A New Technology Policy for the United States?

Murray Weidenbaum

The Clinton administration is correct in proposing a new technology policy for the United States. The existing array of federal activities ostensibly promoting research and development (R&D) remains unchanged from the early Cold War period and is clearly out of date. The administration is wrong, however, in proposing that federal encouragement to commercial technology should take the traditional form—financial subsidy from the U.S. Treasury—that was favored when national security was the motivating force.

By its very nature, successful commercial technology is used by the private sector. It is private companies that produce and market the goods and services embodying the fruits of science and engineering advances. Hence, in order to be effective, any new technology policy should focus on enhancing the basic incentives of a private enterprise system. This requires reducing numerous governmental obstacles to the commercialization of new technology. In contrast, depending on federal departments and agencies for achieving or even directing technological breakthroughs and their application will not work. As we will see from a cursory historical review, that approach is reminiscent of the discredited hangover remedy known as having some of the hair of the dog that bit you.

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The Clinton Administration's Proposals

In its proposals to date, the Clinton administration's technology program relies primarily on new and expanded federal spending. One of its suggested innovations is to broaden the standard definition of federal support for infrastructure beyond traditional bridge building and road construction to include a variety of high-tech projects. Those projects include investing in magnetic levitation transportation and high-speed rail, developing "smart highways," producing a "clean automobile" powered by batteries or fuels like hydrogen and methane, building a national information "superhighway" to link up computers around the nation, expanding the role of the Commerce Department to promote joint ventures between business and government, and increasing partnerships between private industry and the national laboratories.

Two major arguments have been offered to support direct federal involvement in developing and applying technology. First is the oldest bureaucratic justification: we've always done it that way. Indeed, over the years the federal government has financed many business undertakings, especially in the area of technology. The second argument is that other nations, notably Japan, have gotten the jump on American industry supposedly because of help from their governments. Let us examine each of those two arguments.

U.S. Government Efforts to Promote Technology

Over the years the federal government has financed many high-tech undertakings, but past experience with government trying to force technological innovation is not comforting. The $3 billion the federal government wasted in the abortive attempt to develop a commercial synthetic fuels industry was part of a vain effort to reduce our dependence on imported energy. (Deregulation of oil pricing was a far more effective approach.) A recent economic assessment of the synfuels program, by Linda Cohen and Roger Noll, is totally devastating: "The entire synfuels program had a quality of madness to it. Project after project failed. . . . Goals were unattainable from the start. Official cost-benefit studies estimated net benefits in the minus billions of dollars."

But the effort to develop synfuels was not an isolated example. Similar failures occurred in the aborted supersonic transport project and in the Clinch River breeder reactor. Similar shortcomings continue to this day. Witness the space shuttle still seeking to define its mission or the recently terminated superconducting super collider. The General Accounting Office (GAO) reports that the development costs of the space shuttle's advanced solid rocket motor project has virtually doubled in recent years, to $3.25 billion. Meanwhile, the need for the advanced motor has declined. Sadly, the list of problems with federal "investments" in new technology seems to be endless. In a December 1992 report on the National Aero-Space Plane, the GAO states that the program "has been fraught with turmoil, changes in focus, and unmet expectations." Those are only the latest examples of the basic failure of "industrial policy" efforts that extend back to the days of the Reconstruction Finance Corporation scandals in the 1950s.

How does the government decide which industries, technologies, and projects to support? Based on experience, government favors politically powerful firms, which usually means older, more labor-intensive companies. Over the years, those firms have invested substantial resources in heightening their presence in Washington. Moreover, those firms are the "squeaky wheels," suffering the most from competitive forces.

New and growing firms may be economically strong, but they are usually politically weak. They have neither a record of extended financial contributions to political candidates nor sufficient knowledge of lobbying techniques and large groups of agitated employees/voters. Former Senator William Proxmire (D-Wisc.) was right when he said, "Money will go where the political power is. Anyone who thinks government funds will be allocated to firms according to merit has not lived or served in Washington very long."

