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Innovation in Academic Institutions: How a Pharmaceutical Company Capitalizes on University Connections in its Board of Directors

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Innovation in Academic Institutions: How a Pharmaceutical Company Capitalizes on University Connections in its Board of Directors

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ABSTRACT

This study attempts to identify the types of pharmaceutical companies that utilize university employees as directors on their boards and if in fact having university connections on a pharmaceutical board impacts company performance. Board-level data from 2009 and firm-level data from 2008 was gathered for 109 pharmaceutical companies that varied greatly in size and geographic location. The key findings of this study were that the larger the pharmaceutical company and the greater the R&D expense of that company the more likely the company would have university connections on its board of directors; the larger the company, the better the universities and medical schools these directors would be employed at. These connections are believed to symbolize and secure strategic alliances between pharmaceutical companies and academic institutions. Pharmaceutical companies can therefore tap into innovative research pipelines at these universities for new drug discovery and development. While there was not strong evidence that university connections on a pharmaceutical board directly impacted company performance, larger pharmaceutical companies, who were more likely to utilize such connections, did yield greater earnings per share and return on assets than smaller companies, who were less likely to utilize such connections on their boards.

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PREFACE

"The human race can survive perfectly well without an endless supply of new drugs but the corporations that produce them can't" (Law, 2006). In the pharmaceutical industry time truly is money. With blockbuster drug monopolies expiring after 20 years of patent protection, the companies that make these drugs are forced to continue to innovate; utilizing new drug technologies and an extensive and diverse pipeline of research and development in order to bring new drugs to the market. However, developing new drugs is not a given, and in fact, new drugs are becoming more and more of a rarity in an industry that needs them in order to be sustainable. Companies simply cannot exist solely on blockbusters when generics or 'me-too' drugs steal their market share as their patent lives wear off. Numerous methods and strategies exist to keep the drug pipeline pumping. A common move is for pharmaceutical companies to join strategic alliances, merge, or acquire other firms. When this occurs, the joint or parent company increases its catalog of not only drugs presently on the market, but drugs in development and research pipelines to create the necessary innovation for future sustainability.

While the pharmaceutical industry regards itself as a research-based, life-saving industry, justifying high drug prices to fund present and future development, many may be surprised to learn that most of the R&D in this industry is outsourced, and not in the research labs of Pfizer or Johnson & Johnson. So the question becomes, where is this R&D outsourced to? The majority of the R&D in the pharmaceutical industry is performed by (1) the

government, the National Institute of Health (NIH), (2) small biotechnology companies, and (3) academic institutions.

Number (3) is where I will focus this study. When corporate governance of pharmaceutical companies is examined, a common theme becomes apparent. Pharmaceutical companies often have university employees on their board of directors, and thus university connections. Whether they are medical professors, non-medical professors, or even chancellors, the fact of the matter is that these directors are affiliated with a university; a potential R&D pipeline for the pharmaceutical industry. Thus, my initial reaction was, you don't have to look much further than a pharmaceutical companies' board of directors to learn what kind of university research connections it has. Through my extensive research of 109 pharmaceutical companies, patterns began to emerge, and became so clear to me that I was able to quite accurately predict the number of university members on a pharmaceutical company's board, and the quality of universities these directors were affiliated with.

The research on this topic began through my interest in innovation. My initial topic was to research how Apple had gained such a dominant market share position through its innovation of MP3 Players; the iPod. However, to do an appropriate study, there simply weren't enough players in the industry. Thus, Professor Dharwadkar introduced me to another industry, pharmaceuticals. My initial exposure was through the text *The Truth About the Drug Companies*, by Marcia Angell, M.D. I became quite interested with the theme of R&D spending versus marketing spending in the industry, and how firms mask such high

marketing spending to maintain the perception of being research-driven, or life-saving for that matter. Over the course of the next year I read numerous texts and articles on the industry, developing a list of common themes. Eventually, I narrowed down my interests to patents, blockbuster drugs, and university-industry relations. Having already taken the initiative of researching the top medical schools and examining the board of directors at Fortune 500 pharmaceutical companies, combined with Professor Dhardwadkar's expertise in corporate governance, I chose this area to focus my study on. With the initial question of what makes one pharmaceutical company more innovative than another, we would be looking for trends in corporate governance, university connections, and performance in the industry,

To offer a brief introduction and illustration of the research I conducted, and the data I extracted, I will highlight Johnson & Johnson, an American pharmaceutical company with over 118,000 employees and $63.747 billion in sales in 2008 (the largest pharmaceutical company in the world at the time, which has now been surpassed by Pfizer following its late 2009 acquisition of Wyeth). Johnson & Johnson currently has 10 directors on its board, four of whom are employed by universities. These include two medical-related university employees: Susan L. Lindquist, Ph.D., Professor of Biology at the Massachusetts Institute of Technology; and David Satcher, M.D., Ph.D., Director at the Morehouse School of Medicine, and two non-medical university employees: Mary Sue Coleman, Ph.D., President of the University of Michigan, and Michael M.E. Johns, M.D., Chancellor of Emory University. With one of the largest

pharmaceutical companies in the world having a board made up of 40% university employees, one would be safe to assume that their place on the board matters, and matters greatly. Based on credible international university rankings and medical school rankings we can then identify the quality of the universities these directors come from and the type of pharmaceutical companies that utilize them. Certainly one would expect a larger, more established pharmaceutical company to be more likely to have a Harvard Medical School professor on its board than a smaller, unproven company. But if this expectation is in fact a reality, what realistic difference does this make? How does having such connections impact the company? And what types of pharmaceutical companies have such university connections on their boards?

Before I get into the methodology of my study and its findings, it is important to provide an in-depth look into the pharmaceutical industry as a whole. My literature review will cover the areas of patents, research and development, open innovation and externalization of R&D, and the focus of my study: university connections through pharmaceutical companies' corporate governance.

ADVICE TO FUTURE STUDENTS

The Honors Capstone project can be a long and tedious process. Think of it more as a journey rather than a project. It's an elaborate and mind-opening education on a topic of your choice, in the field you wish to gain greater expertise in. While it's easier said than done, I highly suggest starting as early as you possibly can. If you can already be making headway your fall of your Junior year, you'll be in great shape. This is not something you want to rush or ever feel stressed about. Like I said, it's an education, and I don't believe learning should ever be rushed. If you can spread out your research over time, and be well-organized in your pursuit, than the overall experience will be that much more fulfilling.

If you find early on in your process that this is not a topic you will be interested in, stop. It is not worth your time and effort to spend over a year on something you don't care about; you aren't passionate about it. You need to own what you're doing. If you can own your work and truly absorb yourself in the research it'll almost become a sort of hobby for you to be an expert on a topic. You'll find yourself talking to other people about it and genuinely being interested in your own work.

I promise you that if you give yourself plenty of time, work on capstone diligently, and dive into your research, that you will be rewarded in the end. When you have finally finished, it's an incredibly satisfying experience. Whatever your topic, or however many words you write, is not what matters. What matters is that you stuck it out and finished. While many are tempted to

back out of the honors program by their senior year to avoid writing a thesis, the ones that do stick with it and graduate with honors are the ones standing tall and proud in the end. Good luck with your research and pick a topic you will really be interested in learning more about. I knew very little about the pharmaceutical industry when I began, and by the end I was checking the stock tickers of many of the companies I had researched on a daily basis.

ACKNOWLEDGEMENTS

I would first and foremost like to thank my advisor Ravi Dharwadkar. While taking his global business course during the fall of my junior year, I became increasingly interested in the world around me. Aside from his teachings, and my time spent studying abroad, Professor Dharwadkar inspired me to reach my potential for success and made me think about academia, professionalism, and the increasingly globalized world in which we live in, in a different light. Over the nearly two years I was in contact with Ravi I learned a tremendous amount about the Pharmaceutical industry and the complexities of writing a research paper in his field. I owe nearly all of my commitment and hard work on this capstone project to Ravi for his continuous support, direction, and teachings.

I would also like to thank my friends and family who listened intently over the past year about my thesis. Even if they didn't always understand it, or wish to for that matter, they provided me with great support and feedback along the way.

During my nearly two years spent researching and writing this paper, I transformed from a student into a young professional. I went from simply being the educated to doubling as the educator. I grew greatly as a person in and outside of school. While I step into the corporate world next year I will always look back on this process; what I learned, what I accomplished, and my experiences and mentors at Syracuse University that guided me along the way.

PHARMACEUTICAL PATENTS: WHEN A MONOPOLY BECOMES EXPOSED

The constant need for new drugs would not be present if it weren't for the limited life of patents. Patents in the U.S. and the rest of the world expire after 20 years. The life of one patent, covering an approved pharmaceutical product containing a new drug, may be extended by up to five years in the U.S., Europe, and Japan to make up for time lost in obtaining approval for marketing (Voet, 2008). While patents reward companies for their development of new drugs, the reward is limited. Patents prevent pharmaceutical companies from having an infinite stream of revenue from a single blockbuster drug. This time stamp forces pharmaceutical companies to constantly innovate, planning for their future when their current patented drug or drugs have reached their expiration date.

Martin A. Voet, Senior Vice President and Chief Intellectual Property Counsel for a Fortune 500 pharmaceutical company, describes a patent as a 'legal monopoly,' in his book *The Generic Challenge: Understanding Patents, FDA & Pharmaceutical Life-Cycle Management.* As Voet (2008) clarifies, "a patent is a governmental grant that provides the holder for a limited period of time the exclusive right to prevent others from making, using or selling the patented product or process in exchange for his disclosure of the invention to the public." Certainly the most important aspect to patent law is its 20 years of limited life. In 2011, Pfizer will be forced to replace the lost sales of Lipitor, when it runs out of patent protection. Lipitor was by far the world's biggest selling drug in 2008,

with global sales of $13.7 billion (representing 31% of all Pfizer's 2008 global sales). However, in 2011, those sales will start declining, and potentially at a rapid pace. Once patents for drugs, such as Lipitor, run off, generics rush in to steal market share, and they do so at a cheaper price.

Generic companies have no expense for discovery, development, or marketing of drugs. They are legally allowed to copy an innovator's drug after a short time of exclusivity for the innovator, unless there is patent protection, in which they must wait for that protection to run out. If they can overcome the patent protection, they can legally obtain rights to use all the safety and efficacy data developed by the innovator and copy the drug (Voet, 2008). If generics are so much cheaper to develop and deliver, than why hasn't 'big pharma' taken this strategy over blockbusters? Well, in fact, many have, and we can particularly see this trend in foreign companies, most notably Teva Pharmaceuticals. The emergence of this Israeli company, who was ranked 17th in global pharmaceutical sales in 2008, along with the growing power of other generic companies, poses an increasing threat to established pharmaceutical companies (Gassmann, Reepmeyer, & Zedtwitz, 2008). It has been made quite public that companies such as Pfizer, along with Merck, and Schering-Plough have been heavily reliant on blockbuster revenues in recent years and are now facing patent expiration and maturing drug portfolios. It will be interesting to see the effect that patent expiration has on these 'big pharma' companies in then near future. In late 2009 we already saw one reaction to this anticipation of declining sales, as Pfizer acquired Wyeth, 10th in 2008 global pharmaceutical sales, and owners of three big

blockbuster drugs: Effexor, Prevnar, and Enbrel, which had combined sales of $9.2 billion in 2008.

