A COMPARISON OF PROFITABILITY MEASUREMENTS BETWEEN R&D-INTENSIVE AND NON-R&D-INTENSIVE INDUSTRIES

NAM D. PHAM, PH.D. | MARY DONOVAN | BONNIE PIERCE

MARCH 2019

ndp analytics
turning data into action

FOREWORD

The paper by Pham, Donovan, and Pierce emphasizes critical factors to consider when comparing profit margins and returns on capital across industries. These considerations are important in order to avoid erroneously concluding that a particular industry has higher than normal profits and returns and attributing this to alleged unfair protections of that industry.

The authors highlight that R&D is principally treated as an expense by GAAP rather than capitalized. This observation is becoming increasingly accepted as a limiting factor in being able to compare R&D-intensive industries to less knowledge-based industries. An artificially low capital base for R&D-intensive industries, particularly for larger, more mature companies, will produce incorrectly high returns on capital. Pham et al. show that when appropriate adjustments are made to capitalize R&D, returns of R&D-intensive industries, and the biopharmaceutical industry in particular, become much more in line with less R&D-intensive businesses.

The authors also document two other important factors that can distort comparisons of margins and returns across industries. First, one needs to assess whether there is a survivorship bias whereby the firms whose margins and returns are measured are biased towards success given that failed firms are not captured in the sample. They show that the biopharmaceutical industry has relatively few profitable firms, and thus focusing on the winners distorts the overall assessment of industry profitability. Second, margins and return comparisons are meaningless unless they are adjusted for differences in risk across companies or industries. R&D-intensive industries such as biopharmaceutical are inherently riskier, and thus must have higher margins and returns to compensate for the higher risk.

Pham, Donovan, and Pierce's analysis indicate that once these critical factors are taken into consideration, the perception of higher margins and returns in the biopharmaceutical industry appear to be erroneous.

Alexander J. Triantis
Dean and Professor of Finance
Robert H. Smith School of Business
University of Maryland

EXECUTIVE SUMMARY

Two factors explain R&D-intensive industries' tendency to have higher net profit margins than non-R&D-intensive industries: 1) the elevated risks taken by high-R&D-intensive industries and 2) the GAAP accounting treatment of R&D which inflates apparent profits. With these factors taken into account, relative profits between R&D-intensive and non-R&D-intensive industries converge upon the mean for all industries.

1. **Benefits from R&D investments are uncertain and, if they occur at all, are realized over an extended time horizon, all of which increases the risk of such investments.** In order for investors to undertake risky R&D investments and forego safer alternatives for their capital, the return must be commensurate with the elevated risk level. Therefore, compared to low R&D industries, higher returns on revenue are a common characteristic of high R&D industries in general and reflect the "premium" investors require to undertake the greater risk associated with R&D investments.

2. **The apparent higher profitability of high R&D-intensive industries is also an accounting artifact resulting from the GAAP treatment of R&D.** Current accounting rules treat R&D as a short-term operating expense.[1] However, R&D is a long-term investment which produces "knowledge" assets, in the form of new scientific or technical advances. Yet these assets are not fully counted as assets on the balance sheet of R&D-intensive industries. Appropriately accounting for R&D as a long-lived asset removes most of the difference in profitability between R&D-intensive and non-R&D-intensive industries. Relied upon government agencies, such as Congressional Budget Office (CBO), have confirmed this effect.

In 2013, the Bureau of Economic Analysis (BEA) began counting R&D as a long-lived asset in its GDP measurements. Adopting the same view, this paper finds that when treating R&D as a long-lived capital investment, the profit premium between R&D-intensive industries and non-R&D-intensive industries is almost eliminated (compare Figure E.1 and Figure E.2). Thus, claims that R&D-intensive industries, such as biopharmaceuticals, are excessively profitable are not borne out by the evidence.

CLAIMS THAT R&D-INTENSIVE INDUSTRIES, SUCH AS BIOPHARMACEUTICALS, ARE EXCESSIVELY PROFITABLE ARE NOT BORNE OUT BY THE EVIDENCE.

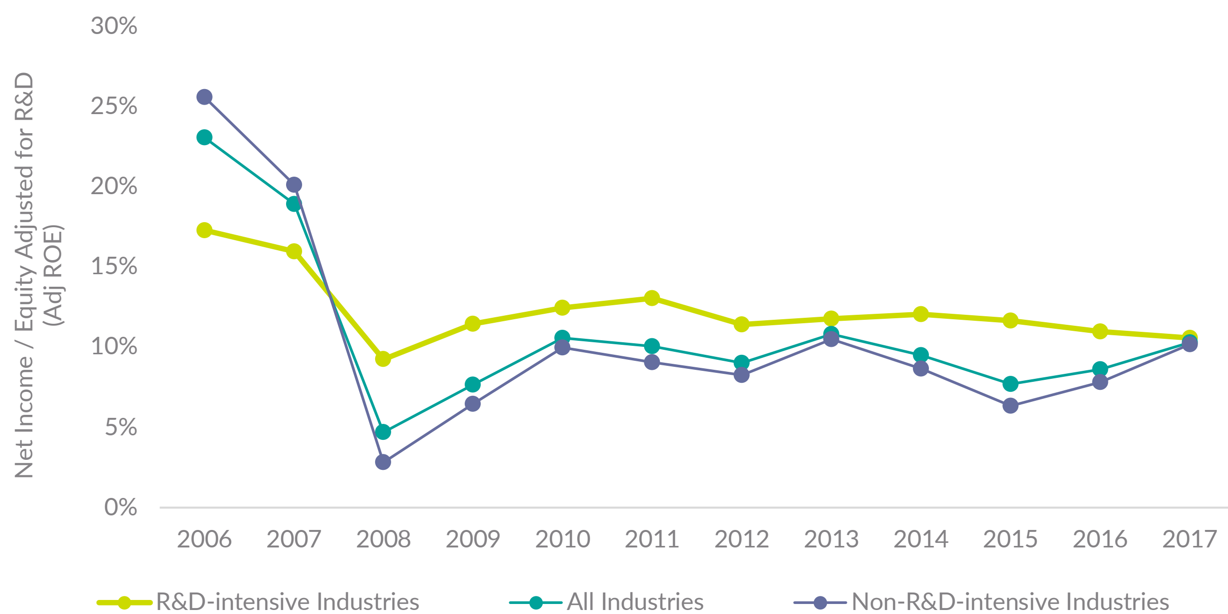
[1] Note: As a result of changes to the tax code contained in the Tax Cuts and Jobs Act of 2017 (H.R.1), beginning in 2022, companies will no longer expense R&D in the year those costs are incurred. Instead, companies will be required to amortize domestic R&D expenses over five years and foreign R&D expenses over 15 years. See Summary of H.R. 1 at https://waysandmeansforms.house.gov/uploadedfiles/tax_cuts_and_jobs_act_section_by_section_hr1.pdf

Figure E.1.

Return on Equity – R&D Treated as Short-Term Expense as Under Current GAAP Rules

Figure E.2.

