THE NEW ARGONAUTS

Regional Advantage in a Global Economy

AnnaLee Saxenian

HARVARD UNIVERSITY PRESS
CAMBRIDGE, MASSACHUSETTS
LONDON, ENGLAND ❖ 2006

Printed in the United States of America

Library of Congress Cataloging-in-Publication Data

Saxenian, AnnaLee.
The new argonauts : regional advantage in a global economy / AnnaLee Saxenian.
p. cm.
Includes bibliographical references and index.
ISBN 0-674-02201-7 (alk. paper)
1. High technology industries—Developing countries.
2. Immigrants—California—Santa Clara Valley (Santa Clara County)
3. Cooperative industrial research—California—Santa Clara Valley
(Santa Clara County) I. Title.

HC59.72.H53S29 2006
338.4′7004091724—dc22 2005055112

CONTENTS

INTRODUCTION

Intel Corporation learned in 1974 that one of its leading scientists, Dov Frohman, planned to return to his native Israel to take a research and teaching position at the Hebrew University of Jerusalem. Frohman was among the company's most talented engineers—he had invented and developed the erasable programmable memory chip (EPROM). To avoid losing him, Intel established its first integrated circuit design center outside of the United States, in Haifa, and asked Frohman to lead it. Thirty years later, Israel had become a leading center of world-wide IC design and manufacturing, renowned for its innovative security and communications products.

In 1984 six Chinese engineers quit their jobs at Fairchild Semiconductor in Silicon Valley to return home and start Taiwan's first three private semiconductor firms. At the time, the only semiconductor company in Taiwan was a government-sponsored start-up. Nasa Tsai, a Stanford Ph.D., recalls that "even though we'd all been in the U.S. for a dozen years, we still had friends, colleagues, and classmates here in Taiwan," which made starting an overseas business feasible. These early semiconductor companies had an uphill fight. One firm, Quasel, folded after five years. The other two, Mosel and Vitelic, survived only by licensing their technology. Neither was

able to build its own foundry until the two companies merged a decade later. Mosel co-founder Peter Chen reports that the company nonetheless had an enormous impact: "We upgraded Taiwan's technology by two generations as soon as we returned." Mosel designed Taiwan's first 16K SRAM; Vitelic co-developed a 64K DRAM a year later. The merged Mosel-Vitelic began volume production in the early 1990s and, riding the semiconductor industry boom, became profitable and went public in Taiwan in 1995. These pioneers became role models for hundreds of subsequent returnees, who by the late 1990s helped to make Taiwan the world's third largest producer of integrated circuits.

Ning-San Chang moved to Shanghai in 2002 with two Chinese colleagues from Silicon Valley to start BCD Semiconductor Manufacturing, China's first bipolar IC foundry. Chang had earned a Ph.D. in electrical engineering from Purdue University, and worked for twenty years in the U.S. semiconductor industry. He regretted missing earlier chances to return to Taiwan and felt lucky that he could contribute to developing the mainland Chinese semiconductor industry. In his words: "It won't make much of a difference if I work in Silicon Valley or Taiwan now, but there are so many opportunities in Shanghai now that I know I can make a difference here." BCD, which designs and manufactures low-cost analog semiconductors for use in phones, computers, and consumer electronic products, has received two rounds of venture funding from top-tier investors in the United States and Asia, including Intel Capital and Acer Technology Ventures, and has recruited "best of breed" managers from Silicon Valley and Taiwan, as well as China, to work in its Shanghai operations.

In 1999 National Semiconductor rejected a plan to design a chip for MP3 players. In classic Silicon Valley fashion, the executives and engineers championing the plan quit and raised venture funds to start Portal Player Inc. Three of the co-founders were of Indian

descent, and they quickly established a design and development team in Hyderabad, India, making the start-up a global company from the start. They hired J. A. Chowdary, one of the chief architects of the Indian information technology industry, to run the operation. Today half of the firm's software engineers are in India, where they contribute to the millions of lines of embedded code—a miniature operating system, or system-on-a chip (SoC)—that control the video, graphics, and music in Apple's popular iPod media player. Portal Player specializes only in intellectual property (IP) and collaborates closely with partners that coordinate the complex manufacturing logistics and quality assurance required to translate its designs into cost-effective integrated circuits. The iPod may be a symbol of American technology and culture, but it is created by a far-flung network of highly specialized enterprises located in Silicon Valley, India, Taiwan, mainland China, and elsewhere.