As patent life wears off, companies such as Pfizer must have new drugs in development and ready to enter market. As I mentioned earlier, time is money. While this phrase is cliché, it truly is the name of the game in the pharmaceutical industry. In the 2008 book *Leading Pharmaceutical Innovation: Trends and Drivers for Growth in the Pharmaceutical Industry*, the authors suggest that time-to-market is extremely important in breakthrough pharmaceuticals, because "the first in the market captures between 40 to 60 percent of the market, and the second only around 1 percent. Coming in third already means a negative business" (Gassmann et al., 2008). Not only do these firms need to have a constant pipeline of new drug development, but they need to be faster and more efficient in developing the drugs than the next firm. They need superior R&D to be a superior pharmaceutical company. Without R&D, innovation is not possible, and without constant innovation, pharmaceutical companies cannot survive.

THE IMPORTANCE OF R&D IN THE PHARMACEUTICAL INDUSTRY

Research and development is the all important sector of the pharmaceutical industry that discovers and drives news drugs to market; fueling innovation. However, R&D is a very delicate area, and truly the one division of a pharmaceutical company that can make or break its fate. The discovery of just one new drug can transform an unknown pharmaceutical company to being a major player overnight. In the case of Lipitor, we can see the tremendous impact just one new blockbuster drug can have on a company's sales. However, in order to grow and maintain sustainability in the future, this pipeline of new drugs must continue; it must be constant. The failure of a newly developed substance during the R&D process causes significant losses. Thus, the attrition rates in drug development expose pharmaceutical companies to tremendous risks. In fact, even the slightest bit of adverse news about a new compound in development can cause share prices of pharmaceutical companies to plummet, literally erasing several billions of dollars in shareholder value within minutes (Gassmann et al., 2008). With such significant risks in R&D, and the pressure on successful drug development, no company is completely safe. However, the bigger companies diversify themselves to reduce such risk. Whether it is in the place of mergers and acquisitions to enhance a company's drug catalog or the outsourcing and diversification of R&D to increase rate and opportunity of new drug discovery, firms understand the tremendous importance of R&D, and take strategic measures to reduce risk and enhance the success rate of new drug discovery.

To help support the importance of R&D to innovation, and thus new drug development, I will draw from an article entitled "Corporate Governance and the Governance of Innovation: The Case of Pharmaceutical Industry," written by Nicola Lacetera in the *Journal of Management & Governance in* 2001. Lacetera (2001) confirms that many studies have shown a strong relationship between R&D and innovative performance in pharmaceuticals and other science-based firms. R&D is so vital that a significant percent of the profits made by drug companies in marketing and selling their current drugs is plowed right back into research to discover and develop future drugs. Martin A. Voet (2008) summarizes this cycle precisely as, "no profits on current drugs, no research on future drugs." It is important to think of R&D in such a cyclical manner, because the purpose of R&D is for future innovation, and this cannot be funded without a firm's current products, which were once drugs in the developmental stage of a research lab as well.

Let's take another example from 'big pharma.' The CEO of Roche Holding AG, Severin Schwan, said in a December, 2008 interview with the *Wall Street Journal*, "Those who fail to bring sufficient innovation will be squeezed out of this market" (Whalen). To that end, Roche has begun to boost its R&D spending as a percentage of its sales in order to spur necessary drug development (Whalen, 2008). In 2008 Roche spent $7.2 billion on R&D, which accounted for roughly 34% of its 2008 global pharmaceutical sales. This was a $500 million increase from 2007 when Roche spent $6.7 billion on R&D (33% of sales). Roche, whose 2008 sales ranked 8th amongst global pharmaceutical companies,

has taken the initiative to spark more innovation in its company through R&D expenses. The authors of *Leading Pharmaceutical Innovation*, agree with Schwan's opinion on the current state of the industry, as they believe there is need for increased innovation as well. According to this source, "pharmaceutical innovation and the number of new products will have to increase in order to sustain growth" (Gassmann et al., 2008). Gassmann et al. (2008) are also in agreement with my previous statements on the need for a continuous flow of new drugs when they state that "the drug development pipeline is the engine that drives pharmaceutical companies."

OPEN INNOVATION AND EXTERNALIZATION OF R&D

Since R&D is so vital to the pharmaceutical industry, and it can be such a risky process, diversification is a necessity. Along with the delicacy of developing new drugs, costs of R&D are rising rapidly, driven by larger and more complex clinical studies and expensive new enabling technologies (Gassmann et al., 2008). Through my research I have found that firms are reacting to these factors in a multitude of ways. Two strategies that are practiced commonly in the industry are (1) open innovation, such as mergers or acquisitions, and (2) externalizing R&D, such as tapping into government sponsored research at universities. The dramatic rise of biotechnology firms can fill both of these strategies as pharmaceutical companies can acquire or partner with them or create an alliance to outsource R&D to them. For the relevance of my study however, I am most concerned with how pharmaceutical companies tap into research at universities. However, open innovation is also extremely relevant to this business model, since mergers and acquisitions increase and diversify a company's resources, and in particular, can increase its university connections for research.

Mergers and Acquisitions

Mergers are a strategic move for pharmaceutical companies because they exploit synergy effects, resulting in the reduction of costs in administration, sales, and development. They also allow for access to new markets and industry subsectors (Gassmann et al., 2008). Mergers and acquisitions increase a company's drug catalog on the market and in development. With more internal

and external research resources available, companies can reduce risk and hopefully increase their production of new drugs.

The case of Pfizer is once again most relevant to this topic of open innovation as it is the most recent 'big pharma' company to make a blockbuster acquisition. A January, 2009 article in *The Economist*, highlights the case of Pfizer, taking over Wyeth, as "cement[ing] its position as the world's leading drugmaker" ("Taking something"). Pfizer, as the article reports, felt the need to make a move during tough economic times as its blockbuster drug Lipitor is set to go off patent in 2011. Its pipeline was not flowing at the rate necessary to plug such a gap. Acquiring Wyeth provides Pfizer with "some protection, as costs could be cut by bringing together research budgets and by reducing vast overlapping marketing operations of the two firms. Wyeth also contained a cash-generating vaccines business and useful biotech expertise, an area where Pfizer had few products" ("Taking something," 2009). In another January, 2009 article in *The Economist,* Charles Farkas of Bain, a consultancy, adds that the deal is a useful "half step" forward for Pfizer. While Farkas (2009) believes that Wyeth's assets will buy it some time, it won't be enough to replenish the research pipeline or to replace Lipitor ("Buying Time"). Ultimately, we get the indication that while Pfizer needed to make a move, the acquisition of Wyeth was simply a short term solution to satisfy its shareholders. In an age when new drug development is declining and innovation is hard to come by in the pharmaceutical industry, a loss of a drug such a Lipitor may be irreplaceable no matter what kind of open innovation measures Pfizer takes.

Big deals such as Pfizer's have been scrutinized by Michael Rainey of Accenture, who has reached the conclusion that "nine out of ten deals created no value or negative value" ("Buying Time," 2009). David Brennan, CEO of AstraZeneca adds that "if big efficiency improvements were really possible, good managers would do them anyway, rather than pursuing mergers" ("Buying Time," 2009). Even amongst research there appears to be no connection between size and success, and if anything, says this article from *The Economist*, "larding on extra layers of research managers stifles the entrepreneurial spirit that makes nimble biotechnology firms successful" ("Buying Time," 2009). Sometimes bigger is not better, and especially in the case of the pharmaceutical industry, expanding research capabilities so greatly, can really hinder the entrepreneurial spirit of the company, as *The Economist* article suggests, having adverse effects on innovation.

Thus, strategic alliances rather than 'set-in-stone' mergers or acquisitions may be a smarter practice for pharmaceutical companies today. Relating back to the article "Corporate Governance and the Governance of Innovation: The Case of the Pharmaceutical Industry," Nicola Lacetera focuses on organizational dynamics that have characterized the pharmaceutical industry. Lacetera (2001) speaks to research that has shown alliances to work better than mergers and acquisitions. This is most likely due to the flexibility and multidimensionality of such deals (Lacetera, 2001). Alliances can be formed in many ways, whether it is through biotechnology firms as Lacetera (2009) focuses on, or for the case of my

study, academic institutions. Regardless, of who the alliance is with, it provides a platform for a pharmaceutical firm to externalize a portion of its R&D.

Externalizing R&D

While industry giants often merge with or acquire other firms, a common practice in virtually all firms is to externalize or outsource R&D. Outsourcing represents the "loosest" form of cooperation between a pharmaceutical company and its partner firm. The rationale behind outsourcing usually refers to the ability to optimize resources used in internal R&D (Gassmann et al., 2008). Once again, this speaks to diversification and reduction of risk in R&D. Gassmann et al. (2008) have identified the primary drivers for outsourcing R&D to include reduction of over capacities, cost cutting or restructuring issues, growth aspirations, reduction of risk (proactive risk management), and corporate governance (strategic make-or-by decisions). The last driver for externalization of R&D is most relevant to my study and I will dig further into the relationship between corporate governance and strategic R&D resources in the next section.

While externalization for many U.S. firms may consist primarily of utilizing research at biotechnology companies or academic institutions, there has been a trend amongst many international firms to outsource their research operations to foreign countries. According to Marcia Angell, M.D., in her 2004 book *The Truth About the Drug Companies*, some European companies are now locating their R&D operations in the United States. "They claim it is because we don't regulate prices, as foes much of the rest of the world. But more likely it is because they want to feed on the unparalleled research output of American

universities and the NIH. In other words it's not private enterprise that draws them here but her very opposite, our publicly sponsored research enterprise" (Angell, 2004). Even despite the recent global recession, Op-Ed Columnist for *The New York Times,* David Brooks (2009) confirms that "The U.S. remains the world's most competitive economy, the leader in information technology, biotechnology and nearly every cutting-edge sector." Thus, it is simply smart business practice for international pharmaceutical firms to tap into America's hotbed of innovation. Specifically, Gassmann et al. (2008) say that the pioneers of R&D internationalization are high-tech companies operating in small markets and with little R&D resources in their home country.

