

Naomi R. Lamoreaux, Daniel M.G. Raff, Peter Temin, eds.. *Learning by Doing in Markets, Firms, and Countries*. Chicago: University of Chicago Press, 1999. vii + 347 pp. \$80.00, cloth, ISBN 978-0-226-46832-7.

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The "learning by doing" in the title of this NBER volume has little to do with the classic case of the Horndal effect or with the productivity effects of learning associated with the long production runs of aircraft or ship construction. Instead, this volume deals with "scaled-up" learning by doing concepts with an analytical reach that extends to a number of forms of organizational learning and, in Gavin Wright's concluding chapter, to learning as a "national network phenomenon" (p. 296). The volume, drawn from an interdisciplinary conference of business and economic historians, is premised on the notion that information - its acquisition and use - "effectively determines whether firms, industry groups, and even nations will succeed or fail" (p. 15). Thus the learning examined in these studies falls within that broad compass.

The first two essays examine how firms learn of the technological frontier and, as well, learn how to appropriate best-practice technologies for competitive advantage. In "Inventors, Firms, and the Market for Technology in the late Nineteenth and Early Twentieth Centuries," Naomi R. Lam-

oreaux and Kenneth L. Sokoloff utilize patent data to develop a quantitative picture of the market for technology. That market, they conclude, was well developed and thus allowed firms to keep track of technological advances via intermediaries in the market (patent agents and solicitors) or by direct contact with inventors. By the beginning of the twentieth century, however, firms increasingly attempted to move inventive activity within the firm and that in turn required further learning on the part of the firm, e.g., in minimizing employee turnover and insuring that patents received by employees were assigned to the firm. The following essay by Steven W. Usselman examines exactly this form of learning by American railroads and their "internalization of discovery" (p. 63). Railroad managers from early in the nineteenth century saw technical innovation in their industry as stemming largely from "the efforts of ordinary mechanics and engineers, not through discrete acts of patentable invention" (p. 63). Since railroads saw firm-specific knowledge as critical to the innovation process, they not only attempted to internalize inventions but also attempted to buffer the impact of external technical develop-

ments by forming railroad associations and patent pools that insured patents would be cross-licensed to the member firms. In a detailed and perceptive comment on the Usselman paper, Jeremy Attack notes that such "... collusion stilled the winds of 'creative destruction' that jeopardized the value of existing investment" (p. 101).

Forms of collusion or, more neutrally, institutionalized forms of information interchange, were not confined to railroads. Avoiding the cartel label and yet still providing interfirm coordination on pricing represents another form of organization learning. In "The Sugar Institute Learns to Organize Information Exchange," David Genesove and Wallace P. Mullin study a "technologically stagnant industry" (p. 106), U.S. sugar refining from 1928 to 1936, where the learning question shifts away from production technology to organizational innovation in interfirm information sharing. The Institute did learn to organize and collect data while insuring members' confidentiality, thus allowing for "increases in the correlation of firm decisions" (p. 133) as price and sugar stock data became available to all members of the Institute. Not incidentally, the availability of common information also precluded secret price concessions. A Supreme Court decision ended this particular form of organizational learning.

Kazuhiro Mishina's paper on "Learning by New Experiences: Revisiting the Flying Fortress Learning Curve" is the only paper in the volume that approaches learning in its familiar learning curve form and the only one to draw on econometrics in its analysis. The magnitude of the productivity increase in Boeing's B17 production from 1941 to 1944 was huge: the direct labor hours per airframe dropped from 142,837 to 15,316, falling to nearly a tenth of the time required at the beginning of the production run. What accounted for a productivity increase of that size? Mishina rejects "the learning-by-doing hypothesis that holds direct workers or engineers as the learning agent" (p. 175). Instead he finds

the answer in the reduction in through-put time and "the operating know-how that enabled it" (p. 175). No direct econometric test of that conclusion is possible and the absence of learning taking place by direct labor and engineers appears improbable. Not surprisingly then, Ross Thomson, in his comment raises the question of whether the learning involved might have been a cumulative process in which output growth, productivity growth, and prior learning interacted.

