High-Tech Industrial Policy: Comparing the United States With Other Advanced Nations

By Robert B. Reich

Often presenting risky investment opportunities, emerging technologies nonetheless can substantially benefit an economy by spawning new products, skills and jobs. Emerging technologies and the industries they support thereby ease the problems of adjustment out of declining industries. But because these benefits seldom redound entirely to private investors, the amount of capital privately invested in emerging technologies, and the allocation of that capital, will seldom match public needs. That is, the social return on the investment in high technology often will be much larger than the private return. Thus, in every nation a strong case exists for policies that accelerate the movement of resources into technologies that can become highly competitive in the world economy, and which are critical to the future competitiveness of the national economy.

The U.S. government has responded to emerging technologies primarily through its national defense and aerospace programs. Notwithstanding that the goal of economic adjustment has not been an objective of these programs, these programs have contributed to U.S. leadership in world sales of aircraft, communication satellite technology, hard plastics, synthetic rubber, computers, semiconductors, lasers, fiber optics, radio and television communication equipment, robotics, optical instruments, scientific instruments and many other products. Together, these U.S. government research and procurement programs constitute the United States' "industrial policy" for high technology. This is in sharp contrast to other industrialized nations, whose high technology industrial policies entail government subsidies for commercial development and also encourage commercial applications through targeted tax and credit programs.

The U.S. Department of Defense now funds approximately 30% of U.S. research and development; for basic research, concerned with broad-based and theoretical experimentation that may have few immediate commercial applications, government funding exceeds two-thirds of the total. In some industries, government

Photo: Martha Stewart

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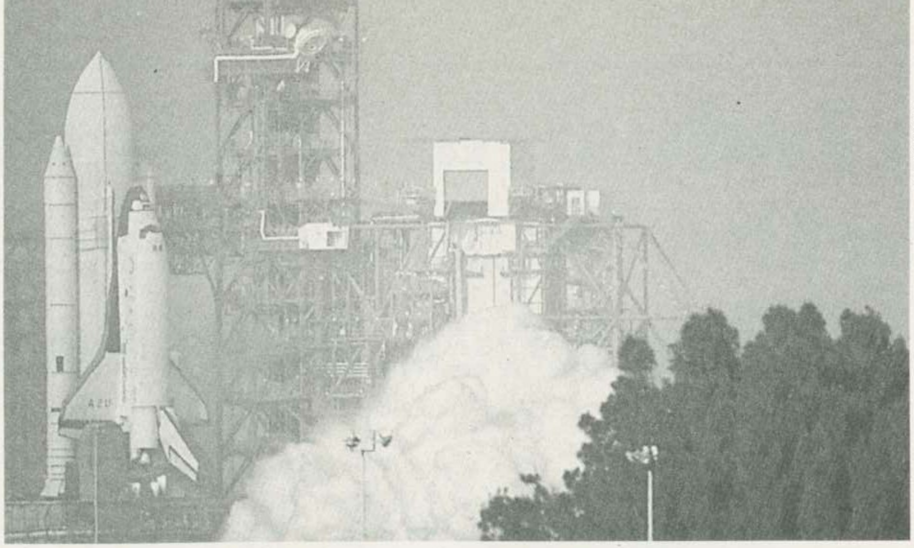
support reaches particularly high levels. In 1977, for example, the government funded 70% of research and development in the aircraft industry and 48% in the communications equipment industry. Other industries—less critical to national defense—have enjoyed very little direct government support and this differential undoubtedly has affected the relative speed of their commercial development. For example, only 1% of the research budget of the pharmaceutical industry is funded by the U.S. government. Governments of other industrial nations fund a much smaller percentage of their national research and development. Even the Japanese government, which is expressly committed to promoting Japan's emerging industries, directly funds only 16% of Japan's research and development.

