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I. Accounting for What?

Accurate financial accounting data are neither inherently right nor wrong, they are only more or less useful for the questions that people want answered. Some questions involve "agency" issues in which shareholders and other interested parties seek to monitor or understand the actions of the managers who run the firm. The monitoring objective has inclined accounting principles toward a conservatism that stresses accuracy in valuation and relies on data generated by arms-length market transactions. One consequence of this conservatism is that the billions of dollars companies spend on R&D and brand development are treated as current expenses by their accountants largely because there are no market-mediated transactions to measure the value of the output created within the company. However, the current success of many companies and their prospects for the future depend on their ability to develop and market products, and not just the ability to manufacture them. Portraying the product development process only as a current expense without recognizing its contribution to future value conceals much of what makes a company successful.

The "market value to book value puzzle" is one reflection of this problem. Successful investments in product innovation create future profits and, in a "perfect" stock market, the discounted present value of these expected profits determines the current value of a company's shares. The puzzle is that the equity implied by the ownership of shares significantly exceeds the book value of shareholder equity appearing on corporate balance sheets. Lev (2001) reports that the average market-to-book ratio for the companies of the S&P 500 index ranged from around 2.0 to 3.5 in the period 1990-1995, and increased to the 3.5-7.5 range during the “tech boom” period 1996-2000.

This gap is too large to be attributed solely to the mismeasurement of conventional equity or to the vicissitudes of the stock market. Numerous observers, including Lev, have pointed to absence of intangibles from corporate balance sheets as one source of the puzzle, and suggested that the gap would be greatly narrowed if intangible assets were added to the accounts.[1] Recent estimates by Corrado, Hulten, and Sichel (CHS (2005, 2006)) suggest that there were approximately $3.6 trillion in intangible assets in the U.S. nonfarm business sector in the period 2000-2003.[2] Whether or not the impact of adding assets of this magnitude to corporate balance sheets would explain a significant portion of the market-to-book valuation puzzle is the question examined in this paper.

We approach the problem by applying procedures similar to those used by CHS to financial data for 617 R&D-intensive corporations complied by Standard and Poor’s in its Compustat database. We construct estimates of “own” investment in R&D and organizational capital using data for the period from 1988 to 2006, and then estimate the corresponding stocks in current prices. We find that the addition of these intangibles to the conventional financial accounts of these companies increases shareholder equity by 141 percent and total assets by 61 percent in 2006, and that the earnings per share increase from an average of $2.68 to $3.98.

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[1] A growing literature exists on the problem of accounting for intangible assets and for the valuation of intangibles in the stock market. Important overviews are provided by Lev (2001) and Blair and Waldman (2001). The literature on the economics of intangibles is reviewed in Corrado, Hulten, and Sichel (2005, 2006), and in the introductory comments of Corrado, Haltiwanger, and Sichel (2005).

[2] Though this estimate covers both corporate and noncorporate companies, much of it belongs to the former. Corporations accounted for some three-quarters of total private non-residential fixed capital during this period, according to BEA estimates (see Katz and Herman (1997) and published BEA data).

These estimates allow us to carry out a sources-of-valuation analysis in which the increase in shareholder equity is seen to explain a significant portion of the market value versus book value puzzle. We find that the 2006 market-to-book ratio for the companies in our sample is 3.2 when intangibles are ignored, implying that conventionally defined equity explains 31 percent of market capitalization. When intangible capital is added to the balance sheets, the 2006 market-to-book ratio falls to 1.3 and augmented shareholder equity now explains 75 percent of stock market valuation. This finding suggests that intangibles are, in a sense, the missing link between financial accounting and financial valuation.

The following sections of this paper describe the details underlying these estimates. We start with the case of a representative company in one year, as a concrete illustration of the issues involved in capitalizing internally produced intangibles. We then move to a parallel analysis of the universe of R&D-intensive companies included in the S&P database. Finally, we use our data to examine the correlation between our intangible capital stocks and market valuation to establish that intangibles are, indeed, capital.

II. The Case of a Representative R&D-Intensive Company

A. Revenue With and Without Intangibles

The problems associated with recognizing intangibles are illustrated by the case of a pharmaceutical company, call it PHARMA, operating in one of the most R&D-intensive industries of the U.S. economy.[3] According to the composite annual financial statements, PHARMA revenues totaled $29.6 billion in 2006, the cost of goods sold was $6.4 billion, and R&D and sales and administrative expenses (SG&A) totaled $13.7 billion, or nearly half of total sales. After depreciation of $1.9 billion, taxes, and other adjustments, after-tax income was $5.5 billion and earnings per share (EPS) amounted to $2.03. PHARMA reported total assets of $50.9 billion on its balance sheet in 2006, of which property, plant and equipment accounted for $10.1 billion. These data are shown in summary form in Tables 1 and 2, in the first column labeled “10k”.[4]

This is the standard version of PHARMA’s 2006 financial report, one that follows the convention that “own” R&D expenditures are treated as a current expense and subtracted from the top line sales figure. The proposal to capitalize R&D involves a change to conventional practice in which R&D is viewed as an investment in the future

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[3] PHARMA is a composite of six of the largest companies in the U.S. pharmaceutical industry: Abbott Laboratories, the Bristol-Myers Squibb Company, Eli Lilly and Company, Johnson and Johnson, Pfizer Inc., and Wyeth. The financial statements of PHARMA are based on an average of the publicly available income statement and balance sheets of these six companies, supplemented by external estimates and assumptions. This averaging procedure helps attenuate the effects of firm-specific events like mergers and acquisitions, and special items on the financial statements of the individual companies. The name PHARMA is an expository invention of this paper and should not be associated with the Pharmaceutical Research and Manufacturers of America (PhRMA), or any other organization or company.

Other R&D-intensive industries could have been used for expositional purposes, but the pharmaceutical industry was selected for the richness of its publicly available data and its innovation track record. The pharmaceutical industry also illustrates the problem of gestation lags in R&D investment.

[4] We refer to PHARMA as a pharmaceutical company in this paper, but it should be noted that the pharmaceutical segment accounted for 75 percent of total 2006 revenue, while other segments, including other medical and consumer products, accounted for the rest.

of the company and treated on a par with investments in tangible capital, instead of being regarded as a pure cost. This shift involves an expanded concept of "output" and "revenues", and since this is a significant departure from current practice, it is useful to illustrate its rationale with the following thought experiment.

First, suppose that PHARMA were to purchase $10 million in *tangible* capital from another company, for example, a technologically advanced piece of laboratory equipment. The standard economic assumption underlying this purchase is that PHARMA invests up to the point that the $10 million cost of the new equipment is just equal to the discounted present value of the expected future profits created by the investment. The investment is added to the PHARMA balance sheet at its cost of $10 million, under the implicit assumption that cost is a valid proxy for future profits and thus of shareholder value. The $10 million addition is an increment to existing tangible capital, and is amortized over its useful life in the years that follow.

The $10 million tangible capital investment is not treated as an expense by PHARMA before figuring profit. On the other hand, the company that sells the equipment to PHARMA does recognize the cost of producing the investment good as an expense, but it also adds the $10 million sale to its revenues. If the cost is, say, $8 million, it records a before-tax profit of $2 million.

