BIOTECHNOLOGY, PHARMACEUTICALS AND THE BAYH-DOLE ACT

Shreefal Mehta

Shreefal Mehta, PhD, MBA is a Research Assistant Professor of Biotechnology Management
At the Lally School of Management and Technology, Rensselaer Polytechnic Institute. He is also CEO and co-founder of Myomatrix Therapeutics, LLC

ABSTRACT

Reviews of the discovery commercialization process in biotechnology are particularly exacerbated in the current climate of rapidly rising costs of health care. Many recent discussions and articles have suggested that modifications in the application of the Bayh-Dole Act can be used to reduce the price of drugs or improve public access to new inventions and products stemming from basic life sciences research. The data discussed in this article show that prices for the most popular drugs will not likely be reduced significantly by leveraging specific provisions of the Bayh-Dole Act.

INTRODUCTION

Comments on the process of commercialization of university-discovered biotechnology are particularly exacerbated in the current climate of rapidly rising costs of health care. The growing rhetoric and debate are reflected in the titles of recent articles [1,2] and in public discussions and topical symposia. The Howard Hughes Medical Institute recently organized a conference (May 2003) specifically to review the impact of the 23-year-old Bayh Dole Act on biomedical technology commercialization and speakers raised several issues with strong suggestions for change [3]. Lawmakers are considering proposals to reverse the Bayh-Dole Act for life sciences discoveries made with federal funds [4]. The open source proposal for intellectual property and discoveries in biotechnology has gone from an outlandish proposal discussed among legal scholars and scientists to the center of public debate among lawmakers [5].

Many of these recent discussions and articles have been inflamed by the recent politically-charged debate on drug pricing. Modifications in the application of the Bayh-Dole Act are suggested, with the goal of reducing the price of drugs or improving public access to new inventions and products arising from basic life sciences research. The data discussed in this article show that prices for the most popular drugs will not likely be reduced significantly by leveraging specific provisions of the Bayh-Dole Act. The act has been successful in its primary goals and most modifications suggested to date could potentially reduce the economic value and rate of commercialization enabled by this process. Is it possible that addressing the process of technology transfer at the point of transaction could alleviate some of the problems perceived in the process today?

TECHNOLOGY TRANSFER

Scientific research leads to discoveries and innovation, and innovative products create wealth. The Bayh-Dole Act of 1980 created an incentive for universities to translate their research discoveries into innovative commercial products by granting them ownership of patents arising from federally-funded research. Specifically, the act was meant to increase the commercialization of federally-funded discoveries. Since 1980, over 1000 new products, over 2,200 new companies, thousands of new jobs and $40 billion of added economic activity are attributed to licensed discoveries made with federally funded research [6]. In the context of human health, the process of technology transfer to industry and subsequent technology commercialization are critical to achieving the goals of public investment in health care research – namely that of generating better solutions for improved health care.

A significant increase in government funding for health care research from a National Institutes of Health (NIH) budget of approximately $3.4B in 1980 to $24B in 2003, accompanied by a steady increase in university patents issued has brought increasing licensing revenues from life science patents to the university. Today, technology transfer is becoming big business, with a recent Association of University Technology Managers (AUTM) report showing that 9,707 licenses were transferred by US universities in the year 2001, with resulting $1Billion in gross licensing revenues [7].

ARE THERE PROBLEMS?

The Bayh-Dole Act has been successful in increasing product commercialization from federally funded academic research. However, recent concerns have arisen over specific cases of fundamental biomedical patents being "misused" in subversion of the Bayh-Dole Act's intended goals. Are these isolated anecdotes driving the rhetoric to modify the application of the Bayh-Dole Act or are there other motivations and effects to this dialogue that should be considered? Is there a deeper dissatisfaction in the public community with the growing commercial outlook of university environment and related academic research?

Reviews of the discovery commercialization process are raised to heated rhetoric in the current climate of rapidly rising costs of health care. These perspectives are reflected in the titles of recent articles: "Are we paying twice for the same drugs? [1]" and "Razing the tollbooths [2]". US Representative Dennis Kucinich (D-Ohio) has recently announced his intentions [4] of introducing new legislation to essentially reverse the Bayh-Dole Act, making federally-funded life sciences discoveries publicly owned, with non-exclusive licenses granted to industry to commercialize products. In his view this will create the healthy competition to manufacture products that is currently prevalent among the generics industry.