Return on Equity – R&D Treated as Long-Lived Asset (BEA Method)



A COMPARISON OF PROFITABILITY MEASUREMENTS BETWEEN R&D-INTENSIVE AND NON-R&D-INTENSIVE INDUSTRIES

NAM D. PHAM, PH.D., MARY DONOVAN, AND BONNIE PIERCE[2]

I. OBJECTIVE

Some commenters have asserted that profits of the biopharmaceutical industry are abnormally higher than other industries without considering all the facts. The basis for this claim seems to stem from accounting comparisons that look solely at net profit margins, a comparison that does not get at the dynamics underlying sales and profit generation in R&D-intensive industries. For example, in its November 2017 report, the U.S. Government Accountability Office (GAO) calculated the weighted average net profit margin (post-tax net income divided by sales) during 2006-15 for the largest 25 biopharmaceutical companies, the largest 25 software companies, and the largest 500 companies in other industries.[3]

We used financial data of public companies traded on U.S. exchanges provided by Compustat to reproduce the GAO analysis (Figure 1).[4] These data show apparent net margins of software and biopharmaceuticals to be substantially higher than the weighted average of all other sectors – which one would expect of R&D-intensive industries relative to lower R&D-intensive industries. Investors will only invest in risky R&D projects, companies or industries if they can expect a return commensurate with the elevated risk. The elevated risks inherent in drug development, as Ayman Chit et al. observed, lies in the fact that "many drug development projects fail and there is a lag between expenditure outlays and the receipt of sales revenues for the drugs that succeed."[5] Similarly, Carmelo Giaccotto et al. also noted that, "high returns are often required to compensate for the higher systematic risk of long-duration pharmaceutical cash flows."[6]

PROFITABILITY COMPARISONS THAT RELY SOLELY UPON NET MARGIN ARE LIMITED, INCOMPLETE, AND PROVIDE A POOR BASIS FOR IMPORTANT POLICY DECISIONS. THIS REPORT PROVIDES A MORE COMPLETE AND MEANINGFUL SET OF FINANCIAL MEASUREMENTS USING COMMON PROFIT METRICS ADJUSTED FOR R&D. BY ELIMINATING THE UPWARD BIAS IN ACCOUNTING MEASURES OF PROFITABILITY, WE PROVIDE A MORE ACCURATE MEASURE OF FINANCIAL RETURNS FOR THOSE WHO INVEST HEAVILY IN R&D.

---

[2] Nam D. Pham is Managing Partner, Mary Donovan is Principal, and Bonnie Pierce is Managing Director at ndp | analytics. Joshua Moore provided research assistance. Pharmaceutical Research and Manufacturers of America (PhRMA) provided financial support to conduct this study. The opinions and views expressed in this report are solely those of the authors.

[3] Figure 5: Average Profit Margin for Drug Companies, Software Companies, and the Largest 500 Companies from Other Industries, 2006-2015, pp 20. U.S. Government Accountability Office. 2017. "Drug Industry: Profits, Research and Development Spending, and Merger and Acquisition Deals." Report to Congressional Requesters, November.

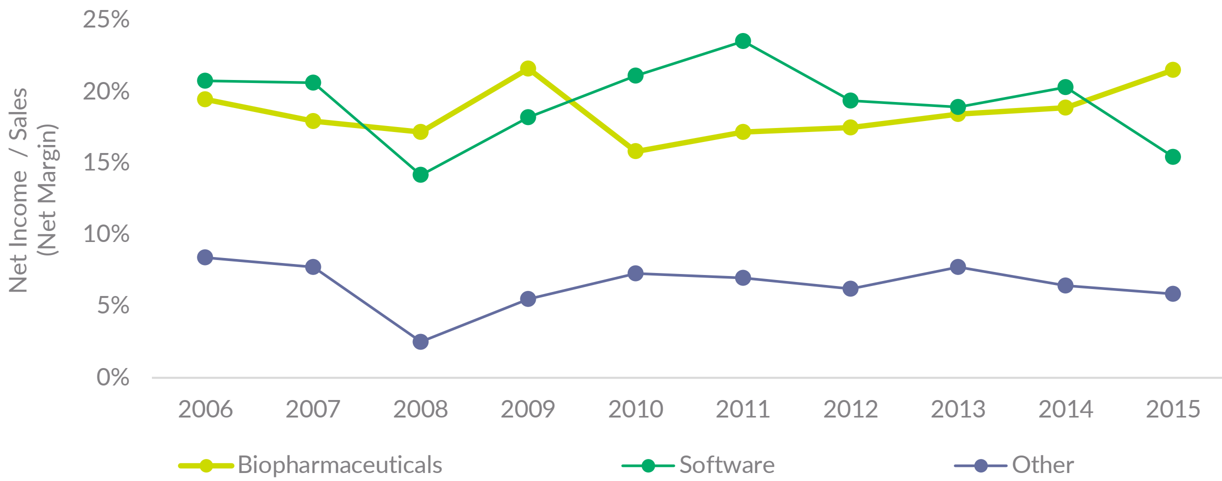
[4] The GAO report does not include the list of companies in the analysis.

[5] Chit, Ayman, Ahmad Chit, Manny Papadimitropoulos, Murray Krahn, Jayson Parker, and Paul Grootendorst. 2015. "The opportunity cost of capital: Development of new pharmaceuticals." Inquiry: The Journal of Health Care Organization, Provision, and Financing 52: G1.

[6] Giaccotto, C, J. Golec, and J. Vernon. 2011. "New estimates of the cost of capital for pharmaceutical firms." Journal of Corporate Finance 17 (3): 526-40.

Figure 1.

GAO: Net Profit Margin of Top 25 Biopharmaceutical Companies, Top 25 Software Companies, and Other 500 Largest Companies, 2006-15



The purpose of this paper is to show that any comparison of profitability across companies and industries which relies solely upon net margins is limited and incomplete and therefore provides a poor basis for important health and welfare policy decisions. The biopharmaceutical industry is unique in many ways, especially with respect to R&D investment and the lengthy development times needed to bring new drug products to market. The economic literature is replete with scholarship showing that a "substantial and upward bias" exists in accounting-based profit measures for companies and industries with high R&D expenditures.[7] For example, the Congressional Budget Office (CBO) reported that "the standard accounting measure of profits overstates true returns to R&D-intensive industries, such as pharmaceuticals, and makes it difficult to meaningfully compare profit levels among industries."[8] To the extent the biopharmaceutical industry tends to be among the most – if not the most – R&D-intensive, this effect is overstated even more so than in other industries. This report provides a more complete and meaningful set of financial measurements using common profit metrics appropriately adjusted for R&D. By attempting to eliminate the upward bias in accounting measures of profitability, we provide a more accurate measure of financial returns for companies and industries that invest heavily in R&D.

II. A SNAPSHOT OF THE BIOPHARMACEUTICAL INDUSTRY

The biopharmaceutical industry has two unique characteristics that are crucial for analyzing and comparing its financial performance with other industries. The primary hallmark is the industry's large-scale R&D investment. On average, the industry spends up to $2.6 billion and 11 years to develop a new drug.[9] Secondly, the distribution of biopharmaceutical companies across the financial spectrum is highly variable. While the industry has approximately 3,000 publicly-traded and privately-held companies, sales are concentrated in several dozen larger biopharmaceutical companies and relatively few companies earn a

[7] Skrepnek, GH. 2004. "Accounting- versus economic-based rates of return: Implications for profitability measures in the pharmaceutical industry." Clinical Therapeutics; see also Danzon, PM. 2000. "Making sense of drug prices." Regulation 23 (1): 56; Scherer, FM. 2007. "Pharmaceutical Innovation." AEI-Brookings Joint Center for Regulatory Studies Working Paper 07-13.

[8] Congressional Budget Office. 2006. "Research and development in the pharmaceutical industry."

