Are Pharmaceutical Profits Excessive? Assessing the Relationship between Profit, Industry, and Research & Development

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1. Introduction

In recent years, the pharmaceutical industry has drawn the spotlight in the United States, with both the public and members of both major political parties expressing the need for change. In rare agreement, political leaders including President Trump and Senator Sanders have called for reductions in drug prices. Coupled with the tragedy of the opioid crisis, public dissatisfaction of the industry is as high as it has been in decades, leading to real possibilities for legislative or executive reform. The pharmaceutical industry has responded to these charges of excessive profiteering with claims that these high prices are necessary to survive the high levels of risk and Research and Development (R&D) spending necessary for drug manufacturing. Given this striking national environment, this paper analyzes pharmaceutical profits, in order to determine if there is an actual, significant, profit differential between this industry and other major industries within the American economy accounting for factors such as R&D spending and company size.

This paper attempts to answer these questions through an econometric model that assesses the relationship between industry and profit, with appropriate controls, that gives context on whether the pharmaceutical industry is an outlier or in line with the rest of the subsectors of the economy. It considers data from the years 2010-2018, both to avoid replicating similar studies that have analyzed older data as well as to focus on the most relevant data given the emphasis on the unique environment of the current pharmaceutical industry. In order to provide a complete picture, this paper presents regressions of solely industry on profits, industry on profits with controls for R&D expense, fiscal year, and market capitalization, as well as subsetted regressions for three year blocks within the time frame. With this multifaceted approach, I hope to provide a thorough accounting of the profit differential.

To precede, this paper is structured first with a full literature review of the relevant work on this issue, preceding the empirical framework and model results. Following that will be a conclusion summarizing the paper and discussing further steps, along with a full appendix of tables and figures of the empirical analysis.

2. Literature Review

In the pharmaceutical world, it is standard for companies to have patent protections on their proprietary drugs, leading to de facto monopolies for the length of their patents. This has led to some consumers paying exorbitant prices for their medications. According to the US Department of Human Services (2015), prescription drug spending in the United States was about $457 billion in 2015, or 16.7 percent of overall personal health care services. This has led to criticism of the industry, and calls for regulation of what critics see as profiteering by these pharmaceutical companies. However, these companies cite the larger Research and Development (R&D) spendings necessary to create these drugs, as well as the temporary nature of their profit window, as explanations for why these high prices are necessary in order for innovation to continue.

One analysis that helped to set the conventional wisdom of the necessary nature of these high profits was Scherer (1993), who stated “a pell-mell march toward regulation of pharmaceutical industry pricing could seriously impair the industry's incentives for investment in new products”. He described a trade-off between moderately excessive profits and slowed innovation, and concluded it was always more important to maintain innovation. Other economists have estimated the social cost of this tactic. Santerre and Vernon (2006) estimate the average opportunity cost of drug development when priority has been placed on innovation.

They find that, for a hypothetical price control policy that holds drug price increases to the same rate of growth as the general consumer price level, the period of time from 1981 to 2000 would be estimated to have "consumer surplus gains from this hypothetical policy of $319 billion at the end of 2000 but would have led to 198 fewer new drugs being brought to the U.S. market, giving an average social opportunity cost per drug developed during this period to be approximately $1.6 billion" (Santerre and Vernon, 2006). However, Santerre and Vernon (2006) noted that there have been studies that show the average social benefit of new drugs at greater than $1.6 billion, and were generally not in support of more price control.

While the pharmaceutical industry has always been accused of excess profiteering, some have argued that companies today have taken it to an extreme, and are seriously hurting consumers. A study done on the effect of high insulin prices on users found that over the past decade, insulin prices have tripled in the United States, and that 25% of insulin patients report cost related insulin underuse (Herkbert, et al. 2019). The Centers for Medicare and Medicaid Services have reported that consumer prescription drug expenditures have gone from $253 billion in 2012 to $335 billion in 2018, a 32% increase in just six years. While the companies have again cited their high R&D costs as the necessary driver behind their pricing, their marketing expenses often outpace their R&D costs. DiMasi et al. (2016) report that of the 10 largest pharmaceutical companies, only one spends more on research than on marketing its products. These factors all point to a need for the reinvestigation into the conventional wisdom cited above about the necessity of high pharmaceutical profits.

