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Has the Bayh-Dole act compromised basic research?

Jerry G. Thursby [a,*], Marie C. Thursby [b,1]

[a] College of Management, Georgia Institute of Technology, 800 West Peachtree Street, NW, Atlanta, GA 30332-0520, United States
[b] College of Management, Georgia Institute of Technology and NBER, 800 West Peachtree Street, NW, Atlanta, GA 30332-0520, United States

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ABSTRACT

We examine three hypotheses regarding the effects of the Bayh-Dole Act on research effort of faculty. The first hypothesis we call the status quo hypothesis and it asserts that there has been no effect on research profiles. The second hypothesis, which we call the negative hypothesis, asserts that faculty have been diverted from their traditional role in basic research toward research with more commercial potential. Our final hypothesis is derived from prior theoretical work that suggests that both basic and applied research is greater when faculty can benefit from commercialization of their research effort; we refer to this as the positive hypothesis. The data we examine are the research and invention disclosure of faculty at 8 US universities over the period 1983–1999. Using a citation based measure of basic research publications we relate basic research effort to invention disclosures. Our findings are clear in that they do not show any support for the negative hypothesis and they show substantially greater support for the positive hypothesis than for the status quo hypothesis.

1. Introduction

With the passage of the Bayh Dole Act in 1980, universities were allowed to retain property rights to the results of federally funded research conducted by their employees and to exclusively license the results in return for royalties. The Act was passed amid concerns that while the United States led other countries in basic research, the results were languishing in university labs since firms had little incentive to develop inventions because they could not appropriate the returns.[2] The premise was that exclusivity would provide the needed incentives for firms to license. Moreover, the royalty payments would provide incentives for universities to market the inventions and faculty to disclose them.

Data on university licensing suggests that the Act had its intended effect. The number of universities with organized technology transfer offices grew from 25 in 1980 to over 230 in 2004. The 119 US non-profit respondents to the Association of University Technology Managers annual survey (AUTM, various years) who responded in both 1996 and 2007 reported that inventions disclosed by faculty between those dates almost doubled from an average of 67.1 per institution to 131.1.[3] New patent applications increased from an average of 23.2 per institution to 77.6 (growth of 334%). The number of license and option agreements executed rose 80.1% from an average of 19–34.4 Licensing income more than tripled in current dollars from $550.7 mil to $1715.6 mil. License income as a percent of total research expenditures rose from 2.25% to 4.31%. The Act was thus touted by some as "perhaps the most inspired legislation to be enacted in America over the past half-century" (The Economist, 2002).

These dramatic increases in university licensing activity have nonetheless fueled controversy as to whether unintended consequences of the Act have had perverse effects on university research. According to some, Bayh-Dole placed "the profit motive directly into the heart of academic life," driving faculty away from curiosity driven basic research (Washburn, 2008). Another claimed that "the kind of basic experimentation that leads to a greater understanding of how the world works . . . has largely been set aside in favor of projects considered to have more immediate market potential" (Rae-Dupree, 2008). This comes at a time when policy makers in the United States are increasingly concerned about the health of the

* Corresponding author. Tel.: +1 404 712 8688.
E-mail addresses: Jerry.Thursby@mgt.gatech.edu (J.G. Thursby), marie.thursby@mgt.gatech.edu (M.C. Thursby).
[1] Tel.: +1 404 894 6249.

[2] Eisenberg (1996) has pointed out, however, that these patents were largely related to research performed under defense contracts and that ownership had reverted to the federal government only after federal contractors elected not to retain rights ceded to them by the Department of Defense. Thus, the evidence cited in support of the Act was not a random sample of federally funded research or patents.

[3] An invention disclosure is the document filed by a faculty member when she believes that she has a commercializable invention.

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research environment for basic research. Universities produce the bulk of basic research, and since 2002 basic research conducted by universities has leveled off while their applied research is estimated to be growing (National Science Board, 2008).

The arguments concerning the impact of university licensing in the post Bayh-Dole era typically come down to whether the research of US university faculty was unaffected by licensing incentives or, as implied above, basic or fundamental research has suffered. We argue that this is much too narrow a framing of the relevant questions since it ignores a potential gain in fundamental research that can be traced directly to an increased emphasis on the licensing of university inventions. That is, licensing incentives may result in faculty increasing their overall research activity, which depending on the nature of a faculty member's research need not reduce their basic research effort. Indeed, in earlier simulations of a theoretical model of licensing and research (Thursby et al., 2007), we show that the most likely outcome of university licensing is that both basic and applied research effort increase, but that applied effort increases more than basic effort. Thus it is entirely plausible (and an empirical issue) that basic research effort increases but that the fraction of effort that is basic decreases.