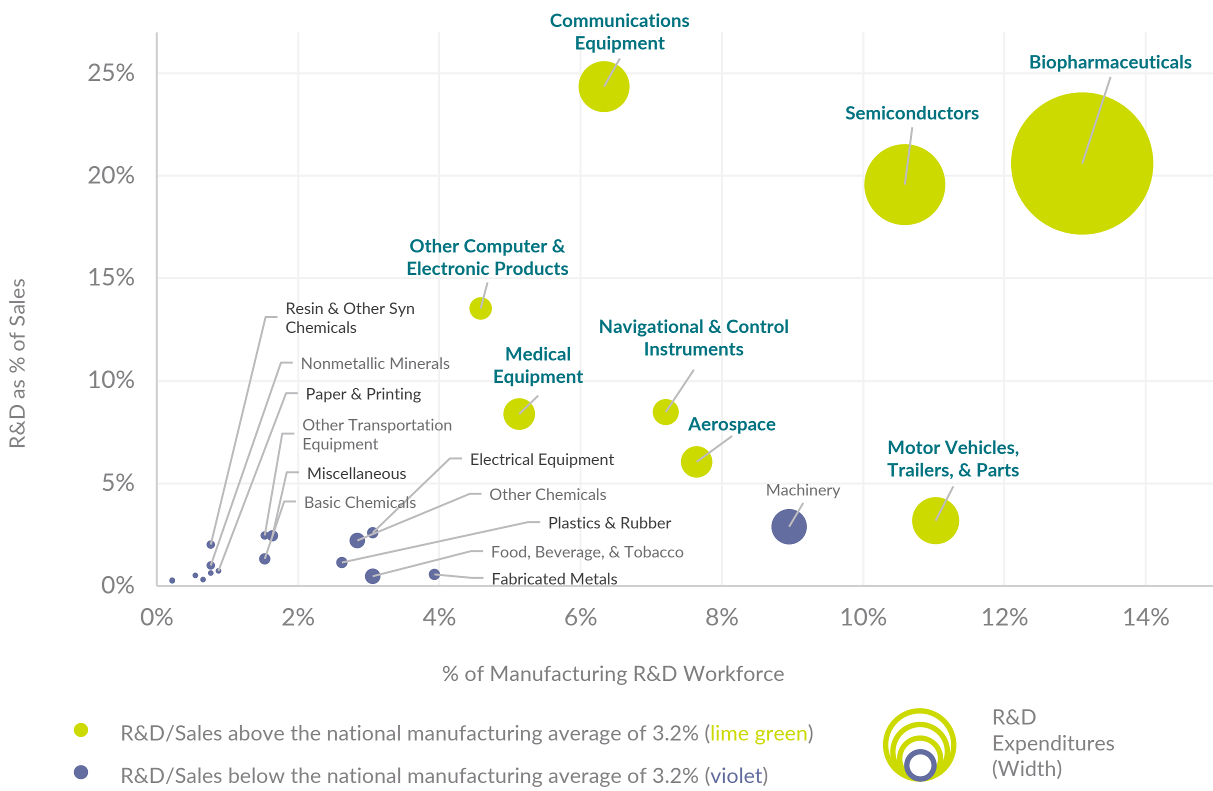
[9] DiMasi, Joseph A., Henry G. Grabowski, and Ronald W. Hansen. 2016. "Innovation in the pharmaceutical industry: New esti-mates of R&D costs." Journal of Health Economics.

profit.[10] Approximately 90% do not have positive earnings.[11] Given these enormous R&D outlays and variability in financial performance, a comparison of profit margin alone does not provide accurate and complete information about the industry's profitability.

R&D Intensity of the Biopharmaceutical Industry

The biopharmaceutical industry requires a substantial amount of capital for risky R&D investment to innovate and develop new drugs. In our previous research, we show the biopharmaceutical industry has the highest R&D investment per employee and as a percentage of sales among all U.S. manufacturing industries.[12] From 2000 to 2015, the biopharmaceutical industry employed 13.1% of all R&D workers in the manufacturing sector, more than any other industry. During the same period, the biopharmaceutical industry spent 20.6% of its revenue on R&D, second only to communication equipment (24.4% R&D/sales). However, the magnitude of spending on R&D by the biopharmaceutical industry is unmatched. In 2015, the biopharmaceutical industry spent $50.2 billion on R&D, 1.7 times more than the second highest spender, semiconductor manufacturing ($28.6 billion), and 2.8 times more than the third highest spender, communications equipment ($18.0 billion). (Figure 2)

Figure 2.
R&D Investment, Intensity and Employment by Selected Industries, 2000-15



[10] Statista; Compustat database; ndp | analytics.
[11] BIO. Unleashing the Next Generation of Biotechnology Innovation. 2015.
[12] Pham, Nam. 2010. "The Impact of Innovation and the Role of Intellectual Property Rights on U.S. Productivity, Competitiveness, Jobs, Wages, and Exports." ndp | analytics; Pham, Nam. 2015. "IP-Intensive Manufacturing Industries: Driving U.S. Economic Growth." ndp | analytics. Pham, Nam. 2017. "IP-Intensive Manufacturing Industries: Driving U.S. Economic Growth." ndp | analytics.

Variable Financial Performance Across the Biopharmaceutical Industry in 2017

Relying on a narrow set of companies to make inferences about overall industry profitability introduces a "winners bias" into the analysis. The financial performance of the top 25 biopharmaceutical companies is very different from the rest of the industry. In 2017, 728 biopharmaceutical companies traded on U.S. stock exchanges.[13] An examination of these companies' financial performance metrics reveals that they are unevenly distributed among large and small firms. Since the net profit margin of the biopharmaceutical sector as a whole atypically dropped to only 6% in 2017 (due to one-time tax expenses related to provisions in the Tax Cuts and Jobs Act of 2017), we provide data for 2015 as well, a more typical performance year. (Table 1)

SHARE OF COMPANIES WITH POSITIVE NET INCOME

14%	65%
BIOPHARMACEUTICAL	ALL OTHER INDUSTRIES

Total net income of the 728 firms was $45 billion ($102 billion in profits from those 102 companies minus $57 billion in losses from 626 companies). The largest 25 biopharmaceutical companies earned $71 billion in net income and the top 10% (73 companies) earned nearly $74 billion in net income. Total net income of all companies below the top 25 was negative $26 billion.

Sales are also concentrated in a small number of larger companies. In 2017, total sales of all 728 companies was over $751 billion. Sales of the largest 25 biopharmaceutical companies was over $670 billion, accounting for more than 89% of industry sales. All other biopharmaceutical companies had less than $81 billion in sales, or 11% of total sales.

In 2017, the profit margin weighted by revenue of the top 25 biopharmaceutical companies was 10.6% compared to negative 32.2% of all other biopharmaceutical companies, and 6.0% for the biopharmaceutical industry overall. (Similarly, in 2015, the weighted profit margin of the top 25 biopharmaceutical companies was 21.7% compared to negative 22.5% of all other biopharmaceutical companies, and 16.9% overall.)

[13] Data reported in Compustat database of all biopharmaceutical companies classified as NAIC 3254.

Table 1.

Panel A. Weighted Average and Simple Average Profit Margins of Biopharmaceutical Companies, 2017

	Net Income ($ million)	Revenues ($ million)	Weighted Average Profit Margin	Simple Average Profit Margin
All 728 companies	$44,959	$751,558	6.0%	-9043%
Top 25 companies	$70,999	$670,637	10.6%	9.9%
All companies below top 25	-$26,040	$80,921	-32.2%	-9526%
Top 10% (73 companies)	$73,632	$735,995	10.0%	2.7%
Top 20% (146 companies)	$69,544	$747,142	9.3%	-22.2%
Top half (364 companies)	$56,359	$751,457	7.5%	-324%
Bottom half (364 companies)	-$11,440	$103	-11074%	-33399%

Panel B. Weighted Average and Simple Average Profit Margins of Biopharmaceutical Companies, 2015

	Net Income ($ million)	Revenues ($ million)	Weighted Average Profit Margin	Simple Average Profit Margin
All 728 companies	$115,384	$682,048	16.9%	-10903%
Top 25 companies	$131,925	$608,642	21.7%	19.6%
All companies below top 25	-$16,542	$73,406	-22.5%	-11477%
Top 10% (74 companies)	$135,765	$669,493	20.3%	10.5%
Top 20% (149 companies)	$134,045	$678,615	19.8%	-6.5%
Top half (369 companies)	$125,823	$681,986	18.4%	-321%
Bottom half (369 companies)	-$10,439	$62	-16857%	-43076%

