Occasional Paper 94

9-1-1991

Technology and Economic Performance: A Different View of the Federal Role

Murray L. Weidenbaum
Washington University in St Louis

NOT FOR RELEASE BEFORE
9 A.M. EDT
SEPTEMBER 12, 1991

Center for the Study of American Business

CSAB

Technology and Economic Performance: A Different View of the Federal Role

Murray Weidenbaum

Occasional Paper 94
September 1991

Contact: Melinda Warren
Assistant Director
(314) 935-5630

Technology and Economic Performance: A Different View of the Federal Role

by Murray Weidenbaum

The pace of technological progress is a prime driving force in our increasingly global economy; government policy on technology needs to be reconsidered in that light. The United States is heavily reliant on the fruits of science and technology to provide its basic strength, both military and economic. Over the years, this nation has maintained its strong military posture, not by having the largest armed force, but by relying on the most technically sophisticated, up-to-date arsenal of weapons and equipment, and the technically trained people to operate them.

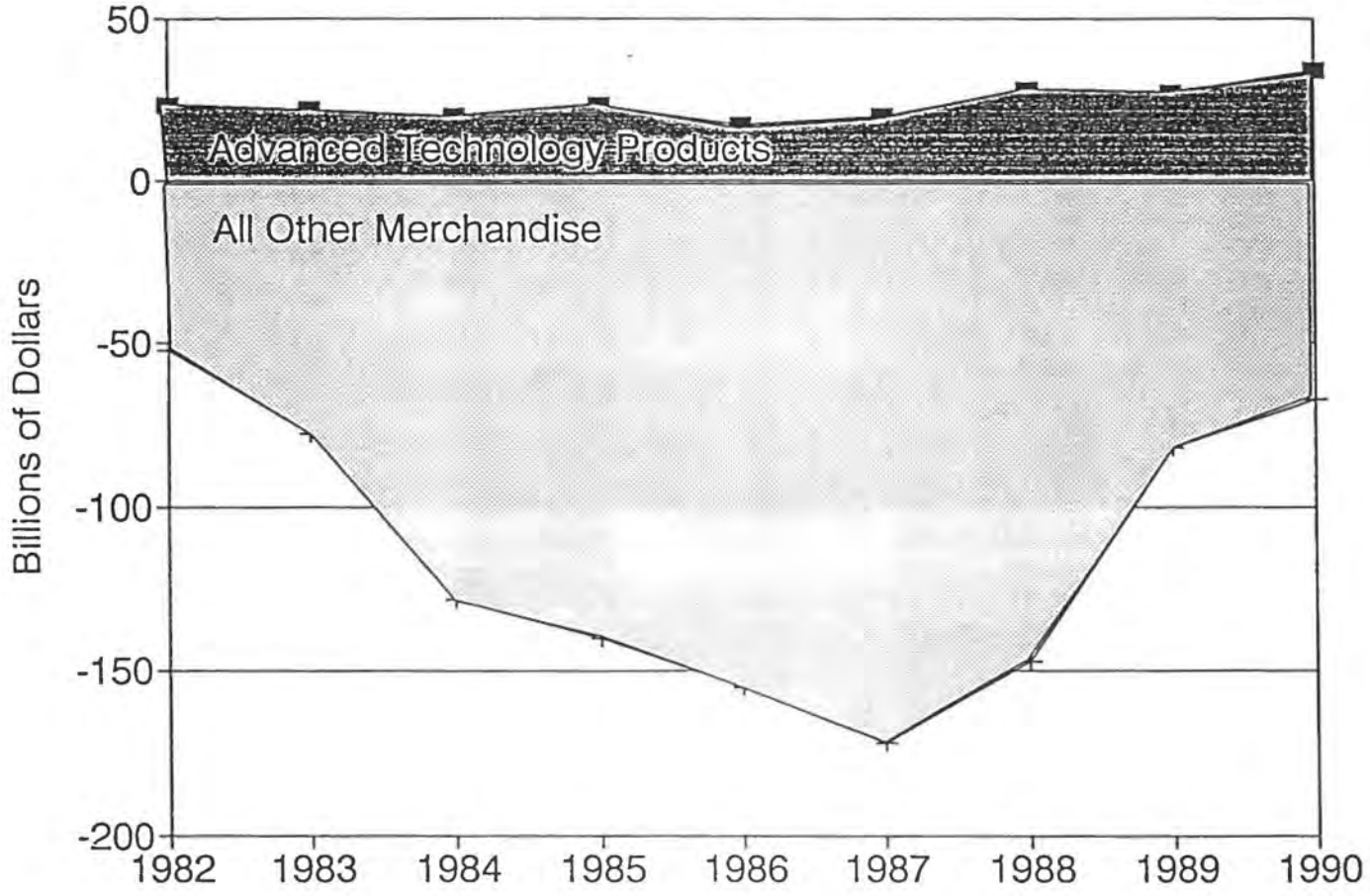
Similarly, high-tech companies maintain a favorable balance of trade, while the low-tech companies have suffered most severely from foreign competition (see Figure 1). R&D-intensive industries also experience greater increases in productivity than the other sectors of the economy. Clearly, advances in technology are a key to the continuation of both the military and the economic power of the United States.

What is not so apparent is the proper course for governmental policy toward technology, especially its use in the private sector. This report addresses the key issues that have to be faced in deciding that important federal role in fostering the development and use of technology. The sections that follow cover national competitiveness, existing science and technology policy, proposed support for commercially relevant technology, the proper boundary between government and private initiative, and the future role of the Department of Defense and other federal agencies.[1]

Murray Weidenbaum is Mallinckrodt Distinguished University Professor and Director of the Center for the Study of American Business at Washington University in St. Louis. This report draws heavily on his forthcoming book, **Small Wars, Big Defense** (Oxford University Press). The author is indebted to Kenneth Chilton, Arthur Denzau, and Bruce Petersen for helpful comments on earlier drafts of this paper and to Harvey James for research assistance.