This further leads to my initial argument that having university connections on pharmaceutical boards makes a difference:

Hypothesis 1*: Geographic location impacts the need for outsourced/external R&D, and thus I believe smaller European companies, with fewer resources in their home countries, will have a greater need for university connections, and this will be reflected on their boards.*

After all, Elan Corp (Ireland), Novartis (Switzerland), and Novo Nordisk (Denmark), must all have a reason for having American university connections on their boards. These companies are based in relatively small countries, with limited resources, and thus the United States would reign supreme for their externalized R&D operations. Of the 24 international companies in my sample of 109 pharmaceutical companies, 11 of the 24 companies have university connections on their boards. However this figure is much more revealing when

broken down, as it is greatly skewed by Canadian companies. In fact, of the 11 Canadian companies in my sample only Bioniche Life Sciences had university representation on its board, while the other 10 had zero university connections on their boards. I could only hypothesize that since Canada, with its close proximity and easy access to the United States, as well as being a NAFTA member, it is quite easy for these companies to tap into American research without the need for university representation on their boards. Of the 24 international companies, 10 were European. Alarmingly, 9/10 European companies in my sample had university connections on their boards. While this sample is quite small, 90% of the European companies I researched had university connections on their boards, while only 51% of American companies did (43/85). This would further support my argument, and the overlying trend found in my literature review, that pharmaceutical companies from smaller markets need to gain access to the tremendous disposal of research in America in order to compete. They can therefore gain these connections or strategic alliances, if you will, through university connections on their boards.

THE BAYH-DOLE ACT: INNOVATION IN ACADEMIC INSTITUTIONS

According to the *Pharmaceutical Executive* magazines "The Pharm Exec 50," a list of the top 50 pharmaceutical companies in the world based on the companies' own reported sales, taken from SEC filing and annual reports, in 2008, the top 10 pharmaceutical companies on that list were: Pfizer, GlaxoSmithKline, Sanofi-Aventis, Novartis, AstraZeneca, Johnson & Johnson, Merck, Roche, Eli Lilly, and Wyeth. While this group of industry giants is diverse in the blockbuster drugs they sell and the countries they find headquarters in, one thing they do have in common is a consistent component of their corporate governance. The boards for all 10 of these 'big pharma' companies have at least one university connection, and on average 2.6 university connections (26/118, or 22%, of the directors in top 10 'big pharma' companies' boards are university employees). So are these directors simply filling leadership positions in their respective companies, chosen for their expertise in medicine, biology, business, etc.? Or, as I have labeled it, are these directors being utilized as a connection? Whether or not the universities they represent are or are not an intentional basis for their election as board members, the more important question for the purpose of this study is: does it matter?

Hypothesis 2A*: Having university representation on a pharmaceutical company's board, enables that company to create a strategic alliance with the university that director is representing. This alliance is strengthened by the director's ability to represent both parties and act as a liaison between the firm*

and the university; helping to maintain consistent communication, ensuring that the firm and universities' strategies and expectations are synergized.

***Hypotheses 2B**: The decision to make a university employee a board member can also be seen as an all important political and prestigious affiliation, giving a member of the university the power to influence corporate decision making on a governance level.*

The problem facing the industry today, and its darkest secret, is that the stream of new drugs has slowed to a trickle, and very few of them are innovative in any sense of that word (Angell, 2004). Due to this fact, 'big pharma' is depending on the government, universities, and small biotech companies for that innovation (Angell, 2004). Tapping into government sponsored research in academic institutions wasn't even a possibility until 1980. The Bayh-Dole Act of 1980 enabled universities and small businesses to patent discoveries emanating from research sponsored by the National Institute of Health, the major contributor of tax dollars for medical research, and then to grant exclusive licenses to drug companies. When a patent held by a university or a small biotech company is eventually licensed to a big drug company, all parties cash in on the public investment in research (Angell, 2004). The key here is that all parties benefit.

The article "University-industry collaboration: Grafting the entrepreneurial paradigm onto academic structures," published for the *European Journal of Innovation Management* in 2007, highlights such partnership. The article notes that in order for collaboration to be successful, there are two key measures of innovative development that drive knowledge exchange between

university research centers and industry: (1) the rate of knowledge development; and (2) the speed of knowledge transfer and exploitation (Dooley & Kirk, 2007). Effective collaboration, according to Dooley & Kirk (2007), "occurs where partner organizations possess synergistic goals and the complementary assets to facilitate achievement of these goals. It is also nurtured where the consortium develops structures and relationship based control systems that encourage knowledge exchange." Thus, in this way, the participating university and pharmaceutical company can both benefit from this collaboration and both enhance their long-term sustainability and innovative outputs (Dooley & Kirk, 2007). Certainly, such synergy of goals would be more easily facilitated through closer connection and communication between firm and university. By having a member of the partnered university on its board, a pharmaceutical company is able to more easily communicate its research strategy and expectations to the university. This board member can act as a liaison, if you will, between the university and firm; a strategic alliance cemented in its very corporate governance; a university connection who also has the power to influence key corporate decisions.

Lacetera (2001) speaks to pharmaceutical alliances with biotechnology firms, and how external agents from these firms can be "called to participate in the organization of central activities of a firm, and may thus affect its strategy and performance." Similarly to alliances with biotech firms, external 'agents' from academic institutions can also be utilized in the decision making process central to the pharmaceutical company the agents' university is aligned with. It is a way for

a pharmaceutical firm to say to the university, “we value you as a partner and we want you to have a say in our company’s decision making process.” Therefore, by placing a member of that university on its board of directors, the university can have a direct or indirect influence on the company’s decision making. It also instills confidence in the university over the security and longevity of their partnership with that company in the R&D of new drugs.

In publicly owned companies, which all of these pharmaceutical companies are, directors are not merely advisers. They are selected to represent the interests of the shareholders, and as a result, they require certain attributes beyond just bringing some competence to the board (Colley, Doyle, Logan, & Stettinius, 2005). Colley et al. (2005), authors of the McGraw-Hill series text *What Is Corporate Governance?* note that “the relative effectiveness of corporate governance has a profound effect on how well a business performs.” Thus while some critics may call their positioning on the pharmaceutical boards as ‘figureheads,’ or put in place for strictly political reasons, it is important to look at all sides of the matter. Certainly their expertise in the medical field, or other professional field can be very beneficial to the board, and the company. After all, “the aim of a corporate board is to have a breadth of expertise in order to deal effectively with the issues confronting the business (Colley et al., 2005). Therefore, while businessmen and women are incredibly important in advising the company, there is also a need for medical and related expertise. If a medical professor from Harvard University provides such expertise and guidance, then why would some companies feel the need to have three or four professors on their

boards? Well, for the very reason that is the route of my argument. Yes, these board members do serve a traditional corporate governance function, representing the shareholders, bringing competence to the board, and offering specific expertise, but there is also a very strategic reasoning behind their selection. They aren't just any medical expert or accounting expert. They represent a university, and most often a high ranking university, particularly in the medical field. They are a bridge between that university and the company they are serving on, and thus their placement is not only strategic by the company who elects them, but smart.

Today, universities are under increased pressure from government and industry to engage more actively in the innovation process, which is resulting in closer links between universities and pharmaceutical firms (Dooley & Kirk, 2007). Whether you call them a link or a liaison, as I have, these university employees elected to pharmaceutical boards have a distinct purpose beyond their standard duties as board members. They assume the obligation to represent the interests of the pharmaceutical companies' owners who cannot represent themselves, undertaking a serious fiduciary responsibility (Colley et al., 2005), and I believe they also must assume the responsibility of representing their respective universities on that board. As I have mentioned, both parties benefit from university-industry collaboration. A Harvard professor serving on Johnson & Johnson's board can be a tremendous asset not only to Johnson & Johnson, but to Harvard as well.

Thanks to the Bayh-Dole Act, drug companies no longer have to rely on their own research for new drugs, and few of the large ones do. As Angell (2004) notes, "increasingly they rely on academia, small biotech start-up companies, and the NIH for that." The importance and effectiveness of this collaboration can be highlighted by Angell's (2004) statistic that at least a third of drugs marketed by the major drug companies are now licensed from universities or small biotech companies, and these tend to be the most innovative ones.

With the 1980 Bayh-Dole legislation, the traditional boundaries between academia and industry were blurred. Academic medical centers now saw themselves as "partners" of the pharmaceutical industry in common endeavors. Consider the case of Harvard: The Dana-Farber Cancer Institute, a Harvard hospital, has a deal that gives Novartis rights to discoveries that lead to new cancer drugs. Another example is Merck, who has built a twelve-story research facility next door to Harvard Medical School (Angell, 2004). One of 12 directors on Novartis's board is Strikant Datar, Ph.D., a Senior Associate Dean at Harvard University. Not surprisingly Harvard is also represented on Merck's board of directors by Samuel O. Thier, M.D, a professor at the Harvard Medical School. Harvard is by far the most commonly represented university of the pharmaceutical boards I researched, showing up 10 times in a sample of 109 companies, meaning that roughly 1 in every 11 companies in my sample had a Harvard University employee on their board; a Harvard University connection. However, as I discovered in my research, and which is also noted by Marcia Angell, M.D., Harvard is not unique. One recent survey showed that two-thirds

of academic medical centers hold equity in start-up companies that sponsor some research. "The drug companies for their part are generous to the medical schools," says Angell (2004). In Harvard Medical School's Dean's Report for 2003-04, for instance, the list of benefactors included about a dozen of the largest drug companies (Angell, 2004). Of the 10 pharmaceutical companies I found to have Harvard representatives on their boards, they included the mentioned Novartis, Merck, as well as 'big pharma' companies Bristol-Myers Squbb, Eli-Lilly, Pfizer, and Teva. We soon begin to see an early indication of a strong relationship between big pharmaceutical companies and elite academic institutions. Not surprisingly, Harvard was ranked #1 in the Academic Ranking of World Universities (ARWU), published by the Center for World-Class Universities and the Institute of Higher Education of Shanghai Jiao Tong University. Harvard was also ranked first in ARWU's list of top 100 'Clinical Medicine and Pharmacy' ranking (www.arwu.org). The big companies clearly see an importance of not only having university relations on their boards, but top university relations. They want research connections at the very best universities. While the benefit of university-industry relations in the pharmaceutical industry appears to be two-way, there is evidence that perhaps the relationship is going too far. In a January, 2010 *New York Times* article entitled "Outside Pay Restrictions Imposed By Harvard Research Hospitals" it was reported in a front page story that "The owner of two research hospitals affiliated with the Harvard Medical School has imposed restrictions on outside pay for two dozen senior officials who also sit on the boards of pharmaceutical or biotechnology companies. The limits

come in the wake of growing criticism of the ties between industry and academia" (Wilson). The rules being imposed would put limits specifically on “outside directors who guide some of the nation’s biggest companies” (Wilson, 2010). Senior officials at Massachusetts General and Brigham and Women’s Hospitals in Boston will be forced to limit their pay for serving as outside directors to no more than $5,000 a day for actual work on the board. The article had sited that some of the directors from academic institutions were receiving up to $200,00 a year. They will also no longer be able to accept stock from their respective pharmaceutical companies while still employed at the university (Wilson, 2010). This brings into question an important point. Is the industry going too far? Or is it the industry’s fault at all? Maybe the blame should be placed more towards the directors who appear to be making too much of a priority for their director roles over their academic positions. But I say, can you really blame them? With the money these pharmaceutical companies are offering outside directors from academic institutions, it is no wonder that they find their positions on their boards as extremely important. Pharmaceutical companies clearly see an advantage in having these board members, and while schools such as Harvard may be feeling threatened that industry is taking time away from their employees, ultimately, I believe that the benefits of industry-university collaboration in pharmaceuticals are two-fold. Industry benefits from university research, and universities benefit through industry plowing money back into their facilities.