III. FINANCIAL PERFORMANCE MEASUREMENTS

To demonstrate the inadequacy of using net profit margin alone to measure financial performance, we must first review the three common accounting metrics established by GAAP to measure the profitability of nearly 7,000 public companies traded on U.S. exchanges during 2006-17. As discussed earlier, the first common measurement is net profit margin, which calculates net income of each dollar of product sales. While net profit margin measures the profit of current sales, it does not provide information on the required capital that a company accumulated to generate its current sales. The second measurement, return on assets, expands upon the profit margin metric to include the sales-generating assets of a company or an industry. Thirdly, since assets include both debt and equity, return on equity measures the net income of each dollar of equity of a company or an industry. (Box 1)

BOX 1: FINANCIAL MEASUREMENTS

Net profit margin (Net Margin) is net income after subtracting operating expenses divided by total sales (net income / sales). The measurement, expressed as the percentage of sales, calculates the profit earned on each dollar of sales. It measures the profitability and operating efficiency of a company.

Return on assets (ROA) is net income divided by assets. The measurement calculates the profit earned on each dollar of a company's assets. The measurement is the product of two components -- profit margin and asset turnover. **Asset turnover** is the ratio of sales to assets, which measures the effectiveness of a company's use of its assets to generate sales. Mathematically, ROA = (net income / assets) = (net income / sales) x (sales / assets).

Return on equity (ROE) is net income divided by equity. The measurement calculates the profit earned on each dollar of a company's equity. The measurement is the product of three components: profit margin, asset turnover, and equity multiplier. **Equity multiplier** is assets divided by equity, which measures the financial leverage of a company to use equity to finance asset purchases. Mathematically, ROE = (net income / equity) = (net income / sales) x (sales / assets) x (assets / equity).

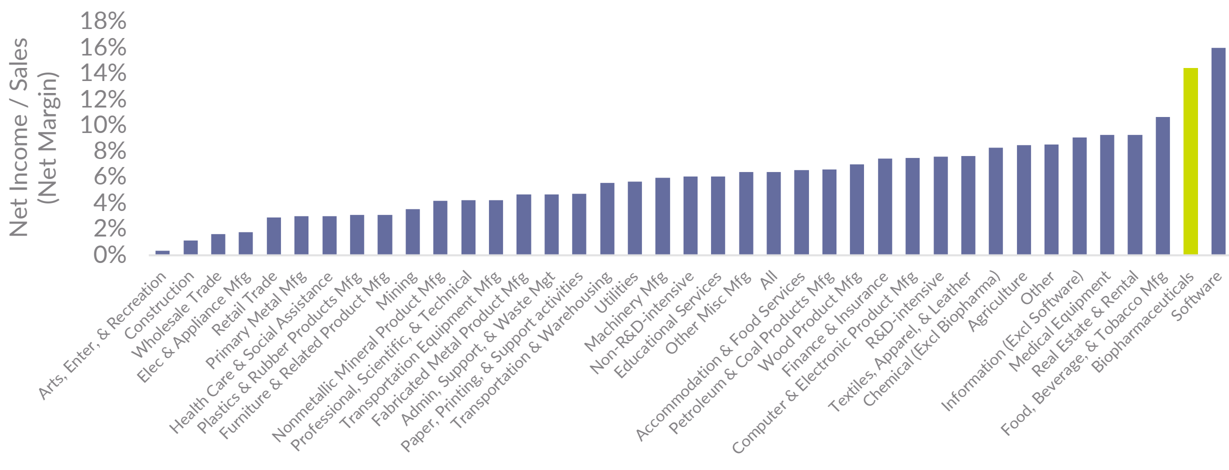
Net Profit Margin

The universe of 7,000 publicly traded companies covers a wide range of business models. Some sectors, such as retailers, have relatively low R&D intensity and tend to specialize in high turnover of commoditized goods (pharmacy benefit managers are classified in the retail trade sector in Compustat data). Others, such as the biopharmaceutical or software sectors, are much more R&D-intensive and specialize in innovative products with relatively short marketable lifespans. While all sectors innovate to some degree, innovation is a do-or-die necessity for those industries on the cutting edge of applied science, indicated by R&D intensity. Companies with lower R&D intensity and who rely less upon innovation are expected to have lower net profit margins while R&D-intensive companies which rely on innovation to compete tend to have higher net profit margins. Hsieh et al. found "positive associations of R&D intensity and all variables of firm performance" including net margin, operating margin, sales growth, and market value.[14] During 2006-17, net profit margin of the biopharmaceutical industry ranked second, just after the software industry. As expected, the net profit margin of the biopharmaceutical industry was higher than other less innovative industries such as retail trade. (Figure 3)

HSIEH ET AL. FOUND "POSITIVE ASSOCIATIONS OF R&D INTENSITY AND ALL VARIABLES OF FIRM PERFORMANCE" INCLUDING NET MARGIN, OPERATING MARGIN, SALES GROWTH, AND MARKET VALUE.

[14] Hsieh, PH, CS Mishra, and DH Gobeli. 2003. "The return on R&D versus capital expenditures in pharmaceutical and chemical industries." IEEE Transactions on Engineering Management 50 (2): 141-50.

Figure 3.
Net Profit Margin by Industry, 2006-17, Without R&D Adjustment



R&D investment and the development of innovative products go hand in hand. In the case of the biopharmaceutical industry, relatively higher net profit margins resulted from billions of dollars and years of investment spent to discover new drugs. We used our classifications of innovative industries from our previous studies to compare the net profit margin of R&D-intensive industries and non-R&D-intensive industries.[15] We calculated and compared annual net profit margins, weighted by revenue, of all R&D-intensive and all non-R&D-intensive industries during 2006-17. (Figure 4) This revealed an important distinction in the apparent profitability between the two cohorts: R&D-intensive industries tended to have a higher profit margin than their non-R&D-intensive counterparts, and higher than the overall average for all industries.

Figure 4.
Net Profit Margin of R&D-Intensive and Non-R&D-Intensive Industries, 2006-17, Without R&D Adjustment

[15] R&D-intensive industries include all companies in chemical manufacturing (NAICS 325) including biopharmaceuticals (NAICS 3254), computer and electronic manufacturing (NAICS 334), transportation equipment manufacturing (NAICS 336), medical equipment manufacturing (NAICS 3391), and software publishers (NAICS 5112).

After analyzing the profitability of R&D-intensive *industries*, we examined the profitability of R&D-intensive *companies*. We defined R&D-intensive companies as those companies that have an R&D-to-sales ratio above the median ratio for all public companies traded on U.S. exchanges. Once again, R&D investment sheds an illuminating light on the differing profitability of individual companies between the two cohorts. During 2006-17, the weighted average net profit margin of all R&D-intensive companies was higher than the weighted average net profit margin of non-R&D-intensive companies (as well as the overall average). (Figure 5)

Figure 5.