During the period following World War II, Taiwan and Israel were peripheral economies, yet in the last decades of the twentieth century they emerged as important global centers of innovation and growth. By 1990, output from Taiwanese and Israeli information technology sectors exceeded that of larger and wealthier nations like Germany and France. At the same time, the rapid growth of technology businesses in select urban centers of China and India made these countries the envy of the developing world. The pioneers of these profound transformations in the global economy are the foreign-born, technically skilled entrepreneurs who travel back and forth between Silicon Valley and their home countries. Like the Greeks who sailed with Jason in search of the Golden Fleece, the new Argonauts undertake the risky but economically rewarding project of starting companies far from established centers of skill and technology.

Traditional theories of economic development assume that new products and technologies emerge in industrialized nations that can combine sophisticated skills and research capabilities with large, high-

income markets, and that mass production is shifted to less costly locations once the product is standardized and the manufacturing process has matured. In this view, success in the periphery builds on the success of more advanced economies: late developers are destined to remain followers because leading-edge skills and technology reside in the corporate research labs and universities in the core.

This model leaves little room for the independent development of technological capabilities in the periphery. At best, foreign investment from the core might accelerate the mastery of mass manufacturing and incremental upgrading of local suppliers. The primary route to development, in this standard view, is the mobilization by the state, in conjunction with national banks and large-scale industry, of the resources to either replicate or import the manufacturing techniques developed in the core. Indeed, multinational corporations have historically relied on peripheral economies like India and China as sources of low-cost manufacturing skill.

Recent developments in the world economy have undermined the power of this core/periphery model, however. The increasing mobility of highly skilled workers and information, as well as the fragmentation of production in information and communication technology sectors, have led to unprecedented opportunities for formerly peripheral economies. Regions that missed the postwar economic boom have provided fertile environments for decentralized growth based on entrepreneurship and experimentation. The key actors in this process are neither policymakers nor multinational corporations acting in isolation, although both certainly play a role, but rather communities of technically skilled immigrants with work experience and connections to Silicon Valley and related American technology centers.

Communities of U.S.-educated immigrant engineers now routinely transfer up-to-date information and know-how to help their home economies participate in the IT revolution. Capitalizing on their experience and the support of professional networks, these new

Argonauts can quickly identify promising new market opportunities, raise capital, build management teams, and establish partnerships with specialist producers located far away. The ease of communication and information exchange within ethnic professional networks accelerates learning about new sources of skill, technology, and capital as well as about potential collaborators, facilitating the timely responses that are essential in a highly competitive environment.

This is not a one-way process. As recently as the 1970s only large, established corporations had the resources and capabilities to grow international businesses, and they did so primarily by establishing marketing offices or manufacturing branch plants overseas. Today the fragmentation of production and the falling costs of transportation and communication allow even very small firms to build long-distance partnerships in order to tap overseas expertise, cost savings, and markets. Start-ups in Silicon Valley today are often global businesses from their first day of operations; many are able to raise capital only if they have a demonstrated ability to subcontract manufacturing or software development and to market their products or services outside the United States.

In this environment, the scarce competitive resource is the ability to locate foreign partners quickly and to manage complex business relationships and teamwork across cultural and linguistic barriers. This is particularly challenging in high-tech industries in which products, markets, and technologies are continually redefined—and where product cycles are often nine months or less. First-generation immigrants like the Chinese and Indian engineers in Silicon Valley who have the necessary language, cultural, and technical skills to function well in the United States as well as in their home markets have a commanding professional advantage. Ethnic professional associations and networks extend these advantages by enabling new as well as established ventures to quickly identify and build partnerships with distant suppliers and customers.

The economies of Taiwan and Israel developed initially as sources

of low-cost skill for labor-intensive manufacturing, just as the old model predicts. However, as U.S.-educated immigrant engineers returned home, either temporarily or permanently, they transferred the institutions of entrepreneurship from American technology regions like Silicon Valley to their home countries. In both countries, a new generation of start-ups pursued the often incremental but cumulatively significant improvements in processes and products that now provide a distinctive competitive advantage. Taiwan is now home to the world's leading IT and networking hardware manufacturers, and Israeli companies have pioneered innovations in network security, telecommunications software, and electronic components. This process is still at an earlier stage in China and India. Yet producers in both countries are quickly leading regions in these nations along upgrading trajectories similar to those in Israel and Taiwan.