Now suppose that PHARMA contracts with another company, call it R&DCOR, to conduct $10 million in research on its behalf.[5] How does this situation differ from the case of the laboratory equipment? One possibility is that the purchased R&D is an intermediate input to PHARMA's production, that is, an input that is used up like office

[5] As before, R&DCOR is name used only for expositional purposes, and does not correspond to any actual company.

supplies in the year in which they are delivered. However, DiMasi (2001) shows that the gestation period for a drug that makes it through the FDA approval process was 14.2 years during the 1980s and 1990s (3.8 years for the pre-clinical phase, 8.6 for the clinical trials, and 1.8 for the approval phase). This finding is highly inconsistent with the idea that R&D is a direct intermediate input to production, and virtually forces the recognition that R&D expenditures are an investment made with the intent of earning future profits. There is thus no substantive economic difference between the acquisition of tangible laboratory capital and intangible knowledge capital. In both cases, the decision to spend $10 million on acquiring the technology presumes that PHARMA expects $10 million in discounted future profits, with the implication that *both* types of capital belong on PHARMA's balance sheet as assets.

As with the laboratory equipment, the company producing the R&D (R&DCOR) treats the $10 million received from PHARMA as revenue, and allocates $8 million to the cost of producing the R&D and records a $2 million before-tax profit. Moreover, if the financial statements of PHARMA and R&DCOR were combined for reporting purposes, the $10 million R&D transaction would appear as part of the combined revenue of the companies. At the macroeconomic level, the $10 million R&D transaction is treated as investment by the BEA, although not as part of the core GDP accounts.[6]

[6] The "new view" of intangibles as capital has taken hold in the U.S. national accounts with the decision by the Bureau of Economic Analysis (BEA) to capitalize expenditures on software, and with the recent move to create a satellite account for scientific R&D (which will enter the core accounts in 2013 according to current plans (Robins and Moylan (2007)). The United Nation's System of National Accounts has also endorsed the capitalization of R&D.

Both of the preceding scenarios deal with externally purchased technology capital. Consider, now, the following situation in which R&DCOR is actually a subsidiary of PHARMA. R&DCOR produces exactly the same R&D as in the preceding case, which is worth the same $10 million, but now the R&D is internally produced within PHARMA and there is no market transaction to validate the internal flow of value. Under current accounting practice, the $10 million disappears from the revenue line of the income statement, because current practice does not consider the internal production of the R&D to be output. Instead, it is treated as a current expense of $8 million, the cost of the materials and labor used to produce the R&D. The $2 million profit of the independent R&D producer of the preceding case (the return to that company's capital) is suppressed into the overall operating surplus. Thus, while there is no essential economic difference between the last two scenarios, there is a large difference in the way the accounts are organized: the R&D is capitalized when the R&D is produced externally but expensed when it is produced internally.

This hypothetical thought experiment is useful for motivating the changes that need to be introduced into the actual PHARMA financial accounts in order to reflect the value of own-produced R&D capital. By analogy with the thought experiment, PHARMA's R&D costs need to be capitalized and treated both as a capital input and as an implicit output. To do this, the $4.9 billion in current R&D expenses shown on line 6 of Table 1 (the labor and materials used in the internal production of R&D, along with the depreciation and amortization of the capital used in generating the R&D), must be increased by the return to the capital used in producing the R&D (by analogy with the $2 million profit on the independent company in the hypothetical example). The actual magnitude of this return is unknown, and we therefore use an indirect procedure in which total operating surplus is allocated to R&D according to R&D's share in current expenses. This results in an estimate of PHARMA's implicit R&D capital cost of $2.3 billion in 2006, leading to an estimate of the total R&D cost (inclusive of this capital cost) of $7.2 billion, the analogue of the $10 million in the R&DCOR example above.

This is the cost side of the investment, and if PHARMA is "doing its math", the $7.2 billion is also the discounted present value of the amount of profits that it expects to earn over time as a result of its investment. Under the "new view" of intangibles, the $7.2 billion in internally produced R&D is combined with PHARMA's $29.6 billion revenue from goods sold to get a new top-line figure of $36.9 billion in the column labeled "+R&D" in Table 1).

B. The "New" View of Financial Accounting: A Closer Look

A salient characteristic of the $7.2 billion of investment added to the top line is that its value is inferred from its cost. This is the implicit assumption for tangible assets as well, so it is hardly a radical departure from current accounting structure. However, the case of intangibles tends to be complicated by factors like longer gestation lags and greater uncertainty about the expected future income stream. Data cited in Berndt et. al. (2006) show that, on average, only 40 percent of drugs that start the pre-clinical process make it to the clinical stage (the Phase I, II, and III trials of the FDA regulatory process), and only 8 percent of the drugs make it to the market place. Given these odds, much of the $7.2 million R&D investment will disappear before it reaches the point at which it earns a return. A further complication arises from the long approval period associated with drug development noted in DiMasi (2001). Moreover, the average cost of bringing a drug to market is $802 million, and this cost is spread over the lengthy development period (DiMasi, Hansen, and Grabowski (2003)). This estimate includes the time value of money, since investments made in the earlier phases tie up money in the project, and this money has an opportunity cost. About half of the $802 million reflects the time-value-of-money adjustment, and the other half reflects direct program costs.

The survival probabilities and time-value of money issues are presumably factored into the investment decision in such a way that the surviving R&D investment is expected to earn a large enough return to cover the total cost of all projects, both the successful and unsuccessful. However, the total cost should in principle be adjusted for the time value of money and this would exceed the $7.2 billion in direct annual outlays for R&D.[7] Unfortunately, the adjustment depends on the duration and costs of the individual R&D projects underway at PHARMA, and because this information is not publicly available, we make no adjustment but note that our estimate of the annual cost is probably underestimated by a significant amount.

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[7] These issues are also problems for tangibles, but to a lesser degree. For example, structures often take several years to build, from the planning through the construction stages of development, and money is tied up in the investment that imposes an additional cost. And, once completed, the vicissitudes of the market place may not deliver the expected return, and it is the *ex post* results that are actually recorded on a company's books. However, the gestation lags in tangible assets like structures do not pose the same problem as the lags in R&D. The value of the tangible investment is normally recorded at the point at which it is completed and ready for transfer to the buyer. The transaction price thus includes a time-value adjustment in the final cost. R&D investments, on the other hand, are self-constructed by the firm, and what is reported on the financial statement is the cost of the R&D in progress, and not the complete project. There is thus no point at which an actual market-based time-value adjustment is made.

C. Depreciation and Asset Valuation

The stock of plant and equipment is recorded on PHARMA's balance sheet summing past investments and adjusting for depreciation (the so-called "perpetual inventory method"). When R&D investments are capitalized and thereby treated symmetrically with plant and equipment, the same method can be used to estimate the R&D stock. A depreciation adjustment is needed for R&D, because, like plant and equipment, R&D investments lose value over time, and the erosion in value has to be recognized in order to properly measure income.

However, the depreciation process for R&D capital differs somewhat from the case of tangible investment. The latter is subject to a loss in value from wear, tear, and accident, or because of obsolescence due to competition from the development of superior types of capital *input*. R&D capital, on the other hand, is more closely tied to the output it generates, and is therefore subject to obsolescence due to competition from new types of *output* with superior characteristics or with similar characteristics delivered at a lower cost. Moreover, there is another dimension not shared with tangible capital. R&D knowledge is largely a non-rival public good whose benefits can accrue to other users without diminishing the *quantity* available to the originator. The *value* of the R&D to the originator, on the other hand, is limited to the commercial value that can be extracted from the investment. If the knowledge diffuses to competitors, that value is eroded as competition leads to lower product prices. Some degree of protection to the originator is promoted, but not assured, by copyrights and patents, and by secrecy, but diffusion almost always occurs at some point, and this leads to the deprecation in the original cost of the investment.