Net Profit Margin of R&D-Intensive and Non-R&D-Intensive Companies, 2006-17, Without R&D Adjustment

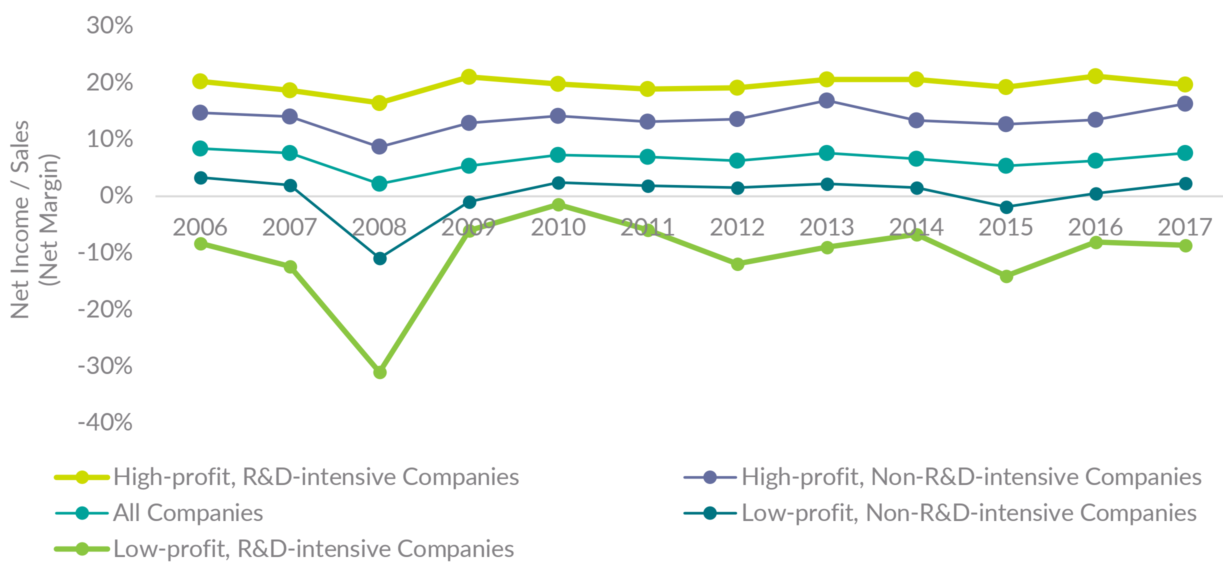
To further explore the correlation between R&D intensity and apparent profitability, we subdivided all companies into two groups based on their profitability in each year. Figure 6, Panel A shows the annual weighted average net profit margin of high-profit and low-profit companies during 2006-17. Not surprisingly, the high-profit companies were more profitable, and the low-profit companies were less profitable, than all companies overall.

More interestingly, however, when we identified R&D-intensive versus non-R&D-intensive companies in both the high-profit company group and low-profit company group, we found a noteworthy divergence. The net profit margin of R&D-intensive companies was either leading all other companies or lagging all other companies. (Figure 6, Panel B)

Figure 6.
High-profit and Low-profit Companies, 2006-17, Without R&D Adjustment

Panel A. All Companies

Panel B. R&D-intensive and Non-R&D-intensive Companies



Stated plainly, these results are a relative risk indicator, and emphasize the feast-or-famine nature of innovative companies and industries. Companies that are more R&D-intensive show higher profits *and greater losses* than companies that are less R&D-intensive, reflecting the inherent risks of R&D investments that may not pan out and the large amounts of capital committed by such firms to develop innovative products and services. If R&D projects are successful, such companies may obtain higher profits. But if R&D projects fail, such companies will not generate revenue and all expenses become losses. In contrast, non-R&D-intensive companies have lower profits, but also lower risks, landing them closer to the mean profitability for all firms. R&D-intensive companies are "high-risk, high-return" companies, while non-R&D-intensive companies are "low-risk, low-return" companies. With this in mind, it seems it should stand to reason that high-R&D companies ought to achieve relatively higher apparent profits than low-R&D companies.

R&D-INTENSIVE COMPANIES ARE "HIGH-RISK, HIGH-RETURN" COMPANIES, WHILE NON-R&D-INTENSIVE COMPANIES ARE "LOW-RISK, LOW-RETURN" COMPANIES.

Return on Assets

Net profit margin only relates profit to sales and does not take into account the assets required to generate sales. Return on assets (net income divided by assets) is a financial measurement that incorporates both profits and the assets used to generate those profits. Return on assets (ROA) can be decomposed into two components – profit margin and asset turnover. The first component measures the profitability while the second component measures the efficiency of using assets to generate sales. Figure 7 below compares return on assets of nearly 7,000 publicly-traded companies on the U.S. exchanges during 2006-17 by industry.

Figure 7.
Return on Assets by Industry, 2006-17, Without R&D Adjustment

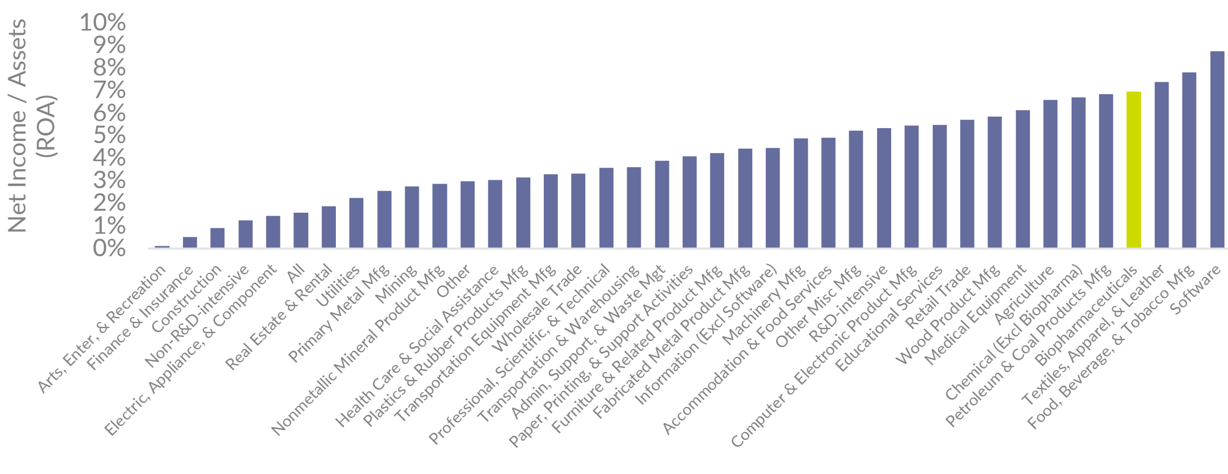


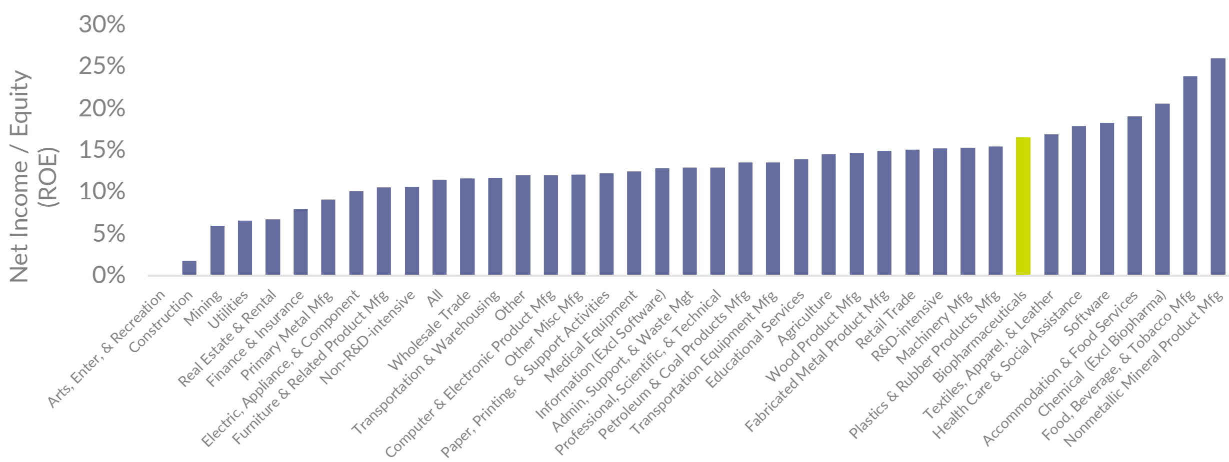
Figure 8 compares ROA of R&D-intensive industries and non-R&D-intensive industries. R&D-intensive industries have higher ROA in every year since 2006, outperforming non-R&D-intensive industries. (Figure 8)

