

gence—computed on national levels, the gross aggregated effort expended on science and technology appears to be converging over time. However, before proponents of the convergence thesis celebrate prematurely, it should be emphasized that Archibugi and Pianta go on in the remaining seven chapters to show that notions of convergence and divergence, at least in terms of scientific and technological activities, are considerably more complex. Because what the authors discover is that, in fact, not only does considerable specialization of scientific and technological activities take place within countries, but with the exception of only two nations—France and the Netherlands—the degree of technological specialization within each country has increased considerably over time. This would suggest that the scientific and technological activities of countries may be becoming less and not more similar over time.

Through their careful analysis, Archibugi and Pianta discover a rich array of striking findings. For example, virtually every country possesses a distinct constellation of technological advantages and disadvantages, not dissimilar to the notion of comparative advantage found in the international trade literature. European technological strengths apparently do not lie in the more dynamic high-technology sectors, leading the authors to conclude that the share of European scientific and technological activity is likely to decrease in the future. The authors point out that Germany, which is the leading technological power of Europe, is not specialized in the most dynamic and fastest growing technological sectors. Japan, by contrast, has concentrated its technological competencies in those high-technology sectors which are growing most rapidly. This leads the authors to predict not only a continued ascent in the Japanese share of technological activities, but also,

a warning about European performance which can be identified behind the aggregate picture: the current sectoral strengths and weaknesses of Europe and Japan are likely to lead to an increasing gap between the technological performances of the two regions. (p. 88)

In chapter eight the authors propose and find considerable support for the hypothesis that the degree to which a country specializes in its scientific and technological activities is inversely related to its size. Apparently only the largest

countries can afford to engage in technological activities across the entire scientific spectrum. Thus, scholars interested in the economic implications of geography should find this work striking in that the spatial distribution of scientific and technological activities is anything but homogeneous—apparently geography matters. Similarly, scholars involved in the debate about the role of national systems of innovation in promoting technological change and ultimately productivity, growth, and international competitiveness may find confirmation that the variance in scientific and technological performance across developed countries reflects profound differences in national systems of innovation.

An important lesson from this study is that, contrary to the standard assertion made in numerous macroeconomic endogenous growth models, science and technology, or R&D, are anything but homogeneous. Rather, as Archibugi and Pianta convincingly demonstrate, the scientific and technological activities of developed industrialized nations are better characterized as being specialized and highly differentiated. Apparently it not only matters how much is allocated towards science and technology but also how those scientific and technological resources are allocated.

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Competitiveness, convergence, and international specialization. BY DAVID DOLLAR AND EDWARD N. WOLFF. Cambridge and London: MIT Press, 1993. Pp. 228. \$35.00. ISBN 0-262-04135-9. JEL 93-1589

Economic growth is back on the agenda of the economics profession. Among the academic work in this field, however, contributions with a clear and direct practical interpretation of economic facts and problems, are less common than some policy makers or analysts would wish. Dollar and Wolff's book is exactly aimed at filling this gap, as they set out to analyze postwar growth performance in the major OECD countries, and relate their findings to the public (U.S.) policy debate on issues such as deindustrialization, loss of competitiveness, the role of knowledge and other factors in productivity growth, and globalization.

The central theme in their analysis is conver-

gence. Thus, they look at the trends in dispersion of productivity levels (labor productivity as well as total factor productivity), trade patterns, capital/labor ratios, and factor prices between the major OECD countries. Although in the end the main concern of the book seems to be aggregate productivity (as the main determinant of relative welfare levels), the argument revolves around a detailed account of sectoral convergence trends.

During the 1960s and 1970s (and to a lesser extent in the 1980s), why did the main OECD countries (and a selected number of developing countries) show such strong convergence of (labor) productivity relative to the U.S., which emerged out of the second World War as the absolute productivity leader in virtually every branch of economic activity? Each of the chapters (besides the first and final, which serve as introduction and conclusion, respectively) sets out one of the pieces of the author's solution to this question. In this solution, the sectoral breakdown of growth and convergence patterns forms the major argument.

Thus, it is shown that (until the mid-1970s) productivity convergence was taking place in almost every sector. However, countries generally did not converge to the U.S.—frontier by shifting their employment mix in the direction of high-productivity industries. Until the mid-1970s, the main source for labor productivity convergence was sectoral convergence in total factor productivity, or in the authors' interpretation, catch-up in technological competence. From the mid-1970s onwards, convergence slowed down considerably, mainly due to stagnating technological convergence. Substitution effects (convergence in capital/labor ratios) tend to explain the little convergence that was taking place from that time on.

This development led to the situation that in the 1980s, all major OECD countries were very close to each other with regard to technological capabilities. This is reflected in the fact that in the 1980s, many different productivity leaders are found for different branches. By the 1980s, according to Dollar and Wolff, the world had changed from one technological leader (the U.S. in the 1960s) to one of "equal technological rivals." The chapter on trade performance finds that although productivity levels were converging, specialization patterns were diverging. Together, these two conclusions imply that each

of the new "leaders" has its own specific combination of branches from which it built its "shared leadership."