The few innovative drugs that do come to market nearly always stem from publicly supported research. In this country, almost all of that is sponsored by the

NIH and carried out at universities, small biotechnology companies, or the NIH itself. About 90 percent of NIH-sponsored research is done mainly at medical schools and teaching hospitals (Angell, 2004).

Major pharmaceutical companies are showing increased interest in directly sponsoring academic research to access innovation and fill dwindling pipelines. Factors influencing these academic-industry collaborations, according to a 2009 *Drug Week* magazine article, include not only the dwindling pipelines, but historical relationships, as well as diminishing federal funding for academia ("Research and Markets"). Notable collaborators that this *Drug Week* article highlight, that I have also researched for my study, include: AstraZeneca, who has four university connections on its board (University of Manchester, University of Cincinnati, Huddinge University, and the Karolinska Institute); GlaxoSmithKline, who is connected to Imperial College, London and the University of Texas Southwestern through its board; Merck, who has three university connections on its board (Vanderbilt University, University of Pennsylvania, and Harvard University); Novartis, who is connected to Harvard University through its board; and Pfizer, who has four university connections on its board (Harvard Medical School, University of Texas Southwestern, New York University, and the Massachusetts Institute of Technology). As mentioned, these university connections are marked by board directors whose primary place of employment is at that of their respective academic institution. Thus, Dennis A. Ausiello, a professor at Harvard Medical School, and a Pfizer board member, is marked as a Harvard University connection for Pfizer through its board of directors. It is

interesting to note that Lacetera (2001) believed in her study that an analysis of the relationship between scientist participation on the board and links with universities and other basic research institutions could be another interesting study, which is quite similar to the study I have conducted here.

The following hypotheses, while related to my literature review, directly relate to the research study I conducted and the data gathered during that research. These hypotheses predict the results of the regression models I ran which look for relationships between board characteristics, particularly university representation, company size, performance, and other firm-level variables.

Hypothesis 3A: *The larger the pharmaceutical company, the more women on its board.*

Hypothesis 3B: *The larger the pharmaceutical company, the more insiders on its board.*

Hypothesis 3C: *The larger the pharmaceutical company, the more likely the chairman of the board is also the CEO.*

Hypothesis 3A is based on the initial trend I observed while examining pharmaceutical boards. Larger, more prominent companies had larger boards, often with at least one female representation, while smaller companies with smaller boards rarely had such representation. It is easier to be diverse in a larger company where there are more employees and larger boards in charge of key decision making processes. Thus, I believe such diversity is more apparent in larger pharmaceutical companies. The suggestion that insiders will be more prominent in larger companies' boards is based on the ideology that larger

companies will have more qualified and impressive individuals in key leadership roles (i.e. CEO, CFO), and these individuals will also take part in their companies' corporate governance practices within the board of directors. The same ideology can be applied for the CEO also charring his or her company's board in larger pharmaceutical companies.

Hypothesis 4A: *The larger the pharmaceutical company, the more university employees it will have on its board and the greater percentage of their boards will be made up of university employees.*

Hypothesis 4B: *The larger the pharmaceutical company, the more quality universities its university representatives will be from on its board.*

Hypothesis 4C: *The larger the pharmaceutical company, the more top-100 ranked medical schools will be represented on its board.*

Hypothesis 4D*: S&P 500 pharmaceutical companies are more likely to have university connections on their boards (connects to 4a.)*

It is my belief that larger pharmaceutical companies will have more university connections and this will therefore be represented on their boards. Larger pharmaceutical companies will also naturally be able to connect and partner with leading universities in medical schools more easily than with smaller, lesser developed firms who have less capital to spend on R&D expenses to foster innovation. Finally, I believe that foreign pharmaceutical companies are more likely to utilize university employees on their boards than domestic companies because they have fewer resources in their home countries. With S&P companies representing American firms, and particularly the larger American firms, these

pharmaceutical companies will have the greatest advantage in gaining university connections, by tapping in to American resources at leading American Medical Schools and through the NIH, and this will therefore be represented on their boards.

Hypothesis 5A: *The more women on a board, the better the pharmaceutical company's performance.*

Hypothesis 5B: *The more insiders on a board, the better the pharmaceutical company's performance.*

Hypothesis 5C: *Pharmaceutical companies whose chairman is also the CEO perform better than companies whose chairman is not the CEO.*

I believe that there is a direct correlation between gender diversity in a company and that company's performance. The same should be said for corporate governance, as increased female representation will foster more innovative ideas and thus greater performance for that company. I believe the same can be said for insider representation on pharmaceutical companies' boards as the more insiders, the more aligned the board will be with the upper management of that company. This alignment and synergy of communication can be greatly enhanced when the CEO also chairs the board, and thus the same person oversees the company as a whole and its corporate governance.

Hypothesis 6A: *The more university employees on a board and the greater percentage of the boards that are made up of university employees, the better the pharmaceutical company's performance, the greater the R&D expense.*

Hypothesis 6B: *The higher total quality university connections on a pharmaceutical board, the better the company's performance, the greater the R&D expense/*

Hypothesis 6C: *The more top-100 ranked medical schools represented on a pharmaceutical company's board, the better the company's performance, the greater the R&D expense.*

Hypothesis 6D: *Despite having more university connections on their boards, foreign pharmaceutical companies will not outperform American pharmaceutical companies because they are at a disadvantage due to limited resources in their home country.*

In conjunction with Hypothesis 2, I believe pharmaceutical companies greatly benefit from having university representatives on their boards, and this will therefore be reflected in those companies' performance. Greater university connections also imply that these companies are also investing more in R&D. If a company is connected with a number of universities and can be visibly represented through investments in those schools (such as building of research labs) along with having employees from those schools acting as directors on the company's board, it is quite clear that the company is making significant investments in R&D via academic research. I also believe that the level or quality of university research matters. A company will benefit from having university connections but it will benefit more if these connections are top level international universities and medical schools. Therefore, I hypothesize that the level of performance and R&D expenses will increase as the institutions' ranking

increases. Finally, I believe, while foreign firms will have to make up for lack of domestic resources in their home countries to compete with American firms, their increased use of university connections on their boards will not make up for their geographic disadvantages associated with their R&D pipelines.

METHODS

Sample

Using COMPUSTAT data from Wharton Research Data Services, I used the SIC Code of 2834, Pharmaceutical Preparations, to extract data on the industry. Of the 222 companies, I eliminated all companies that did not have complete data for Assets, Sales, R&D Expense, and Employees for the five-year period of 2004-2008. I also eliminated a select few of small companies that did not offer sufficient information on their board of directors on their respective corporate websites. I eventually arrived at 109 pharmaceutical companies that had complete data necessary for the study. These companies' boards were then researched one-by-one noting the characteristics of board size, gender breakdown, insiders vs. outsiders, if the chairman is/isn't the CEO, university members (medical and non-medical), committee memberships of these university members, and the proportion of university members on the boards. Profiles were created for all board directors who were presently employed by universities. In my database I have a total of 99 director profiles who are employed by a university (see Appendix B for Pfizer's director profiles). If a director was a retired university professor, for example, I did not include that member as having an active affiliation. All of my data was collected in 2009 and the results and conclusions contained in the study are subject to change in subsequent years. Since I was using 2009 board data, I eliminated Wyeth and Schering-Plough from the sample as they have been acquired or merged in the past year; no longer being traded as

S&P 500 companies under their own ticker (This decreased my dataset of companies from 111 to 109).

All board-level data, as mentioned was extracted in the year 2009. However, all firm-level data is from the year 2008. 2008 was the most recent, complete firm-level data that could be extracted, while the time period of individual pharmaceutical board research was done during the latter part of 2009. Ideally we would have liked to have firm-level data and board-level data from the same year; however, it would not have been realistic to have extracted board data for all of the pharmaceutical companies in the dataset from the previous year. Companies display their most recent board profiles on their corporate websites and thus identifying all of the changes from 2008 to 2009 in board profiles would have been unrealistic, yielding mostly null data. We can justify that the relationships between firm and board-level variables will not change significantly over one years' time as corporate strategy in terms of board makeup and director goals towards the companies' vision and direction are more long-term minded. The large majority of board members that were on these companies' boards in 2009 were there in 2008, as the directors of boards are changed infrequently, and on a one-by-one basis. Thus, board characteristics stay quite consistent, year-by-year.

Firm-level data necessary for my study was extracted using company tickers. Once I had compiled all of my data for the 109 companies, I broke it down by company, size, performance, board characteristics, and other data (i.e. R&D, geography, etc.). Once the dataset was complete, and checked over

multiple times for accuracy, the data was moved to Minitab Statistical to begin statistical analysis. My first step was to run basic descriptive statistics on all of the data. This included finding the mean, standard deviation, minimum, maximum, and median for all of the variables in the set. This information allowed me to double check the data for accuracy, identifying any alarming outliers (min/max), and the spread and variation in data.

Next, I created box plots for all of the variables on Minitab. The box plots enabled me to visually see the descriptive statistics of the data and easily identify outliers. Once I could specifically spot outliers that were skewing my data, I performed logs and winsorsing techniques in order to reduce the effects of outliers that could impact the eventual regression results. For the most part I chose to use the winsorising method in variables that I foresaw negative impacts of outliers in the dataset. Winsorising allowed me to transform extreme values in my data by simply making the three highest values for a variable the same as the fourth highest value, and the three lowest values the same as the fourth lowest value. This reduced the effect of outliers, eliminating skewing of the data, and created a more accurate description of the firm-level data in this industry.

My initial group of hypotheses was set to perform simple regression. For the most part I had hypothesized one-to-one relationships (i.e. the correlation between company size and the percent of women on a board, or the correlation between an S&P 500 company and performance). Simple regressions were run on Minitab revealing all one-to-one relationships that I had previously hypothesized. However, the number of simple regressions provided an inefficient

correlation representation of the data. As well as being inefficient and difficult to summarize, the relationships tested in simple regression were unrealistic because they ignored the many moving parts of a company. While size and board characteristics are variables of a pharmaceutical company, at the same time a company has performance metrics, a geographical location, R&D expenses, etc. Thus in order to illustrate the relationships more efficiently and to more realistically show the strength of such relationships, multiple regressions needed to be conducted. The results of multiple regression including coefficients and strength of the relationships within each model can be seen in Appendix C.

Measures: Dependent Variables

Board characteristics and Performance

Board-Level Dependent Variables

% Women on Board – Mean = 0.09 (9%), Standard Deviation = 0.09. While I expected most companies would have at least one woman serving on its board, in fact, only 67/109 (61%) of the companies in the sample had at least one woman serving on its board. Thus, an alarming 39% of the pharmaceutical companies in the sample had no female representation on their board of directors.

% Insiders on Board – Mean = 0.17 (17%), Standard Deviation = 0.10. Typically a company will have at least one insider on its board, most often the CEO; and many of the companies in the sample had multiple insiders serving (1.4 on average). While not traditionally consider insiders, I did include retired CEO's serving on a companies' board as insiders since

they were at one time 'inside' the key decision making process of the company and had greatly influenced the companies' current state and vision.