In this paper we exploit a unique database of university research and licensing to shed light on three hypotheses. The first is that research has remained unchanged over the life of the Bayh-Dole Act. Hereafter we call this "status quo hypothesis" since it suggests no change in research effort and orientation. Second, we consider the hypothesis that there as has been a decrease in basic research in order to support an increase in applied effort in order to reap commercial gain—we call this the "negative hypothesis." Finally, we consider the hypothesis that both basic and applied effort have increased (though possibly by a differential amount). We call this the "positive hypothesis." Before proceeding it is important to note the terms "negative" and "positive" are not meant to have normative implications, since depending on one's perspective an increase in basic research could be viewed as desirable or undesirable. For example, in contrast to the views of Washburn and Rae-Dupree, others would argue that, particularly in the biotechnology area that faculty have been too engaged in basic research to the neglect of translational research needed to convert discoveries into drugs (Begley and Carmichael, 2010). The terms are meant to refer only to the effects of licensing on basic research.

There is a small but growing body of empirical research that has focused on several related topics. Stephan et al. (2007) show that only a minority of faculty in top US universities are involved in patenting and for those faculty there appears to be a positive relationship between patenting and publishing. Thursby and Thursby (2010, 2011) show that only a minority of faculty at eleven major universities are engaged in disclosing inventions to their universities, and those who file disclosures are generally more research active (as measured by research funding, publications and citations) than those who never disclose. Further, those who disclose are generally most research active around the time of a disclosure. Azoulay et al. (2007, 2009) provide evidence to suggest that patent applications appear to follow flurries of publication. In contrast to this work, we focus on the nature of the research.

In this paper we construct a measure of the basic research effort of faculty in PhD granting departments of eight major universities over the period 1983–1999 and compare this measure econometrically to the interest level that faculty show in the licensing process. Our measure of licensing interests is based on the disclosure of inventions by faculty to their university licensing office. After controlling for sources and amounts of research funding as well as demographic factors we find support for the positive hypothesis in that our measures of faculty interest in licensing are generally positively associated with basic research.

2. Conceptual underpinnings

The conceptual underpinnings of our three hypotheses come from Thursby and Thursby (2002) and Thursby et al. (2007), both of which emphasize that the impact of financial incentives associated with licensing depends on both faculty motivation of faculty and the research production process.

One of the implications of the academic freedom is that both the research outputs available for licensing and the disclosure of inventions for license are largely dependent on faculty discretion. While university policies in the context of Bayh-Dole clearly provide a "carrot" to induce faculty to disclose when they have research that they believe has commercial potential, their effectiveness relies of faculty perceptions of commercial potential and their willingness to disclose. All US university contracts state that faculty should disclose such inventions, but they are hardly enforceable. As discussed in Thursby and Thursby (2002), faculty who are interested in pursuing basic research may not be interested in devoting time to licensing activity even if they realize the commercial potential of their work. Indeed one reason that one might expect to find data consistent with the "status quo" hypothesis is that the faculty who pursue basic research either do not recognize licensable opportunities or are not interested in pursuing them.

This notion is more formally pursued in Thursby et al. (2007) which develops utility maximizing models of faculty research over their life-cycle. In these models, faculty have a taste for doing research, so that their utility is a function of the time they spend solving research problems, the reputation they develop, and their income. It is the last of these that Bayh-Dole affects, so that faculty who are passionate about solving fundamental puzzles or pick research topics primarily with their academic reputation in mind may not alter their behavior in response to license income.

The equilibrium research choices of faculty depend as well on what is possible, that is, research production functions. Thursby et al. (2007) consider several different functions, including basic research that is only published, applied research that is only licensed, as well as research in Pasteur's Quadrant which is fundamental, publishable research that can also be patented and licensed (Murray, 2002; Jensen and Murray, 2005). In the Pasteur's Quadrant specification, basic and applied effort are essentially complementary. Using these research characterizations, Thursby et al. (2007) simulated faculty research choices over their life cycle with and without the possibility of licensing.

Introducing the potential for license income into our simulations has several effects. The most important of these is that licensing does not necessarily compromise either the amount of basic research or total research effort. Indeed, in the majority of simulations the presence of licensing increases both basic and applied research efforts and less time is spent on leisure activities. However, the effect on applied effort is greater than the effect on basic research so that the ratio of applied to basic effort increases. Interestingly, these results hold whether or not the relationship between applied and basic efforts in the research production function is that of complements or substitutes. The cases in which basic and total research effort are lower with licensing are ones in which applied research is not publishable or when license income is extremely high.

These simulations results are the basis for our positive hypothesis. In a world where applied research is publishable or one in which the returns from licensing are not too high (the simulations are unable to reveal what constitutes a "high" level of income) the positive hypothesis is expected to hold. Whether it indeed holds is essentially an empirical issue and we turn to this in the next sections.