The policy conclusions that are drawn in the book are mainly presented in the final chapter, and relate mostly to the U.S. debate (although the policy advice given is so broad that it applies to other countries as well). The main contribution to this debate seems to be the message that U.S. policy should not be based upon pessimism. The assumed loss of U.S. competitiveness is interpreted as an inevitable trend, and the U.S. leadership of the 1960s as an extraordinary situation not likely to emerge again. Viewed in this way, the U.S. is no longer considered the big loser in the convergence wave of the 1960s and 1970s, but instead is seen as "first among equals" in the 1980s. Investment in knowledge, infrastructure, and education are seen as the most important aspects of public policy in this new situation.

This is certainly a sound conclusion, but it is not always clear where it is based in the empirical analysis of the rest of the book. The step from the detailed empirical accounts in the main body of the book, to the broad policy conclusions in the final chapter is a giant, although certainly not counter-intuitive, one. It therefore seems to me that the most important contribution of this book lies in the detailed empirical work, and not so much in the general policy conclusions. The sectoral data sources used, together with the careful interpretation by the authors, certainly adds significantly to our understanding about growth in the postwar period.

At the same time, however, this detailed sectoral approach implies an important limitation of the book. Due to data-availability, the coverage of other than major OECD countries is confined to a single chapter on the performance of five so-called "Newly Industrializing Countries" (NICs). Thus, issues such as the experience of less developed OECD-countries fall outside the scope of the analysis. Moreover, the choice for "hard statistics" also implies that the discussion of many historical and institutional factors (which must necessarily be based on case study material) is absent. Finally, the richness of their data set provides a temptation to dwell on issues that only seem vaguely related to the central theme of the book (such as the detailed refutation of the simple

Heckscher-Ohlin trade theory) that the authors cannot always resist.

However, these remarks do not detract from the significance of the volume, which deserves to be read not only by the specialist in the growth field. The above remarks serve only to point out that this book, like most others, cannot provide the reader with the final answer on what determines the relative growth performance of an economy.

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Technology and the wealth of nations. Edited by NATHAN ROSENBERG, RALPH LANDAU, AND DAVID C. MOWERY. Stanford: Stanford University Press, 1992. Pp. xiv, 443. \$49.50, cloth; \$16.95, paper. ISBN 0-8047-2082-7.

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This book, which originated in a conference at Stanford University, is concerned with the factors influencing the commercialization of new technology. Without question, the ability of organizations and firms to commercialize new technology is at least as important as the ability to develop it. For example, the available evidence suggests that the difficulties U.S. firms have had in competing with their Japanese rivals have stemmed more from problems in commercializing new technology than in originating it (see Mansfield 1988). Certainly, this is a topic where more research can usefully be carried out.

The authors of the papers are well-known economists and technologists, many of whom have had extensive experience in the analysis and management of industrial R&D. In the first two parts of the book, Michael Boskin and Lawrence Lau discuss the role of technology and capital formation in economic growth; Richard Nelson puts commercialization of technology into a context that recognizes that technology has public aspects as well as private; Ralph Landau and Nathan Rosenberg describe how commercialization has taken place in the chemical process industries; Steven Durlauf takes up relevant issues in the determination of long-run output in industrialized economies; B. Douglas Bernheim and John Shoven compare the cost of capital in Japan and the United States; David Teece discusses strategies for capturing the financial benefits from technological innovation; and Peter Huber analyzes liability and insur-

ance problems in the commercialization of new products.

To illustrate the range of the discussion, consider the papers by Nelson, Teece, and Landau and Rosenberg. Nelson argues that:

To try to make universities more like industrial labs will tend to take attention away from their most important functions, which are as a major source of new public technological knowledge, and as society's most effective vehicle for making technological knowledge public. (p. 70)

Teece points out that, given that intellectual property protection is often weak, the extent to which an innovator can appropriate the returns from its R&D investment may depend on whether it has ready access to specialized complementary assets required to produce and market the innovation. If the technology itself is easy to imitate, the innovator may be able to appropriate a substantial proportion of the returns only if it is in a favorable position with regard to the availability and effectiveness of such complementary assets. Based on this argument, he is skeptical of claims that manufacturing does not matter, and that research and design will provide sufficient foundation to guarantee economic growth. Landau and Rosenberg conclude that:

The history of the chemical industry forcefully underlines the inadequacy of a neoclassical microeconomic approach that simply treats all industrial firms as homogeneous maximizing agents, whose distinctive internal structure, characteristics, and history are not examined, or at least are not treated as central to the analysis. (p. 116)

In the last three parts of the book, Ken-Ichi Imai discusses the Japanese pattern of innovation and its evolution; Franco Malerba describes the innovation process in the European electronics industry; Ronald McKinnon and David Robinson take up dollar devaluation, interest rate volatility, and the duration of investment; Kiyonara Sakakibara and D. Eleanor Westney describe Japan's management of global innovation; David Mowery takes up international collaborative ventures and the commercialization of new technologies; Ralph Gomory discusses the stages of the technology-product relationship; William Howard and Bruce Guile describe a National Academy of Engineering study of the commercialization process; and Sergio Barabasi analyzes the

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