The rate of depreciation of PHARMA's R&D is thus tied to the commercial life cycle of the products developed from its R&D programs. The erosion in value over time is therefore hard to summarize in a single estimate. Unfortunately, the externally available information is such that a single rate (or useful life) is all that is currently feasible. Not surprisingly, the literature on this subject has produced a broad range of estimates that vary from around 10 percent to around 25 percent (CHS (2006), Mead (2007)). The recent study by Hall (2007) suggests that the range of uncertainty could be even wider.

Faced with this problem, we somewhat arbitrarily select a procedure near the midpoint of the range in the literature, and amortize each investment dollar (as it is spent) over a ten-year average life, using a pattern that declines slowly in the early years of the period and accelerates at the end. This amortization assumption results in an estimated stock of R&D capital of $38.6 billion (column 2, line 9 of Table 2). This is the expected *commercial* value to PHARMA of its R&D stock.

The amortization of the R&D stock is reflected on the adjusted income statement of Table 1 as an additional depreciation charge of $3.2 billion (column 2, line 11). This offsets some of the $7.2 billion increase in "revenue" and results in before-tax income of $10.9 billion (line 15). Taxes are assumed to be unaffected when R&D is capitalized (that is, R&D is assumed to be expensed for tax purposes), so after-tax income on line 17 is now $9.5 billion. This is a 73 percent increase over the conventional accounting after-tax income. Earnings per share increase from $2.03, the amount without the adjustment for R&D, to $3.52 when R&D is capitalized.[8]

The assumption of a 10-year write-off period is, at best, a guess based on the bits of econometric evidence in the literature on R&D, and may not apply to the case of PHARMA. For one thing, it implies that *all* of the value of an investment from any year is gone after 10 years, and this is not consistent with the data on project survival. As a robustness check, we applied the perpetual inventory method to our investment data with a 20-year write-off period rather than the 10-year life above. This alternative amortization assumption results in an estimated stock of R&D capital of $55.2 billion, some $16 billion greater than the previous estimate. Changes of this magnitude indicate that the estimates of Table 1 and 2 clearly depend on the magnitude of this uncertain parameter.

The perpetual inventory method also requires an adjustment for changes in the price level over time. R&D investments from past years are initially recorded in the historical prices of the years in which they were made, and, as prices change, the historical investment needs to be expressed in the common prices in order to insure comparability (that of the year in which the stock of R&D is to be valued). The price deflator used by BEA in its R&D satellite account was used for this purpose (see Robbins and Moylan (2007)). Unfortunately, current accounting practice does not allow for systematic revaluation of prices for tangible assets in the balance sheet, so we make no adjustment to the estimates reported in Table 2. However, we note that BEA

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[8] It is important to note, here, that capitalizing intangibles does not necessarily increase after-tax incomes and EPS. In companies where R&D programs are in decline relative to historical levels, the amortization cost of past investments may exceed the amount added to the top line from current expenditures. In this situation, EPS may be reduced relative to current practice when intangibles are capitalized (see Lev (2001)).

estimates from their Fixed Asset Tables suggest that the current value of the fixed assets used in the U.S. corporate business sector in 2006 (non-residential structures and producers durable equipment) was 50 percent greater than the corresponding historical cost.

D. Organizational and Human Assets

R&D is not the only type of intangible expenditure associated with the innovation process. Pharmaceutical companies like PHARMA have large marketing budgets designed, in part, to launch new products. New drugs typically take time and effort to penetrate the market place, and some part of the marketing expenditure is a necessary coinvestment made in order to recoup the substantial up-front costs of product R&D. PHARMA spent $1.6 billion on advertising in 2006, and this is only part of total marketing expenses.[9] These expenditures help establish a new drug in the market place, and, once established, the resulting brand equity is an asset to the firm. By implication, some fraction of these marketing expenditures should therefore be accorded the same treatment as R&D investment.[10]

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9 This estimate is based on the four companies for which 2006 advertising spending was available: Bristol-Myers Squibb, Johnson and Johnson, Pfizer, and Wyeth.

10 This argument contrasts with the popular view that the marketing expenditures of pharmaceutical companies like PHARMA are unproductive and merely serve to drive up the cost of drugs to the consumer. This rent-seeking view implicitly assumes that a good drug will sell itself, implying a rapid and costless dissemination of information. In fact, the up-take of new drugs is often far from rapid even when they turn out to be highly efficacious, despite considerable marketing efforts by the drug companies. The rationale for capitalizing some fraction of the marketing expenditures is based on the idea that a company will not undertake the cost to bring a new drug to market (recall the $802 million estimate of DiMasi, Hansen, and Grabowski (2003)), unless there is the prospect of selling enough of the drug to cover the cost. Seen in this way, the marketing of a new drug is part of the innovation process.

PHARMA also invests in organizational development (e.g., strategic planning, new management systems) and worker training. Brynjolfsson, Hitt, and Yang (2000, 2002) and Brynjolfsson and Hitt (2005) note that much of the boom in IT spending was linked to organizational development, as a coinvestment to other organizational expenditures.[11] Bloom and van Reenan (2006) also establish a link between management effectiveness and stock market value, and a number of papers do the same for worker training (see Bassi et. al. (2002), and Black and Lynch (2005) for further discussion).

Because direct estimates are not available on the financial statements, we have taken the CHS estimates and translated the approximate proportions of brand equity and organizational development into a corresponding fraction of SG&A spending. We thus impute about 30 percent of PHARMA's total SG&A outlays in 2006 to capital investment, and the rest for current operations. When adjusted for profits (the same rationale as for R&D), this procedure results in a further addition to PHARMA's top line of $4.1 billion, and leads to a total adjusted revenue of $41.0 billion. These estimates are shown in the last column of Table 1 (labeled "+ ORG K").

As with R&D, the investment portion of SG&A adds to the existing stock of organizational capital, which is composed of the cost of past annual investments adjusted for depreciation. Depreciation arises because the capitalized value of marketing expenditures loses value when new goods appear in the market place or the marketing programs of competitors cut into brand equity; training investments erode

[11] For the nonfarm business sector as a whole, CHS estimate that the value of brand equity was $161 billion in 2003, and $425 billion for the other forms of organizational capital.

with worker attrition and with the adoption of new products, processes, and market strategies; management competencies erode for many of the same reasons. The different types of intangibles undoubtedly depreciate at different rates, and there is a debate over the appropriate treatment of depreciation for each element (CHS (2006)).

There is also little information on how PHARMA's SG&A is split between elements other than advertising, so we adopt the simple assumption (based on CHS) that each investment dollar is amortized over a six year period, again using a pattern that declines slowly in the early years of the period and accelerates at the end. This results in an estimated stock of organizational capital of $16.3 billion (column 3, line 10 of Table 2). This estimate has been adjusted for price inflation using a BEA price deflator and is thus expressed in the current prices of 2006.