Spitz and Wickham (2012) attempt to determine the profitability of pharmaceutical companies in comparison to other industries. The authors found that "to the question of whether pharmaceutical drug costs are justified by R&D, the answer is no. Pharmaceutical firms do

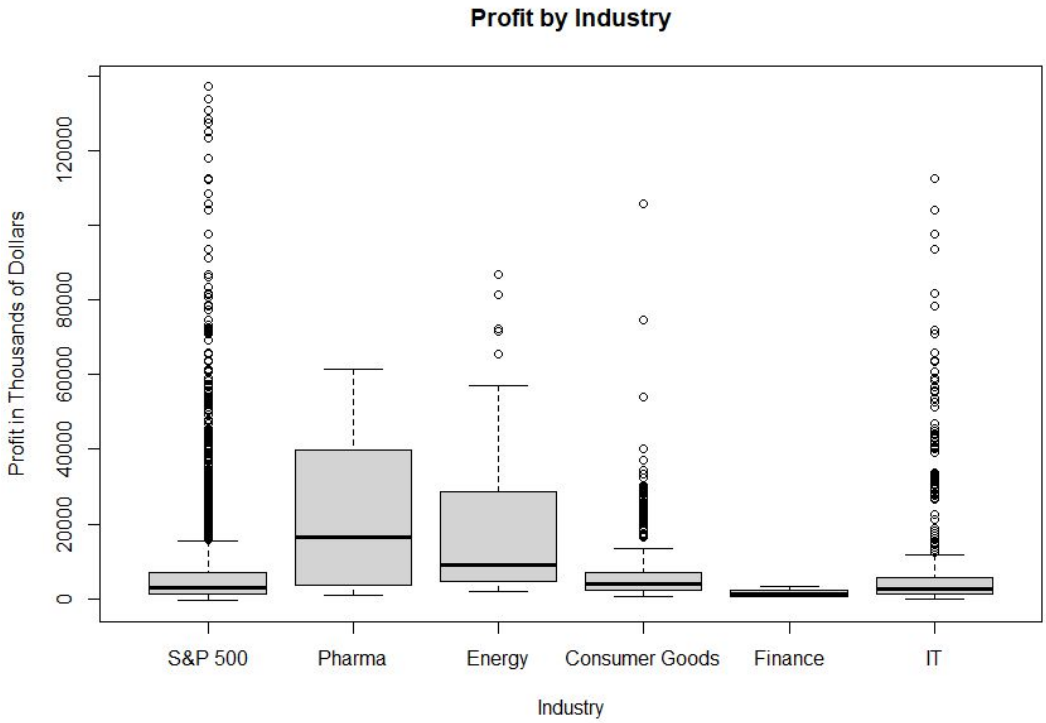
indeed invest money in R&D, as do other production and service firms, but this investment does not account for their large ongoing profit, which ranges from 2.5 to 37 times the non-pharmaceutical industry average over time" (Spitz and Wickham, 2012). They saw that there were comparable firms in many different industries that survived while investing a similar percentage of their operating income into research and development while making far less profits, and further that most of the excess profits in the pharmaceutical industry did not go back into R&D. Of particular interest to this paper is their empirical model which arrived at the 2.5 to 37 figure, as the differential profits of pharmaceuticals compared to all other industries is also the topic of this paper. Their equation predicted profit for a company 'i' in year 't' using an indicator variable for the pharmaceutical sector, which provides the coefficient of interest, and controls for R&D spending and a second indicator variable for whether or not the company is in the service industry. This analysis was based on data from the years 1988 to 2009. While the question is the same, my approach relies on a different regression equation and dataset.

While this topic has been studied extensively, my paper will still add a necessary piece to the literature. In my research, data through 2009 was the latest addition to the literature, which shows the necessity for an update. As discussed above, extreme pricing in the pharmaceutical industry has risen substantially since 2009, potentially changing the profitability differential. In addition, the passage of the Affordable Care Act has altered the industry, and may have an affect on the results. My empirical methodology also differs from that of prior studies, through the addition of year fixed effects to account for yearly trends, as well as a control for market capitalization to account for the effect that company size has on profits. By using a different methodology and an updated dataset, this paper provides clarity on the current state of profitability in the pharmaceutical industry compared to the general S&P 500.

