

Learning and Technological Change. Edited by Ross Thomson. New York: St. Martin's Press, 1993. Pp. xiii, 290. \$55.00.

As Ross Thomson argues in his introduction, both the public and the academic community increasingly recognize that technology is a key determinant of economic growth, employment, corporate growth, regional differences, and many other variables. Yet our understanding of technological change is inadequate, and scholars are wary of the subject due to the static nature of most economic analysis, the unwillingness of most economists to engage in interdisciplinary work, and the complexity of technological progress that makes it hard to model.

This volume is the result of an interdisciplinary conference held at the New School for Social Research in 1989. Only at the conference did the participants recognize that a common theme ran through most of their work. The result is that the papers here hang together well for a conference volume.

The main theme is that technological innovation should be viewed as a process of learning. New technology is a synthesis of prior knowledge. Economic agents need to combine appropriate pieces of information so that commercially viable processes and products can be created. Along with learning by doing, the authors speak of learning by using and learning by selling. William Parker points out that one advantage of focusing on learning is that many social scientists are not technically adept, but we are all familiar with learning.

A second theme is a focus on institutions. The rate and direction of technological change will be shaped by the institutional structure in which agents operate. Institutional change often fosters technological change, whereas static institutions may be inimical even to borrowing new technology. The authors speak about the organization of firms, governments, patents, universities, and professional organizations.

Economists often speak of a trade-off between the incentive to research provided by access to proprietary information (especially patents), and the diffusion of information across firms that can facilitate further innovation. Richard Nelson suggests that this conflict is exaggerated. Surveys indicate that much of the knowledge produced by research is firm-specific and can only be adapted by competitors with considerable time and effort. Firms devote much of their research work to monitoring each other (including reverse engineering). Thus, generic knowledge does spread rapidly across firms. Firm advertising and university contacts aid this information flow.

Alfred Chandler argues that firms formed to commercialize particular innovations—for example, the railway or telegraph—had to institutionalize a learning process so that they could continue to innovate. This learning process is not just concerned with technical matters; the firms must actively pursue feedback from the marketplace. If they could successfully integrate technical knowledge with market needs due to their expertise in both production and marketing, these firms could fend off entrepreneurial upstarts. If, however, they tried to diversify far from their area of expertise, they would suffer. The history of modern business and modern technology are interdependent.

John K. Smith starts from the recognition that the key to successful innovation is the marriage of technical knowledge and market needs; this does not necessarily require great technical changes (for example, applying old technology to a different use). However, it is more difficult for a firm to maintain proprietary interest in such a technology. This is in part because we have biased our patent system due to a one-sided focus on technical advance.

Edward J. Nell suggests that early factories, faced with the difficulty of matching production to demand fluctuations, concentrated on efforts to control work effort. Although it is not clear how time-and-motion studies alleviate this predicament, as he suggests, mechanization and the use of more flexible energy sources (electricity, internal combustion) certainly could. This early period is characterized by ruthless price competition. Later, firms focus on product innovation; one result is that output rather

than prices are cut in recession. Although his analysis has many interesting points, it oversimplifies the course of nineteenth-century technological development and business cycles. And many would argue that highly mechanized mass-production firms found it very difficult to change products in the era before numerical control.

The volume contains two attempts at modeling the innovative process. Francesca Chiaromonte, Giovanni Dosi, and Luigi Orsenigo try to model the role of norms in affecting institutional decision-making. Willi Simmler borrows models from biology to examine the effects of different sorts of firm interaction. The authors are, with good cause, humble in speaking of the explanatory power of their models. I am skeptical that, at the present state of our knowledge especially, mathematical simulation will tell us much about the process of innovation. Faced with the complexity of innovation, and the insight gained from Nelson's surveys and Chandler's case studies, researchers would be well advised to move beyond the usual methodology of the economist.

How do firms interact with the wider environment? Carolyn Cooper discusses the role of the patent system in transferring technology. Ross Thomson argues that capital-goods firms, in industries in which they have attained a certain scale, are the key source of both innovation and diffusion. William Parker discusses the fact that the rise of science and engineering has reduced the uncertainty inherent in research; he also urges us to concern ourselves with the values of society and how these do—and should—shape technological progress.

Such economy-wide transmission mechanisms are essential to continuous technological advance. Many of the authors recognize that research on any one product or process is likely to eventually run into decreasing returns. If not for the cross-fertilization of ideas by which new lines of research are born, the rate of innovation must fall. It is regrettable that this important process—the generation of radically different technologies—was not the explicit focus of any of the authors.

Donald Harris argues that whereas the ability to borrow technology does cause developed nations to converge in terms of both technology and incomes, this force is unlikely to entirely eradicate income differences. Catching up gets harder the more one catches up. William Lazonick is even more pessimistic, suggesting that different institutional structures are a powerful source of divergence. Alice Amsden and Takashi Hikino suggest that catching up is especially difficult in the late twentieth century. I doubt that they are right in suggesting either that it is no longer possible to leapfrog ahead with new technology, or that firms in medium-income countries will be squeezed by having neither the best technology or the cheapest labor (one needs a certain level of human capital to exploit much modern technology). Still, they are right in suggesting that, in the complex realm of technology, convergence in the past (if one chooses the right set of countries) need not imply convergence in the future. Nor, though, does a present state of backwardness need to be permanent. Less developed countries and their firms tend naturally to develop different institutions in the catching-up process; these can be the source of unimagined growth potential.

I have only been able here to touch upon some of the high points of the book. Many of the pieces reflect the latest thinking of scholars who have been leaders in the field for decades. The book is thus a handy introduction to key elements of the diverse literature on technology. Those more familiar with the technology literature will also find much of interest here.

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Closing the Door to Destitution: The Shaping of the Social Security Acts of the United States and New Zealand. By Raymond Richards. University Park, PA: The Pennsylvania State University Press, 1994. Pp. xxx, 178. \$42.50.

This uneven book reflects the insecure state of scholarship on the origins of the welfare state. It asks why New Zealand's Social Security Act of 1938, a very generous