The combined value of "own" R&D and organizational capital shown in Table 2 is $54.9 billion, compared to total conventional "10k" assets of $50.9 billion and only $10.1 billion in plant and equipment. And, this comparison is somewhat misleading because the conventional "10k" assets include $16.7 billion in purchased intangibles and goodwill, bringing the total value of PHARMA's intangible assets to $71.6 billion, or 68 percent of all assets (including intangibles). Moreover, when current and other long-term assets are subtracted from the total assets to arrive at long-run core productive assets, intangibles account for nearly 88 percent of the core asset base. The basic implication of these estimates is that PHARMA is essentially a knowledge-based operation.

The impact of organizational capital can be also seen in the adjusted income statement of Table 1. Capitalizing a fraction of SG&A expenses further increases

PHARMA's top line by $4.1 billion (column 3, line 3 of Table 1). Total depreciation/amortization is also increased by $3.5 billion, resulting in an adjusted after-tax income of $10.1 billion. This estimate leads to an increase in Table 1 EPS from $2.03 without capitalization to $3.74 when all intangibles are taken into account.

E. A Decomposition of the Sources of PHARMA's Market Valuation

This "new view" of intangibles involves significant guesswork, but it nevertheless provides a more complete account of the factors driving the market value of the company. According to the Compustat data shown in Table 2 on line 13, the stock market value of PHARMA averaged $102.9 billion in 2006. This figure greatly exceeds the reported shareholder equity of $26.7 billion (column 1, line 12 of Table 2), a figure that excludes the intangibles developed within the company. The size of the gap can be measured by Tobin's average "q", the ratio of the stock market value to the book value of equity, or its inverse, which indicates the fraction of the stock market values explained by the accounting measure of shareholder equity. These metrics are shown in lines 18 and 19 of Table 2, and they reveal that the traditional "10k" measure of shareholder equity explains only 26 percent of PHARMA's stock market value.

Conventional accounting practice implicitly regards this gap as a combination of goodwill and identifiable intangibles and, when a company is sold, the gap between the price paid and the book value of equity has to be accounted for on the acquiring company's books. A different approach has been taken in this paper. Rather than viewing the valuation gap as arising from intangibles and goodwill *a priori*, we attempt to fill the gap with our independent estimates of the company's intangibles. Following this approach, we are able to explain a large portion of the gap, since shareholder equity inclusive of our intangibles jumps to $81.6 billion, a figure far closer to the stock market's appraisal of the company. The corresponding measure of Tobin's "q" falls to 1.26 and shareholder equity now explains 79 percent of PHARMA's stock market value in 2006.[12]

A look at Figure 1 shows that this result is not unique to the year 2006. It is apparent that "own" intangibles have played an important role in explaining the market-to–book puzzle over the entire decade from 1997 to 2006, and that the importance of intangibles in explaining the gap grows over the course of that period.

Some part of the remaining valuation gap may reflect the volatility of the stock market, with its episodes of exuberance and pessimism evident in Figure 1. Another part of the gap may reflect innovation rents earned by PHARMA over this period. PHARMA represents the case of the highly successful innovator and one aspect of its success is the ability to identify drug discovery programs that generate *ex post* super-normal profits above the *ex ante* expectations embodied in the development costs. Recall, however, that the probability of developing a successful drug is quite low, and a sampling of the less successful ventures that populate the industry would tend to show the opposite pattern. An analysis of the successful innovators will tend to generate an

[12] This result can be portrayed in a different way. The average rate of return to equity, r_e, is equal to Tobin's "q" times the inverse of the price/earnings ratio (the implied average rate of return to shareholder equity). The r_e for the conventional case is 21 percent, and 12 percent when intangibles are included. A hybrid version of r_e is also interesting, since it sheds light on the intermediate case in which the asset base is expanded to account for intangible capital, but only the conventional after-tax income derived from sales and other current income is counted. This version of r_e is only 7 percent, implying a significantly lower "conventional" rate of return when all of the relevant capital is counted.

upward bias relative to the industry average in the gap between the stock market valuation and cost-based estimates of the value of intangibles.

Some part of the observed gap may also be due to systematic errors in the way the variables are measured. We have already noted that the $10.1 billion in tangible assets on the corporate balance sheet are (largely) valued at historical prices, that is, the price in the years that the asset was built or acquired, and the price inflation occurring over the years after the original investment is therefore not taken into account. This can lead to an understatement of the current value of an asset (particularly for structures, which have long service lives). The BEA estimate of a 50 percent inflation factor for nonresidential business plant and equipment suggests that $5 billion would be added to the balance sheet on line 2 if that ratio were applied to PHARMA's plant and equipment in 2006, with a corresponding reduction in the gap.

Other errors undoubtedly arise from our assumption about the amortization of intangibles, given the range of uncertainty about the appropriate depreciation pattern. We previously noted that the 10-year write-off period for R&D investments may be too short, and that a 20-write-off period leads to an estimate of $55.2 billion for the R&D stock, $16.6 billion larger than the figure recorded in Table 2. This, too, contributes to explaining the gap, as does another measurement factor, the absence of a time-value-of money adjustment is almost certainly the biggest single bias in the estimates. The DiMasi estimate suggests that, for successful projects, the total cost (including the time-value adjustment) is twice the direct cost. However, if only eight percent of the projects are successful, this multiplier is much smaller for the average project. If we use 20 percent as the appropriate multiplier for PHARMA, and apply it to the higher $55.2 billion for the R&D stock, the additional write-up in value is $11 billion.

The sum of these three factors adds up to $32.6 billion ($5.0+$16.6+$11 billion). Collectively, they explain more than the remaining valuation gap of $21.3 billion. This overshoot could signal an error in the preceding adjustments. However, the excess valuation also reflects the average stock market performance of the component companies of PHARMA since 2001, which Figure 1 reveals to be relatively flat. This pattern reflects a variety of factors not related to the cost of the R&D and marketing programs, and might signal a period of market pessimism.

Other sources of error may bias the results in the opposite direction, like the fraction of SG&A considered as a capital expenditure and the method used to impute a share of overall operating surplus to R&D and organizational capital. But, however imprecise these estimates are, and they certainly are imprecise, it seems reasonable to conclude that own-produced intangible investments are potentially a very important factor in explaining the valuation of PHARMA.

F. Pros and Cons of the New View

Neither the "old" nor "new" view of the income statement is inherently correct. The rationale for the current practice of excluding intangibles from the top line is that it monitors the success of the firm at selling its products, and that an accurate measure of the annual sales provides important *ex post* information about this success, as do the corresponding *ex post* profits. Adding $11.4 billion in prospective future value to actual sales in Table 1, or $4.6 billion to after-tax profits, does not help illuminate the question of how well the company's products are selling in the current year, and may actually obscure this issue. Moreover, any advantages of the "new view" estimates must be weighed against the fact that they are based on imputations rather than on market transactions, and that the value of intangible investments are inferred from its cost.

On the other hand, the practice of treating R&D only as an expense can obscure a company's true long-run position in its market. For example, many start-up biotechnology companies spend millions of dollars developing a new drug and go many years without earning significant revenues. Some of these start-ups are successful and develop into very profitable companies based on their R&D programs, but none of this success is anticipated by current accounting practice. Including the very investments that lay the foundation for a technology company's future success provides a better *ex ante* view of its prospects, however imperfect this view is.