3. Data, Methodology and Empirical Findings

To focus on the actual findings, the first question to ask is whether profits in the pharmaceutical industry are actually significantly higher than those in the rest of the S&P 500. To assess that, I plot the average profit by industry in the selected time period in Figure 1.

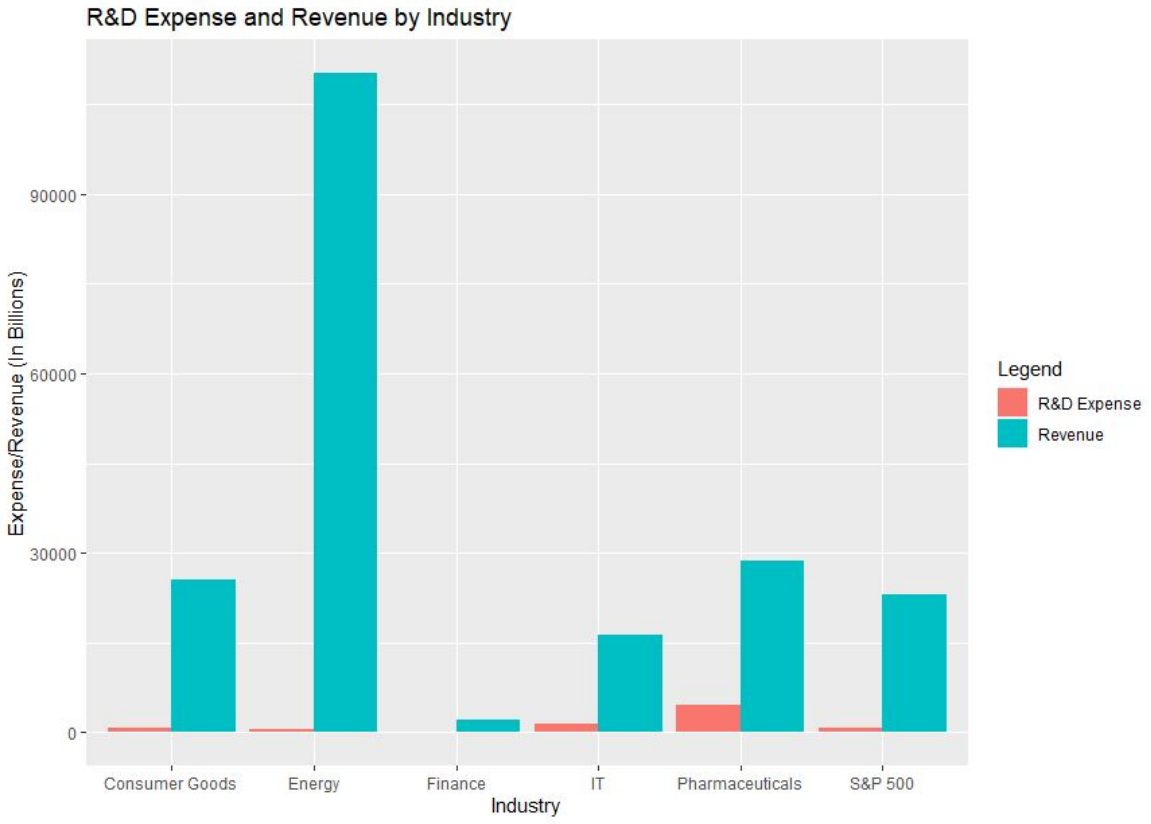
Figure 1



As is clear in Figure 1, the average profit in the Pharmaceutical industry is higher than in the overall S&P 500, as well as greater than selected high-profit industries such as Energy, Finance, and Information Technology. From this initial, simplistic but informative analysis, the size of this difference is extremely pronounced, as the 25th percentile of profit for pharmaceutical companies is roughly equal to the 75th percentile of profit for the overall S&P 500. Put another way, the profits of a great year for the average company in the overall S&P 500 index and the profits of a poor year for an average pharmaceutical company are expected to be relatively equal.