Figure 8.
Return on Assets: R&D-intensive and Non-R&D-intensive Industries, 2006-17, Without R&D Adjustment

Return on Equity

The third commonly used profitability metric is return on equity (ROE). Assets are in the form of debt and equity. ROE measures net profit against equity only. Figure 9 below shows the ROE of nearly 7,000 publicly-traded companies on U.S. exchanges during 2006-17. As can be seen, the ROE rankings of R&D-intensive industries such as biopharmaceuticals and software begin to move away from the higher end of the spectrum and closer to the middle while less R&D-intensive industries move toward the high end of the range. (Figure 9)

Figure 9.
Return on Equity by Industry, 2006-17, Without R&D Adjustment



We put all R&D-intensive industries together and all non-R&D-intensive industries together to calculate ROE from 2006 to 2017. While R&D-intensive industries outperformed non-R&D-intensive industries most years, R&D-intensive industries were closer to the mean than shown in the other profitability metrics. (Figure 10)

Figure 10.

Return on Equity: R&D-intensive and non-R&D-intensive Industries, 2006-17, Without R&D Adjustment

Return on Equity Adjusted for R&D

It is critical to point out here that in both ROA and ROE discussed above, while those metrics do incorporate the tangible assets (such as plant and equipment) of firms and industries into the profitability equation, the large *intangible* asset base of high-R&D industries is still largely not captured. When one considers that R&D creates considerable intangible assets (i.e. new scientific or technical knowledge which drives the development of new products or services), then it can be readily seen that high R&D firms such as biopharmaceuticals and software are also intangible asset-intensive. Thus, there exists a substantial undercounting of assets in high-R&D firms and industries.

This is the result of how R&D is treated under current accounting rules and has significant consequences for calculating financial returns on assets and equities. R&D is recorded as a current expenditure and deducted as an operating expense in the year of spending, even though the benefits of R&D investment are usually realized many years after the expenditure has been made. The CBO confirmed: "Accounting measures treat most R&D spending (except for capital equipment) as a deductible business expense rather than as a capitalized investment. But the intangible assets that research and development generate – such as accumulated knowledge, new research capabilities, and patents – increase the value of a company's asset base. Not accounting for that value overstates a firm's true return on its assets."[16] As a result, returns on assets and equity do not appropriately reflect the financial performance of highly R&D-intensive companies and industries.

[16] CBO *op cit.*

To correct for this omission, we incorporate the uncounted intangible assets derived from R&D into our profit calculations using R&D expenditure as the best available proxy for intangible assets, a method used by the Bureau of Economic Analysis,[17] and Igor Goncharov et al. in their work on R&D accounting in the pharmaceutical industry.[18]

We followed the methodology and assumptions of the amortizable life of R&D by industry described in New York University Stern School of Business Professor Aswath Damodaran's research to value and capitalize research assets.[19] We describe the amortization assumptions and ROE calculations adjusted for R&D in Box 2 and Table A.1 of the Appendix.

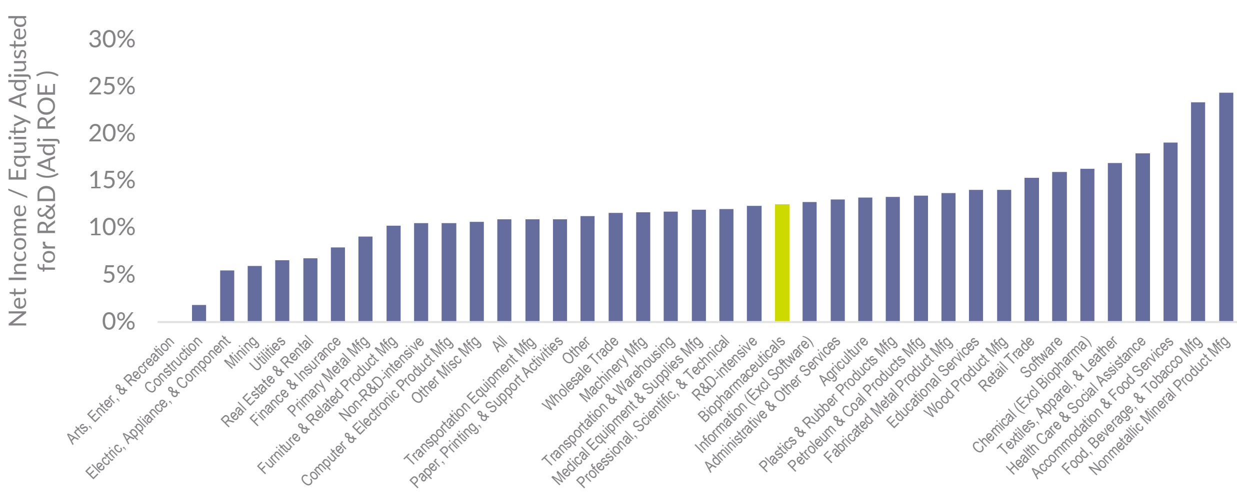
Figure 11 below shows return on equity adjusted for R&D for the biopharmaceutical and other industries. After adjusting for R&D investment – by adding the value of intangible R&D assets into the asset base of all industries – ROE of the biopharmaceutical industry and other R&D-intensive sectors falls near the middle of the range for all industries. In contrast, adjusted ROE of non-R&D-intensive sectors has climbed the rankings.

BOX 2. THREE STEPS TO CACLUATE RETURN ON EQUITY ADJUSTED FOR R&D

1. **Determine an amortizable life for R&D investment for each industry.**
   - Given the length of the approval process for new drugs by the FDA, the amortizable life of biopharmaceutical R&D is assumed to be 10 years. Other industries have different amortization schedules.
   - For simplicity, a linear amortization schedule is also assumed (i.e., 10% of the annual R&D investment is amortized each year).
2. **Calculate the value of R&D assets and amortized and unamortized portions of R&D assets.**
   - Collect annual R&D investment for all years for each industry.
   - Apply the amortizable life schedule in step 1 to calculate amortized and unamortized portions of R&D investment for each industry by year.
   - Unamortized R&D is included in the assets of each industry while amortized R&D is expensed against net income.
3. **Calculate return on equity adjusted for R&D.**
   - Adjusted net income equals net income plus current year R&D minus amortized R&D.
   - Adjusted equity equals total equity plus unamortized portion of R&D.

Figure 11.

Return on Equity Adjusted for R&D by Industry, 2006-17



[17] Bureau of Economic Analysis. 2013. Preview of the 2013 Comprehensive Revision of the National Income and Product Accounts: Changes in Definitions and Presentations.