Chairman = CEO? – Mean = 0.35, Standard Deviation = 0.48. Note that this was a coded variable, Yes = 1, No = 0. Thus, the mean of 0.35 indicates that more pharmaceutical companies in my sample had separate individuals serving as their CEO and Chairman of the board then both positions being held by the same individual.

University-Medical Connections on Board – Mean = 0.63, Standard Deviation = 0.90**.** 46/109 (42%) of the companies in the sample utilized at least one medical-related university employee on its board. These could be any university positions in the research or practicing fields of all medical, pharmaceutical, or related-sciences. Pfizer has three University-Medical Connections on its board: Dennis A. Ausiello, M.D. (Jackson Professor of Clinical Medicine, Harvard Medical School), Michael S. Brown, M.D. (Regental Professor, University of Texas Southwestern Medical Center at Dallas), and William C. Steere, Jr.(Director: NYU Medical Center).

University-Other Connections on Board – Mean = 0.24, Standard Deviation = 0.53. These are university connections that are not directly medical-related. 22/109 (20%) of the companies in the sample utilized non-medical university employees on their boards. The employee may represent a university with a top medical school but his or her position is

not in the medical or a related field (i.e., Business professor, Chancellor, etc.). For example, Pfizer has one University-Other connection on its board: Dana G. Mead, Ph.D. (Chairman: MIT). Dr. Mead does not hold a medical-related position at MIT, instead he holds a position of governance over the entire university.

University-Total Connections on Board – Mean = 0.86, Standard Deviation 1.10. This represents the total of University-Medical and University-Other connections. Connections can be counted twice on board (two Harvard's by two different employees), so that the total power/influence of the connections is accounted for. All university connections accounted for only include current or active positions held. Retired university employees serving on a board or directors with past university-positions, but nor current, were not accounted for. What is most notable about this variable is the standard deviation of 1.10, which indicates a significant amount of variance in the sample. There is clearly a great difference in philosophy amongst companies in this industry regarding the utilization of university connections on their boards.

% of Board University Employees – Mean = 0.09 (9%), Standard Deviation = 0.11. The mean of this variable is skewed by smaller companies. For example, 29% (4/14) of Pfizer's board is made of university employees. A higher percentage is quite common amongst the larger S&P 500 companies, while the trend for smaller, less developed

firms in the sample is that they are far less likely to have university connections on their boards compared to their 'Big Pharma' counterparts.

University Ranking Total – Mean = 3.46, Standard Deviation = 4.89. This is a coded variable. If a university represented on a board was ranked 1-100 in the world, it received 5 points, 101-200 = 4 points, 201-300=3, 301-400=2, and 401-500=1. The higher total, the more 'better' university connections that company has on its board (total power/quality of university connections). The rankings were taken from the Academic Ranking of World Universities (ARWU), published by the Center for World-Class Universities and the Institute of Higher Education of Shanghai Jiao Tong University. For example, Pfizer received 20 points on my scale for 'university ranking total': it received this total because it has four universities (Harvard, Texas Southwestern, NYU, MIT) represented on it board of directors that are ranked between one and 100 for 'world universities.' I can use this point system therefore to reflect the overall power of Pfizer's university connections. They not only have four connections, but they are internationally-elite university connections.

Top 100 Medical Schools Represented – Mean = 0.58, Standard deviation = 0.94. This is also a coded variable, in which a company receives one point for every top-100 med school represented on its board. The rankings were taken from ARWU's list of top 100 'Clinical Medicine and Pharmacy' rankings. For example, Pfizer receives four points, because it

has four top-100 medical schools represented on its board (the same four universities that were ranked in the top-100 for world universities).

Firm-Level Dependent Variables

Sales Growth – Mean = 1.03, Standard Deviation = 7.89. The sales growth was calculated for the years of 2006-2008 by using net sales (revenue) of the companies. This is a performance metric.

Return on Assets (ROA) – Mean = -0.52, Standard Deviation = 1.28. This is a performance metric that shows how profitable a company's assets are in generating revenue.

Earnings per Share (EPS) Basic – Mean = -0.09, Standard Deviation = 1.79. This is also a performance metric.

Independent Variables – x's

Size, Geography, Index, R&D, Performance

Board-Level Independent Variables

The board-level independent variables were all utilized to equal the control firm-level independent variables, with the three performance measures of (sales growth, ROA, and EPS) being tested for each equation model. The following board characteristics were all used as board-level dependent variables in the multiple regression equations (described above): Percent of Women on Board, Percent of Insiders on Board, Chairman = CEO?, University-Medical Connections on Board, University-Other Connections on Board, University-Total Connections on Board, Percent of Board University Employees, University Ranking Total, and Top 100 Medical Schools Represented.

Firm-Level Independent Variables

Along with performance measures of sales growth, ROA, and EPS, that were also used as dependent variables in the equation models for multiple regressions when the dependent variable was a board characteristic; the firm-level independent variables below were utilized for all equation models despite the dependent variable. These are the control variable:

Size (log of assets) – Mean = 5.53, Standard Deviation = 2.69. This is the main indicator I used for company size. Assets are economic resources owned by a company, and thus a good indicator of a companies' size.

Geography (domestic vs. foreign) – Mean = 0.21, Standard Deviation = 0.41. This variable is utilized to identify the behavior of companies in U.S. versus the rest of world. This is a coded variable in which Domestic = 0 and Foreign = 1. In the sample there were 85 domestic companies, and 24 international companies. I would have liked a more balanced sample, but the majority of data available to me in the industry was for American-based firms. As mentioned previously, board characteristics for foreign companies were skewed by Canadian firms that did not have a large university presence on their boards.

S&P 500 Companies – Mean = 0.10, Standard Deviation = 0.30. The S&P 500 is an index of the prices of 500 large-cap common stocks actively traded in the U.S., representing the behavior of large U.S-based companies. This is a coded variable in which S&P 500 companies = 1, and Non S&P 500 companies = 0. There were 11 S&P 500

pharmaceutical companies in the sample (Abbott, Allergan, Bristol-Myers Squibb, Hospira, Johnson & Johnson, King, Eli Lilly, Merck, Mylan, Pfizer, and Watson)

R&D Expense – Mean = 760 (million). Standard Deviation = 1975. R&D expense in a company represents it's an investment in innovation, the most important aspect of the pharmaceutical industry, and a key variable to this study.

RESULTS

After performing multiple regressions the results were grouped by the strength of the relationship found. In Appendix C I have created regression tables for all multiple regression outputs. The coefficient is either left alone or given a symbol. The three symbols of †, *, and ** represent a weak relationship, medium relationship, or strong relationship respectively. If the coefficient was not given a symbol, the p-value of the t-statistic for that variable was greater than 0.1 and therefore the relationship was not significant. A weak relationship was characterized by a p-value < 0.1, a medium relationship had a p-value < 0.05, and a strong relationship had a p-value < 0.01. R-squares were also provided to represent the level of predictability in the model; how strong the relationship was between the dependent variable and the predicting independent variables.

I found there to be a strong relationship between company size and the percent of women on a board. The trend is the larger the company, the greater the percentage of woman on a board. This holds true to Hypothesis 3A.

There is a weak relationship between R&D expense and sales growth and the percent of a board that will be made up of insiders. The correlation indicates that a company with greater R&D expense, when ROA is used a performance metric, will have a greater percentage of insiders on its board. It also indicates that companies with larger sales growth will have a greater percentage of insiders on their board.

When the dependent variable was set as the board characteristic 'Chairman = CEO,' logistic regression was used. This was necessary since the

dependent variable was coded. These regression equations were set up slightly different than the others. With logistic regression the independent variables of total assets, geography, S&P 500, R&D (as percent of sales), and the performance metrics were set equal to Chairman = CEO; the only relevant relationship was a medium strength correlation with S&P 500 companies when the performance metrics were sales growth and EPS, and a weak relationship between S&P and Chairman=CEO when ROA was the performance metric in the logistic regression equation. The results show that S&P 500 companies are more likely to have the same employee in both positions than non S&P 500 companies. We can hypothesize that for high-level American pharmaceutical companies the CEO is a highly qualified, impressive individual that the company feels would be more than capable of charring its board of directors, and should be the chairman in order to have more control over the company's decision making.

The dataset shows there to be a weak relationship between company size and the number of medical university connections on a board, when sales growth is used as a performance metric, while there is a medium strength relationship between size and medical university connections on a board when ROA and EPS are used as performance metrics. There is also a medium strength relationship between R&D expense of a company and the number of medical university connections on a board when sales growth and EPS are used as performance metrics, and a weak relationship when ROA is used as a performance metric. To put it more plainly, the larger the company and the greater the R&D expense of

that company, the more medical university connections on its board, proving Hypothesis 4C true..

There is a weak relationship between S&P 500 companies and the number of 'other' (non-medical) university connections on a board when sales growth and ROA are used as performance metrics and a medium relationship when EPS is used to measure company performance. S&P 500 companies will on average have more non-medical university connections on their boards. This trend could be due to larger board sizes in S&P 500 companies and the need to have a wide range of expertise to oversee the broad scope of these firms.

There is a medium strength relationship between company size and the total number of university connections on a board. There is also a medium relationship between R&D expense and total university connections on a board when ROA is a performance metric, and there is a strong relationship between R&D expense and total university connections when sales growth and EPS are used as performance metrics. The larger the company and the greater the R&D expense of a company, the more university connections it wall have on its board, proving Hypothesis 4A to be true.

There is a weak relationship between R&D expense and the percent of a board that's made up of university connections when sales growth and EPS are used as performance metrics. While the relationship is not strong, it is relevant enough to say that the greater the R&D expense of a company the greater percentage of that company's board will be made up of university connections, which was predicted in Hypothesis 6A.

There is a weak relationship between the size of a company and the power and quality of its university connections when sales growth is used as a performance metric. There is a medium relationship between company size and the power and quality of its university connections when ROA and EPS are used as performance metrics. There is a strong relationship between R&D expense and university ranking power and quality. Thus, while size is a predictor of university connections, a company's R&D expenses is a strong predictor; the greater the R&D expense, the more quality universities that company will be connected to, validating Hypothesis 6B.

There is a weak relationship between company size and the number of top-100 medical schools represented on a board when sales growth is used as a performance metric. There is a medium relationship between company size and the number of elite medical school connections when ROA and EPS are used as performance metrics. There is a strong relationship between R&D expense and the number of top-100 medical schools represented on a pharmaceutical company's board. Thus the larger the company and more importantly, the greater the R&D expense of that company, the more likely top-100 medical schools will be represented on its board, proving Hypothesis 4C and Hypothesis 6C true.

There is a strong relationship between the geography of a pharmaceutical company and the sales growth of that company. American companies outperform international companies in terms of sales growth on average, which I implied in Hypothesis 6D.