Government-created market

Large-scale defense and aerospace contracts also have provided emerging industries in the United States with a ready market for which they have expanded production and thereby gained valuable experience, know-how and scale economies. The Pentagon's willingness to pay a high premium for quality and reliability, moreover, has helped emerging industries bear the cost of refining and "debugging" their products. Largely as a result of government contracts, for example, the U.S. semiconductor industry was able to reduce its unit costs quickly during the 1960s and emerge as a commercial leader in the world market. As the arms race and the moon race both demanded smaller, faster, and more reliable memory units, the Defense Department and the National Aeronautics and Space Administration (NASA) became the largest purchasers of semiconductors—together accounting for almost one-third of the market by 1967. Integrated circuits which cost $50 in 1962 cost only $2.33 by 1968, making them attractive for use in many commercial products. Over the same period the size of the semiconductor market increased from $4 million to $31 million.

Many other emerging industries in the United States have followed the same pattern. In 1950, government purchases accounted for 92% of aerospace sales. Military aircraft thereafter were adapted to civilian uses—the Boeing B-47 and B-52 bombers became the Boeing 707; the Douglas A-3D, A-4D, and B-66 military aircraft became the DC-8. The nascent American computer industry also relied on government support. In 1954, the government was the only major purchaser of computers; by 1962, the government market still represented almost one-half of total computer sales. The U.S. government continues, moreover, to provide a substantial market for several U.S. industries. In 1977, government purchases accounted for 56% of all U.S. aircraft shipments, 57% of the sales of radio and communications equipment, 12% of engineering and scientific instruments, and 12% of transmitting electron tubes. By 1982, U.S. government purchases accounted for 67% of the sales of laser technology, and 80% of super computers.

To a significant extent this government-created market has been open only to U.S. firms. Although the "Buy American" provisions of the government procurement laws were relaxed somewhat in 1979, government contracts involving national



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NASA is a good illustration of the strong involvement of a government in R&D projects.

security still are awarded solely to domestic firms.

U.S. defense and aerospace programs have accelerated the emergence of new industries in other ways as well. Large government contracts often have required that private manufacturers cooperate on research projects, parceling out tasks to one another in a manner that the U.S. antitrust laws might otherwise prohibit. Military and NASA training has also spawned several generations of advanced engineers and skilled machinists whose training has been critical to the development and production of commercial high technology.

Pentagon, MITI squaring off

Viewed in this light, there is a striking similarity between America's defense-related and aerospace programs, and other nations' industrial policies that are expressly designed to accelerate the development of emerging industries. For example, Japan's MITI has sought to hasten the development of high technology products through its direct support of research, joint research projects involving several companies simultaneously, and leasing arrangements and (at least until the mid-1970s) import controls designed to give Japanese producers a large and captive home market and thereby enable them to gain the experience and scale necessary to reduce their unit costs and compete internationally.

Even the technologies on which MITI and the Pentagon are focusing are similar. Since 1975, for example, MITI has financed one-third of the development costs of very-large-scale integrated circuits—the next major stage in the evolution of semiconductors. The project involves four leading Japanese semiconductor and computer manufacturers. In 1979, the Defense Department launched its own very-large-scale integrated circuit project, involving nine American semiconductor and computer manufacturers. The Pentagon has budgeted $300 million for the project over a ten-year period. Similarly, MITI has embarked on a program to spur the Japanese robotics industry, entailing an expenditure of $140 million over the next seven years. The U.S. Air Force and NASA have their own version of the same project—a $75-million program to develop an automated "factory of the future," based on integrated computer-aided manufacturing technology. MITI also has organized a seven-year project to develop the technology for flexible manufacturing systems, with a total budget of $65 million. Likewise, the Defense Department has launched a manufacturing technology program ("ManTech") aimed at improving the capabilities of defense contractors, at a cost of approximately $140 million in 1983.