Moreover, if a more mature company wants to give the appearance of good economic health during rough times, the company can increase its current profits by cutting its R&D expenses.[13] In the case of Table 1, if the entire $4.9 billion current R&D cost were eliminated, conventionally reported before-tax income would increase by this amount and, assuming an unchanged average tax rate, 2006 EPS would jump from $2.03 to $2.74. However, this strategy does not work when R&D is capitalized, because EPS actually fall from $3.14 to $2.94 when current R&D is zeroed out. This

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[13] The success of this strategy requires that the financial markets do not recognize the loss in future value, if any, associated with a reduction in investment in R&D. Lev (2001, 2003) and Bassi et. al. (2004) argue that this tends to be the case, with the implication that current accounting practice creates a disincentive for investment in R&D and other expensed intangibles.

occurs because more is lost from the top line than is offset by a reduction in current cost, so that operating surplus falls (line 9 in Table 1) while the amortization costs from past R&D (line 11) must still be deducted in arriving at before-tax income. Thus, intangible-adjusted EPS may present a more accurate view of the firm's long-run position in its market than current EPS.

III. A Broader Look at Corporate Financial Accounting with Intangibles

The case of PHARMA may be instructive, but is it representative? After all, PHARMA is a collection of the more successful companies in the U.S. economy. Are intangible assets as important for other companies as they are for PHARMA? To answer this question, we extracted a sample of U.S. corporations from the Compustat database and constructed tables for this sample that parallel the items in Tables 1 and 2.[14] The estimates cross many industries, but the 617 companies in our sample are only a small fraction of the universe of 9885 in our Compustat database.

The companies in our sample are those for which R&D and SG&A expenditures are available for most of the 19 years covered by our data (1988-2006). By restricting our sample to firms with a continuous record of reported R&D spending, we censor the larger sample in a way that biases our results in favor of intangibles.   Around 60 percent of the companies in the 617 sample come from just six of the 41 two-digit

[14] The Compustat data are derived from company financial statements, adjusted to harmonize them across companies (thus, they do not necessary match the data on the company reports). There are well-known risks in using these data for time-series and cross-sectional comparisons (see Hall (2007)). Accounting rules change over time, and merger and acquisitions (and spinoffs) occur that can greatly affect the income statements and balance sheets of a company. Comparisons over time, as well as the perpetual inventory estimates of the R&D and organizational capital stocks, must be interpreted with these caveats in mind.

industries and include the largest R&D performers.[15] It is therefore not surprising that the estimates in Tables 3 and 4 show a roughly comparable pattern to those for PHARMA in Tables 1 and 2. The fraction of PHARMA's market valuation explained by equity alone was 26 versus 31 percent, and this changes to 79 versus 75 percent when own intangibles are counted.

Intangibles are clearly a large fraction of market valuation in both cases. A look at Figures 1 and 2 shows that the time series patterns are similar, but with PHARMA showing more unexplained residual market valuation. Notice, however, that the "tech wreck" following the boom of the late 1990s was more attenuated for PHARMA than for these other companies.

These estimates refer to the corporate sector of the U.S. economy (indeed, only a segment of this sector), and are therefore not directly comparable to the CHS estimates for the entire nonfarm business sector, which includes noncorporate companies.[16] The CHS study also includes the category "non-scientific" R&D as part of intellectual property.[17] But, despite these differences, it is worth noting that the 2006

[15] To check the difference between the 617 R&D-intensive companies and the rest, we constructed the equivalent to Tables 3 and 4 for the entire sample less those companies. A comparison of these tables with the estimates of Tables 3 and 4 indicate the 617 firms with a complete record are far more intangible-intensive relative to plant and equipment. One problem with this comparison is that missing data in the latter sample were assigned a zero, whereas the few cases of missing data in the 617 firm sample were interpolated. The problem of missing data is the principal reason that we do not analyze the complete sample in this paper.

[16] The CHS estimates refer to the value of assets in the U.S. non-farm business sector in current prices for the year 2003. Moreover, the estimates of the book value of assets and equity in this study are in historical prices.

[17] Non-scientific R&D includes research on new types of financial products, architecture designs, motion picture development, and other non-laboratory types of research. CHS estimate the amounts to a larger sum, $237.2 billion in 2000-2003, than the traditional scientific variety, $230.5 billion. It is unclear how much of the R&D spending reported on company financial statements includes non-scientific R&D, but much is probably omitted. If so, the estimate of the own intangibles in the 617 firm sample may be biased downward, and this may be true, to a lesser extent, for PHARMA as well.

investment rate in intangibles (the share of intangibles in sales) is very close to the investment rate report by CHS (12.7 percent here versus the CHS rate of 11.8 percent for GDP and 15.5 percent for value added (not sales) in the business sector). When non-scientific R&D is removed from this last estimate, the investment rate falls to 12.5 percent. The similarity of the results from the two approaches reinforces the case that intangibles are an important source of value, but, at the same time, it should be recalled that the stock of SG&A was based, in part, on a proportion derived from the CHS study.

IV. Are Intangibles Really Capital Assets?

The estimates presented thus far have assumed that R&D and a portion of SG&A should be treated as a capital expenditure. We have already noted earlier in this paper that the long gestation periods for the R&D programs of the pharmaceutical industry virtually force the conclusion that they should be regarded as capital investments, and this conclusion is reinforced by the body of evidence linking intangibles to company valuation and productivity. This literature includes studies relating R&D to market valuation (e.g., Hall (1993), Hall and Hall (1993), Lev (2001)); managerial and organizational capital (see Bloom and Van Reenen (2006), Bryjolfsson and Hitt (2005)), advertising (Hall (1993), Ayainian (1983)), and worker training (Abowd et. al. (2005), Bassi et. al. (2004)).

The difficulties in using stock market data to value intangibles are now well known (Hall (2005) provides a cogent overview of the problems). The boom-bust stock market cycle evident in Figure 2 contrasts sharply with the much smoother trends in the intangible stock variables, which are built up from successive investments over the years and therefore do not change rapidly, even in periods where investment spending is volatile.[18] These stocks are measured in terms of their cost, whereas the corresponding stock market valuation is (at best) based on expectations about the future earnings associated with the cost-based stocks. History shows how volatile stock market expectations can be, and any attempt to forge a tight link between the two is subject to misspecification and misinterpretation.

This being said, the S&P data assembled for this paper at least allow us to check for correlations between the key variables. To do this, we further narrowed our sample of R&D-intensive companies to a time-series, cross-section panel of only the 422 companies that have a complete record of *all* data series for the years 1997-2006. This smaller sample excludes those companies in the 617 data set for which some observations had to be extrapolated or interpolated. We then used these data to estimate a model in which the value of a company's shares, $V_{i,t}$, depends on the book value of the company's equity, $E_{i,t}$, the estimated value of its R&D capital, $R_{i,t}$, its organizational capital, $O_{i,t}$, and the average price-earning ratio Z_t of the principal industry to which the company belongs (the latter is included in order to account for shifts in financial market optimism about future earnings). The linear form of this model is

$$V_{i,t} = \alpha + \beta E_{i,t} + \gamma R_{i,t} + \theta O_{i,t} + \lambda Z_{i,t} + \varepsilon_t \qquad (1).$$

[18] Recall, here, that the perpetual inventory estimates of the current stock of capital in this paper are derived by adding the *cost* of this year's investment to last year's capital stock, adjusted for a rate of depreciation that does not vary over time.