The new Argonauts are undermining the old pattern of one-way flows of technology and capital from the core to the periphery, creating far more complex and decentralized two-way flows of skill, capital, and technology. They have created dynamic collaborators in distant and differently specialized regional economies, while largely avoiding head-on competition with industry leaders. Silicon Valley is now at the core of this rapidly diversifying network because it is the largest and most sophisticated market as well as leading source of new technology.

Will Silicon Valley remain the center from which new Argonauts continue to set forth? I will return to this question in the concluding chapter. It is clear that the relationships between these newly emerging technology regions are multiplying, and that the new markets opening up in China and India will further transform the dynamics of the world economy.

Not all peripheral regions can become centers of technology entrepreneurship like Taiwan and Israel. Nations that have invested

heavily in higher education—particularly technical education—are the best positioned to compete in these industries. Most of the developing economies in Asia, Africa, and Latin America have failed to make such investments. Others, like Singapore and Scotland, do not lack skill but have focused their development efforts on attracting foreign investment, or, like Iran and Russia, they lack the political stability required to entice emigrants to return as entrepreneurs.

Many advanced industrial nations, such as France and Japan, have been slow to develop institutions that support technology entrepreneurship. The state planners, bankers, and large corporations that collaborated to support the postwar mass production system have resisted such change. Moreover, the economic opportunities at home for talented young people in these countries are sufficiently attractive that few choose to leave for higher education, and if they do, they return home as soon as they graduate to take top corporate or civil service positions rather than staying abroad. This has isolated them from distant sources of technology and markets.

Developing countries that invested heavily in education in the postwar period did not achieve their planned outcome either. It was these countries that suffered from a "brain drain" as their most talented students left to take advantage of educational opportunities abroad. Policymakers complained bitterly about these losses and even sought to control them. At the time, none foresaw that emigrant engineers and entrepreneurs might become a valuable asset in the twenty-first-century global economy.

A small but meaningful proportion of individuals who left their home countries for greater opportunities abroad have now reversed course, transforming a brain drain into a "brain circulation." They are returning home to establish business relationships or to start new companies, while maintaining their professional and social ties to the United States. The spread of venture capital provides an example of this process. In the early 1980s, emigrants returning from Silicon

1 ❖ Surprising Success

The recent economic successes in Israel, Taiwan, China, and India are particularly surprising given that all of these countries had poor agricultural economies throughout the postwar boom. China and India are still among the world's poorest countries, and until recently they were isolated from the competitive pressures of the world economy. As recently as the late 1980s, few would have predicted that companies in these backward economies would compete in the leading technology sectors of the global economy. Yet today Taiwan's specialized semiconductor and computer-related firms define the international state of the art for efficient, flexible electronic systems manufacturing and logistics. Israel, with a population of just over 6 million, can claim more than a hundred companies listed on NASDAQ—more than in any other country outside North America. India is the leading global provider of software development services and business process outsourcing, and China has overtaken Japan to become the world's second largest IT manufacturing center outside the United States.

What can explain these surprising successes? Standard accounts of industrialization focus either on the activities of the nation-state or on investment patterns of multinational corporations. In the former, the archetypal development program is an efficient and relatively autonomous national bureaucracy that collaborates with dominant

corporations and financial institutions to channel domestic investment and resources to emerging sectors. Export-led industrialization in Japan and Korea involved the early identification and imitation of technologies such as semiconductors and disk drives, followed by the rapid ramp-up and refinement of high-volume, low-cost mass production. Policymakers coordinated the enormous investments required for research and development and for large-scale manufacturing.

The other dominant accounts of economic development give a central role to foreign direct investment, typically motivated by competitive pressures to cut costs. Multinational corporations from the United States, Japan, and Europe aggressively expanded manufacturing in low-wage locations of the Third World starting in the 1960s. These investments ensured the creation of the supplier infrastructures and skill base needed to master high-volume manufacturing of electronic components in places such as Singapore, Malaysia, Scotland, and Ireland. They also contributed to substantial improvements in the standard of living in these economies.

Neither approach explains the rise of indigenous entrepreneurship in the new technology regions. Policymakers have invested, to varying degrees, in infrastructure, education, and research and development, and multinationals have expanded their investments as well. But the innovative dynamism of the new regions has come not from the state, established firms, or foreign investors, but rather from the domestic enterprises started since 1980s with little (if any) state support. The most successful of these, like Taiwan's Acer, Israel's Mirabilis, India's Infosys, and China's Lenovo, have grown to become significant global competitors, but they are only the most visible of the technology businesses in these economies. Each is surrounded by hundreds of enterprises of differing sizes, ages, ownership, and specializations, and by an ongoing flow of entrepreneurial start-ups and failures.

