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PUBLIC INTEREST COMMENT

UNIVERSITY-INDUSTRY COLLABORATION FOR STRONGER INNOVATION

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Request for Information Regarding Federal Technology Transfer Authorities and Processes
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This comment is in response to the Request for Information (RFI) by the National Institute of Standards and Technology (NIST)—docket 180220199-819-01—regarding the current state of federal technology transfer.

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I have focused on university technology transfer in my response to the four questions of the RFI, although some comments also apply to national laboratories.

QUESTION 1 INVITES PRAISE AND CRITIQUE FOR EXISTING PRINCIPLES AND PRACTICES OF FEDERAL TECHNOLOGY TRANSFER.

- The guiding general principle of university technology transfer has been, over the past four decades, the good management of university intellectual property. I propose here a broader aim: technology transfer properly understood is the cultivation of partnerships between universities and industry and the fostering of entrepreneurship. This alternative principle includes the good management of IP (see below for good practices) but is much broader and subordinates the management of intellectual property to the higher aim of cultivating productive and sustainable partnerships. Two eminent surveys of industrial R&D—known as the Yale (1987) and Carnegie (1994) surveys—found that most manufacturing firms do not

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traditionally see intellectual property to be the main mechanism to appropriate returns to R&D investments (with a few exceptions, such as chemicals and pharmaceuticals) and that informal channels of knowledge diffusion rank higher than patent licensing agreements.[1]

- I would like to bring to the attention of NIST the public declaration of best practices in technology transfer signed by a group of university research officers in 2007. The declaration is entitled *In the Public Interest: Nine Points to Consider in Licensing University Technology*.[2]

  While most research universities have subscribed to this declaration, they do not evenly observe each of these practices. Federal research agencies could encourage their observance by issuing guidance and by introducing soft compliance incentives and departure deterrents.

QUESTIONS 2 AND 3 INVITE CONSIDERATION OF SYSTEMIC CHALLENGES TO THE EFFECTIVE TRANSFER OF TECHNOLOGY, KNOWLEDGE, AND CAPABILITIES RESULTING FROM FEDERAL R&D AND INVITE PROPOSED SOLUTIONS.

Three clear challenges for federal technology transfer policy are (1) how to turn patents from ends into means (that is, patent licensing agreements should be subordinated to specific university-industry agreements rather than as separate contracts); (2) how to broaden the scope of federally supported research; and (3) how to allow federal agencies sufficient latitude to serve their mission by advancing innovation effectively, given that they have different missions and partner with different industries.

- *Challenge 1: How to subordinate intellectual property management to university-industry partnerships.* It is widely believed that technology transfer works like a title transfer in a real estate purchase: inventors tender their ideas (in the form of a patent title) in return for pecuniary compensation. But the past four decades of innovation studies taught us that technology transfer is rather an interactive and ongoing exchange between the researchers and entrepreneurs involved in an innovation project. A better analogy for technology transfer is a joint venture where research organizations partner with industry in the recursive problem-solving process of developing and marketing a new product.

  Thus, the broader goal of technology transfer policy should be to foster and sustain productive partnerships between research and business organizations. In practical terms, this means recasting university offices of patent management into offices of partnership and entrepreneurship.
- *Challenge 2: How to broaden the scope of federally supported research.* It is often argued that universities and federal laboratories are specialized in fundamental research; a subset of

[1] Richard C. Levin, Alvin K. Kevorick, Richard R. Nelson, and Sidney G. Winter, "Appropriating the Returns from Industrial Research and Development," *Brookings Papers on Economic Activity* 3 (1987): 783–820; Wesley M. Cohen, Richard R. Nelson, and John P. Walsh, "Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)" (NBER Working Paper No. 7552, National Bureau of Economic Research, Cambridge, MA, February 2000); Wesley M. Cohen, Richard R. Nelson, and John P. Walsh, "Links and Impacts: The Influence of Public Research on Industrial R&D," *Management Science* 48, no. 1 (2002): 1–23.

[2] Association of University Technology Managers, *In the Public Interest: Nine Points to Consider in Licensing University Technology*, 2007.

that research—that can be codified into patents—is then "transferred" to industry. This view is highly problematic. First, much of nonpatented research has historically found its way into useful application; research supports innovation regardless of its patentability. Second, there is no evidence of this presumed exclusive specialization of academic research on fundamental inquiry. In fact, universities often deploy their intellectual resources to solve practical problems as much as they tackle theoretical ones. Rather than insular specialization, the most innovative work of universities is highly responsive to industrial needs. It is worth noting here that, compared to other high-income countries, the proportion of nonacademic basic research performed in the United States by the government is relatively low, while that of industry remains relatively high.