The invention of the semiconductor shows the limits of government assistance. During World War II, the government sponsored a huge research program on the fundamental properties of germanium and silicon, to respond to the limitations of silicon diodes used in radar. Thirty to 40 U.S. research laboratories were involved. Nevertheless, the important early semiconductor device was invented at the civilian Bell labs, which did not receive a research and development grant from the military for semiconductors—until after its invention.

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Every business going to Washington for financial help resents and tries to avoid the term "subsidy." In contrast to federal subsidies to farmers, corporate executives always describe their extraction from the federal treasury as an investment in future economic growth or some such worthy pursuit. The American-Japanese semiconductor agreement illustrates the danger of that rhetorical approach. The agreement surely helped some firms, but at the expense of the American computer manufacturing industry. The results are typical of special-interest legislation, benefitting some industries or companies or regions at the expense of the national interest.

As recently as the early 1980s, the American semiconductor industry outsold Japanese firms. Japanese companies responded by investing

more heavily than their American counterparts—at a time when American firms could have afforded to stay ahead of the foreign competition. Not surprisingly, by the middle of the 1980s, Japanese semiconductor producers began outselling American firms and American companies asked for a generous handout from the U.S. taxpayer.

The government's response was to subsidize Sematech, a consortium for semiconductor manufacturing technology. It comes as no surprise to anyone familiar with the history of U.S. industrial policy that Sematech favored the older, more established companies at the expense of the newcomers who generate much of the innovation.

Reading between the lines of a carefully and cautiously written report on Sematech by the GAO is revealing. Even if Sematech achieves all of its technological objectives, Japanese competition will continue to have lower manufacturing costs per semiconductor chip because their quality is higher (a higher percentage of chips produced meet specifications). The GAO notes laconically that Sematech might have worked better if it had more thoroughly assessed the market position of U.S. semiconductor producers and then adopted an initial operating plan with realistic objectives and milestones. The GAO also notes that Congress has set no deadline for terminating the large federal contribution (currently $100 million a year). Federal spending programs do have a life of their own. Another GAO report reveals that five member companies charged off part of their payments to Sematech as overhead costs on government contracts. Although legal, this procedure increases the federal government's total support to Sematech. It also helps to explain Sematech's popularity with the recipients of its largesse.

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In any event, an important side benefit of the Sematech experience was the loosening of regulatory restraints to allow the member companies to work together on precompetitive research. That limited experiment in deregulation—which does not require any government subsidy—led to positive results and is worth repeating. Independently, the U.S. chip industry has made an impressive comeback, concentrating on innovative designs not especially connected to Sematech's efforts.

The current debate on whether government or private industry should take the lead in building a new high-tech fiber-optic telecommunications network (the information superhighway) provides yet another striking case in point of avoidable governmental subsidy to high technology. The quickest way to achieve a data superhighway is to permit the existing telephone and cable TV companies to compete using their current digital technology. For example, Tele-Communications, Inc. of Denver is embarking on a $2 billion program to lay fiber-optic cable throughout more than 400 communities across the country by 1996. Telephone companies are also showing a strong interest in this potential new market and could use existing copper telephone cables. That will require the federal government to relax its ancient regulatory restraints on interindustry competition in telecommunications.

Freeing new portions of the radio spectrum now blocked by administrative action also could spur innovation. Rather than urging such long-overdue regulatory reform, proponents of the data superhighway concept are proposing that the federal government build a more technologically advanced system on its own. But, as any cynic or seasoned observer of the Washington scene would readily expect, the notion of government subsidy to telecommunications has attracted support from many quarters. The proponents of a new high-technology handout range from prospective suppliers of equipment (many companies are attracted by the prospect of lucrative contracts) to prospective users (who expect the government to subsidize their access to the network). Moreover, some communications experts warn that moving too rapidly would result in the United States having the first, but the world's most primitive, fiber-optic communications system.