With this knowledge, the next question concerns the R&D expenses that are required for each industry. As discussed in the literature review above, a primary defense of higher profits in the pharmaceutical industry is that significantly more R&D expenses are required of companies in this industry, and that the risk and loss due to the time value of money inherent in this investment is why higher profits are necessary. To analyze this, a comparison again of the pharmaceutical industry and other industries within the S&P 500 is presented in Figure 2. For context on the size of the companies and how large of an expense R&D is to their overall income, revenue is included in the figure as well.

Figure 2



From Figure 2, it is clear that R&D expenses are on average far higher in the Pharmaceutical industry. This does give merit to the defense often brought by the pharmaceutical industry, that the levels of profit are necessary because of this burden of R&D expenses. This result led to the inclusion of R&D expenses in the regression model in an effort to account for this.

The data used in this paper comes from the Wharton Research S&P 500 Database, which contains detailed financial information on each company within the index. The time frame of the data is from the years 2010-2018. I estimated the profit differential with the regression equation below.

$$\text{Profit}_{i,t} = \beta_0 + \beta_1 \text{Pharmaceutical}_i + \beta_2 \text{R\&D}_{i,t} + \beta_3 \text{Market Capitalization}_{i,t} + \gamma_t + \varepsilon_{i,t}$$

Where $\text{Profit}_{i,t}$ is the profit of a company *i* in year *t*. Pharmaceutical_i is a categorical variable equal to 1 if *i* company is classified as within the pharmaceutical industry, and 0 if otherwise. $\text{R\&D}_{i,t}$ and $\text{Market Capitalization}_{i,t}$ are both control variables that take on the value of the Research and Development expense and Market Capitalization value respectively for each company *i* in each year *t*. γ_t are the fiscal year fixed effects, and $\varepsilon_{t,i}$ are the error terms for each company *i* and year *t*.

While other analyses have used very similar regression models, the analysis presented here is unique and adds to the literature for two primary reasons. It is the first to use this exact specification, controlling for both R&D expenses and Market Capitalization, and it focuses on more recent data, analysing a time period from after previous studies have been published.

While the Wharton Research Database is very reliable, there was a significant amount of missing values, especially within the Research & Development variable. As this control is crucial to the analysis and interpretation of the findings, the model was restricted to companies and years in which all relevant data was reported and found within the database.

The estimation results are shown in Table 1. All numbers are in millions of dollars, and the base year for the year fixed effects is 2010.

Table 1

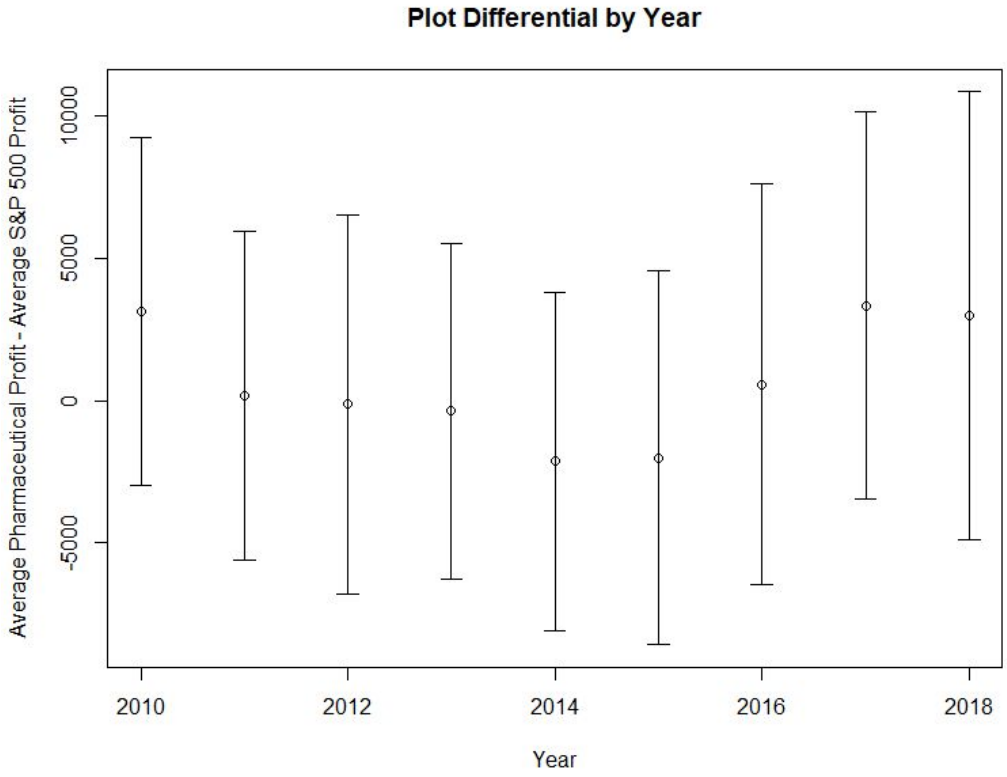
Pred. Variable	(1)	(2)	(3)
Intercept	7658.3*** (300.3)	1581.37*** (198.19)	2664.16*** (535.3)
Pharmaceutical	14433.8*** (1766.4)	3674.29*** (1097.47)	3654.29*** (1091.45)
R&D Expense		.119 (.124)	.099 (.12)
Market Capitalization		.162*** (.0033)	.164*** (.00332)
2011			421.45 (749.17)
2012			18.51 (747.7)
2013			-978.17 (747.47)
2014			-1308.63* (744.2)
2015			-1566.21** (744.43)
2016			-1875.83** (744.61)
2017			-2843.06*** (740.72)
2018			-1963.71** (736.72)
Observations	2451	2451	2451
R^2	.026	.698	.70