There is a strong relationship between size and R&D expense with ROA. The larger the company, and the greater R&D expense of that company, one can confidently imply the greater the ROA of that company. This is certainly one reason why bigger is often better from a financial strength and performance barometer, because larger companies will naturally have more assets, and return on these assets.

There is a strong relationship between company size and EPS. Thus, one can confidently imply that EPS will be greater on average for larger pharmaceutical companies. This relationship would indicate to investors that larger pharmaceutical companies will yield greater returns on their investments. It is quite clear from this dataset that larger pharmaceutical companies simply outperform small ones and this is reflective in ROA and EPS. However, larger pharmaceutical companies do not necessarily grow faster than smaller companies, as I did not find a significant relationship between company size and sales growth.

DISCUSSION AND CONCLUSION

In my study I have discovered that R&D expense and company size proved to be the most consistent predictors of the dependent variables I tested. Larger pharmaceutical companies, with greater R&D expenses had more diversified boards, and were particularly more likely to have university connections. While patterns emerged amongst domestic vs. international pharmaceutical companies, and S&P 500 companies vs. non-S&P 500 companies, there were not consistent relationships between these variables and board characteristics. Ultimately the best predictor of a company utilizing university employees as directors on its board is the size of that company. Size and R&D expense go hand in hand, as larger pharmaceutical companies spend more. While it was revealing to see that the size of a pharmaceutical company strongly correlates with its board university connections, ultimately the most important question is does having these connections matter? I did not find any direct evidence in my data that these connections directly impact performance. There was not a significant relationship in my multiple regression results that indicated a relationship between any of the board characteristics tested and the performance metrics of sales growth, ROA, or EPS.

However, what we do know is that larger pharmaceutical companies outperform small ones. When it comes down to it, the ultimate objective of these companies and any for-profit companies for that matter is to make money. As publicly traded companies these firms must also satisfy their shareholders. While the university-board relationship is quite significant I have found, ultimately these

companies need to perform and make money, whatever their strategy towards innovation or corporate governance may be. To me, the most revealing results therefore in my study were not that bigger companies spend more on R&D or have more university connections, but that bigger pharmaceutical companies significantly outperform the smaller ones. There was a strong relationship between size and EPS and size and ROA. Quite simply, 'Big Pharma,' yields greater returns on investment to their shareholders; they make their shareholders more money. But in the end that's why they are 'Big Pharma,' they became a blockbuster company by selling blockbuster drugs. They sell more drugs, and bigger drugs at that, because they have better quality R&D and more of it. They benefit from greater R&D pipelines that in return yield more innovation.

While my data does not show a direct link between university connections on a board and performance of that company, what we do know is that the larger pharmaceutical companies are more likely to have such connections, and that larger pharmaceutical companies outperform smaller ones. This trend wouldn't exist and be so consistent if these connections didn't help however. Even if the benefit of university connections on a pharmaceutical board can be directly linked to sales growth, EPS, or ROA of that company, as I have argued throughout my paper, the benefits of such connections go far beyond monetary Ultimately, leading pharmaceutical companies need university research to survive, and electing leading professionals from these universities as directors on their respective firms' boards, an alliance is created; a relationship is establish, and

university-industry communication and strategic goals for research can be more easily aligned.

I will conclude by returning to the initial point: “The human race can survive perfectly well without an endless supply of new drugs but the corporations that produce them can’t” (Law, 2006). It is quite clear that the pharmaceutical industry will try to get any edge it can to develop new drugs. Sustainability and growth is inconceivable without new drugs, and new drugs cannot be discovered without innovation. You must give the credit where credit is due. Pharmaceutical innovation is born through research and development performed by the government, small biotechnology companies, and most importantly, academic institutions; i.e. Harvard University. Due to this fact, pharmaceutical companies will continue to create strategic alliances with the ‘Harvard’s’ of the world in order to tap into their increasingly valuable R&D.

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APPENDICES

A- Data Examples: Pfizer vs. EpiCept (The Extremes)

	Pfizer Inc.	EpiCept Corp
Size (log of assets)*	11.6186	0.8202
Total Assets	$111,148,000,000	$2,271,000
Employees	81,800	21
Revenue (Net Sales)	$48,341,000,000	$265,000
Sales Growth (2006-08)	0.001 (0.1%)	-0.644 (-64%)
Earnings before Interest & Taxes (EBIT)	$16,835,000,000	-$21,957,000
Return on Assets (ROA)	7%	-1118%
Return on Equity (ROE)	14%	143%
Earnings Per Share (EPS) Diluted	$1.19	-$0.41
EPS Basic	$1.19	-$0.41
R&D Expense	$8,578,000,000	$12,623,000
R&D Growth (2006-08)	0.009 (0.9%)	-0.493 (-49%)
R&D (as percent of sales)	18%	4763%
Market Value of Equity	$1.19E+11	$52,764,800
Market Value of Equity Growth (2006-08)	-0.195 (-19%)	0.067 (7%)
Tobin's q	1.15	23.36
Geography	0	0
S&P 500	1	0
Board Size**	14	6
Men	12	6
Men (% of board)	86%	100%
Women	2	0
Women (% of board)	14%	0%
Insiders	2	1
Insiders (% of board)	14%	17%
Outsiders	12	5
Chairman = CEO?	1	0
Medical University Connections	3	0
Non-Medical University Connections	1	0
Total University Connections	4	0
% Board University Connections	29%	0%
University Ranking Total	20	0
Top-100 Medical School Connections	4	0

* Firm Data from 2008

** Board characteristics from 2009

- *Geography* (Domestic 0, Foreign 1)
- *S&P 500* (Yes=1, No=0)
- *Chairman=CEO?* (Yes=1, No=0)
- *Univ. Ranking Total*: (University ranked: 1-100=5, 101-200=4, 201-300=3, 301-400=2, 401-500=1)
- *Top 100 medical school* (1 for every representation)
- *Tobin's q*: the ratio between the market value and replacement value of the same physical asset. The ratio represents quality of R&D (If Tobin's q is greater than 1.0, then the market value is greater than the value of the company's recorded assets

B - Director Profiles Example (Pfizer Inc.)

*Note that EpiCept does not have university connections on its board.

Board Member	Title	Committee Memberships	Profile
Dennis A. Ausiello, M.D	Jackson Professor of Clinical Medicine at **Harvard** Medical School	• Audit • Audit Financial Experts • Science and Tech • Corporate Governance	The Jackson Professor of Clinical Medicine at Harvard Medical School and Chief of Medicine at Massachusetts General Hospital since 1996. President of the Association of American Physicians in 2006. Member of the Institute of Medicine and a Fellow of the American Academy of Arts and Sciences. Director of MicroCHIPS (drug delivery technology) and Advisor to the Chairman of the Board of TIAX (formerly Arthur D. Little). Our Director since December 2006. Member of our Audit Committee, our Science and Technology Committee and our Corporate Governance Committee.
Michael S. Brown, M.D.	Regental Professor: **University of Texas Southwestern** Medical Center at Dallas	• Corporate Governance • Science and Tech	Distinguished Chair in Biomedical Sciences since 1989 and Regental Professor since 1985 at the University of Texas Southwestern Medical Center at Dallas. Co-recipient of the Nobel Prize in Physiology or Medicine in 1985 and the National Medal of Science in 1988. Member of the National Academy of Sciences, the Institute of Medicine and Foreign Member of the Royal Society (London). Director of Regeneron Pharmaceuticals, Inc. Our Director since 1996. Chair of our Science and Technology Committee and member of our Corporate Governance Committee.
William C. Steere, Jr.	Director of the **New York University** Medical Center	• Science and Tech	Chairman Emeritus of Pfizer Inc. since July 2001. Chairman of our Board from 1992 to April 2001 and our Chief Executive Officer from 1991 to 2000. Director of MetLife, Inc. and Health Management Associates, Inc. Director of the New York University Medical Center and the New York Botanical Garden. Member of the Board of Overseers of Memorial Sloan-Kettering Cancer Center. Our Director since 1987 and a member of our Science and Technology Committee.
Dana G. Mead, Ph.D.	Chairman of the **Massachusetts Institute of Technology**	• Compensation • Science and Tech	Chairman of Massachusetts Institute of Technology Corporation since July 1, 2003. Chairman and Chief Executive Officer of Tenneco, Inc. from 1994 until his retirement in 1999. Chairman of two of the successor companies of the Tenneco conglomerate, Tenneco Automotive Inc. and Pactiv Corporation, global manufacturing companies with operations in automotive parts and packaging, from November 1999 to March 2000. Chairman of the Board of the Ron Brown Award for Corporate Leadership and a Lifetime Trustee of the Association of Graduates, U.S. Military Academy, West Point. Former Chairman of the Business Roundtable and the National Association of Manufacturers. Our Director since 1998. Chair of our Compensation Committee and a member of our Science and Technology Committee.

*The above data represents four of the 99 director profiles that I gathered across 55 pharmaceutical companies that had university representation on their board

C - Multiple Regression Tables:

$^{\dagger}p < 0.1$ (weak relationship) $*p < 0.05$ (medium relationship) $**p < 0.01$ (strong relationship)

Predictor	**% Women on Board**		
Constant	0.00	0.01	0.00
Size	0.02**	0.02**	0.02**
Geography	-0.03	-0.03	-0.03
S&P 500	0.01	0.01	0.01
R&D Expense	0.00	0.00	
Sales Growth	0.01		
ROA		0.01	
EPS			0.00
R-Sq	27.2%	27.1%	27.0%

Predictor	**% Insiders on Board**		
Constant	0.15	0.12	0.14
Size	0.00	0.01	0.01
Geography	0.00	0.05	0.05
S&P 500	-0.02	-0.03	-0.03
R&D Expense	0.00	0.00†	0.00
Sales Growth	0.02†		-0.01
ROA		-0.02	
EPS			-0.01
R-Sq	8.1%	7.7%	7.2%

Predictor	**Chairman = CEO**		
Total Assets	9.55E-6	8.45E-6	5.67E-6
Geography	-1.05	-1.25	-1.06
S&P 500	2.65*	2.43†	2.63*
R&D as % of sales	-0.03	0.00	-0.02
Sales Growth	-0.06		
ROA		0.66	
EPS			0.10
R-Sq	15.2%	16.8%	14.9%

Predictor	**University-Medical Connections on Board**		
Constant	0.10	-0.10	0.00
Size	0.08†	0.12*	0.11*
Geography	-0.28	-0.32	-0.31
S&P 500	0.07	0.01	0.05
R&D Expense	0.00*	0.00†	0.00*
Sales Growth	0.18		
ROA		-0.13	
EPS			-0.07
R-Sq	25.3%	25.0%	25.4%

Predictor	**University-Other Connections on Board**		
Constant	0.01	-0.03	-0.03
Size	0.03	0.03	0.03
Geography	0.07	0.11	0.11
S&P 500	0.38†	0.40†	0.40*
R&D Expense	0.00	0.00	0.00
Sales Growth	-0.09		
ROA		-0.01	
EPS			-0.01
R-Sq	22.6%	21.9%	22.0%