Variants of this model are found in the literature linking intangibles to stock market valuation (see, for example, the discussion in Brynjolfsson and Hitt (2005)). Some studies use Tobin's "q" in place of $V_{i,t}$; the tangible capital stock replaces $E_{i,t}$ in others; and various types of intangible stocks or flows are used instead of $R_{i,t}$ and $O_{i,t}$, along with different ancillary variables.

The issue of causality is a potential problem in most of these models (including ours). The causality problem arises because, while lower rates of investment in intangibles may indeed lead to a lower market valuation (the usual interpretation), it may also be the case that a deterioration in business prospects leads both to a lower market valuation and a lower propensity to invest. This direction of causality may arise from a common economy-wide shock to both variables, like a recession. In this regard, it has been noted that R&D investment tends to be pro-cyclical.[19] Or, the problem could arise from firm-specific events in which the diminished (or enhanced) prospects for a company jointly affect its market value and its investment programs.

The narrower objective of this paper is to test the current accounting practice versus the "new view" that intangibles should be capitalized on financial statements. Current practice assumes that the coefficients of the intangible stocks in equation (1) are zero; in a Hall (2005) zero-rent economy with prefect foresight, no omitted variables, and correctly priced equity, α and λ should be zero and β should equal

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[19] Economic explanations of this pro-cyclical behavior of R&D are discussed in Barlevy (2007). The incentive to cut R&D spending during periods of falling profits because R&D is expensed, noted by Lev (2001) and Bassi et. al. (2004), may contribute to this problem by offering a way to boost EPS in the near term. However, one problem with these explanations is the inherent nature of research programs. They often involve multi-year commitments, witness the DiMasi data on gestation lags in pharmaceutical R&D, and are frequently undertaken in competition with the programs of other firms. Canceling or slowing this sort of R&D program involves more than simply short-run cost considerations.

one. In the world as it stands, with its imperfect information, volatile expectations, mismeasurement, and omitted variables, these parameters can take on a variety of values, and the valuation function may not be linear. However, the key issue is still whether or not coefficients of the intangible variables are significantly different from zero. If they are, the case for capitalizing intangibles is enhanced. On the other hand, if there is no correlation between the stock of intangibles and market value, the case is diminished.

To test these hypotheses, we carried out the regression indicated by the valuation equation, in both its level form, as shown above, and in its natural logarithms (in which case the valuation equation is assumed to be multiplicative). The first column of Table 5 gives the results of imposing the restriction that intangibles do not affect market value. The estimate of β is 3.59 and is statistically significant, indicating that a $1 increase in the book value of equity increases market value by an expected $3.59. The average annual industry price/earning ratio also shows a significant positive effect on valuation. However, the constant term, α, is not statistically significant. Dummy variables for each year are also included as a separate control for general market effects. The R-squared statistic is respectably large.

The next column introduces the two stocks of intangible capital, but omits equity. The results are, again, statistically significant and indicate a large effect, particularly for the stock of organizational capital, providing evidence in favor of the capitalization hypothesis. On the other hand, when equity and intangibles are used together, the estimated coefficients of all variables fall, and that of the stock of organizational capital becomes statistically insignificant though still positive. However, there is a very high correlation between the equity and organizational variables in the data, so it is hard to sort out the separate contributions of the two variables. It is worth recalling, here, that the equity and R&D variables are derived from reported data whereas the organizational capital is imputed as a faction of SG&A.

Much the same pattern is observed in last three columns of Table 5, which report results for the multiplicative form of the valuation equation. The key variables are transformed to the natural log form, with the result that the parameters are now interpreted as elasticities. Equity by itself is again a strong variable, with the magnitude of the coefficient now implying that a one percent change in the amount of equity leads approximately to a one percent change in stock market value. The R&D and organizational capital variables, by themselves, are both strongly significant and their combined coefficients are close to one. Again, when all three variables are included in the regression, all coefficients fall but the sum continues to be close to one. The R-squared statistics in this specification are higher than in the preceding table.

A number of other regressions were run for various separate industries and years, with varying results. Organizational capital is a strong explanatory variable in the chemical and pharmaceuticals industry but has the wrong sign in Instruments. However, the general industry patterns are consistent with the more aggregate Table 5. Combined with evidence from past studies, we interpret our results as lending statistical support to the case for capitalizing intangibles.

V. Concluding Remarks

The estimates of this paper suggest that including "own" intangibles on corporate financial statements leads to a better explanation of the market value of R&D-intensive companies than conventional accounting procedures. These intangibles explain some 40 to 50 percent of the market value of R&D-intensive companies in the U.S., and appear to be a significant factor in explaining the market-to-book-value puzzle. While this evidence must be regarded as somewhat imprecise, imprecisely correct estimates seem far better suited to the fundamental question of company valuation than the precisely incorrect estimates provided by current practice (to paraphrase John Maynard Keynes).

However, the issue of omitted intangibles goes beyond the mechanical problem of adding or modifying data on company financial statements. A company's accounting data are generated by its actual economic performance, and this performance is determined in the long run by the nature and quality of its business model. How the data are organized and reported should ideally reveal the nature of this model and the corresponding organizational structure. Current accounting practice falls short of this ideal because it implicitly portrays the company primarily as a *producer* of goods and services. Mandel (2006) puts his finger on this problem when observes that, while the Apple iPod is made in China, "Where the gizmo is made is immaterial to its popularity. It is great design, technical innovation, and savvy marketing that have helped Apple Computer sell more than 40 million iPods." Mandel goes on to observe that by ignoring the value of Apple's large investments in R&D and marketing, that is, by imposing a pure production function view of Apple, the company is implicitly portrayed as simply a reseller of this phenomenally successful product.

In fact, the modern corporation is most often a complex organization that develops, produces (or, increasingly, arranges for others to produce), and markets a range of products. Characterizing this process in all its complexity goes far beyond the simple production function framework to a more realistic model of the firm of the sort suggested by Penrose (1959). Developing the metrics of this more elaborate description of the firm requires a parallel development in the way a company's performance data are organized and presented. Treating expenditures on product development and organizational capability as investments in a company's future rather than current expenses is an important step in this direction.

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TABLE 1
'NEW VIEW' INCOME STATEMENT[1]
BASED ON SIX COMPANY AVERAGE ("PHARMA")
2006 ($ BILLIONS)

	10k[2]	*+ R&D*[2]	*+ORG K*[2]
1. CONVENTIONAL REVENUE	$29.6	$29.6	$29.6
2. OWN PRODUCTION OF R&D[3]	$0	$7.2	$7.2
3. OWN PRODUCTION OF ORG. CAPITAL[3]	$0	$0	$4.1
4. TOTAL ADJUSTED REVENUE (L1+L2+L3)	$29.6	$36.9	$41.0
5. CONVENTIONAL COST OF REVENUE	$6.4	$6.4	$6.4
6. CURRENT COST R&D[4]	$4.9	$4.9	$4.9
7. CURRENT COST OF SG&A[4]	$8.8	$8.8	$8.8
8. TOTAL CURRENT COST (L5+L6+L7)	$20.2	$20.2	$20.2
9. OPERATING SURPLUS (L4-L8)	$9.5	$16.7	$20.8
10. DEPRECIATION ALREADY ACCOUNTED FOR[5]	$1.9	$1.9	$1.9
11. AMORTIZATION OF OWN R&D[6]	$0.0	$3.2	$3.2
12. AMORTIZATION OF OWN ORG. CAPITAL[6]	$0.0	$0.0	$3.5
13. ADJ. OPERATING SUPLUS (L9-L10-L11-L12)	$7.6	$11.6	$12.2
14. NET INTEREST AND OTHER ADJUSTMENTS	-$0.7	- $0.7	-$0.7
15. BEFORE-TAX INCOME (L13-L14)	$6.9	$10.9	$11.5
16. INCOME TAX PAID[7]	$1.5	$1.5	$1.5
17. AFTER-TAX INCOME	$5.5	$9.5	$10.1
18. EARNINGS PER SHARE	$2.03	$3.52	$3.74