[18] Goncharov, Igor, Jörg Mahlich, and B. Burcin Yurtoglu. 2017. "Accounting Profitability and the Political Process: The Case of R&D Accounting in the Pharmaceutical Industry." Available at SSRN: https://ssrn.com/abstract=2531467 or http://dx.doi.org/10.2139/ssrn.2531467

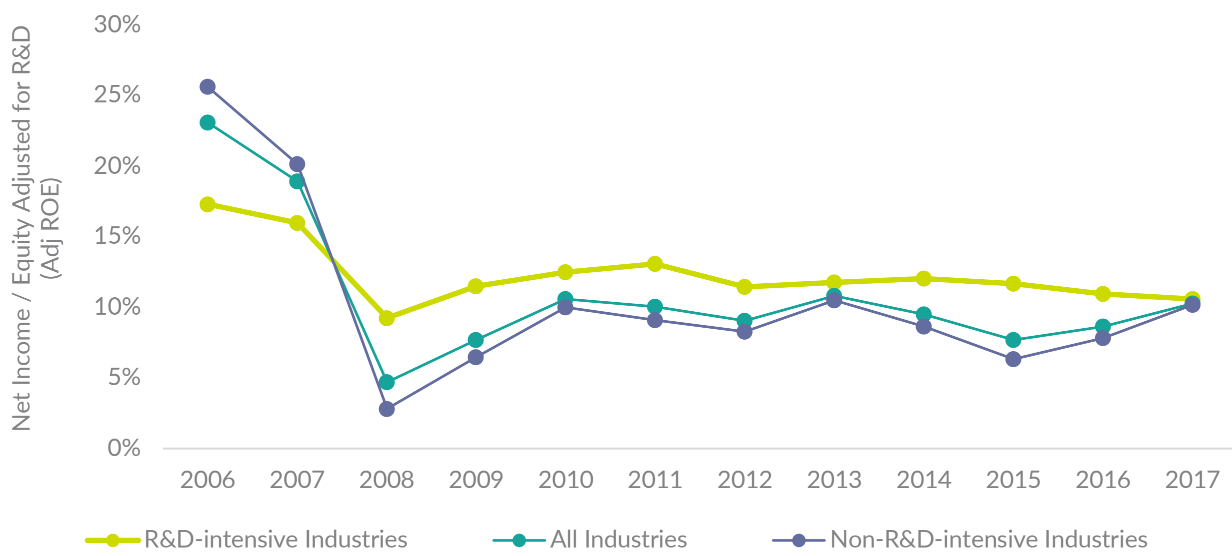
[19] Damodaran, Aswath. 2007. "Return on Capital (ROC), Return on Invested Capital (ROIC) and Return on Equity (ROE): Measurement and Implications." Stern School of Business.

We calculated annual ROE adjusted for R&D for the two cohorts of industries, R&D-intensive and non-R&D-intensive, for the period 2006-17. (Figure 12) In contrast to unadjusted ROE and net profit margin, the difference in profitability between R&D-intensive and non-R&D-intensive industries has been almost eliminated, as the R&D-intensive cohort gets closer to the mean. These results closely match prior observations by noted economists such as Harvard University's Frederic M. Scherer: "Correctly accounting for R&D as a long-lived investment tends to reduce substantially, if not to eliminate altogether, the inference that pharmaceutical companies are on average achieving supranormal profit returns."[20] The key learning for policymakers is that there is a balance between risk and reward, and that the undertakings of seemingly high profit industries with large R&D expenditures come only at great expense and risk.

"CORRECTLY ACCOUNTING FOR R&D AS A LONG-LIVED INVESTMENT TENDS TO REDUCE SUBSTANTIALLY, IF NOT ELIMINATE ALTOGETHER, THE INFERENCE THAT PHARMACEUTICAL COMPANIES ARE ON AVERAGE ACHIEVING SUPRANORMAL PROFIT RETURNS."

Figure 12.

Return on Equity Adjusted for R&D: R&D-intensive and Non-R&D-intensive Industries, 2006-17

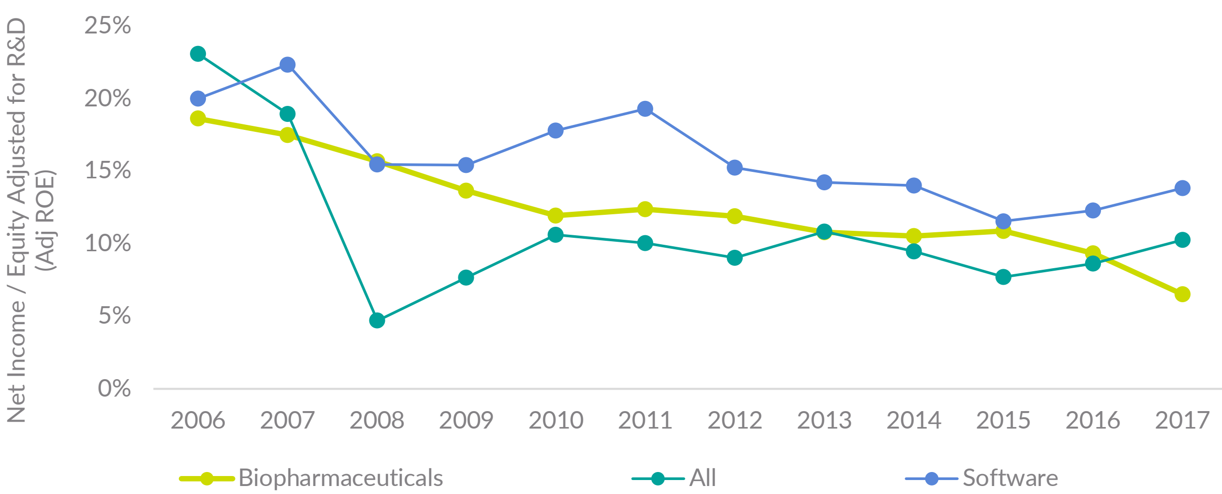


[20] Scherer *op cit.*

IV. FINAL REMARKS

Financial measures with adjustments made for R&D show that the profitability of the biopharmaceutical industry is balanced with that of less risky enterprises and the market as a whole. In Figure 13 below, we reconstructed the 2017 GAO chart shown earlier, only this time using ROE adjusted for R&D. Much of the difference between biopharmaceutical and software profitability and the rest of the market has been nearly eliminated. In particular, biopharmaceutical profitability largely aligns with the rest of the overall market. This demonstrates that the higher apparent profitability of the biopharmaceutical sector seen in net margin analyses is due to differences in R&D intensity and the accounting treatment of R&D.

Figure 13.
Return on Equity Adjusted for R&D: Biopharmaceutical, Software, and Other Industries, 2006-17



In sum, when comparing across industries, a profitability assessment based solely on net profit margin is inappropriate. A meaningful assessment of financial performance of companies and industries requires additional financial measurements, such as adjusted ROE which brings the value of intangible assets created by R&D into the equation. Indeed, any analysis of an innovative, R&D-intensive sector must account for R&D, the most crucial element in innovation, to be considered complete.

Across all measures based on current standard GAAP accounting rules, R&D-intensive industries outperform non-R&D-intensive industries, but the relative scale of R&D investment accounts for this difference. For the biopharmaceutical industry specifically, and in light of this paper's findings, conclusions made about the industry's profitably based on net profit margin alone can only be considered misleading.

REFERENCES

Bureau of Economic Analysis. 2013. Preview of the 2013 Comprehensive Revision of the National Income and Product Accounts: Changes in Definitions and Presentations.

Chit, Ayman, Ahmad Chit, Manny Papadimitropoulos, Murray Krahn, Jayson Parker, and Paul Grootendorst. 2015. "The opportunity cost of capital: Development of new pharmaceuticals." Inquiry: The Journal of Health Care Organization, Provision, and Financing 52: G1.

Compustat database.

Congressional Budget Office. 2006. "Research and development in the pharmaceutical industry."

Damodaran, Aswath. 2007. "Return on Capital (ROC), Return on Invested Capital (ROIC) and Return on Equity (ROE): Measurement and Implications." Stern School of Business.

Danzon, PM. 2000. "Making sense of drug prices." Regulation 23 (1): 56

DiMasi, Joseph A., Henry G. Grabowski, and Ronald W. Hansen. 2016. "Innovation in the pharmaceutical industry: New estimates of R&D costs." Journal of Health Economics.

Giaccotto, C, J. Golec, and J. Vernon. 2011. "New estimates of the cost of capital for pharmaceutical firms." Journal of Corporate Finance 17 (3): 526-40.