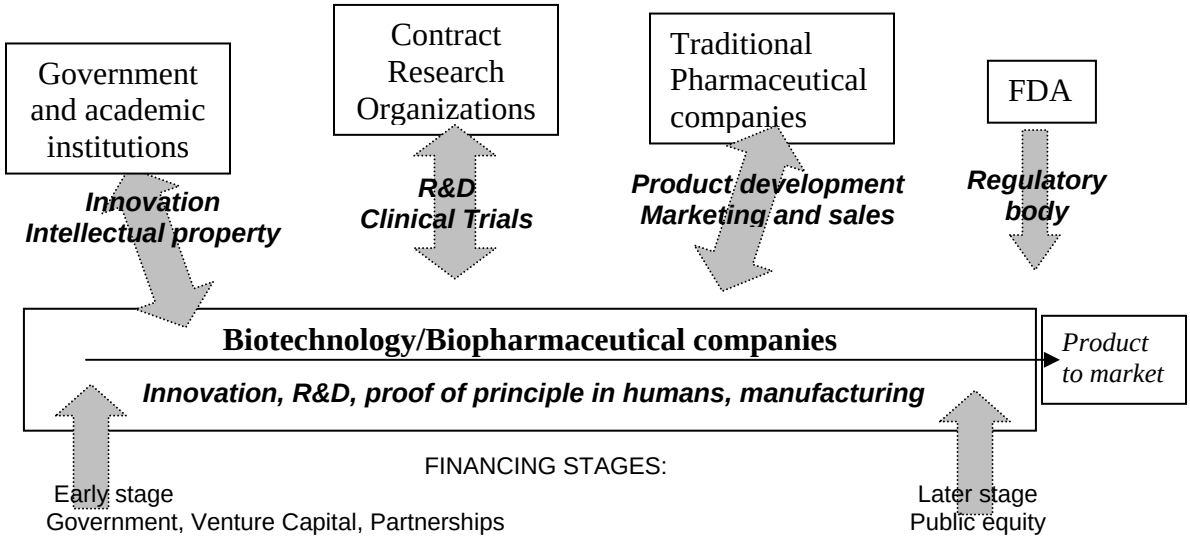
Two key control mechanisms afforded by Section 203 of the Bayh-Dole Act are 1) enforcing government march-in rights on products based on federally funded research, to force universities to either non-exclusively license basic patents or to license to chosen entities 2) insist on licensing terms that provide for lower pricing to the public for products supported by these basic patents.

In this respect, it is worth examining the nexus of academic and industry that exists in the biotechnology-pharmaceutical industry and whether the solutions and goals discussed above can

be met efficiently to give the public the best results – more innovative medicines and diagnostics that are affordable to more people.

Academia in the Biotechnology Industry

The components and value chain within the biotechnology industry are represented in the generalized schematic below, with value increasing from left to right in the diagram.



Intellectual property, products and capital flow amongst the players in a comprehensive economic-system. In the generic schematic shown above, a biotech company licenses in technology developed at a university through government financing. The company then obtains financing from government (SBIR), private individuals or venture capital to achieve commercial proof of concept. The product development process is managed by the biotech/biopharma company and strategic partnerships are formed with big pharma whose deep pockets and market expertise and presence would bring the product through the FDA checkpoints and out to a wide public. Government taxes and royalties to licensors collected from these companies are funneled back into basic research through grants and distributions respectively. While the industry portrait above is by no means the only route to commercialization, it is certainly a frequent paradigm in a rapidly changing industry.

Growth in the biotechnology industry has been triggered by technology innovation and basic life sciences discoveries made by publicly funded research. There is thus an intrinsic role for academic institutions within the biotechnology industry, defined by their role as sources of basic biological discoveries.