Predictor	**University-Total Connections on Board**		
Constant	0.11	-0.14	-0.02
Size	0.10*	-0.15*	0.13*
Geography	-0.18	-0.19	-0.18
S&P 500	0.49	0.44	0.48
R&D Expense	0.00**	0.00*	0.00**
Sales Growth	0.11		
ROA		-0.16	
EPS			-0.09
R-Sq	37.3%	37.6%	38.3%

Predictor	**% Board University Connections**		
Constant	0.05	0.03	0.04
Size	0.01	0.01	0.01
Geography	-0.04	-0.03	-0.03
S&P 500	0.04	0.04	0.04
R&D Expense	0.00†	0.00	0.00†
Sales Growth	0.00		
ROA		-0.02	
EPS			-0.01
R-Sq	18.0%	18.6%	19.2%

Predictor	**University Ranking Total**		
Constant	0.32	-0.34	-0.20
Size	0.43†	0.56*	0.54*
Geography	-1.19	-1.31	-1.24
S&P 500	1.40	1.17	1.31
R&D Expense	0.00**	0.00**	0.00**
Sales Growth	0.06		
ROA		-0.44	
EPS			-0.36
R-Sq	39.7%	39.5%	40.2%

Predictor	**Top 100 Medical Schools Represented**		
Constant	-0.05	-0.28	-0.20
Size	0.08†	0.12*	0.11*
Geography	-0.13	-0.16	-0.15
S&P 500	0.30	0.24	0.28
R&D Expense	0.00**	0.00**	0.00**
Sales Growth	0.17		
ROA		-0.15	
EPS			-0.11
R-Sq	40.6%	40.5%	42.1%

Predictor	**Sales Growth**								
Constant	0.14	0.04	0.12	0.13	0.14	0.13	0.14	0.13	0.14
Size	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03
Geography	-0.31*	-0.36**	-0.31*	-0.30*	-0.32*	-0.32*	-0.33*	-0.31*	-0.31*
S&P 500	-0.24	-0.22	-0.27	-0.24	-0.19	-0.25	-0.24	-0.25	-0.26
R&D Expense	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Women	0.46								
% Insiders		0.66†							
Chairman = CEO?			0.09						
University-Med				0.07					
University-Other					-0.10				
University-Total						0.03			
% Board Univ							0.04		
Univ Ranking								0.01	
Top 100 Med									0.08
R-Sq	7.3%	8.4%	7.4%	8.1%	7.8%	7.2%	6.9%	7.4%	8.2%

Predictor	**Return on Assets (ROA)**								
Constant	-1.68	-1.58	-1.71	-1.70	-1.68	-1.68	-1.66	-1.68	-1.69
Size	0.24**	0.24**	0.24**	0.25**	0.24**	0.25**	0.25**	0.25**	0.25**
Geography	0.19	0.20	0.21	0.16	0.18	0.16	0.16	0.16	0.16
S&P 500	-0.14	-0.16	-0.21	-0.14	-0.13	-0.11	-0.12	-0.13	-0.12
R&D Expense	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**
% Women	0.33								
% Insiders		-0.65							
Chairman = CEO?			0.18†						
University-Med				-0.06					
University-Other					0.87				
University-Total						-0.06			
% Board Univ							-0.45		
Univ Ranking								-0.01	
Top 100 Med									-0.09
R-Sq	45.0%	45.6%	46.0%	45.3%	44.9%	45.4%	45.3%	45.1%	45.6%

Predictor	**Earnings Per Share (EPS)**								
Constant	-1.60	-1.50	-1.69	-1.66	-1.68	-1.65	-1.59	-1.66	-1.69
Size	0.25**	0.26**	0.26**	0.28**	0.26**	0.28**	0.27**	0.28**	0.29**
Geography	0.42	0.45	0.42	0.33	0.41	0.35	0.34	0.34	0.33
S&P 500	0.20	0.17	0.17	0.21	0.25	0.30	0.27	0.26	0.30
R&D Expense	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Women	0.66								
% Insiders		-1.17							
Chairman = CEO?			0.07						
University-Med				-0.21					
University-Other					-0.11				
University-Total						-0.21			
% Board Univ							-1.62		
Univ Ranking								-0.04	
Top 100 Med									-0.36
R-Sq	31.8%	32.2%	31.6%	32.7%	31.8%	33.1%	32.8%	32.8%	34.3%

D - Correlation Table

	chairm-o	univmed	univot-r	univto-s	boardu-v	univer-u	top100-s	boards-e	menofb-d	womeno-d	inside-d	total_-s	employ-s	revenue-s	s-200608	ebit	roanet-s	roe	rpsdil-d	rdaspe-s	market-y	capita-s	tobinsq	geogr-y	sp500
Chairmanceo	1.00																								
Univmed	**0.04**	1.00																							
	0.67																								
Univother	0.18	0.15	1.00																						
	0.06	0.13																							
univtotal~s	0.11	0.88	0.59	1.00																					
	0.26	**0.00**	**0.00**																						
Boarduniv	**0.08**	0.85	0.53	0.94	1.00																				
	0.40	**0.00**	**0.00**	**0.00**																					
university~u	0.11	0.89	0.41	0.91	0.83	1.00																			
	0.24	**0.00**	**0.00**	**0.00**	**0.00**																				
top100medi~s	0.12	0.83	0.36	0.83	0.72	0.92	1.00																		
	0.20	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**																			
Boardsize	**0.09**	0.45	0.38	0.54	0.33	0.55	0.58	1.00																	
	0.36	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**																		
Menofboard	-0.21	-0.21	-0.15	-0.24	-0.14	-0.25	-0.24	-0.40	1.00																
	0.03	**0.03**	0.11	**0.01**	0.16	**0.01**	**0.01**	**0.00**																	
womenofboard	0.21	0.21	0.15	0.24	0.14	0.25	0.24	0.40	-1.00	1.00															
	0.03	**0.03**	0.11	**0.01**	0.16	**0.01**	**0.01**	**0.00**	**0.00**																
insidersof~d	-0.05	**0.07**	-0.14	-0.03	**0.04**	-0.02	**0.00**	-0.11	-0.01	**0.01**	1.00														
	0.61	0.48	0.14	0.72	0.68	0.86	0.99	0.25	0.95	0.95															
total_assets	0.17	0.40	0.39	0.51	0.33	0.54	0.54	0.63	-0.24	0.24	-0.14	1.00													
	0.07	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	0.15														
Employee	0.16	0.41	0.39	0.53	0.34	0.54	0.51	0.64	-0.28	0.28	-0.12	0.96	1.00												
	0.09	**0.00**	**0.00**	**0.00**	**0.03**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.22	**0.00**													
revenuenet~s	0.19	0.41	0.41	0.53	0.35	0.56	0.53	0.60	-0.28	0.28	-0.13	0.97	0.98	1.00											
	0.00	**0.00**	**0.00**	**0.19**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.19	**0.00**	**0.00**												
sales~200608	-0.07	-0.06	-0.06	-0.07	-0.07	-0.06	-0.05	-0.09	**0.09**	-0.09	-0.15	-0.04	-0.05	-0.04	1.00										
	0.47	0.57	0.57	0.47	0.44	0.54	0.62	0.38	0.35	0.35	0.12	0.66	0.64	0.65											
Ebit	0.16	0.44	0.38	0.54	0.36	0.57	0.55	0.58	-0.26	0.26	-0.11	0.96	0.96	0.98	-0.04	1.00									
	0.09	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	0.27	**0.00**	**0.00**	**0.00**	0.67										
roanetinco~s	0.18	0.12	0.14	0.16	**0.09**	0.16	0.14	0.27	-0.26	0.26	-0.03	0.17	0.18	0.17	-0.00	0.17	1.00								
	0.06	0.22	0.16	0.11	0.34	0.11	0.16	**0.00**	**0.01**	**0.01**	0.77	**0.08**	**0.06**	**0.07**	0.97	**0.08**									
Roe	**0.00**	**0.00**	**0.01**	**0.01**	**0.00**	**0.06**	**0.07**	-0.08	0.10	-0.10	-0.26	**0.03**	**0.03**	**0.03**	**0.02**	**0.03**	-0.06	1.00							
	1.00	0.99	0.90	0.95	0.99	0.52	0.49	0.42	0.30	0.30	**0.01**	0.80	0.77	0.78	0.80	0.78	0.52								
Epsdiluted	0.16	0.16	0.22	0.23	0.11	0.24	0.19	0.40	-0.26	0.26	-0.10	0.53	0.59	0.58	-0.05	0.56	0.31	**0.01**	1.00						
	0.10	0.10	**0.02**	**0.02**	0.26	**0.01**	**0.04**	**0.00**	**0.01**	**0.01**	0.29	**0.00**	**0.00**	**0.00**	0.58	**0.00**	**0.00**	0.89							
rdaspercen~s	-0.12	-0.12	-0.10	-0.15	-0.14	-0.13	-0.11	-0.11	0.20	-0.20	-0.05	-0.09	-0.10	-0.97	-0.03	-0.09	-0.36	0.10	-0.12	1.00					
	0.22	0.20	0.30	0.13	0.16	0.18	0.26	0.27	**0.04**	**0.04**	0.64	0.33	0.30	0.32	0.75	0.34	**0.00**	0.28	0.20						
marketvalu~y	0.19	0.39	0.42	0.52	0.35	0.54	0.51	0.59	-0.27	0.27	-0.11	0.95	0.97	0.99	-0.04	0.97	0.17	**0.03**	0.57	-0.09	1.00				
	0.05	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.24	**0.00**	**0.00**	**0.00**	0.66	**0.00**	**0.07**	0.79	**0.00**	0.33					
captialexp~s	0.15	0.38	0.40	0.50	0.33	0.52	0.49	0.60	-0.26	0.26	-0.13	0.94	0.97	0.98	-0.04	0.95	0.17	**0.03**	0.57	-0.09	0.98	1.00			
	0.13	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	0.18	**0.00**	**0.00**	**0.00**	0.66	**0.00**	**0.08**	0.79	**0.00**	0.33	**0.00**				
Tobinsq	-0.08	-0.07	-0.11	-0.11	-0.11	-0.10	-0.05	-0.05	0.133	-0.13	0.09	-0.08	-0.07	-0.07	-0.01	-0.06	-0.70	-0.09	-0.09	0.36	-0.05	-0.06	1.00		
	0.41	0.48	0.27	0.27	0.25	0.32	0.60	0.57	0.17	0.17	0.34	0.43	0.45	0.49	0.89	0.51	**0.00**	0.38	0.37	**0.01**	0.64	0.52			
Geography	-0.19	-0.04	0.11	**0.02**	-0.07	**0.01**	**0.04**	0.24	**0.06**	-0.06	0.17	0.25	0.29	0.24	-0.07	0.24	0.15	-0.01	0.22	0.12	0.24	0.27	-0.97	1.00	
	0.05	0.69	0.26	0.81	0.45	0.91	0.67	**0.01**	0.55	0.55	**0.08**	**0.01**	**0.00**	**0.01**	0.48	**0.01**	0.11	0.91	**0.02**	0.20	**0.01**	**0.00**	0.48		
sp500	0.39	0.31	0.37	0.43	0.32	0.41	0.41	0.37	-0.32	0.32	-0.16	0.43	0.43	0.46	-0.05	0.44	0.15	0.02	0.29	-0.09	0.44	0.40	-0.09	-0.17	1.00
	0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.20	**0.00**	**0.00**	**0.00**	0.70	**0.00**	0.11	0.84	**0.00**	0.36	**0.00**	**0.00**	0.36	**0.07**	

*Bolded numbers indicate the correlation is significant at a p-value below 0.1.