Foreign Experience

Proponents of more federal subsidies to private

"I take it they killed the Super Collider."

business often cite the example of Japan. Japan's Ministry of International Trade and Industry (MITI) is often heralded as a fine example of successful business-government cooperation, but, when one takes a closer look, the details are not as convincing.

MITI is a powerful agency of the Japanese government, with substantial influence over business decisionmaking. However, its own decisions have not been altogether wise. MITI attempted to keep Sony from entering the consumer electronics market. MITI also tried to keep Mazda and Honda out of the auto business because it badly underestimated the growth of Japan's export market. Then there was MITI's textile fiasco. MITI bought and scrapped 180,000 looms to finance the textile cartel it was setting up. At the same time, however, 160,000 illegal looms came into production.

MITI also purchased a 30 percent stake in an international consortium building a new jet engine. In part because of numerous delays in the project, the major Japanese airlines continue to buy jet airliners powered by U.S.-built engines.

Shipbuilding is also portrayed as another classic MITI success story. Following World War II, MITI used subsidies to nurture this industry, and by 1957 Japan was the world's largest shipbuilder. In the early 1970s, when Korea's comparative advantage became clear,

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MITI began to shift resources out of shipbuilding in favor of new growth sectors—or so the admirers of MITI claim. While the results are essentially as portrayed, Japanese industrial pol-

icy was by no means so farsighted.

In practice, MITI's subsidies were provided only to ships that were to be operated under the Japanese flag and that employed Japanese seamen. As the rising wages of those seamen undermined their competitive position, Japanese shipping firms gradually switched to ships operating under foreign "flags of convenience" during the 1970s. (Sounds familiar?) The result was a large decline in subsidized shipbuilding and, thus, in total Japanese shipbuilding. This negative trend occurred even while MITI was forecasting increases in the demand for Japanese-built ships. Japanese industrial policy planners did not foresee either a decline in domestic shipbuilding or an increase in the use of foreign ships. Once again, market forces thwarted government efforts to sustain a domestic industry.

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High-definition television (HDTV) provides a current example of Japanese government failure. The government chose the technology that would be used for HDTV in Japan and financed its development. However, it now seems that the analog technology selected by the Japanese government turns out to be inferior to some alternatives. Without the "benefit" of similar government assistance, the U.S. industry has developed promising alternatives to Japanese HDTV using digital technology of a higher quality. This year, the European Community abandoned development of its analog approach to a new generation of television—acknowledging the superiority of U.S. digital technology.

On a more positive note, the Japanese response since 1987 to the rise of the yen in world currency markets is very revealing. On their own, Japanese companies took quick and tough actions to restore their global competitiveness. Within weeks, or at most months, of the change in the external financial environment, many of them undertook vigorous campaigns to improve productivity and quality. Some manufacturing operations were quickly moved to lower-cost locations and, in some cases, senior executives reduced their own salaries. MITI was not particularly involved at all.

A Free Lunch from the Peace Dividend?

Many people who are concerned with American industry's lag in international competitiveness see a new source of financing for all sorts of panaceas—the peace dividend supposedly arising from the end of the Cold War. For example, some would have the Department of Defense finance civilian technology directly, conveniently overlooking the fact that the military buildup was financed out of borrowed money. There is no surplus cash sloshing around in the U.S. Treasury.

Others justify their desire to have the Department of Defense subsidize civilian science and technology by pointing to the armed services as important users of society's pool of scientific and technical knowledge. But there is no limit to that line of reasoning, given the large military purchases of items ranging from missiles to mittens, from ground support equipment to golf balls.

Proposals to expand the Defense Advanced Research Projects Agency (DARPA) are a convenient way of bypassing traditional military procurement procedures. Little known and small by Washington standards, DARPA contracts with over 300 corporations and universities to conduct high-risk research. Over the past 30 years, DARPA-funded products have led to the development and commercialization of computer time-sharing, advanced aeronautics, new types of software, and new telecommunications procedures.