The next two essays are intensive examinations of organizational decision-making/learning. David Hounshell focuses on one critical meeting of the Ford Motor Company Executive Committee on December 2, 1949. This is the "Whiz Kid" era at Ford and Hounshell sees the meeting as defining a turning point in Ford's strategic course since the meeting reversed Ford's strategy of a decentralization of production. Hounshell asks how such a reversal came about, explores several hypotheses, but concludes he can do no more than speculate on the mechanisms that might have accounted for the Executive Committee's about-face on strategy.

Daniel M.G. Raff and Peter Temin's essay also examines strategy decisions within a firm, in this case two marketing decisions made by Sears, one in the 1920s and a second in the 1980s. At the earlier date, retailing channels were expanded from mail order operations to own retail stores; in the latter case, financial services were added to the product array in its retail stores. Again, as with Ford, the question is how these decisions were made and whether they relied on the firm's learning of its corporate strengths and accurate perceptions of its competitive advantages in evolving markets. Differences in leadership capability in the two eras were, in Raff and Temin's view, the critical variable at work. Leadership in the 1920s focused on an attractive market that could be tapped by "exploiting [the] firm's existing competitive strength" (p. 246). The 1980s leadership failed in both learning the market and in recognizing Sears' competitive strengths.

Perhaps of most interest methodologically is Leslie Hannah's test of whether the "lump of corporate capability" (p. 257) presumably possessed by the giant corporations of 1912 grew or declined by 1995. Survivability to the 1995 date is the first test, but Hannah also poses a second: among the survivors, how did a given firm's growth in market equity capitalization compare with a price-deflated market index? Using those tests, Hannah notes that "disappearance or decline was nearly three times more likely among the giants than growth" (p. 271). Observing that high incidence of corporate decline and failure, he turns to a consideration of what types of "corporate architectures" and strategies allowed large firms to "retain their position, continue to add value, and expand their capabilities" (p. 270).

In the final essay, Gavin Wright questions whether learning should be equated solely with changes in total factor productivity. Rather, when looking at the learning associated American economic growth in the nineteenth century, the learning "was substantially a national network phenomena" (p. 296). As such, "collective national learning may reside just as much in the discovery, expansion, and accumulation of the factors of production as in their productivity" (p. 296). To develop his point, he examines the U.S. mineral industry, "one of the earliest and largest American technological networks," (p. 307) and the development of chemical engineering as it changed the way in which chemical knowledge was acquired.

A collection of learning-by-doing studies as diverse as these serve to expand definitions of the forms of learning. Can one measure the learning taking place or generalize from the case studies, as Leslie Hannah and the editors attempt to do? The answer would appear to be: with considerable difficulty. The problem lies not only with the diverse definitions of learning employed, but also with the difficulty of devising any empirical measures of the learning taking place. Once one moves beyond the patent data of Lamoreaux and

Sokoloff or the production data of Mishina, measurement is elusive. One test would appear to be success in the marketplace, perhaps indicated by firm size and survivorship - a measure that Hannah attempts to make explicit. Market success may be an appropriate measure, if the firm's organizational capability, its use of patented technologies, or its "ability to collect and use information effectively" (p. 15) represent the major forms of learning occurring and can be linked to market outcomes. However, as Bruce Kogut points out in his comment on Hannah's paper, there are more variables involved. "... a firm's duration is contingent on the evolution of its broader competitive and institutional landscape. This broader landscape consists of firms, workers (sometimes organized in unions), governments, political interests, research centers, suppliers and buyers, idea merchants, and, of course, mechanisms of financial intermediation and corporate governance" (p. 289). With that array of variables at work, it may be that business and economic historians will not be able to move significantly beyond case studies in examining these larger forms of organizational and national learning. Or, as Leslie Hannah resignedly puts it for the large corporation case: "To date, ... we have made great strides in storytelling, but a clearer, surer recipe for sustained success for large corporations has remained elusive" (p. 270).

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