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Technological Innovation in a Multipolar System: Analysis and Implications for U.S. Policy

DAVID C. MOWERY

ABSTRACT

This paper analyzes recent data on the "globalization" of industrial R&D, emphasizing that the patterns of international R&D investments differ significantly among industries, and seem to differ among different activities within the innovation process. I distinguish among the creation of new technologies (often identified with invention), the development of these inventions into commercially attractive products, and the production and marketing of these new products. None of these activities is well measured within industrial economies, and our measures of their international dimensions are even less reliable. The available evidence on trends in each of these three activities suggests that the most significant increases in "internationalization" have taken place in the exploitation of new technologies, largely as a by-product of increased crossborder direct investment in production activities. But at least some evidence indicates that much of the technology creation activities of large firms remains concentrated in their home economies.

Nevertheless, the structure of activity in technology development and exploitation resembles the pattern of trade in industrial manufactured products—increased specialization in specific technologies or innovative activities that relies on a supportive national infrastructure and innovation system, combined with declining costs of communication and crossnational investment. As a result, intrafirm and interfirm networks for the support of innovation are developing rapidly throughout the world. The growth of these networks is one of many indicators of the development of a "multipolar" science and technology system in the world economy.

Introduction

The "internationalization," "globalization," or "multinationalization" in the national distribution of industrial R&D activity, citing only a few of the many terms for the phenomenon, has received a great deal of attention from various expert groups and scholars during the past 20 years. Two of the most recent studies are those by the Congressional Office of Technology Assessment [1] and the National Academy of Engineering [2], and literally dozens of academic studies of this topic have been published. The bibliography in the recent NAE study covers 12 pages of text in very small type.

DAVID C. MOWERY is the Milton Terrill Professor of Business Administration at the Walter A. Haas School of Business, University of California, Berkeley.

Address correspondence to D. C. Mowery, University of California, Berkeley, Haas School of Business, Berkeley, CA 94720-1900.

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Like many other topics of debate within the scholarly and policy communities, however, discussion of this phenomenon continues to produce controversy as often as it yields consensus. The debates are fueled by the rapid pace of change in the technology and the organization of innovation within many U.S. and foreign industries, as well as by change in the broader global economy that has produced new competitors and new opportunities. The terms of the domestic debate over the desirability of international R&D have undergone at least three broad shifts in the past 25 years. U.S. firms' increased investments in offshore R&D during the 1960s sparked expressions of concern over the loss of employment and other technological opportunities associated with the domestic performance of R&D. This discussion was part of a broader debate over the benefits and costs to U.S. citizens of the expanding international activities of U.S.-headquartered multinationals, in which some participants argued that the private interests of U.S. multinationals no longer coincided with those of U.S. citizens. Beginning in the early 1980s, as flows of foreign investment into the United States grew rapidly, and this economy became an important host nation for foreign-owned enterprises, concerns were expressed that such investments created employment opportunities only in low-wage, low-skill assembly operations, and did not bring with them the "high value-added" activities of R&D and innovation. Most recently (captured in some of the discussion in the 1994 OTA report cited earlier), policymakers have expressed concern that foreign-owned enterprises invest in R&D within the United States as a means of "cherry-picking" the fruits of U.S. R&D, especially publicly financed basic research in U.S. universities, and that such foreign investments are a conduit for the export of technological advances and economic opportunities from the United States to foreign economies. This most recent debate cites differences among the "national innovation systems" of the industrial economies of the OECD and newly industrializing economies, suggesting that asymmetries in U.S. and foreign firms' access to the technologies developed in one another's home economies creates disadvantages for U.S. firms.

This brief survey cannot begin to cover the array of issues raised by the increasing international interactions in R&D and other technology-development activities. Instead, I hope to sketch out some of the complexities of current phenomena, noting that the pattern and implications of such interactions seem to differ significantly among industries, and seem to differ among different activities within the innovation process. Extending the work of Archibugi and Michie [3], one can distinguish among the creation of new technologies (often identified with invention), the development of these inventions into commercially attractive products, and the production and marketing of these new products. None of these activities is well measured within industrial economies, and our measures of their international dimensions are even less reliable. R&D investment, for example, spans both the creation and the development of new technologies, and in many cases is associated as well with the exploitation of these technologies (as in the case of "localization" of new products for specific offshore markets). The available evidence on trends in each of these three activities suggests that the most significant increases in "internationalization" have taken place in the exploitation of new technologies, largely as a by-product of increased crossborder direct investment in production activities. But at least some evidence indicates that much of the technology creation activities of large firms remains concentrated in their home economies.

Nevertheless, the structure of activity in technology development and exploitation resembles the pattern of trade in industrial manufactured products—increased specialization in specific technologies or innovative activities that relies on a supportive national infrastructure and innovation system, combined with declining costs of communication