DARPA already finances private-sector R&D in a variety of areas—superconductivity, advanced semiconductors, HDTV, and very sophisticated types of integrated circuits. While DARPA justifies its sponsorship of those projects because of their expected relevance to military missions, many of the technologies being developed are expected to help American industries compete in commercial markets. About one-half of DARPA's budget is currently allocated to technologies that have both civilian and military applications. However, DARPA is no magician. It operates in the special world of military procurement, where one monopsonistic buyer dominates the market. Surely, DARPA has experi-

enced its share of flops. After spending $200 million, it closed the books on an experimental helicopter-airplane. Another project that fell short was a scheme to use artificial intelligence to guide a combat vehicle over rough terrain.

Some compare DARPA with Japan's MITI. But, unlike DARPA, MITI is a cabinet-level agency that is charged with enhancing the nation's international competitiveness. Expanding the role of DARPA to include all of the civilian technology that other federal departments and agencies are willing to sponsor, as is now being urged, would dilute DARPA's mission and weaken its focus. To a significant degree, DARPA has succeeded by virtue of its ability to bypass the Pentagon bureaucracy. If it gets much larger, it will likely lose this special characteristic.

A more fundamental objection to using the military budget to support private-sector technology is that it will politicize the process. Giving the Department of Defense, rather than the marketplace, the authority to choose the technologies and firms to be funded is an incentive for political pressures. History tells us that such opportunities will not go unused for long. We need go no further than the Army Corps of Engineers for an illustration. The Corps' military functions are first rate. Its civilian dam-building activities, however, are embroiled in politics and have generated numerous projects with little economic justification. The Corps' record of generating "pork" for powerful legislators is hardly a precedent that justifies expanding the role of the Department of Defense in the civilian economy. To sum up the point in this age of quantification, the direct role of the military establishment in promoting civilian technology should be, to four or more decimal places, zero!

Some analysts urge that a strengthened Department of Commerce provide greater investment in the development of the nation's technology base. In 1988, Congress converted the staid old National Bureau of Standards into the National Institute of Standards and Technology (NIST). The expanded agency is handing out millions of dollars in seed money to the private sector to develop high-tech proposals and, as noted earlier, the Clinton administration wants to expand those efforts rapidly. Having a federal civilian agency determine which new areas of commercial technology will be subsidized by government is only marginally better than giving the role to the Pentagon.

As we have seen, there is little in the history of federal support of technology to justify the optimism that underlies this approach. Government—at least in the United States—is not good at choosing which areas of technology to support and which organizations to do the work. We are much better off when private enterprises risk their own capital in selecting technological activities and then carry through on the successful ventures. A recent report from the National Bureau of Economic Research (NBER) makes that point clearly. NBER Research Associate Frank Lichtenberg, professor of economics at Columbia University, found that the net impact on productivity of government R&D spending is lower than the return on privately funded R&D and may even be negative. In striking contrast, his research shows that the social return to private R&D investment is about seven times as large as on plant and equipment.

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This macroeconomic approach is reinforced by a more microeconomic study by the GAO. It reports that most small manufacturers cannot effectively use the advanced state-of-the-art automated technologies developed at the Department of Commerce's NIST.

On reflection, those results are not surprising. When a company's own laboratory comes up with a product or process advance, there are far fewer barriers to using it than when government takes on that role. The many pathetic efforts of the Department of Commerce to interest private business in using the research it has financed reminds me of a forlorn street corner vendor trying to peddle his wares to preoccupied passersby.

