Book Ratio on Future Residual Earnings and Future Royalty Income

(t-values in parentheses)

Panel A: Pooled Sample (1990 - 1998)

Model: $P/B_{it} = \gamma_0 + \gamma_1 PVFAE_{it} + \gamma_2 PVFROY_{it} + \psi_{it}$

	Intercept	$PVFAE_{it}$	$PVFROY_{it}$	Adj. R^2
5% per annum growth of royalty income	3.674	0.333	1.087	0.17
	(17.140)	(2.410)	(4.438)	
H_0: $PVFROY_{it} = PVFAE_{it}$	Chi-square statistic = 9.152 (significance level = 0.003)			
0% per annum growth of royalty income	3.734	0.329	1.133	0.16
	(17.366)	(2.366)	(4.357)	
H_0: $PVFROY_{it} = PVFAE_{it}$	Chi-square statistic = 7.906 (significance level = 0.005)			

Panel B: Nine Separate Year Regressions (1990 - 1998) [a]

	Intercept	$PVFAE_{it}$	$PVFROY_{it}$
Mean Coefficient	3.469	0.404	1.529
Number of Coefficient > 0	9	9	9
Number of t-Statistics > 1.65	9	6	8
Z_1	21.340	5.151	10.222
Z_2	8.119	4.544	5.589

[a] Results in this panel are based on the regression assuming an annual growth rate of 0% for future patent royalty.

P_{it} is the stock price three months after fiscal year-end of year t, B_{it} is the book value of equity at fiscal year-end, $PVFAE_{it}$ is the present value of future residual earnings, minus expected patent royalty, and $PVFROY_{it}$ is the present value of expected royalty income (calculated by using reported patent royalty of year t and an assumed future growth rate of 5% and 0%, respectively). All independent variables are deflated by the book value of equity at fiscal year-end. Reported t-statistics are based on White (1980) standard errors.

$Z_1 = (1/\sqrt{T})\sum_{j=1}^{T}(t_j/\sqrt{k_j/(k_j-2)})$.

$Z_2 =$ mean t-statistic / (standard deviation of t-statistics $/\sqrt{T-1}$).

Table 5
Patent Royalty and R&D

Regression of Stock Price on Book Value, Future Residual Earnings, and Estimates of Future Royalty Income and R&D
(t-values in parentheses)

Model: $P_{it} = \gamma_0 + \gamma_1 BV_{it} + \gamma_2 PVFAE_{it} + \gamma_3 PVFROY_{it} + \gamma_4 PVFRD_{it} + \gamma_5 Roy\_Int_{it} \times PVFRD_{it} + \psi_{it}$

Intercept	BV_{it}	$PVFAE_{it}$	$PVFROY_{it}$	$PVFRD_{it}$	$Roy\_Int_{it} \times PVFRD_{it}$	Adj. R^2
5.924 (6.656)	1.365 (12.636)	0.619 (6.651)	1.201 (8.169)	0.195 (3.823)		0.56
H_0: $PVFROY_{it} = PVFAE_{it}$		Chi-square statistic = 27.723 (significance level = 0.001)				
5.258 (5.569)	1.439 (12.623)	0.643 (6.492)	1.033 (7.327)	0.137 (2.371)	2.154 (2.491)	0.56
H_0: $PVFROY_{it} = PVFAE_{it}$		Chi-square statistic = 8.286 (significance level = 0.005)				

P_{it} is the stock price three months after fiscal year-end of year t, BV_{it} is the book value of equity at fiscal year-end, $PVFAE_{it}$ is the present value of future abnormal earnings, $PVFROY_{it}$ is the present value of expected royalty income, $PVFRD_{it}$ is the present value of expected R&D expenditures, and Roy_Int_{it} is the current royalty to sales ratio. All independent variables are deflated by number of shares outstanding at the end of fiscal year. Reported t-statistics are based on White (1980) standard errors.

Table 6

Patent Royalty and R&D

Regression of Price-to-Book Ratio on Future Residual Earnings and Estimates of Future Royalty Income and R&D

(t-values in parentheses)

Model: $P/B_{it} = \gamma_0 + \gamma_1 PVFAE_{it} + \gamma_2 PVFROY_{it} + \gamma_3 PVFRD_{it} + \gamma_4 Roy\_Int_{it} \times PVFRD_{it} + \psi_{it}$

	Intercept	$PVFAE_{it}$	$PVFROY_{it}$	$PVFRD_{it}$	$Roy\_Int_{it} \times PVFRD_{it}$	Adj. R^2
	3.621 (17.661)	0.314 (1.903)	1.032 (3.724)	0.037 (2.773)		0.17
H_0: $PVFROY_{it} = PVFAE_{it}$	Chi-square statistic = 9.711 (significance level = 0.001)					
	3.361 (17.061)	0.329 (2.921)	0.972 (3.574)	0.025 (2.582)	0.981 (2.264)	0.19
H_0: $PVFROY_{it} = PVFAE_{it}$	Chi-square statistic = 6.595 (significance level = 0.01)					

P_{it} is the stock price three months after fiscal year-end of year t, B_{it} is the book value of equity at fiscal year-end, $PVFAE_{it}$ is the present value of future abnormal earnings, $PVFROY_{it}$ is the present value of expected royalty income, $PVFRD_{it}$ is the present value of expected R&D expenditures, and Roy_Int_{it} is the current royalty to sales ratio. All independent variables are deflated by book value of equity at the end of fiscal year. Reported t-statistics are based on White (1980) standard errors.

Table 7

Patent Royalty and R&D: Industry Perspective

Regression of Stock Price on Book Value, Future Residual Earnings, and Estimates of Future Royalty Income and R&D

(t-values in parentheses)

Model: $P_{it} = \gamma_0 + \gamma_1 BV_{it} + \gamma_2 PVFAE_{it} + \gamma_3 PVFROY_{it} + \gamma_4 PVFRD_{it} + \gamma_5 Roy\_Int_{it} \times PVFRD_{it} + \psi_{it}$

Intercept	BV_{it}	$PVFAE_{it}$	$PVFROY_{it}$	$PVFRD_{it}$	Roy_Int_{it} x $PVFRD_{it}$	Adj. R^2
Biotechnology and pharmaceuticals (SIC = 28)						
5.946	1.824	0.515	1.055	0.076	3.390	0.66
(4.557)	(12.938)	(3.731)	(5.169)	(2.046)	(2.024)	
All others						
6.020	1.130	0.714	1.188	0.039	1.879	0.49
(5.356)	(7.291)	(5.407)	(3.589)	(0.315)	(1.848)	

P_{it} is the stock price three months after fiscal year-end of year t, BV_{it} is the book value of equity at fiscal year-end, $PVFAE_{it}$ is the present value of future abnormal earnings, $PVFROY_{it}$ is the present value of expected royalty income, $PVFRD_{it}$ is the present value of expected R&D expenditures, and Roy_Int_{it} is the current royalty to sales ratio. All independent variables are deflated by number of shares outstanding at the end of fiscal year. Reported t-statistics are based on White (1980) standard errors.