Product development and patent protection for new drugs

Focusing on pharmaceutical drug products (which generally have the most expensive and longest R&D process), consider the estimated cost of developing a drug and the contribution of academic or government-sponsored research towards new drug products. Development of a drug from concept to market, costs an average of $403 million in out-of-pocket costs ($802 million in capitalized costs) [8]. Comparing the investments made by industry and the NIH in basic research and development shows that in 2001, the pharma industry invested roughly $30 billion [9] while the *entire* NIH budget was $20.3 billion. More significantly and to the point, the bulk of the costs

for product development, namely the costs for clinical trials, are borne by industry, with approximately $10 billion invested in 2001. In comparison, only $2.1 billion from NIH funds went towards clinical research in 2001. In drug development, the risks are high (>95 % chance of failure) and experiments to meet regulatory demands are expensive, until phase II clinical trials are successful, after which the risks are lowered significantly but costs increase (large phase III trials).

From the above discussion, even though an original discovery was made and patented by the university's technology transfer programs, the biotech/pharma industry clearly undertakes the greatest portion of the financial risk through their significant investment in the development and commercialization of the university discovery.

This issue should also be viewed in light of the intellectual property position surrounding a new drug – "method" patents and "composition of matter" patents. The former defend the right to treat a disease by a specific target and the latter defends a particular composition of a compound that can effectively address the target to treat the disease. Universities generally hold method patents, as basic research uncovers novel diseases mechanisms in biochemical pathways in the body [10]. However, companies have traditionally valued composition of matter patents – this bias is partly a reflection of judicial process (see, for example, the Rochester "method" patent's inability to claim infringement by drug makers addressing the Cox-2 pathway) [11]. This differential significance of specific types of patents to protection of commercial rights is an important context to this discussion.

Reducing the price of drugs with Bayh-Dole provisions

Addressing the issue of whether the government has intellectual property rights (through provisions in the Bayh-Dole Act) to force marketed drug prices lower, a recent study by the NIH (NIH report, 2001) found that of the 47 drugs that achieved sales above $500 million in 2000, only 4 could be shown to have direct or indirect use or ownership rights by the government. Of the 284 new drugs approved in the US from 1990-1999, 93.3% originated from industrial sources, with government sources accounting for 3.2% of the approvals and other non-profits accounting for the other 3.5% [12].

Thus the highly risky, tightly-regulated and expensive drug-development and commercialization process is primarily driven by the commercial pharmaceutical and biotechnology industry. Although the process may start with basic research discoveries supported by public monies, these discoveries would not make it in the development process, to a disease-modifying or ameliorating drug product that is available to the public on the market without the substantial investment and risk-taking from the industry. While it is beyond the scope of this article to discuss drug pricing strategies, the companies are clearly trying to appropriate the maximum economic value from the markets. It is also clear that federally-sponsored research is successfully meeting its goals – creating new insights into disease biology that lead to novel and better treatments. Discoveries made by government funded basic research are clearly important, but contribute less than 10% to the new disease-modifying discoveries that are developed by the biotech and pharma industry. It would be inefficient to get at current drug pricing through leveraging or modifying the Bayh-Dole Act, as seen from the above data.

PATENTS RULE

As an interesting and significant related issue, recent concerns have emerged about the onerous enforcement of broad method patents by universities. It has been argued that these basic mechanism-of-use patents held by universities can potentially block novel products from reaching the public in a cost-effective or timely manner. The USPTO may have occasionally erred in issuing patents with unduly broad claims, allowing patent owners to effectively "tax" marketed products or their development costs with licensing fees or infringement lawsuits. However, it is the view of this author that such issues of patent infringement be settled in the legal system and not by policy makers. The applications of a technology are not always known or well understood when first patented. Therefore, requiring federal agencies to govern licensing terms is a clear step back from the free market approach that the Bayh-Dole Act has successfully propagated. Control by the granting agency or any other government agency of the patenting process and licensing terms could inhibit the open commerce that brings new technologies out to market.

BADNESS IS ONLY SPOILED GOODNESS – C.S. LEWIS

Perhaps the problems with the implementation of the Bayh-Dole Act lie within the changing goals of the universities? In adopting aggressive technology transfer activities that enforce patents and maximize licensing revenues, are the research universities diverted from their original mission of effective transfer of new knowledge to benefit a multi-dimensional and global society? Drs Rai and Eisenberg in their recent article [13], recognize this problem but pass it over, hinting that no one university will be the first to relinquish the sizeable revenues available through aggressive technology transfer activities. If the incentives for effective transfer of discoveries into useful products are separated from licensing dollar revenues gained by technology transfer personnel, would this still result in an effective system of product commercialization? Are exclusive licenses required for effective product commercialization? Is a university part of the commercial economy in the biotech industry or as a non-profit educational institution, can it claim to have goals other than appropriating maximal economic value from its intellectual property "products"?