Note 1: Based on S&P Compustat data and authors' calculations. Detail may not add up due to rounding error.
Note 2: Column 1, designated "10k", contains conventional financial data from Compustat; Column 2, designated "+R&D", adds R&D data to the data of column 1; Column 3, designated "Org K", adds organizational capital data to column 2.
Note 3: "Own Production of R&D" is shadow value of the investment in R&D made by the company. It is equal to current cost of R&D on line 6, all of which is considered to be a capital expenditure, plus markup for profit (imputed fraction of line 9 attributable to production of R&D). "Own Production of Org. Capital" is shadow value of the investment in organizational capital made by the company. It is equal to approximately 30% of current SG&A costs on line 7, the portion considered to be a capital expenditure, plus markup for profit (imputed fraction of line 9 attributable to production of organizational capital).
Note 4: Current cost of R&D (line 6) and organizational capital (line 7) is the outlay for labor and materials, plus applicable depreciation and amortization. This differs from the shadow values on lines 3 and 4 (see note 3).
Note 5: Conventional Depreciation and amortization are allocated to costs on lines 5 to 7. They are subtracted, here, in order to arrive at net income.
Note 6: The amortization of own R&D and organizational capital arises when these items are capitalized, as in columns 2 and 3. R&D is amortized over a 10 year useful life with a quasi-hyperbolic write-off pattern. Organizational capital is amortized over a 5 year useful life with a quasi-hyperbolic write-off pattern.
Note 7: Assumes that the implicit income from R&D and organizational capital is not taxed.

TABLE 2
'NEW VIEW' ASSET ACCOUNTS[1]
BASED ON SIX COMPANY AVERAGE ("PHARMA")
2006 ($ BILLIONS)

CONVENTIONAL BALANCE SHEET[2]	*10k*[3]	*+ R&D*[3]	*+ ORG K*[3]
1. CURRENT ASSETS	$19.8	$19.8	$19.8
2. PLANT AND EQUIPMENT	$10.1	$10.1	$10.1
3. PURCHASED INTANGIBLES	$8.0	$8.0	$8.0
4. GOODWILL	$8.7	$8.7	$8.7
5. OTHER LONG TERM ASSETS	$4.3	$4.3	$4.3
6. TOTAL ASSETS (L1+L2+L3+L4+L5)	$50.9	$50.9	$50.9
7. TOTAL LIABILTIES	$24.2	$24.2	$24.2
8. EQUITY	$26.7	$26.7	$26.7
ADJUSTMENTS FOR OWN INTANGIBLES	*10k*	*+ R&D*	*+ ORG K*
9. R&D CAPITAL[4]	$0.0	$38.6	$38.6
10. ORGANIZATIONAL CAPITAL[4]	$0.0	$0.0	$16.3
11. ASSETS ADJ. FOR OWN INTANG. (L6+L9+L10)	$50.9	$89.5	$105.8
12. EQUITY ADJ. FOR OWN INTANG. (L8+L9+L10)	$26.7	$65.3	$81.6
COMPANY VALUATION	*10k*	*+ R&D*	*+ ORG K*
13. MARKET VALUE OF EQUITIES[5]	$102.9	$102.9	$102.9
14. FINANCIAL VALUE OF FIRM (L13+L7)[6]	$127.1	$127.1	$127.1
15. CORE FINAN. VALUE OF FIRM (L14-L1-L5)	$103.0	$103.0	$103.0
16. CORE ASSETS (L11-L1-L5)	$26.9	$65.4	$81.7
17. TOTAL INTANGIBLE ASSETS (L3+L4+L9+L10)	$16.8	$55.3	$71.6
VALUATION RATIOS	*10k*	*+ R&D*	*+ ORG K*
18. TOBIN'S EQUITY Q_E (L13/L12)	3.85	1.58	1.26
19. Percent MV value explained (1/ Q_E)	0.26	0.63	0.79
20. TOBIN'S ASSET Q_A (L14/L11)	2.50	1.42	1.20
21. Percent FV value explained (1/ Q_A)	0.40	0.70	0.83

Note 1: Based on S&P Compustat data and authors' calculations. Detail may not add up due to rounding error.
Note 2: Conventional balance sheet items recorded at historical cost.
Note 3: See note 2 of Table 1.
Note 4: See note 2 of Table 1 for amortization assumptions. Note also that valuation of intangibles is at current, not historical, cost.
Note 5: Average monthly market value of outstanding equities.
Note 6: Average monthly market value of outstanding equities plus balance sheet liabilities.

TABLE 3
S&P CORPORATIONS WITH CONTINUOUS R&D
'NEW VIEW' INCOME STATEMENT[1]
2006 ($ BILLIONS)

	10 k	*+ R&D*	*+ ORG K*
1. CONVENTIONAL REVENUE	$4899	$4899	$4899
2. OWN PRODUCTION OF R&D	$0	$220	$220
3. OWN PRODUCTION OF ORG. CAPITAL	$0	$0	$401
4. TOTAL ADJUSTED REVENUE (L1+L2+L3)	$4899	$5119	$5520
5. CONVENTIONAL COST OF REVENUE	$3283	$3283	$3283
6. CURRENT COST R&D	$165	$165	$165
7. CURRENT COST OF SG&A	$673	$673	$673
8. TOTAL CURRENT COST (L5+L6+L7)	$4121	$4121	$4121
9. OPERATING SURPLUS (L4-L8)	$778	$998	$1399
10. DEPRECIATION ALREADY ACCOUNTED FOR	$191	$191	$191
11. AMORTIZATION OF OWN R&D	$0	$134	$134
12. AMORTIZATION OF OWN ORG. CAPITAL	$0	$0	$305
13. ADJ. OPERATING SURPLUS (L9-L10-L11-L12)	$587	$673	$769
14. NET INTEREST AND OTHER ADJUSTMENTS	$18	$18	$18
15. BEFORE-TAX INCOME (L13-L14)	$605	$691	$787
16. INCOME TAX PAID	$192	$192	$192
17. AFTER-TAX INCOME	$413	$499	$595

1. Data from 617 R&D-intensive U.S. corporations. See notes to preceding tables.

TABLE 4
S&P CORPORATIONS WITH CONTINUOUS R&D
'NEW VIEW' BALANCE SHEET[1]
2006 ($ BILLIONS)