MITI and the Defense Department also are squaring off in fiber optic communications (MITI is devoting approximately $30 million over the next few years, and Nippon Telephone and Telegraph, the large Japanese public corporation, is providing a major market and the Pentagon, meanwhile, is spending about $40 million annually on this technology); lasers (MITI is coordinating and subsidizing research while the Pentagon has requested $526 million in research funds for 1984 and now accounts for just under 50% of U.S. laser sales); computer software (MITI has launched a three-year, $180-million program for new applications of software packages and the Pentagon is about to launch a $20-million software program applicable to missile guidance and radar); supercomputers (MITI has organized a seven-year project to develop a superspeed computer; the Defense Department's Advanced Research Planning Agency is seeking $50 million in 1984 for a similar project); and a host of other technologies.

Although further behind in the development of many of these technologies, France, Britain and West Germany are also assisting their emerging industries to become internationally competitive. The French government, for example, is supporting the development of very-large-scale integrated circuits by encouraging joint ventures with American companies and simultaneously providing $140 million in direct subsidies. West Germany is taking a similar approach, with subsidies of approximately $150 million. And Britain is providing its emerging integrated circuit industry with $110 million.

Pentagon: security before innovation

Here, however, the similarities with the United States end. While U.S. defense and aerospace programs have spurred industrial development, they have not always spurred it in the direction of commercial success. Apart from the Pentagon's broad concern for the economic health of U.S. defense contractors and NASA's recent flirtation with commercial applications for its space shuttle, the Department of Defense and NASA have little or no interest in the successful marketing of new products. Indeed, defense and aerospace programs actually may have jeopardized the international competitiveness of American manufacturers. By contrast, the efforts of U.S. trading partners, particularly Japan, have been focused directly on world competition for commercial markets.

The marketing of new commercial products is stimulated by domestic competition, which forces firms to improve their performance and aggressively seek foreign outlets. Although MITI allows firms to cooperate on specific basic research projects, it helps ensure that they are fiercely competitive in marketing. For example, 32 Japanese companies now produce semiconductors, and the competition is intense. The competition is equally strong in the computer industry.

The U.S. Defense Department, however, has been unconcerned about competition within American industry. Over 65% of the dollar volume of U.S. defense contracts is awarded without competitive bidding. And even where competitive bidding has occurred, the bids are often rendered meaningless by substantial cost overruns. The Pentagon seems most comfortable with large, stable contractors who are relatively immune to the uncertainties of competition. Most of the early defense contracts for integrated circuits, for example, went to large, well-established manufacturers that were producing soon-to-be-outmoded vacuum tubes, like Western Electric, General Electric, Raytheon, Sylvania and R.C.A., instead of innovators like Texas Instruments, Motorola and Transitron. Even as late as 1959, the old-line vacuum tube companies were awarded 78% of the federal research and development funds devoted to improving the performance and reducing the cost of the transistor, although they then accounted for only 37% of the commercial market. The innovators eventually penetrated and then dominated the market, despite the Department of Defense. On occasion, the Pentagon actually seems averse to competition, particularly when competition threatens the stability of a prime contractor. Secretary of Defense Caspar Weinberger recently argued that the government's antitrust suit against the American Telephone and Telegraph Company should be dropped on the ground that, if successful, it would threaten the viability of AT&T, and hence jeopardize national security.

MITI: a stable policy environment

The successful marketing of new products also requires long lead times, during which firms can apply new technologies and make sure they have adequate capital, labor and productive capacity to meet anticipated demand. Many MITI projects span a decade or more. But Pentagon and NASA programs are subject to relatively sudden changes in national security needs and prevailing politics. Between 1967 and 1974, in the wake of Vietnam, defense-related research and development declined by $3.7 billion (in constant 1972 dollars), drastically reducing the nation's demand for scientists and engineers and retarding the development of various defense spin-offs. Because this contraction came during a recession, when the economy was trying to adjust to the oil-price rise, emerging industries that had relied in part on defense contracts were doubly hit. American semiconductor manufacturers, for example, cut their capital equipment purchases by half and laid off thousands of skilled workers. By contrast, the Japanese chip makers—with their tax privileges, loans and subsidies in place—could afford to expand their production and improve their technology in anticipation of the next economic upturn.

