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The economic impact of licensed commercialized inventions originating in university research

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ABSTRACT

The purpose of this article is to estimate quantitatively the contribution that university licensing makes to the national U.S. economy. As regions and nations face increased economic problems, they seek ways to augment opportunities for economic growth and to identify areas where public funding can be cut. It is now well-recognized that the research university can be a significant engine of economic growth and job creation. University research and research-related activities contribute in many important ways to modern economies: notably through increased productivity of applied R&D in industry due to university-developed new knowledge and technical know-how; provision of highly valued human capital embodied in faculty and students; development of equipment and instrumentation used by industry in production and research; and creation of concepts and prototypes for new products and processes, which may have some unexpected and large social and economic impacts. Yet clear documentation of the proportional contributions these make to economic growth remains elusive. This article provides detailed estimates of the economic impact on the U.S. national economy of one core university activity – licensing of university inventions to industry.

Our approach combines licensing data for U.S. universities with national input–output (I–O) model coefficients and provides more valid and complete estimates of the national economic impacts of university licensing of intellectual property than have previously been available. Our results estimate national economic impact expressed as annual increases in gross domestic product (GDP), in total industry output, and employment generated over a 15-year period.

Summing over the entire 15 years for which we have data – 1996–2010, we estimate that assuming no product substitution effects and a 2–10% royalty fee, the total contribution of university licensing to gross industry output is at least $162.1 billion and as much as $686.9 billion (2005 dollars); estimates based on 5% royalty rates yields an estimated impact of $293.3 billion (2005 dollars) over the period.

Assuming 2% royalty fees and no product substitution effects, we estimate that over a 15-year period, university licensing agreements based on product sales contributed at least $70.5 billion and as much as $277.6 billion (2005 dollars) to the U.S. GDP; with a moderately conservative estimate based on 5% royalty rates, such agreements contributed more than $122.2 billion (2005 dollars).

The I–O model also calculates the number of jobs (person-years of employment) directly created or supported per million dollars of final purchases. Estimates of the total number of additional jobs created as a function of year due to university-licensed products (assuming no product substitution effects) ranged from about 7000 jobs in 1996 to 23,000 in 2010, or more than 277,000 person-years of employment over the entire 15-year period.

Because of uncertainty, we also provide estimates of the economic impact of university licensing income based on a range of product substitution rates—5%, 10% and 50%. The magnitude of the estimated impact depends significantly on the assumptions made, for example the royalty fees and substitution rates, but even the most conservative yet reasonable assumptions yield estimates of very large impacts on GDP, industry output, and employment.

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Major discoveries emanating from academic and/or publicly-funded research have had enormous global economic and social impacts that are obvious but difficult to predict and quantify (e.g., Google, the World Wide Web, nanotechnologies, etc.). Although this article examines the economic impact of only a select technology transfer activity, it nevertheless offers quantitative evidence that the economic impact of university research and technology transfer activities is significant.

1. Introduction

As regions and nations increasingly face major economic challenges, they seek ways to augment opportunities for economic growth. It is therefore important for policymakers to better understand the role and impact of the university as an engine of economic growth. This article provides detailed quantitative estimates of the economic impact on the United States of licensing university inventions to industry under the Bayh–Dole Act. Issues involving the proper scope and interpretation of the Bayh–Dole Act were recently before the U.S. Supreme Court in Board of Trustees of the Leland Stanford Junior University, Petitioner v. Roche Molecular Systems, Inc., et al. (Stanford v. Roche Docket number 09-1159). An earlier report of a portion of the estimates of the economic impact of university licensing presented in this article was cited in briefs in this case. Issues such as who should control licensing agreements concerning federally-funded research and development are becoming more contentious and increasingly command the attention of policymakers at both regional and national levels. It is thus important to have more complete and accurate data on the economic value and impact of such licensing agreements.

These issues are not only of interest in the United States, but also to other countries searching for sustainable growth strategies. University research and research-related activities contribute in many important ways to the national economy, notably through increased productivity of applied R&D in industry due to university-developed new knowledge and technical know-how, provision of highly valued human capital embodied in faculty and students, development of equipment and instrumentation used by industry in production and research, and creation of concepts and prototypes for new products and processes. These benefits are enabled primarily through publications, conferences, information exchange via consulting and collaborative research, and hiring of trained students.

This article presents detailed quantitative estimates of the economic impact on the United States of just one of these research-related activities, licensing of university intellectual property, an impact of major significance for the economy but by no means the largest source of the total impact of university research. It reports the results of a modest approach that makes use of existing Association of University Technology Managers (AUTM) annual survey data and relatively straightforward economic calculations.[1] Using data from annual AUTM surveys of U.S. universities and coefficients from national input–output models, it is possible to develop systematic, conservative estimates of the economic impacts of university–industry research collaborations that result in licenses to firms. Although "deals" between university technology licensing offices and private firms take many forms such as one-time flat fees, taking equity positions in university-based start-ups, and even in some rare cases donating intellectual property (IP) to nonprofits for charitable purposes, in many cases universities base licensing fees on the percentage of sales of new products developed using the university-based IP.

Annual survey data collected by AUTM are available on the licensing income from U.S. universities responding to the survey. The universities responding to the AUTM survey represent a majority (88% in 2009) of the academic R&D expenditures when compared with those reported by the National Science Foundation. Licensing income data by reporting institution are available from 1996 through 2010. With these data as a base, we combined the AUTM survey results with other data and employed the U.S. Commerce Department's Bureau of Economic Analysis (BEA) input–output (I–O) model to develop estimates of the annual national economic impact of university licensed products that have been commercialized and generated sales. These impact estimates take two forms: the change in gross output of all industries due to the university licensed products in the marketplace, and the impact on gross domestic product (GDP) of university licensed products.[2]

Below we describe the data used to generate these estimates, the methods used to develop the estimates, and the results obtained. We first place these results in the context of university licenses as just one of the many economic impacts of university research and education, and in the context of the history of university licensing of intellectual property. The subsequent section shifts the focus to the results of empirical studies of the impact of university research generally and of university licensing particularly.[3] We then present the details of our work. The final sections discuss our results, noting especially the assumptions and caveats that should be kept in mind in interpreting them, and provide suggestions for future research.

1.1. The economic significance of university research

The focus of this article is on the economic impact of university licensing; this represents only one of many outputs from university research that are highly valued in the economy.

Although the intellectual property aspects of university–industry relationships have assumed salience in recent policy debates about the appropriate role of universities in technology commercialization, university-based applied research in areas of interest to industry is not new. During the latter part of the 19th century and well into the 20th, much university research in the United States was actually oriented toward the economic interests of the states in which they resided (and from which they drew their primary support). It was not until the period following World War II that American research universities assumed the role as the primary performers of the nation's basic research (Geiger, 1986; Rosenberg and Nelson, 1994; Mowery and Rosenberg, 1989; Atkinson and Blanpied, 2008).

[1] There are several relatively sophisticated methods that could be used to estimate the economic value of innovations based in university research (e.g. consumer surplus estimates for specific innovations), but most would require costly data collection and/or threaten the proprietary interests of innovating firms.

[2] Gross output includes purchases of intermediate inputs (purchases from other industries) and primary inputs (factors of production), and therefore, double counts industry output. GDP measures gross output minus intermediate purchases, and does not double count output. Changes in GDP measure the changes in economic output of the nation.

[3] A more complete literature review for the first two sections on historical trends in university licensing and the results of empirical studies of the impact of university research can be found in the longer technical report to BIO upon which this article is based. See http://www.oregonbio.org/Portals/0/docs/Education/BIO_EDU_partnership_final_report.pdf.