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AS A POWER TOOL FOR ECONOMIC GROWTH**

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INTELLECTUAL PROPERTY AND RESEARCH AND DEVELOPMENT INVESTMENT

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Technology Shelved or Technology Commercialized?

The traditional means used by universities to disseminate their knowledge has included the hosting of research seminars on their campuses to discuss “works-in-progress”; presentations at scholarly research conferences attended by specialists in particular disciplines and fields; publication in peer-reviewed scholarly research journals; and helping their students find jobs in academic, government, and industry research settings. American policymakers came to believe in the 1980s that this generally effective research system was nevertheless not as effective as it could be at encouraging the commercialization of research findings with potential market applications: Too many promising technologies remained shelved.

The United States Congress with the Bayh-Dole Act and CRADA Act gave universities and government research laboratories the authority to apply for patents for research findings that resulted from public funding so that rights to the research could be formally licensed to the private sector for further development and commercialization. The policy rationale was the property rights would provide incentives to individual university researchers to consider market applications in their research, to the administrators at universities to organize for technology transfer, and to private industry to invest in further commercial development of basic technologies.

These policy reforms were controversial at the time and have become perhaps more controversial as the number of patents earned by universities has increased. The primary effect of Bayh-Dole on university research has been the establishment of technology transfer offices (TTOs) at many research universities, a substantial increase in the number of patents earned by universities and their researchers, and a few examples of universities with substantial royalty revenues. To critics of Bayh-Dole, however, the primary effect has been mission conflict: Is the mission of the university to create and disseminate knowledge and, if so, why establish barriers to access? Say the critics:

“The economic theory of scientific research that was ignored in Bayh-Dole ignores that patenting the results of publicly funded research is necessary to induce the research investment and that restrictions on use associated with patents reduce to social returns to the public investment. ...[I]f the findings of publicly funded university research are placed in the public domain, or are inexpensively licensed to anyone who wants to use them competition alone may stimulate their widespread application” (Mowery et al, 1999:268).

Their analysis, that open dissemination of science and technology best facilitates technological progress, fundamentally challenges the policy rationale of Bayh-Dole. Their claim that patents and TTOs are diverting university resources away from their primary mission of basic research and public dissemination is sobering and worthy of careful scrutiny and study. The Bayh-Dole critics inspired other social scientists to gather evidence and assess the merits of the critique.

Study of MIT’s TTO, an operation which long pre-dates the Bayh-Dole Act, shows, even at a university famous for the number of patents earned, that the number of technologies that get to the marketplace, and the number of students and faculty who start-up enterprises, patenting still represents a very small percentage of research activity at the university (Agrawal and Henderson, 2002).

Another study finds that most patents do not contribute much if any royalty revenues; only a few patents bring home substantial royalties and only one or two patents prove to be blockbusters (Feldman et al, 2002).

An industry survey with the assistance of the Association of University Technology Managers finds that 85% of university research still needs more development research to be useful; 45% of university research need a great deal more development research to be useful (Thursby and Thursby, 2002).

The economics of patenting MIT, hence, look like the economics of technology innovation more generally—i.e., most innovations fail in the marketplace. These economics of university patenting challenge TTOs to manage skillfully their resources, which tend to be modest: Many technologies do not merit the expense of the patent process; those that do depend on TTOs that identify the appropriate licensee(s) and that's a tricky proposition (Mowery et al, 2002).

A management scholar who studies technology innovation and markets asks perhaps the most critical question of all regarding the utility of Bayh-Dole: Do university patents lead to more commercialization successes (Shane, 2002)? His evidence is about 1400 patents earned at MIT between 1980 and 1996, supplemented by interviews with the MIT TTO staff. He studied the licensees and the licenses that were later terminated because the licensees “cannot make the technology work in a cost-effective manner, because their strategic plans change, because the company does not want to continue to pay license fees, or because they have changed the product or business that they are developing so that the intellectual property is no longer useful” (Shane, 2002:127).

Professor Shane finds that “inventions are more likely to be licensed when patents are an effective mechanism for appropriating the returns to innovation because the patent system reduces the transaction costs of technology transfer.” Effective university patents allow “commercialization to be undertaken by economic actors who possess a comparative advantage in that activity” (Shane, 2002:133). When the patents are ineffective, the technology is either developed by the inventor himself, or goes unsuccessfully, or goes undeveloped. He explains, “Technology commercialization involves a set of skills—including identifying customer needs, developing product concepts, designing products and processes, prototyping, and manufacturing—that university inventors rarely possess” (Shane, 2002:123). These findings provide important support for the policy rationales provided by proponents of Bayh-Dole. These findings also comply with generalizations that have come to be known about technology management.

“Innovation means “the process by which technology is conceived, developed, codified, and deployed on a large scale” (Brooks, 1985:37). Scholars of technology management sought to explain why, e.g., RCA and AMPEX innovated video cassette recorder technology but technological followers JVC, Matsushita (the Panasonic brand), and Sony turned them into great consumer products. RCA lacked the marketing vision and AMPEX lacked the manufacturing capabilities to put a VCR in every home in America. Technology innovation in the laboratory is not enough; successful technology innovators are able to produce the product and distribute it in the marketplace as well. Successful technology innovators seek to secure all the “complementary assets” needed to commercialize successfully their innovation.

However, the technological innovator need not possess all the complementary assets in-house. Some of the essential questions of technology management concern which capabilities to possess, acquire, or build inside the organization and which capabilities to leave to a partner. When these capabilities can be gained through partnership, management scholars say that there exist “technology markets” (Arora, Fosfuri, and Gambardella, 2001). Without efficient technology markets technology innovators have either to possess, acquire, or build the complementary assets themselves—or fail in the marketplace with the new technology. Efficient technology markets depend on effective patent rights. Efficient technology markets in the United States have fostered the existence of specialized engineering firms in industries such as chemicals, biotech, and information technology (Arora, 1997; Arora and Gambardella, 1990). These specialized firms might be thought of as pure intellectual property enterprises, for rather than investing into production capabilities themselves, they license their patent rights to others with manufacturing and distribution capabilities. The university-based technology innovator whose TTO licenses a patented technology to a business enterprise is taking similar advantage of the existence of an efficient technology market.

Licensing of technology has been increasing by about 10% per year in the United States and by about 18% per year internationally (Kotabe, 1996). Licenses typically are either vertical or horizontal with respect to the marketplace: An owner licenses vertically when it provides the patented know-how to firms which may then use or market the invention. Thus vertical licensing generally intends to carry out a product distribution strategy. Vertical licensing depends on effective intellectual property rights, either patent rights when the technology is to be used or trademark rights when it is to be brand-marketed.

An owner licenses horizontally when it provides the patented know-how to firms which will provide mutual assistance in the development of products. Thus, horizontal licensing generally intends to carry out a product development strategy. Effective patent rights crucially facilitate horizontal license technology market transactions (Arora, 1995). The parties to a licensing or cross-licensing of technology relationship look to patent rights so that the nature of the knowledge to be transferred and the terms of its use can be specified through contract (Grindley and Teece, 1997). Strategic alliances, too, depend on patents.

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