A Positive Approach to Encouraging Technology

Government can play an important role in promoting technology, but it should do so with a

minimum of expenditure or intervention in private decisionmaking. So far, the Clinton administration has ignored this positive approach: to create a business environment that is more conducive to using new technology by eliminating or at least reducing the numerous obstacles to innovation that government itself has erected over the years. Most proponents of increased federal spending for technology ignore the wide variety of regulatory restrictions that inhibit the growth and application of corporate R&D. It is futile for the federal government to pour vast sums into high-tech enterprises if, at the same time, it continues to erect statutory and administrative roadblocks to the application of those new technologies. That's like a driver who has one foot on the gas pedal and the other on the brake.

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The supporters of large-scale federal outlays for new technology seem to operate in a policy vacuum. They are oblivious to the fact that the deregulating trend of the late 1970s and early 1980s has been replaced by expanded government regulation of business. Because many federal regulations exempt existing facilities, products, and processes, the main burden of expanding regulation falls on new enterprises, new undertakings, and new technology.

Consider America's world-class pharmaceutical industry, which generates substantially more exports than imports. President Clinton ran on an economic program that specified that he would be "cracking down" on the industry for its high prices and profits. (Parenthetically, in recent years, prescription medicine prices have risen at about the same rate as health-care costs generally.) But if he carries out his threat, it is a surefire guarantee of slowing down the rapid rate of new product innovation that characterizes the pharmaceutical industry.

In many areas—chemicals, pharmaceuticals, and biotechnology—the supply of venture capital is substantial; the key limitation is not financial. The major constraint on commercializing technology arises from government itself. Consider the hysterical reaction to the use of the protein BST in increasing the production of milk. Aside from health concerns, which have been fully addressed by the Food and Drug Administration, "consumer advocates" vehemently oppose the move because it reduces the price of milk. State legislatures follow their lead by preventing the use of this advance in biotechnology. Governmental actions like that have a powerfully negative effect on the incentive to commercialize new technology, notwithstanding large amounts of federal financial support for "precompetitive R&D."

The uncertainty engendered by government and special interest groups has hindered the development of biotechnology generally. While scientists are able to engineer more prolific crop strains, the regulatory framework governing the commercialization of their work remains ill-defined. One analyst warns that, under such circumstances, some companies may avoid the problem by going overseas via joint ventures or establishing new subsidiaries.

There is a modest direct role for government in supporting commercially oriented technology and here some reforms would be desirable. For example, a simpler and more effective patent system would encourage the creation and diffusion of technology. Such a change would ensure that smaller inventors are not overwhelmed by the cost of obtaining patents and defending them against legal challenges. Also, larger firms would be encouraged to seek patents rather than protecting their new products and processes by maintaining secrecy.

In addition, revisions in the antitrust laws are needed to avoid impeding the formation of joint ventures to develop new technology. According to the private Council on Competitiveness, current antitrust laws—or even the perception of them—discourage technological cooperation among companies, trade associations, and professional societies. The capital requirements to develop what is termed "generic" or "pre-competitive" technology are often beyond the financial capability of a single firm. Waiving or amending the antitrust statutes is a far more

sensible approach than urging the federal government to provide the necessary financial support. But, most fundamentally, a substantial dose of deregulation—or at least regulatory reform—would be quite helpful.

Another desirable contribution that the federal government could make to foster private technology is to privatize the hundreds of national laboratories, converting them into private institutions of both a for-profit and non-profit nature. Given the substantial federal investment made in those laboratories during the Cold War, many of them make excellent research facilities. Private-sector use is now generally limited to specialized equipment, such as particle accelerators. The Clinton administration's proposal to find a civilian mission for the labs through partnerships with private business is misguided. If the labs were privatized instead, firms in the private sector would be more likely to use their expertise designing new products.

Tax Incentives

It is also necessary to respond to the concern that society as a whole underinvests in applied R&D because of various imperfections in the market economy. Potential entrepreneurs and financiers of new high-tech ventures may lack adequate information about the opportunities in and returns from such investments. As noted earlier, the overall returns on applied R&D are quite high in relation to traditional economic activity. Under the circumstances, government action to lower the private sector's decisionmaking threshold on R&D would be useful, provided it is done in a manner that preserves the entrepreneurial nature of the individual firm's decisionmaking. This would not be the case with large-scale direct subsidies. A more equitable and effective alternative to direct financial subsidies is for the federal government to provide generalized tax incentives for private-sector investment in R&D.