The new Argonauts are the main actors in this process. They are

products of the postwar brain drain, when thousands of foreign-born students earned science and engineering degrees at U.S. universities annually, and remained after graduation to work in the nation's fast-growing technology companies. These immigrant technologists—often the best and brightest from their home countries—integrated themselves into local economies by creating ethnic social structures and institutions that supported professional advancement and entrepreneurial success. By extending these social networks to their home countries, they have transplanted the institutions and relationships of technology entrepreneurship and are reshaping global technology competition.

PROBLEMS AND SOLUTIONS

Late-developing economies typically face two major disadvantages: they are remote from the sources of leading-edge technology, and they are distant from developed markets and the interactions with users that are crucial for innovation.[1] Firms in peripheral locations traditionally use a variety of mechanisms to overcome these disadvantages, from joint ventures and technology licensing to foreign investment and overseas acquisitions. However, the existence of a network of technologists with strong ties to global markets and the linguistic and cultural skills to work in their home country is proving to be a more efficient and compelling way to overcome the limitations of distance. Cross-regional entrepreneurs and their communities facilitate the diffusion of technical and institutional know-how, provide access to potential customers and partners, and help to overcome the lack of reputation or information that results in trade barriers for isolated economies.

The increasing sophistication of information and communication technologies and the liberalization of global markets have ac-

celerated this process. It is now quick, simple, and inexpensive to communicate internationally and to transfer information between distant locations. Information systems that facilitate the formalization of knowledge are dramatically expanding the volume as well as the variety of information exchange. However, information technology alone cannot ensure successful coordination or efficient transfers of technical and institutional knowledge. Long-distance collaborations still depend heavily upon a shared social context and language to ensure mutual intelligibility between partners in markets where speed and responsiveness determine competitive success.

Market liberalization has likewise been important to the economic transformation of both China and India. However, the reduction of trade barriers and bureaucratic intervention alone does not create the institutional capability and social context, or the domain knowledge, required for entrepreneurial success in global industries. Technology entrepreneurship remains highly localized even in the most advanced economies, and it cannot be created by fiat, as evidenced by decades of failed attempts to "grow the next Silicon Valley." Efforts to jump-start entrepreneurship by mobilizing researchers, capital, and a modern infrastructure cannot replicate the shared perspective, language, experience, and trust that permit open information exchange, collaboration, and learning (often by failure) alongside intense competition in places like Silicon Valley.

The new technology centers differ significantly from one another, and from Silicon Valley, in their technological sophistication as well as in the specialization of local producers. Cross-regional entrepreneurs rarely compete head-on with established U.S. producers; instead they build on the skills and the technical and economic resources of their home countries. Israeli entrepreneurs, for example, have successfully applied the findings of the nation's advanced military research to innovations in the Internet security and telecommunications arenas. Indian entrepreneurs, by contrast, recognized

the opportunity to mobilize thousands of underemployed English-speaking Indian engineers to provide software development services for American corporations. Returning entrepreneurs are ideally positioned to identify appropriate market niches, mobilize domestic skill and knowledge, connect to international markets, and work with domestic policymakers to identify strategies to overcome obstacles to further growth.

Investors and engineers in these regions are promoting the development of local ecosystems for entrepreneurship, while also maintaining close connections to technology and markets in the United States. The infrastructure for entrepreneurship is best developed in Israel and Taiwan, where thousands of technologists have returned since the 1980s. Both regions have also completed several entrepreneurial cycles in which successful entrepreneurs have reinvested their capital and contributed accumulated know-how and contacts to a subsequent generation of technology ventures, while also serving as role models. This cycle is both the cause and the consequence of the relationships and informal information flows that support regional experimentation and learning. It does not guarantee the success of any individual firm, but it provides local producers with the collective capacity to adapt and improve.

The dynamism of these technology regions is not reducible to cost advantages. Investors in India and China may have been initially motivated by the availability of low-cost skill, but the concentration of technology production has already generated rapidly rising wages and intensifying congestion in these regional economies. Engineering salaries in both Bangalore and Shanghai, for example, are now among the highest in their respective nations, yet new and established producers continue to cluster there rather than seeking lower-cost locations. The experience of Silicon Valley demonstrates that decentralized economies can flourish long after their labor cost advantages disappear, as long as local investors and entrepreneurs are

able to create and recreate their regional advantage by collectively learning, innovating, and upgrading local capabilities.