E- Frequency of University Representation on Boards

College	# of Instances	Top 100 Med	Top 500 U	1-100	101-200	201-300	301-400	401-500
Yale	2	x	x	X				
Alabama-Birmingham	1		x		x			
Harvard	10	x	x	X				
Texas Southwestern	5	x	x	X				
NYU	1	x	x	X				
MIT	4	x	x	X				
Vanderbilt	1	x	x	X				
Upenn	3	x	x	X				
Morehouse	3							
Michigan	1		x	X				
Emory	3	x	x	X				
Duke	4	x	x	X				
Stanford	5	x	x	X				
Pittsburgh	1	x	x	X				
USC	2	x	x	X				
Depaul	1							
UMDNJ	1	x	x			x		
Bar-Ilan	1		x				x	
Netanya Academic	1							
Oxford	4	x	x	X				
Imperial	1	x	x	X				
American College of Rheumatology	1							
Charleston	1							
Ashkelon Academic	1							
Ben-Gurion	1							
Temple	1		x				x	
Lehigh	1							
Indiana	1		x	x				
Cal San Diego	1	x	x	x				
Washington U (St. Louis)	1	x	x	x				
Miami	1	x	x		x			
Mainz	1		x		x			
Mount Sinai	3		x		x			
Manchester	1	x	x	x				
Cincinnati	1	x	x		x			
Huddinge	1							
Karolinska Institute	1	x	x	x				
McGill	1	x	x	x				
Dalhousie	1							
Hebrew U of Jerusalem	1		x	x				
Tel Aviv	1		x		x			
Maryland	1		x	x				
Columbia	1	x	x	x				
Rice	1		x	x				
American College of Physicians	1							

American College of Chest Physicians	1							
King College	1							
Louisville	1							
Carnegie Mellon	1		x	x				
Sydney	1		x	x				
Tufts	2	x	x		x			
The Cancer Institute of New Jersey	1							
Robert Wood Johnson School of Medicine	1							
Institute for Advanced Study	1							
Princeton	1		x	x				
Case School of Medicine	1							
Cambridge	1	x	x	x				
Scripps Research Institute	1							
UNC-Wilmington	1							
University of Heidelberg	1	x	x	x				
Johns Hopkins	1	x	x	x				
San Diego State	1		x				X	
Mayo	1							

SUMMARY OF CAPSTONE PROJECT

For my capstone project I have taken an in-depth look at the pharmaceutical industry. I have particularly focused my study on the collaboration between pharmaceutical companies and academic institutions. Before further detailing the study itself, I must first outline the importance of industry-university relations in the pharmaceutical industry. This relationship boils down to research and development. In order to understand the great importance of R&D in the pharmaceutical industry it is important to first learn about patents. One cannot describe the pharmaceutical industry without mentioning patents. When blockbuster drug monopolies expire after 20 years of patent protection, the companies that make these drugs are forced to continue to innovate; utilizing new drug technologies and an extensive and diverse pipelines of R&D in order to bring new drugs to the market. However, developing new drugs is not a given, and in fact, new drugs are becoming more and more of a rarity in an industry that needs them in order to be sustainable. Companies simply cannot exist solely on blockbusters when generics or 'me-too' drugs steal their market share as their patent lives wear off. Numerous methods and strategies exist to keep the drug pipeline pumping. A common move is for pharmaceutical companies to join strategic alliances, merge, or acquire other firms. When this occurs, the joint or parent company increases its catalog of not only drugs presently on the market, but drugs in development and research pipelines to create the necessary innovation for future sustainability.

While the pharmaceutical industry regards itself as a research-based, life-saving industry, justifying high drug prices to fund present and future development, many may be surprised to learn that most of the R&D in this industry is outsourced, and not in the research labs of Pfizer or Johnson & Johnson. So the question becomes, where is this R&D outsourced to? The majority of the R&D in the pharmaceutical industry is performed by (1) the government, the National Institute of Health (NIH), (2) small biotechnology companies, and (3) academic institutions.

Number (3) is where I have focused this study. When the corporate governance of pharmaceutical companies is examined, a common theme becomes apparent. Pharmaceutical companies often have university employees on their boards of directors, and thus university connections. Whether they are medical professors, non-medical professors, or even chancellors, the fact of the matter is that these directors are affiliated with a university; a potential R&D pipeline for the pharmaceutical industry. Thus, my initial reaction was, you don't have to look much further than a pharmaceutical companies' board of directors to learn what kind of university research connections it has.

To offer a brief illustration of the initial research I conducted, and the data I extracted, I will highlight Johnson & Johnson, an American pharmaceutical company with over 118,000 employees and $63.747 billion in sales in 2008 (the largest pharmaceutical company in the world at the time, which has now been surpassed by Pfizer following its late 2009 acquisition of Wyeth). Johnson & Johnson currently has 10 directors on its board, four of whom are employed by

universities. These include two medical-related university employees: Susan L. Lindquist, Ph.D., Professor of Biology at the Massachusetts Institute of Technology; and David Satcher, M.D., Ph.D., Director at the Morehouse School of Medicine, and two non-medical university employees: Mary Sue Coleman, Ph.D., President of the University of Michigan, and Michael M.E. Johns, M.D., Chancellor of Emory University. With one of the largest pharmaceutical companies in the world having a board made up of 40% university employees, one would be safe to assume that their place on the board matters, and matters greatly. Based on credible international university rankings and medical school rankings we can then identify the quality of the universities these directors come from and the type of pharmaceutical companies that utilize them. Certainly one would expect a larger, more established pharmaceutical company to be more likely to have a Harvard Medical School professor on its board than a smaller, unproven company. But if this expectation is in fact a reality, what realistic difference does it make? How does having such connections impact the company? And what types of pharmaceutical companies have such university connections on their boards?

The paper is divided into two main parts: (1) a literature review, where I summarize and analyze the main themes in the pharmaceutical industry, with focus on university-industry relations, based on literature I read over a year's time, and (2) Statistical analysis, where I hypothesized the relationships of numerous company metrics in my dataset, performed multiple regressions, and analyzed the results. Before I could test data, I needed to gather it.

Using COMPUSTAT data from Wharton Research Data Services with the SIC Code of 2834, Pharmaceutical Preparations, to extract data on the industry, I initially arrived at 222 companies. I further narrowed my dataset down to 109 companies by eliminating all companies that did not have complete or sufficient data available at a firm or board level. These 109 companies' boards were then researched one-by-one noting many board characteristics such board size, gender breakdown, insiders vs. outsiders, if the chairman is/isn't the CEO, university members (medical and non-medical), committee memberships of these university members, and the proportion of university members on the boards. Profiles were created for all board directors who were presently employed by universities. In my database I have a total of 99 director profiles who are employed by a university. All board-level data was gathered during the latter half of 2009.

In order to answer my initial questions and test my hypotheses it was necessary to test the data I had gathered. Prior to testing, all of the data had to be populated completely, and checked over numerous times for accuracy. For some variables such as 'total university ranking,' which represented the power and quality of universities on a pharmaceutical companies board, coding schemes had to be developed. While I initially found basic descriptive statistics such as mean, max, min, etc. in order to discover and eliminate any potential outliers, eventually I performed regressions. The setup for multiple regression was to test a number of independent firm-level variables (data gathered from 2008) to predict board characteristics (depend variables). Company size (log of assets), geography, S&P 500 Index, R&D expense, and performance metrics of return on assets (ROA),

earnings per share (EPS), and sales growth (2006-2008) were used to predict the board characteristics of percent of women on a board, percent of insiders on a board, chairman=CEO?, number of medical university connections, non-medical university connections, total university connections, power and quality of universities represented, and top-100 medical schools represented. The purpose of these multiple regressions was to see what type of companies had these particular board characteristics; what type of pharmaceutical companies had university connections on their boards? The different independent variables are designed to see if geographic location, size, investment in innovation, and/or performance impact its board makeup. The next set of multiple regressions set the performance metrics of ROA, EPS, and sales growth as the dependent variables, and the independent variables of geography, S&P 500, R&D expense, and board characteristics were used to predict performance. This model was to answer the question: Does having university connections on a pharmaceutical board matter? Thus, does it impact company performance?

The strength of relationships between variables based on the output of the multiple regression models was analyzed using the p-value of the t-statistic. The p-value represents the level of statistical significance. The scale used to analyze such strength was if $p < 0.1$, there was a weak relationship, a medium-strength relationship if $p < 0.05$, and a strong relationship if $p < 0.01$. 0.00 would be the lowest p-value possible, and represent the strongest relationship. For p-values greater than 0.1, I considered the variables to have no significant relationship.

The key findings of this study were that the larger the pharmaceutical company and the greater the R&D expenses of that company the more likely the company would have university connections on its board of directors. The larger the company, the better the universities and medical schools these directors would be employed at. These connections are believed to symbolize and secure strategic alliances between pharmaceutical companies and academic institutions. Pharmaceutical companies can therefore tap into innovative research pipelines at these universities for new drug discovery and development. While there was not strong evidence that university connections on a pharmaceutical board directly impacted company performance, larger pharmaceutical companies, who were more likely to utilize such connections, did yield greater earnings per share and return on assets than smaller companies, who were less likely to utilize such connections on their boards.

The data has strongly shows that larger companies with greater investment in innovation are more likely to utilize university employees as directors on their boards. In my literature I suggest many potential reasons for these connections such as establishing a liaison position to create closer communication, firms creating strategic alliances with universities, and using such connections to tap into university research pipelines. While one would be wise to conclude that board university connections give pharmaceutical companies an edge in innovation, it is difficult to conclude how significant this edge is. While there is quite a clear pattern between size and university connections, the pattern is not always consistent. Not every company follows 'the rule.' Not every company

utilizes university employees on their boards. I believe these connections can have a tremendously positive impact on a pharmaceutical company, but the data doesn't always directly suggest that. Business is not a perfect science and there is not always a right or wrong way of doing things. However, some things can help, and while pharmaceutical companies clearly have different strategies when structuring their boards, 'big pharma' trends towards having as many quality university connections as possible on their boards.

It is quite clear that the pharmaceutical industry will try to get any edge it can to develop new drugs. Sustainability and growth is inconceivable without new drugs, and new drugs cannot be discovered without innovation. Pharmaceutical innovation is born through research and development performed by the government, small biotechnology companies, and most importantly, academic institutions. Due to this fact, pharmaceutical companies will continue to create strategic alliances with these institutions in order to tap into their ever-valuable R&D.