

Sematech: Saving the U.S. Semiconductor Industry. *By Larry D. Browning and Judy C. Shelter.* College Station: Texas A&M University Press, 2000. 320 pp. Table, bibliography, index. Cloth, \$44.95. ISBN 0-890-96937-X.

Reviewed by Andrew Davies

The United States is well known for its commitment to the view—shared by Republicans and Democrats alike—that private enterprise should predominate in the economy and government should play a subordinate role, except, as pointed out by Andrew Shonfield in his classic text *Modern Capitalism: The Changing Balance of Public and Private Power* (1965), during times of “manifest national emergency.”

This book is about America’s response to a national emergency during the 1980s that was unlike previous ones the country had faced, such as the cold war, when the federal government funded and coordinated the private companies that were involved in large military and defense projects. This time the external threat was foreign competition.

Larry D. Browning and Judy C. Shetler have set out to explain how an unprecedented cooperative effort by public and private interests—semiconductor makers and the American government—saved the U.S. semiconductor industry from the threat of Japanese competition. America responded to the Japanese challenge by creating a consortium called Semiconductor Manufacturing (Sematech).

According to Browning and Shetler, prior to the creation of Sematech in 1987 the U.S. semiconductor industry largely conformed to the ideal in neoclassical economics of free market competition. All its early technological achievements—from the invention of the microchip in 1959 to the creation of a pervasive technology upon which advanced economies now depend—were accomplished within an aggressively entrepreneurial and competitive environment.

Yet, by the mid-1980s, competition from Japan revealed weaknesses in the U.S. model. American semiconductor manufacturers could no longer compete with vertically integrated foreign manufacturers—supported by huge government subsidies—in making memory chips that were both high in quality and low in price. Rather than continuing to develop proprietary product designs, U.S. chipmakers recognized that they could only defeat Japanese competitors if they worked together to select manufacturing standards and improve their manufacturing processes. However, such cooperation was difficult to achieve in an industry previously characterized by secrecy, fierce rivalry, and antitrust sentiment.

Browning and Shetler cogently analyze how, between 1987 and 1994, Sematech managed to overcome obstacles to cooperation and create a viable organization that enabled U.S. manufacturers to resume world leadership in the semiconductor market. Avoiding the mistake of explaining Sematech's success by reference to a single causal factor, the authors present three different perspectives for analyzing the consortium's achievements:

1. Horizontal collaboration between chip manufacturers, vertical partnerships with their equipment suppliers, and collaboration with academic and national laboratories created a viable, cooperative consortium of organizations that had previously been competitors.
2. The consortium built a close relation with the government by gaining assurance of antitrust exception, securing support from the Department of Defense, and heading off excessive government control of Sematech's operational activities.
3. Sematech successfully carried out its technological strategy of producing increasingly miniaturized silicon chips and improving its equipment and manufacturing processes.

Each factor had its individual impact, but the synergy of the three led to Sematech's success.

Browning and Shetler seek generic lessons from the Sematech story that can be applied to other critical industries in the United States and elsewhere. Sematech was a national initiative that stimulated debate over the appropriate balance between public and private sectors. The Clinton administration viewed the private-public consortium as a national asset to be held up as a new model for twenty-first century cooperation between government and threatened sectors of the economy. Critics of Sematech called the consortium an "industrial policy"—a form of neomercantilism—that picked domestic winners in the race for global technological supremacy.

Clearly, an understanding of the consortium's success is relevant to any national industry whose survival is threatened by increasing global competition. But Browning and Shetler conclude that Sematech provides no blueprint for the recovery of critical industries. Rather, "the most valuable lesson of all is that the consortium's experience offers insights into the process of how competitors learned to co-operate, rather than a specific formula of success for others to follow" (p. 200). Browning and Shetler are right to emphasize the particular characteristics of the Sematech experience. In Europe, public-private consortiums—such as Airbus—are driven by government interests, and private members are less likely to be leaders. Sematech, by contrast, was an industry-led consortium. Once its technology goals were accomplished, the consortium voluntarily relinquished its federal funding after 1994.

But there is another, more compelling, reason—ignored by Browning and Shetler—that explains why the Sematech experience is not repeatable. The conditions that once allowed leading nations to organize exclusively domestic responses to foreign competition are no longer present in an age of global competition. Take, for example, third-generation (3G) mobile communications technologies. As well as a strong presence in the United States and Europe, all the world major 3G suppliers—Motorola of the United States, Nokia of Finland, and Ericsson of Sweden—have facilities in Japan for developing and commercializing the next generation of technology.

While the perspective is historical, the central theoretical focus of the book is Sematech as an experiment in organization. Sematech's development is analyzed with the tools and methods of organizational science and—as we learn at the end of the book—complexity theory.

Missing from the theoretical summary, however, is a discussion of the literature on the dynamics of innovation. This growing body of knowledge is concerned with how firms and nations have developed strategies and organizational structures that can inspire and nurture successful technological innovation. Browning and Shetler could, for example, have interpreted the emergence of Sematech in the mid-1980s as a switch in the product life cycle from competition based on product innovation (i.e., alternative chip designs) to one that emphasized process innovation (i.e., high-volume chip manufacturing).

Although the book is well written and clearly argued, it raises many questions about how the data are to be understood. These questions are not addressed until the final two chapters. The reader may have difficulty navigating this highly descriptive account of Sematech. The argument would perhaps have been clarified had a theoretical framework been presented at the outset.

Andrew Davies is a senior fellow at Science and Technology Research at the University of Sussex. He is the author of Telecommunications and Politics: The Decentralised Alternative (1994) and of numerous articles, including "Innovation in Large Technical Systems: The Case of Telecommunications," in Industrial and Corporate Change (1996). At present, he is working on studies of the dynamics of innovation in complex products and systems across a number of industries.