Those who see universities as factories of purely abstract ideas would direct all public support to fundamental research, but that would deprive society of the wide range of research questions that universities are prepared to answer. To meet the challenge of broadening the scope of support for academic research, I submit that all the marginal growth of federal funding for research over current levels should be directed to clusters of research programs examining practical problems. I elaborate this point below, but it is sufficient to say here that practical problems must be identified by research agencies in consultation with the business sector and other stakeholders.

- *Challenge 3: How to allow federal agencies sufficient latitude to serve their mission.* One of the central lessons in the economics of innovation is that innovation is organized differently, even idiosyncratically, across the various industries. Several critical factors specific to each industry—including the nature of the underlying technology, industrial organization of the sector, regulatory constraints, and resilience to external shocks—make innovation a highly heterogenous phenomenon across the board. Consequently, policies such as patent protection or antitrust law do not introduce uniform incentives across all industries. In pharmaceuticals, a small number of patents undergird any new product; innovators therefore seek to secure all relevant patents before committing to a project. In contrast, computers or automobiles, as sold to consumers, assemble hundreds if not thousands of patents in a single product, many of which have to be licensed from the competition. No company in these industries can secure control to all relevant patents. A similar case occurs in economic sectors where standards depend on specific patents and competing firms set up patent pools of "standard essential patents" as a cooperative solution because withholding any of these patents would bog down innovation in the entire sector. Consider the additional example of patented research tools. Exercising their rights under the law, some universities licensed their patented research tools to private parties who then sought to profit from licensing those tools to the research community at exorbitant fees. These universities, together with their licensees, had to fend off accusations of profiteering at the expense of scientific openness and the pace of innovation itself.

  To meet this challenge, federal agencies should be permitted to adopt implementation strategies to seize opportunities specific to the economic sectors in their portfolio. These strategies should always adhere to the letter and spirit of the law, but insistence on

interagency homogeneity of strategies would hamper rather than enhance the ability of agencies to advance their missions.

QUESTION 4 INVITES PROPOSALS OF ALTERNATIVE WAYS TO IMPROVE THE TRANSFER OF TECHNOLOGY TO ULTIMATELY BOOST ECONOMIC GROWTH.

University technology transfer has largely focused on the management of intellectual property, but this strategy has been expensive for universities and has had only a modest effect on innovation. Universities will have a larger effect on innovation if they turn their strategy to enhancing their collaboration with industry and to fostering academic entrepreneurship. Allow me to elaborate both points further.

Patenting is bad business for universities.

The Bayh-Dole Act of 1980—the law that grants universities the right to take title to inventions made by their employees—is widely considered to have initiated an era of university-industry partnership and thus a new role for universities in innovation. Yet that partnership did not start in 1980; rather, it has a precedent in the late 19th century and first half of the 20th century, when wealthy philanthropists—who made their fortunes in emerging industries—created universities and endowed others and generously funded research in the top institutions of learning. The significant expansion of federal R&D during World War II was extended in the war's aftermath and never retreated to prewar levels; instead, over the past 70 years it has grown at 2.8 percent per year (adjusted for inflation).[3]

One commonly used indicator of the economic impact of universities is patent licensing activity (i.e., licensing fees, number of new license agreements, etc.). Yet very few university patents appear to be of commercial interest. In the rare instances when they are, those patents are coveted by the private sector and universities can charge handsome licensing fees. These "blockbuster" patents are like winning the lottery, but for a university to enter the raffle, it must be among the top 40 recipients of federal research funds. The most promising research in commercial terms is likely a subset of the most promising research in terms of intellectual merit, which is what the federal grant process is designed to reward. Indeed, the best-funded universities are the ones winning the patent licensing lottery, but this fact only exacerbates the disparities observed at the funding level. The top half of universities in terms of research funding controls about 90 percent of patent licensing revenue. Inequality in licensing income is even deeper: 8 universities take half of all revenue, and 16 universities about two-thirds of all revenue.[4] Furthermore, the licensing operations of most universities do not even cover operating costs.

It is not at all clear, however, that funding all universities at the same generous level as elite universities would necessarily increase patenting or licensing revenues of the system as a whole;

[3] American Association for the Advancement of Sciences, "Historical Trends in Federal R&D," accessed July 27, 2018, https://www.aaas.org/page/historical-trends-federal-rd.
[4] See more details in Walter D. Valdivia, *University Start-Ups: Critical for Improving Technology Transfer* (Washington, DC: Brookings Institution, 2013).

and even if it would generate more patenting, it is not at all clear whether that would promote innovation and economic activity.