The precipitous rise in U.S. Defense spending planned for the next five years is likely to create bottlenecks in the production of key subcomponents and capital goods, and shortages of engineers and scientists in advanced electronics and machinery. Even in the midst of a recession, unfulfilled defense orders totaled $63 million in 1981—up 30% from 1980. Now that the recession is ending, the bottlenecks are apt to be worse. There is already a shortage of an estimated 60,000 skilled machinists.

Finally, and most important of all, commercialization requires that new technology be transferable to commercial uses at relatively low cost. MITI sees to it that new technologies are diffused rapidly into the economy, and incorporated into countless commercial products. Japanese firms bid to participate in MITI projects, offering to absorb some of the cost of the research projects. Not only does this competitive bidding process help ensure that government subsidies are as low as are necessary to spur the private sector into action, but it also helps guarantee that Japanese companies will utilize the new technologies, because they already have a financial stake in them.

Defense & economic policies uncoordinated

The advanced designs required by tomorrow's elaborate military hardware—designs incorporated into precision-guided munitions, air-to-air missiles, cruise missiles, night-vision equipment, and missile-tracking devices—will not be as easily applicable to commercial uses as were the more primitive technologies produced during the defense and aerospace programs of the late 1950s and early 1960s. Precisely because America's commercial semiconductor industry is not likely to be adaptable to defense needs in the years ahead, for example, the defense department has launched its own research and development program for the "chip of the future." In explaining the program, William J. Perry, then Under Secretary of Defense for Research and Engineering, told the Senate last year that while the Department has "an outstanding ability to direct technology resident in the defense industry to high priority programs... [it has] little ability to influence those companies whose sales are predominantly commercial. This is a serious limitation in the case of the semiconductor industry, whose products play a crucial role in nearly all of our advanced weapons systems," Mr. Perry went on to say:

Therefore we have initiated a new technology program intended to direct the next generation of large-scale circuits to those characteristics most significant to Defense applications... This program will ensure that the U.S. maintains a commanding lead in semiconductor technology and that this technology will achieve its full potential in our next full generation of weapon systems.

Rather than encourage American commercial development, defense spending on emerging high technologies may therefore have the opposite effect over the long term, diverting U.S. scientists and engineers away from commercial applications.

Moreover, defense concerns about the transfer of technology to the Soviet Union increasingly are casting a veil of secrecy over commercial high technology research in the United States. At one recent photo-optics engineering meeting, for example, the Defense Department ordered that 170 unclassified papers be withdrawn. As a result of this increasing secrecy, technological innovations will not as readily be applied to commercial products and processes in the future.

The problems posed by the disjuncture between defense policies and economic needs are likely to loom larger in the next few years, as the defense buildup proceeds apace. Planned military spending will exceed $1.5 trillion over the next six years. This will profoundly affect several emerging industries. Between now and 1987, for example, defense spending for semiconductors is expected to increase by 18.3%, while commercial semiconductor purchases will increase by only 11.8%. A similarly divergent growth pattern is expected for computer sales (16.4% for defense, 11.8% for commercial purposes), engineering and scientific equipment sales (9% for defense, 5.6% for commercial purposes), and sales of communications technologies (11.6% for defense, 5.3% for commercial purposes). Meanwhile, the Defense Department's share of government research and development outlays is expected to rise to over 60% in FY 1983. There already are signs that the Defense Department is taking over NASA's space shuttle program, thereby cutting off the shuttle's fledgling commercial applications. At the same time, the Department's share of government research and development outlays is expected to rise to over 60% by 1983. The Reagan Administration has requested from Congress $45.8 billion for research and development in 1984, of which $29.9 billion would be applied to defense.

In sum, U.S. industrial policy for high technology is no less interventionist than that of other industrial nations. And in many respects, the U.S. has a more profound and direct effect on the development of its high technologies than do other nations. But because these programs are not strategically related to commercial competitiveness, they may actually retard economic growth rather than accelerate it. ●

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