

# Foreword

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Albert Link and Zachary Oliver's *Technology Transfer and US Public Sector Innovation* is a major contribution both to an understanding of the changed, increasingly impactful role of federal laboratories as sources of commercially oriented technology within the US innovation system, and to the craft of program evaluation. The first contribution documents increased contributions to technological change and technology transfer attributable to lab activities between the catalytic impetus of the Stevenson-Wydler Technology Innovation Act of 1980 and the Federal Technology Transfer Act of 1986 to the present. The second rests in a theory-grounded, empirically rich and technically skilled assessment of the economic impacts of lab initiatives in technology transfer. Drawing upon newly accessible, disaggregated data sets, the book contributes breadth and depth to earlier studies to present more refined and precise estimates to "how much" and "so what" questions relating to labs' impacts.

The increasing engagement of federal laboratories to nurture and support programs and policies that foster the conversion of their core, mission-shaped R&D agendas into commercial products and services has become such an organizationally routinized part of their activities that it is easy to lose sight of the transition recounted in Link and Oliver's narrative chapters. The construct of national innovation systems—the "set of institutions that (jointly and individually) contribute to the development and diffusion of new technologies" (Sharif, 2006, p. 745)—provides a convenient analytical template for demarking this transition. The construct emerged in the 1980s amidst cross-national concerns among OECD nations, as each, to varying degrees, confronted an unwelcome mixture of slower rates of productivity increase, intensified international competition, and for some, obviously not all, the shrinkage of historically dominant positions in traditional manufacturing sectors, aggravated by real and perceived slippage in competitive standing in newly emerging, technology-intensive industries. Arising out of these concerns were derivative debates about the appropriate role(s) of governments in supporting research initiatives directed at promoting commercially oriented technological innovation.

The construct also can be constructively used to trace the evolution of a single nation's innovation system, as it considers and indeed installs new

features, modifying or shedding earlier ones in the process. To borrow the concept of a “take-off” found both in Rostow’s Stages of Economic Growth or, more aptly here, in the paradigmatic “origin” phase of slow, pre-accelerated adoption associated with Griliches’s classic study of the diffusion of hybrid corn, the decade of the 1980s in lab engagement in technology transfer is characterized by modest start-up initiatives and learning-by-doing (which implies errors).

Symptomatic evidence of the limited, problematic positioning of the labs within the larger US national innovation system is suggested by the absence of attention to them in Mowery and Rosenberg’s 1993 contribution on the United States to National Innovation Systems, a cross-national study of national innovation systems. Their account treats many of the structural changes occurring in the US post-WWII research system, with considerable coverage devoted to long-standing public sector support of agricultural research and academic research and evolving changes in industry–government–university relationships. Little note though is made of the federal laboratories.

Even accounting for the enabling, prodding legislation of the early 1980s, a similar assessment of the limited role of the labs appears as follows in the US Office of Technology Assessment’s 1990 report, *Making Things Better: Competing in Manufacturing* (OTA, 1990, p. 19):

Most of the \$21 billion per year spent on R&D in the Federal labs is for defense or basic research—missions not directly relevant to commercial manufacturing. Some of this R&D could be made useful to civilian manufacturing both by transferring lab technology to industry for further development and by lab–industry cooperative R&D on subjects of mutual interest. Although Congress passed several bills in the 1980s to encourage commercialization of technology from the Federal labs, such commercialization has been modest.

Viewed against this backdrop, the book’s opening historical chapters along with its longitudinal data sets of multiple metrics of technology transfer—patents, licenses, Cooperative Research and Development Agreements (CRADAs), and more—across federal agencies document the emergence of federal laboratories as an integral part of the US innovation system.

The core of the book though is its work toward posing and then answering the following question: “A reasonable question to ask is: Did the Stevenson-Wydler Act of 1980 and/or the Federal Technology Transfer Act of 1986 have a measurable impact on technology transfer activity from federal laboratories?” Nested within this question in fact is a series of sub-questions directed at specific programmatic initiatives, both specific to the labs, such as CRADAs as well as agency-wide, generic programs directed

at instilling a technology diffusion orientation to US R&D strategy, such as the Small Business Innovation Research Program (SBIR).

The methodologies, data bases, estimation procedures, and policy implications to the authors' answers are presented in a series of transparent and technically adept chapters. The book balances fair assessments of previous empirical research with grounded claims for its distinctive contributions.

Three features of the book's place in the larger evaluation literature on the federal government's post-1980 and continuing efforts to foster technology transfer warrant special attention, and commendation.

First is its grounding in a positive theory of the welfare gains from enhanced technology transfer activities. These gains were treated as self-evident in the policy agenda debates of the 1980s and are likewise treated as givens in current discussions of by now established programs. In a related, if oblique way, evaluations of these programs, even as they seek to assess economic impacts, tend to focus on the protocols of rigorous design, data quality and estimation procedures, reporting positive or negative effects as the study warrants, but generally not circling back to reexaminations of the economic welfare arguments underlying program design and implementation.

Second is its assessment of multiple initiatives within a single study. Like kindred policy initiatives of the 1980s—the Bayh Dole Act of 1980, Small Business Innovation Research Program of 1982, the National Cooperative Research Act of 1984, the Omnibus Trade and Competitiveness Act of 1988—enactment of Stevenson-Wydler had to course a political gauntlet opposed to programs redolent of industrial policy. As characterized by Alan Bromley, President George Bush's Assistant to the President for Science and Technology between 1989 and 1993, the perspective of the Administration and much of Congress during the contentious debates about the needs for and ideological rectitude of such programs was that although the federal government had a substantial role to play through the entire precompetitive phase of technology development, it “had neither more information nor greater wisdom than those in the private sector to make competitive judgments” about specific uses for the technology (Bromley, 1994, pp. 127–128).

A consequence of this contested political finding was that the new policies were under early and demanding pressures to produce “credible” evidence-based findings of performance and efficiency. The offshoot of these strictures was the start-up of a cottage industry of evaluations of specific legislative programs. Few federal science and technology programs may be said to have been as systematically evaluated as early in their histories as CRADA's, the Advanced Technology Program, and Manufacturing Modernization Centers. Technically adept as many of

these evaluations were, their policy- and program-specific focus inadvertently drew attention away from their cumulative, systemic effects on the mission, organization, behaviors, cultures, and performance of genotypes, such as federal labs or universities. Considering multiple technology transfer activities across multiple agencies within a single organizational context, as provided by Link and Oliver, helps refocus attention on placement within a larger national context.

Third, this book makes a major contribution towards filling in their words the conspicuous void in previous studies about relevant technology transfer metrics either in the aggregate or in an agency over time. It presents extensive and detailed series on all publicly available agency data on federal laboratory technology transfer metrics. The newly expanded data series not only underlie, and enrich, their own analyses but also constitute a public good resource, and public service, for future use by other researchers.

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