The nexus between academia and industry, particularly small business commercial entities (less than 500 employees), has assisted in the rapid commercialization of many university discoveries, and there are many positive aspects to a clearly circumscribed relationship. In support of the efficiencies of the US system, take the case of Germany. University professors there have long been allowed to own patents but the external environment was not conducive to commercialization of these patents (data from 1980 to 1996) and these innovations stagnated [14]. The US system, with institutions motivated by financial returns and an entrepreneurial market with venture capital money available, lends itself as an energetic environment for technology commercialization; one that is being copied worldwide.

The economic cycle depicted earlier is worth revisiting here: licensing revenues earned by universities are invested back into more basic research benefiting the public - with gains shared between the institution, inventors and their laboratories or academic departments. One indicator that licensing revenues have not been misused to fatten administrative overheads at universities,

is that over the last decade, there has been no increase in the average facilities and administration fee negotiated on federal grants by academic institutions.

SUMMARY

The external environment in America is closely tied to the intermingling of interests among industry and academia. The open and democratic nature of academic discourse lends itself to transparency in these dealings. The fact that these concerns are being raised today is a clear indicator that there is a growing awareness and need to have open discussions on the relationships and vested interests of university researchers, technology transfer offices and the commercial sector. There is clearly a need to alter a few things in the system, but do a few outstanding cases on biotechnology commercialization gone sour due to greed warrant a change in the entire system? Are we focusing on this discussion with the right perspective? After all, let us not forget the primary reason for all that public investment in research – our tax moneys – to create innovations and insights that can eventually be turned into better products to help us lead a healthy and productive life.

REFERENCES

[1] Arno, Peter and Davis, Michael. Paying twice for the same drugs, *The Washington Post*, Washington DC: pp. A.21, Mar 27, 2002.

[2] Stix, Gary. Razing the tollbooths: A call for restricting the patents on biomedical research. *Scientific American*, Apr 2003.

[3] HHMI conference on Bayh Dole act. May 2003. website

[4] Kucinich, D. Comment in The Nation (online edition), 19 June 2003. Found online at www.thenation.com/doc.mhtml?i=20030707&s=kucinich. Last accessed 1 December, 2003.

[5] Cukier, KN. "Community Property" *Acumen Journal of Life Sciences*, vol 1(3): 54-60. Oct/Nov 2003.

[6] www.autm.net - Website for Association of University Technology Managers, with information on the Bayh-Dole Act, technology transfer, and university licensing surveys. Last accessed 12 November 2003.

[7] Association of University Technology Managers (AUTM). AUTM Licensing Survey, Fiscal Year 2001 Survey Summary. Available at http://www.autm.net/surveys/01/01summarypublicversion.pdf. 2002.

[8] DiMasi, Joseph A, Hansen, Ronald W, and Grabowski, Henry G. The price of innovation: new estimates of drug development costs, *Journal of Health Economics*, **22**:151–185. 2003.

[9] Pharmaceutical Industry Profile 2002, The Pharmaceutical Research and Manufacturers of America (PhRMA) online at www.phrma.org. Last accessed 10 November 2003.

[10] There are some striking exceptions to this statement, for example the University of Wisconsin. Their discoveries in the Vitamin D area have contributed 80% of the IP to the $1 billion/year sales of that market. Many of their discoveries have been new molecules.

[11] Shulman, S. A painful IP ruling. *Technology Review*. **106**(5), 75. Cambridge: Jun 2003.

[12] NIH report: A plan to ensure that taxpayer's interests are protected. http://www.nih.gov/news/070101wyden.htm. July 2001. Last accessed 10 September 2003.

[13] Rai, A.K., and Eisenberg, R.S., Bayh-Dole Reform and the Progress of Biomedicine - Patents on government-supported research can work against the public interest, *American Scientist*, **91**(1), 52, 2003.

[14] Casper, Steven and Kettler, Hannah. National Institute frameworks and hybridization of entrepreneurial business models: The German and UK biotechnology sectors. *Industry and Innovation*, 8(1): 5-30. April 2001.