This approach has several attractive features. It would be available to all private companies that pay U.S. income taxes. Private companies receiving the incentive would choose the projects they wish to undertake. Finally, and most relevant, the private firms involved in R&D would continue to bear most of the financial risk; the government's share would be much smaller.

We have a good example of that approach in the R&D tax credit that expired in 1992. It was revived and extended through June 30, 1995. Researchers in this field continue to debate the benefits and costs of that R&D tax credit. There is one aspect, however, over which no controversy exists; namely that the reluctance of Congress to enact this provision on a permanent basis sharply reduces its effectiveness. To extend credit begrudgingly a year or two at a time makes it less likely that companies will take account of this incentive in their decisionmaking on long-range commitments to R&D, such as building and operating expensive new laboratories.

A recent study at the NBER estimates that the response to a temporary change in the tax credit is about one-half of the reaction to a permanent change. The report notes that R&D spending adjusts slowly to revisions in tax rules since many projects cannot be started or stopped on short notice. The study also estimates that a permanent increase of 5 percent in the R&D tax credit would increase long-run private spending on R&D by about 5 to 10 percent. The existing 10 percent credit for R&D surely should be made permanent. Consideration also should be given to increasing it, perhaps to 20 percent. Most important, the private firm undertaking the R&D would still be bearing most of the risk.

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Reforming the Military Procurement Process

No serious discussion of encouraging new technology can ignore the present array of costly regulation that burdens the military acquisition process and inhibits the flow of innovation between the military and civilian sectors. Since the end of World War II, the Department of Defense has been a major financier of R&D and the largest purchaser and developer of new scientific applications. It is also true that past spinoffs from military technology have been impressive—computers, jet airliners, composite materi-

what happened in the case of the ill-fated supersonic transport when, in 1971, Senate supporters suggested that cancellation of the project would not be responsible in view of the substantial outlays that had already been made.

Government policymakers must learn to refrain from jumping every time a constituency asks for help. The current pressure to "do more" for the promotion of technology is not an exceptional case. Even a cursory examination of past and current large-scale government efforts to promote the use of civilian science and technology does not inspire confidence in the ability of federal agencies to choose among alternative technologies and their uses. The Clinton administration should abandon its proposal to set up business-government partnerships in such areas as computer linkage, automobile design, and environmental technology. The United States holds a strong position in each of those areas. Governmental participation would be an unnecessary diversion with its usual combination of "free" money with lots of strings attached.

Some obstacles to the commercialization of technology, it must be recognized, arise from shortcomings in the private sector—shortcomings that can only be remedied by business executives themselves. For example, many experts contend that, despite superior American achievements in science *per se,* Japanese firms are strong competitors because they assign more talent to such engineering activities as detailed product design and quality control. They place their most talented engineers in production, which is not a general practice in the United States.

As a result, much of their product development is done in the factory where the product is produced rather than in a remote laboratory. Thus, Japanese firms often enjoy quicker responsiveness to market opportunities, lower costs, and equal or better quality than U.S. manufacturers.

Not too surprisingly, widespread concern is evident in American industry about the ability to move products from the laboratory to the marketplace. An example frequently cited is the videocassette recorder, which was invented in the United States. Two Japanese firms, Sony and Matsushita, now control 90 percent of the U.S. market, and the remaining 10 percent is supplied by other foreign firms. There is only one place to lodge the responsibility for dealing with such challenges to American management and that is, of course, business management itself.

In any event, identifying new shortcomings in the private sector does not automatically justify another round of government intervention in the economy. The well-publicized "market failure" is far overshadowed by even larger government failure.

Selected Readings

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