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# Growth and productive efficiency of university intellectual property licensing

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## Abstract

Licensing activity of US universities has increased substantially in recent years. We examine this increase focusing on the ‘productivity’ and ‘changes in productivity’ of licensing activity. While it is generally acknowledged that there has been a dramatic increase in licensing, there is little understanding of the licensing process as it relates to university characteristics, nor is there evidence on the extent to which this is the result of increased resources devoted to commercialization or whether it stems from other factors. This paper employs data envelopment analysis (DEA) combined with regression analysis to examine the overall productivity of university licensing activity as well as the productivity of individual universities. We find that licensing has increased for reasons other than increases in overall university resources. Given input levels, universities are today more commercially productive than they were in the recent past; we propose reasons for this shift and analyze factors associated with the shift and factors associated with relative levels of commercialization. © 2002 Elsevier Science B.V. All rights reserved.

*Keywords:* US universities; Licensing; Productivity; Commercial activity

## 1. Introduction

It has been suggested in a number of venues that university resources are not fully exploited as a source of economic growth and competitiveness and recent public policy has been aimed at increasing the commercial impact of universities.<sup>1</sup> For reasons of greater US ‘competitiveness’, the federal government has encouraged greater interactions between universities and the private sector. The Bayh–Dole Act of

1980 changed the nature of ownership of inventions developed under federally funded programs. With passage of the Act, universities could elect to retain title to such inventions, but they are required to file patent applications on those inventions. The Act also encourages the technology transfer activities of universities. The federal government has not been alone in encouraging university licensing activity. State governments have looked increasingly toward public universities as sources of economic development.<sup>2</sup>

Have these efforts made a difference? According to results reported in the AUTM Licensing Survey (Association of University Technology Managers, 1997), as well as AUTM press releases, university

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<sup>1</sup> See for example, Grey et al. (1986); Public Policy Center for Stanford Research International (1986); Geisler and Rubenstein (1989); National Academy of Sciences (1992); National Science Board (1993) and Grossman et al. (2001).

<sup>2</sup> See for example, Parnes et al. (2000).

licensing activity has increased over the 6-year period during which AUTM has collected data. Using the sample of universities that participated in all years of the survey, we find that the number of license agreements rose by nearly 70% and the amount of royalties received (in real terms) more than doubled between 1991 and 1996. Prior to 1980, fewer than 250 patents were awarded annually to universities; currently, over 1500 patents are awarded annually. The number of universities actively engaged in technology transfer has increased eight-fold since 1980 to now more than 200.

In this paper, we examine closely this increase in licensing activity. In particular, our focus will be on the ‘productivity’ and ‘changes in productivity’ of licensing activity by US universities over a 6-year period. While it is generally acknowledged that there has been a dramatic increase in university licensing and patenting, there is little understanding of the licensing process as it relates to university characteristics, nor is there evidence on the extent to which this is the result of increased resources devoted to commercialization or whether it stems from other factors. This paper employs data envelopment analysis (DEA) combined with regression analysis to examine the overall productivity of university licensing activity as well as the productivity of individual universities. We find that licensing activity has increased for reasons other than increases in overall university resources. That is, given input levels, universities are today more commercially productive than they were in the recent past; we propose reasons for this change. The regression analysis allows us to relate efficiency to university characteristics. We find that private universities tend to be more efficient in commercialization than public, while universities with medical school are less likely to be efficient. The latter result is particularly interesting given that the majority of university licenses are in the life sciences. We also examine efficiency as related to the size and quality of research faculty in biological sciences, engineering, and physical sciences. Our measures of faculty input in biological sciences and engineering are significantly related to efficiency, while they are not for physical sciences; we propose reasons for this difference.

In our study of the licensing of university intellectual property (IP) we consider the levels and changes in the levels of the ‘outputs’.

1. Sponsored research agreements between universities and industry.
2. License agreements which permit the use of university IP by private sector firms.
3. Royalty payments received by universities in exchange for the use of IP.
4. Disclosures by faculty to their central administration of potentially commercializable innovations.
5. University patent applications.

Each of these outputs is an integral part of a university’s efforts to obtain commercial rewards from the creation of IP.<sup>3</sup> We settle on these five outcomes as commercialization outputs based on interviews and survey results reported in Thursby et al. (2001). Each is viewed as important in measuring the success of a university’s technology transfer. For want of better terms we use ‘commercialization’, ‘commercial activity’ and ‘licensing activity’ as succinct ways of referring to the process by which universities produce these five outcomes.

## 2. Relevance to policy

Whether in response to government incentives for commercial activity or whether it has followed from greater university needs/wants for revenues, the evidence suggests a shift in university goals toward greater commercialization. The Public Policy Center for Stanford Research International (1986) reported in that more than 90% of universities in their sample intended to increase interactions with industry. Morgan et al. (1997) report said that survey results which show increasing responsiveness of engineering faculty to industry needs. Lee (1996) reports a similar finding based on his survey of engineering and science faculty. Cohen et al. (1998) discuss efforts by industry and policy makers to make university research more relevant to industry, and they report growing ties between universities and industry. Finally, we note that university

<sup>3</sup> We do not include start-up companies as output. AUTM defines start-ups as new firms that are formed using a license from the university. As such, we do not view start-ups as output that is necessarily different from a license to an existing firm which then starts a new division or produces a new product based on that license.

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