Goncharov, Igor, Jörg Mahlich, and B. Burcin Yurtoglu. 2017. "Accounting Profitability and the Political Process: The Case of R&D Accounting in the Pharmaceutical Industry." White Paper.

Hsieh, PH, CS Mishra, and DH Gobeli. 2003. "The return on R&D versus capital expenditures in pharmaceutical and chemical industries." IEEE Transactions on Engineering Management.

Pham, Nam. 2017. "IP-Intensive Manufacturing Industries: Driving U.S. Economic Growth." ndp | analytics.

2015. "IP-Intensive Manufacturing Industries: Driving U.S. Economic Growth." ndp | analytics.

2010. "The Impact of Innovation and the Role of Intellectual Property Rights on U.S. Productivity, Competitiveness, Jobs, Wages, and Exports." ndp | analytics;

Scherer FM. 2007. "Pharmaceutical Innovation." AEI-Brookings Joint Center for Regulatory Studies Working Paper 07-13

Skrepnek, GH. 2004. "Accounting- versus economic-based rates of return: Implications for profitability measures in the pharmaceutical industry." Clinical Therapeutics.

Statista.

U.S. Government Accountability Office. 2017. "Drug Industry: Profits, Research and Development Spending, and Merger and Acquisition Deals." Report to Congressional Requesters, November.

APPENDIX

Table A.1.

Amortization Period of Individual Industries

Industry	Years	Industry	Years
Advertising	2	Insurance (Prop/Casualty)	3
Aerospace/Defense	10	Internet	3
Air Transport	10	Investment Co. (Domestic)	3
Aluminum	5	Investment Co. (Foreign)	3
Apparel	3	Investment Co. (Income)	3
Auto & Truck	10	Machinery	10
Auto Parts (OEM)	5	Manuf. Housing/Rec Vehicles	5
Auto Parts (Replacement)	5	Maritime	10
Bank	2	Medical Services	3
Bank (Canadian)	2	Medical Supplies	5
Bank (Foreign)	2	Metal Fabricating	10
Bank (Midwest)	2	Metals & Mining (Div.)	5
Beverage (Alcoholic)	3	Natural Gas (Distributor)	10
Beverage (Soft Drink)	3	Natural Gas (Diversified)	10
Building Materials	5	Newspaper	3
Cable TV	10	Office Equip & Supplies	5
Canadian Energy	10	Oilfield Services/Equip.	5
Cement & Aggregates	10	Packaging & Container	5
Chemical (Basic)	10	Paper & Forest Products	10
Chemical (Diversified)	10	Petroleum (Integrated)	5
Chemical (Specialty)	10	Petroleum (Producing)	5
Coal/Alternate Energy	5	Precision Instrument	5
Computer & Peripherals	5	Publishing	3
Computer Software & Svcs	3	R.E.I.T.	3
Copper	5	Railroad	5
Diversified Co.	5	Recreation	5
Drug	10	Restaurant	2
Drugstore	3	Retail (Special Lines)	2
Educational Services	3	Retail Building Supply	2
Electric Util. (Central)	10	Retail Store	2
Electric Utility (East)	10	Securities Brokerage	2
Electric Utility (West)	10	Semiconductor	5
Electrical Equipment	10	Semiconductor Cap Equip	5
Electronics	5	Shoe	3
Entertainment	3	Steel (General)	5
Environmental	5	Steel (Integrated)	5
Financial Services	2	Telecom. Equipment	10
Food Processing	3	Telecom. Services	5
Food Wholesalers	3	Textile	5
Foreign Electronics	5	Thrift	2
Foreign Telecom.	10	Tire & Rubber	5
Furn./Home Furnishings	3	Tobacco	5
Gold/Silver Mining	5	Toiletries/Cosmetics	3
Grocery	2	Trucking/Transp. Leasing	5
Healthcare Info Systems	3	Utility (Foreign)	10
Home Appliance	5	Water Utility	10
Homebuilding	5	Non-technological Service	2
Hotel/Gaming	3	Retail, Tech Service	3
Household Products	3	Light Manufacturing	5
Industrial Services	3	Heavy Manufacturing	10
Insurance (Diversified)	3	Research, with Patenting	10
Insurance (Life)	3	Long Gestation Period	10

ABOUT THE AUTHORS

Nam D. Pham, Ph.D., Managing Partner

Nam D. Pham is Managing Partner of ndp | analytics, a strategic research firm that specializes in economic analysis of public policy and legal issues. Prior to founding ndp | analytics in 2000, Dr. Pham was Vice President at Scudder Kemper Investments in Boston. Before that he was Chief Economist of the Asia Region for Standard & Poor's DRI; an economist at the World Bank; and a consultant to both the Department of Commerce and the Federal Trade Commission. Dr. Pham is an adjunct professor at the George Washington University. Dr. Pham holds a Ph.D. in economics from the George Washington University, an M.A. from Georgetown University; and a B.A. from the University of Maryland. He is a former member of the board of advisors to the Dingman Center for Entrepreneurship at the University of Maryland, Smith School of Business and the Food Recovery Network.

Mary Donovan, Principal

Mary Donovan is a Principal at ndp | analytics. She serves dual roles of economist and communications manager. Her responsibilities include client research and analysis, as well as public relations. Before joining ndp | analytics, Mary was an Account Executive at the Kellen Company where she provided full-service management, including government affairs work and strategic consulting, to trade associations in the payments and food-business industries. Mary holds a Master's in Applied Economics from the University of Maryland and a Bachelor's from State University of New York (SUNY) Geneseo.

Bonnie Pierce, Managing Director

Bonnie Pierce is a Managing Director of ndp | analytics where she is responsible for strategic project development. She has over 20 years of experience in partnering with global and domestic corporations, governments, foundations, and universities to build customized investment solutions and instil best practices. Prior to joining ndp, she spent her career at New Century Advisors, Mercer, State Street Global Advisors, Schooner Asset Management and Schooner Capital Corporation. Bonnie holds an MBA from Columbia Business School and an MBA from London Business School with concentrations in Finance and Corporate Strategy respectively. She also holds an MA in International Relations and a BA in History from Boston University. She is a former trustee of the National Presbyterian School in Washington, DC and is an adjunct professor at the George Washington University School of Business International Business as well as the Strategic Management and Public Policy Departments and a former member of GWU's Healthcare MBA Advisory Board. Bonnie is also a Sommelier.

ABOUT NDP | ANALYTICS

Founded in 2000, ndp | analytics produces reports and products through the rigor of quantitative analyses. Our work is rooted in economic fundamentals that construct deliverables that appeal to a broad audience through clear messaging.

Our firm has advised the business community on the economic impacts of a wide-range of public policies, developed comprehensive research-based advocacy programs, established benchmarks across industries, and assessed the costs and benefits of major legislation and regulations.

The work our team has conducted has been prominently cited in numerous channels including the Economic Report of the President to Congress, national media outlets, reports from government agencies, Congressional testimonies, and by Members of Congress. We provide support to a diverse group of clients including trade associations, corporations, law firms, multilateral organizations, and government agencies.

"In his usual writing style of clarity and focus, within just a few pages, Dr. Pham efficiently exposes an important bias potentially present in many studies of operating and financial performance of technology-intensive firms. In a short paper, sufficiently illustrated by graphs and inserts that highlight the gist of every page, he brings to light the materiality of mismeasurement of certain important corporate metrics, which mismeasurement results from the common but not entirely appropriate treatment of the research and development account."

Robert Savickas, Professor of Finance, School of Business,
The George Washington University

Connect with us

www.ndpanalytics.com

@ndpanalytics

www.linkedin.com/company/ndpanalytics/

ndp analytics
turning data into action