Notes: Standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.001.

As Table 1 shows, at every model specification companies within the pharmaceutical industry are more profitable on average than the average of the rest of the companies within the S&P 500, even after controlling for market capitalization, R&D spending, and year fixed effects. The initial regression, with just the binary pharmaceutical variable, gave a profit differential of over 14 billion dollars, a tremendous gap. However, adding in R&D expenses and market capitalization decreased the estimate to roughly 3.674 billion, suggesting that even for companies across industries with comparable values of R&D spending, there still exists a significant profit differential. The year fixed effects did not have a significant effect on the profit differential, but do provide additional context to the economic environment. Additionally, it is important to note that the profit differential was statistically significant to a high degree across all three regressions, meaning that the probability of such a difference occurring by pure chance alone is extremely unlikely.

It is also of interest to determine the consistency of this profit differential, and to analyze whether these effects come primarily from specific years or if there is some wide year by year variation. To do so, Figure 3 plots the profit differential found from the regression model (2) on a subset of the data for each year within the model, with 95% confidence intervals around the estimate.

Figure 3



While Figure 2 does show some year to year variation, the majority of the estimates are still positive. Comparable plots of other industries show much more volatility, as would be expected over a decade with large economic shifts. While none of these 95% confidence intervals are conclusively above zero, taken together the probability of the average being below 0 is exceedingly small, as shown in Table 1. All together, this figure confirms that the profit differential is likely to exist each fiscal year.

4. Conclusion

The profits of the pharmaceutical industry are a crucial value for the health of the people it serves, and as much information as possible is needed for informed decision making by involved parties. It is a balancing act, where too much regulation and insufficient profits may lead to less new drugs created in the future, while too much profit and too little regulation may lead to people unable to access the medicine they need to live.

The empirical findings in this paper do show average profits in the pharmaceutical industry as well above the average for companies in all other sectors of the S&P 500. The primary model finds this difference, for the years 2010-2018 and after controlling for research and development expenses, market capitalization, and year fixed effects, to be about 3.674 billion dollars a year. While this result only applies to companies on the S&p 500 index and within this time period, the result was statistically significant, with a p-value of less than .0001.

As discussed in the literature review section, the primary argument on why this profit differential is necessary has to do with the level of R&D spending, while reform advocates label it excessive due to the adverse effects high prices have on consumers. The empirical findings in this paper do not seem to support the R&D argument, as controlling for this expense still resulted in a profit differential in the billions. However, these are complicated issues and more research should be done as to the long term effects of large R&D expenses, as well as what percentage of these higher profits are re-invested in R&D. This issue is crucial to the lives of millions, and my hope is that this analysis along with further research can lead to the right balance of regulation.

5. Works Cited

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