The contributions of an international technical community in transferring the institutions of technology entrepreneurship should not be confused with the broader role of a diaspora in the home country. The aggregate remittances, investments, or demonstration effects of a diaspora can affect an economy in a variety of different but largely limited ways. The new Argonauts, by contrast, are a small subset of highly educated professionals whose potential contributions to economic development are disproportionately significant. They are not typically drawn from the traditional economic or political elites of their home countries. Instead, they are often the top engineering students from middle-class households whose access to education in the United States has exposed them to a very different technological and institutional environment.

At one level, this is not surprising. Long-distance migrations have shaped the contours of the world economy throughout history. The transfer of skill and know-how that accompanies the movement of individuals and groups within and between nations can have an enduring impact on patterns of economic development, as with the modernization of Japan during the Meiji restoration in the nineteenth century, or the transfer of British textile and German steel technology to the United States during the nineteenth century. Economic historians have documented the contributions of personnel recruitment to knowledge transfer and have demonstrated that the experience, relationships, and tacit knowledge that reside in individuals and their communities play a central role in long-distance transfers of technology and economic institutions.[2] But tacit knowledge alone is not sufficient. Transferring production to a new location requires deep knowledge of the local context—the subtle as well as the more apparent differences in social, cultural, and institutional settings. And long-distance collaboration rarely succeeds without the

shared language and social context that facilitate communication. Because there are few substitutes for native experience, cross-regional entrepreneurs accelerate the adaptation of technology and institutions to local circumstances that are inevitably different from those in the United States.

FROM BRAIN DRAIN TO BRAIN CIRCULATION

Scholars have long viewed the postwar brain drain as reinforcing global inequality—a net loss for developing economies but yet another advantage for already rich and industrialized nations. According to a classic textbook on economic development, "The people who migrate legally from poorer to richer lands are the very ones that Third World countries can least afford to lose—the highly educated and skilled. Since the great majority of these migrants move on a permanent basis, this perverse brain drain not only represents a loss of valuable human resources but could also prove to be a serious constraint on the future economic progress of Third World nations."[3]

Although data on the emigration of skilled workers are hard to find, the United Nations estimated a total of 300,000 highly skilled emigrants moving from all developing countries to the West during the 1960s, and the 1990 U.S. Census showed 2.5 million highly skilled immigrants, excluding students. Researchers seeking to quantify positive feedback effects from migration, such as remittances, investments, or return migration, concur that these effects have been limited, particularly among highly skilled immigrants who rarely returned to their home countries.[4] Such analyses have even led economists to consider a system of global taxes on either the migrants or the receiving countries to compensate for the loss of human capital by poor nations.[5]

The picture today is different. The countries that suffered most

from the postwar brain drain—especially Taiwan, Israel, India, and China—are those that now benefit most directly from the rise of the new Argonauts. Developing nations that invested heavily in high-quality tertiary technical education were most likely to lose their most promising young people to higher education abroad during the postwar years; they also typically lacked the industrial base to employ the larger numbers of graduates who never left the country. As a result, these countries were often home to large numbers of unemployed or underemployed graduates. In recent decades U.S.-educated engineers from places like Taiwan and Israel recognized them as potential sources of skill. By returning home, the new Argonauts have created economic and professional opportunities for former classmates and for subsequent generations of technical graduates, ultimately reducing the brain drain.

Returning emigrant communities are not replicating Silicon Valley around the world. The emerging regions combine elements of the Silicon Valley industrial system with inherited local institutions and resources. The well-developed institutions that support the Silicon Valley system, including efficient capital markets, property rights enforced by an independent judiciary, regulatory oversight, sophisticated education and research, and technological infrastructure, are rarely all present in peripheral economies. Returning entrepreneurs typically attempt (with varying success) to transfer venture capital finance, merit-based advancement, and corporate transparency to economies with traditions of elite privilege, government control, and widespread corruption. They seek to create team-based corporate cultures with minimal hierarchy in environments that are dominated by family-run or state-owned enterprises.