CONVENTIONAL BALANCE SHEET	*10 k*	*+ R&D*	*+ ORG K*
1. CURRENT ASSETS	$1726	$1726	$1726
2. PLANT AND EQUIPMENT	$1389	$1389	$1389
3. PURCHASED INTANGIBLES	$210	$210	$210
4. GOODWILL	$604	$604	$604
5. OTHER LONG TERM ASSETS	$468	$468	$468
6. TOTAL ASSETS (L1+L2+L3+L4+L5)	$4397	$4397	$4397
7. TOTAL LIABILITIES	$2794	$2794	$2794
8. EQUITY	$1910	$1910	$1910
ADJUSTMENTS FOR OWN INTANGIBLES	*10 k*	*+ R&D*	*+ ORG K*
9. R&D CAPITAL	$0	$1239	$1239
10. ORGANIZATIONAL CAPITAL	$0	$0	$1448
11. ASSETS ADJ. FOR OWN INTANG. (L6+L9+L10)	$4397	$5636	$7084
12. EQUITY ADJ. FOR OWN INTANG. (L8+L9+L10)	$1910	$3149	$4597
COMPANY VALUATION	*10 k*	*+ R&D*	*+ ORG K*
13. MARKET VALUE OF EQUITIES	$6146	$6146	$6146
14. FINANCIAL VALUE OF FIRM (L13+L17)	$8940	$8940	$8940
15. CORE FINAN. VALUE OF FIRM (L14-L1-L5)	$6746	$6746	$6746
16. CORE ASSETS (L11-L1-L5)	$2203	$3442	$4890
17. TOTAL INTANGIBLE ASSETS (L3+L4+L9+L10)	$814	$2053	$3501
VALUATION RATIOS	*10 k*	*+ R&D*	*+ ORG K*
18. TOBIN'S EQUITY Q_E (L13/L12)	3.22	1.95	1.34
19. PERCENT MV VALUE EXPLAINED ($1/Q_E$)	0.31	0.51	0.75
20. TOBIN'S ASSET Q_A (L14/L11)	2.03	1.59	1.26
21. PERCENT FV VALUE EXPLAINED ($1/ Q_A$)	0.49	0.63	0.79
22. TOBIN'S CORE ASSET Q_{CA}	3.06	1.96	1.38
23. PERCENT CV VALUE EXPLAINED ($1/Q_{CA}$)	0.33	0.51	0.72

1. Data from 617 R&D-intensive U.S. corporations. See notes to preceding tables.

TABLE 5
DETERMINANTS OF MARKET VALUE
S&P SAMPLE OF 422 COMPANIES WITH
COMPLETE RECORD OF R&D

	LEVELS			LOGS		
	(1)	(2)	(3)	(4)	(5)	(6)
EQUITY	3.59***		2.07**	1.09***		0.87***
	(6.29)		(2.13)	(56.13)		(15.28)
R&D STOCK		2.32***	1.95***		0.37***	0.17***
		(5.50)	(6.36)		(7.19)	(6.81)
ORG. STOCK		3.64***	1.04		0.67***	0.07
		(14.58)	(0.77)		(9.39)	(1.12)
PE RATIO	-0.48	-1.06	-1.54*	-0.0001	-0.0000	-0.0001
	(-0.40)	(-1.57)	(-1.78)	(-1.47)	(-0.12)	(-1.51)
YEAR DUMMIES	Y	Y	Y	Y	Y	Y
CONSTANT	1360	8.20	190.14	0.56***	1.40***	0.63***
	(1.36)	(0.02)	(0.41)	(6.63)	(7.71)	(10.09)
R-SQUARED	0.72	0.76	0.79	0.93	0.89	0.94
#OBS	4220	4220	4220	4220	4220	4220

Notes: Firm-level panel data drawn from Compustat covering the period 1997 to 2006. The dependent variable is the average of the monthly market value of a firm. The results in columns (1), (2), and (3) refer to specification in which the variables are in levels. The results in columns (4), (5), and (6) refer to specification in which market value, equity, R&D stock, and the stock organizational capital ("Org" stock) are transformed to natural logarithms. The P/E ratio is the corresponding industry average for each company. Standard errors are clustered by 2-digit industries.

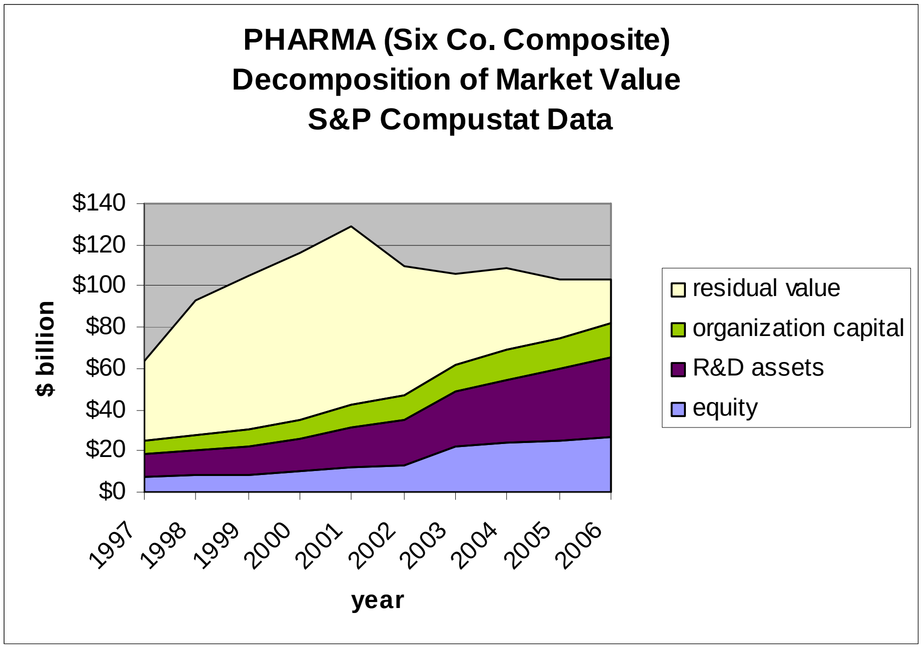

FIGURE 1

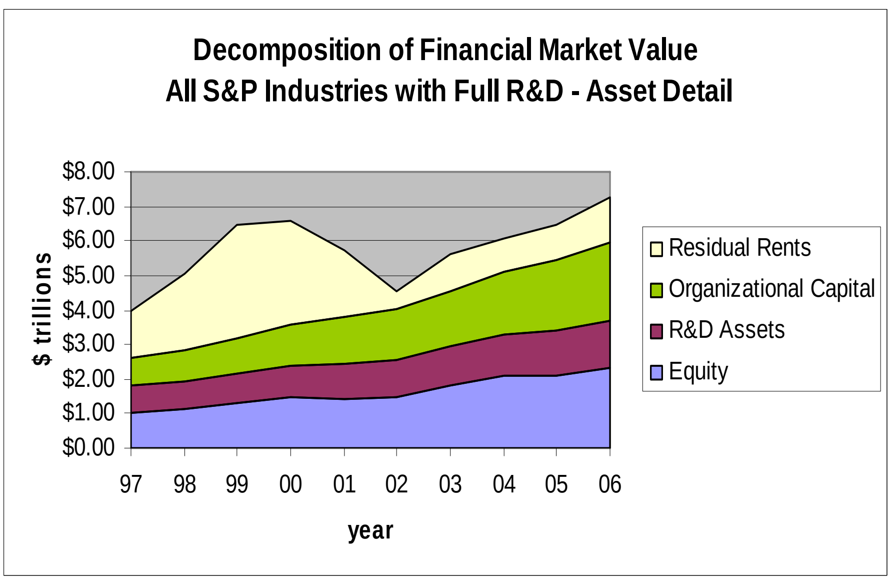

FIGURE 2