Consider the fact that the business sector patents less than universities as a proportion of their R&D investments, at only 2.54 patents filed per million dollars and 1.16 patents granted per million in 2012.[5] Universities in turn filed 14,224 new patent applications and were issued 5,145 new patents the same year, which is equivalent to 12.26 patents filed and 4.44 patents granted per million dollars of R&D. Businesses decide to patent only when they see a potential profit from incurring the administrative and legal expenses of filing a patent, or when they anticipate a business necessity to protect their intellectual property or use it as a bargaining chip. By this logic, universities are overly eager to patent, and this explains the low licensing income they ultimately earn.[6] The total licensing revenue of the university system, reported by the Association of University Technology Managers (AUTM) for 2012, was $2.6 billion, or a paltry 4.1 percent of the university system's R&D budget.[7]

Tech transfer policy should enhance university-industry collaboration and academic entrepreneurship.

There is no reason to assume that university research can or should be like that of for-profit laboratories. The very justification for a government subsidy for research is that the government is intervening to address a market failure; that is, to pay for work of national interest that the private sector has insufficient incentives to perform. But that is not a reason to confine universities to fundamental research, as there are innumerable practical problems in society without obvious incentives to attract problem solvers. Universities can take on this market failure and direct some of their intellectual resources to find solutions to these problems, or design incentive structures that would attract problem solvers. By practical problems, I mean those real-life problems of society at large as perceived and confronted by businesses, the public sector, and civic and not-for-profit organizations.

Public investments in the university have paid off handsomely in terms of developing a creative capacity for problem solving. One promising avenue to unleash that potential is to cultivate university-industry collaboration. A related avenue is to foster academic entrepreneurship. Faculty and students can be encouraged to engage with the practical problems and challenges of the world outside campus. A more socially robust model of technology transfer will stimulate university-industry collaboration and academic entrepreneurship to invigorate traditional for-profit enterprises as well as charitable and humanitarian ventures.

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[5] Ratios calculated with data from US Patent and Trademark Office, "U.S. Patent Statistics Chart: Calendar Years 1963–2015," July 27, 2018, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm; National Science Foundation, *Science and Engineering Indicators 2014*, 2014.

[6] We could determine whether the business sector is likely to be more effective commercializing their patents if we could account for the presumed licensing fees that companies do not pay themselves for patents developed in house.

[7] Calculated using R&D statistics from the National Science Foundation. See National Center for Science and Engineering Statistics, *National Patterns of R&D Resources: 2011–12 Data Update*, 2013. The actual licensing revenue figure of the university system should be slightly higher because not all patenting universities participate in the AUTM survey. See Association of University Technology Managers, *FY2012: U.S. Licensing Activity Survey*, 2013.

When rethinking technology transfer, public policy should promote university-industry collaboration and academic entrepreneurship. The smart and expert management of university patenting is important, but we should recall that a patent is one instrument among many in the toolkit of the entrepreneur. Fortunately, we have witnessed in the last few years the organic emergence in the university system of alternative practices of technology transfer that emphasize collaboration with industry and academic entrepreneurship over patent licensing. For instance, universities are "nurturing startups" by emphasizing low-fee patent licenses, incubator services, and organizational incentives. One key difference with the traditional license model is that universities license their IP to their own startups for low or nominal fees. In addition, some universities are pursuing partnerships with local and state governments and business associations to establish incubators that can provide startups with basic services, such as office space, legal counsel, and administrative services—as well as more sophisticated services—such as access to laboratory space, expensive equipment, and libraries. But again, the management of IP is only one fraction of the entrepreneurship equation. The virtue of partnerships with industry and university startups is that they can tap the resources of the university—knowledge and problem-solving capacity—and direct them to meet social needs.

Establishing the socially embedded university.

The entrepreneurial university will contribute amply to innovation, but universities cannot reinvigorate economies alone or in a vacuum. These efforts will thrive in states and regions with adequate economic and policy environments, including a diversified industrial base, transportation and communications infrastructure, well-developed capital markets, regulatory relief for innovators, and an entrepreneurial culture.

Shaping the entrepreneurial spirit on campus requires discarding the mental models of innovation that imagine the university as single purposed, research as an economic input, and technology transfer as a matter of stronger patent protection. Rather, universities should foster entrepreneurship, as this is the broad avenue for technology transfer, and in nurturing their startups they should seek the proper balance between the incentives and restrictions to creativity introduced by patents. The most innovative university is not an ivory tower that transfers its wisdom to society from afar, but a socially embedded organization.