Nevertheless, returning entrepreneurs have adapted to conditions in their home countries, as attested by the growing presence of technology entrepreneurship in each of these economies. In India, early entrepreneurs relied on private telecommunications facilities and power

supplies rather than on the nation's costly and unreliable infrastructure, while in China returning entrepreneurs have learned how to negotiate the Byzantine rules and relationships that regulate private companies. Returning entrepreneurs also have the advantages of access to American institutions: not only do they have the benefit of a graduate education in the United States, but many choose to incorporate their businesses there, establishing headquarters or research labs in Silicon Valley, raising venture capital, retaining professional services, and hiring managerial and technical talent from the United States. Many eventually raise public capital on U.S. stock exchanges. At the same time, in all these countries, cross-regional entrepreneurs and their communities have contributed to the transformation of domestic institutions by advising national governments on legal, regulatory, and capital market reforms, by working with regional governments on improving local infrastructure, universities, research, and training institutions, and by creating forums for information exchange among local companies.

A region's economic trajectory is shaped not only by local institutions but also by the range of technological and market opportunities available at the time it enters global markets. The most successful producers in Israel and Taiwan are those that have identified niches that allow them to differentiate and complement, rather than compete directly with, established producers in Silicon Valley—thus avoiding price and trade wars like those between U.S. and Japanese semiconductor firms in the 1980s. The fast-growing market for wireless communication in Asia has created opportunities for firms in China and India to contribute to the direction of the technology and its applications—even if they do not define the leading edge. Over time, producers in developing regions build independent capabilities and define entirely new markets. Organizational and institutional innovations will also likely emerge from these new centers of technology entrepreneurship, as they did from Japan in an earlier era.

Entrepreneur-led growth, with competitive, sophisticated small- and medium-sized technology producers in high skill regions connecting to and collaborating with counterparts elsewhere, is only one possible future for these formerly peripheral regions. They could forgo the opportunity to upgrade local skills and capabilities, and instead remain suppliers of low-cost labor. China and India have the labor supply to do this for a relatively long time. However, many transnational entrepreneurs have maintained close ties to the technology and markets of Silicon Valley and are constructing firms committed to an alternative, high-value-added trajectory.

ENTREPRENEURSHIP IN THE POSTWAR ECONOMY

Entrepreneurship largely disappeared from scholarly and policy debates in the postwar period. As recently as the 1980s, the general consensus was that the large mass-production corporation represented the optimal way to organize production. Alfred Chandler traced the evolution of the "modern corporation" in the United States to serve a rapidly expanding national market, the adoption of increasingly capital-intensive plant and equipment to maximize throughput and achieve economies of scale, and the related need for control over the sources of supply as well as demand to ensure the ability to amortize these huge initial investments. He also described how the detailed division of labor and delegation of administrative tasks to professional managers within the corporation further lowered unit costs and increased throughput, while a central managerial hierarchy served as "guardian of the organization's centralized knowledge base."[6]

Policymakers in planned as well as market economies attempted to emulate America's unprecedented postwar growth by adopting the organizational model of the twentieth-century modern corporation.

European attempts to master large-scale production began as early as the 1940s, but the process was uneven and often required state intervention at the expense of alternative industrial systems. Scholars have described the hybrid production systems that emerged in Germany, France, and Italy.[7] However, the institutional similarities across these economies, which Alexander Gerschenkron referred to as "late developers," were striking as well—the activist state and leading domestic banks working with giant corporations to mobilize the technology and resources needed for high-volume manufacturing and scale economies.[8]

When microelectronics technologies were commercialized in the 1960s and 1970s, policymakers assumed that the large corporation was the appropriate vehicle for development of this emerging sector. Governments in East Asia as well as Europe sponsored "national champions" in the semiconductor and computer industries that were typically linked closely to national defense, aerospace, and telecommunications agencies. The dominant domestic producers in France, Germany, and Italy, for example, received preferential treatment including public procurement, research funding, and low-cost loans—all justified in the interest of national security and prestige. In Japan and South Korea, the government similarly privileged a few gigantic, diversified electronics and computer producers at the expense of potential competitors, both domestic and foreign, through generous incentives and subsidies. Japan's *keiretsu* and Korea's *chaebol* (large corporate groups or conglomerates) not only became export leaders in technology sectors, but also played dominant roles in the design and operation of financial institutions.

The classic economic model accurately described the postwar period. Long product cycles and stable markets allowed technology firms to shift high-volume production to low-cost locations while maintaining research and development at home. In the 1960s and 1970s, for example, U.S. semiconductor firms relocated their low-skill testing and assembly operations to Southeast Asia, followed in