Figure 1

Trade Balances in Advanced Technology and All Other Products



Source: Computed from data of the U.S. Bureau of the Census.

National Competitiveness

R&D Trends

An important aspect of aggregate economic policy is to maintain an environment conducive for financing and performing commercially oriented technology. To judge by the numerical results, that necessary environment has been created in recent years, although not necessarily at the optimum level. In the two decades prior to 1980, the federal government was the number one funding source for R&D in the nation. In the 1980s, however, the private sector outspent the public sector on R&D (see Table 1).

The implication of this shift from public to private sponsorship of R&D deserves more attention than it has received. First of all, it is noteworthy that the private sector has risen to dominance even though a rapid expansion in Defense Department funding of R&D occurred during much of the same period. Secondly, the change in relative importance of private versus public funding means that commercial needs, rather than government programs, now dictate the greater part of the work of American scientists and engineers. Although we cannot pinpoint the precise results, an enhanced flow of new products and improved production processes should occur in the private sector of the American economy during this decade as a result.

Trade Trends

In any event, the proponents of direct federal support for commercially relevant technology point to the large U.S. trade deficit as an indicator of a lack of national competitiveness. It is easy to show that the United States has lost its "supremacy" in the global economy in the four decades since the end of World War II. In 1950, the United States generated approximately 40 percent of the world's gross product and 17 percent of world trade. In the past few years, in striking contrast, the U.S. share of gross product has dropped to about one-fourth of the global total and its trade to about 14 percent.[2]

Table 1

Federal Versus Industry Financing of R&D
(in billions of dollars)

Decade	(1) Federal Government	(2) Private Industry	(3) (1)-(2) Difference
1961-70	129.0	72.7	+56.3
1971-80	203.8	183.3	+20.5
1981-90	518.8	569.7	-50.9

Source: U.S. National Science Foundation.

Historical analysis explains that shift quite readily. In 1950, the economies of Western Europe and Japan were still recovering from the devastation of World War II. Under those circumstances, the American economic giant had little difficulty dominating many world markets, particularly its own. Such a powerful position was bound to be transitory, however, as the economic competitors regained their traditional strength, with very substantial help from both the U.S. government and its citizens. In fact, by 1960, the U.S. share of world trade already had declined to 13 percent, approximately the current ratio.

It is intriguing to note that the Soviet Union did not take as benign an attitude as the United States in the postwar period. It shackled the economies of defeated nations within the sphere of its control. The subsequent poor economic performance of all of the Eastern bloc economies is hardly a tribute to that approach.

As James Schlesinger has noted, perhaps the United States should have done better in the period since World War II, "but we have not done all that badly."[3] The United States remains the leading economic, political, and military power in the world. A recent survey of Japanese views reported that "the United States is still a vital nation with unchallenged military

power, the world's largest economy, an affluent lifestyle, and natural abundance that leaves resource-poor Japan in awe."[4]

The notion that the United States is in decline is simply inaccurate, in any absolute sense. The United States is not becoming poorer, and its economy is not weak or feeble. In 1990, U.S. farms, mines, factories, and offices produced $5.5 trillion of goods and services — a record high and double that of second-place Japan. At best (or worst) the proponents of the decline hypothesis are forced to rely on relative comparisons.

This upbeat conclusion is not just the result of Americans patting themselves on their backs. Similar, and more strongly worded, sentiments were voiced by the managing director of Credit Européen:

> Since the early eighties, after a decade of relative decline, the United States has clearly regained its rank as the leading economic and political superpower in the free world. Neither the erratic movements in the dollar exchange rate, nor the huge U.S. balance of payments deficit and foreign debt can reverse that judgment which is shared by a great majority of Europeans.[5]

The Competitiveness Challenge

The United States does not have a competitiveness problem, but faces a continuing competitiveness challenge. This distinction is not a quibble. American-produced goods and services are more than holding their own in world markets. Our merchandise exports rose from $224 billion in 1980 to $390 billion in 1990, a 74 percent increase over the decade.

Inevitably, not every company is doing that well — while other enterprises are reporting results much above average. The political noise level is uneven among the two groups. The poor performers have every incentive to come to Washington in search of government help. The stronger companies, in contrast, are too busy designing, producing, and marketing their products to lobby for federal aid.

The United States does have a large, albeit declining, trade deficit. Merchandise imports rose over the past decade at a more rapid rate than exports, approximately doubling from $250 billion in 1980 to $498 billion in 1990. In large measure, this reflects the fact that

the United States is a high-consuming, low-saving society. This is an important concern to economic policymakers, but it transcends the issue of competitiveness and technology.

The triple-digit federal deficits have exerted a powerful, and negative, effect on the trade balance of the United States. For any nation, if domestic saving is inadequate to finance both capital formation and government borrowing, an inflow of foreign funds will result. The foreign funds are earned, in turn, by exporting more than trading partners are importing. Those U.S. budget deficits cannot be blamed on foreigners; they definitely have a made-in-America label.[6]

To some degree, the high exchange rate value of the dollar in international trade in the early 1980s made imports especially cheap (and our exports relatively expensive). However, since the peak reached in early 1985, the value of the dollar has declined substantially, albeit irregularly. This change helps dampen our imports as well as encourage our exports, thus reducing the trade deficit.

Some of the change in the U.S. trade position is cyclical. Our imports tend to decline with recession here, while our exports depend heavily on economic conditions overseas. Thus, a portion of the recent reduction in the overall trade deficit may be temporary. A renewal of economic growth in this country should exert an upward pressure on imports while economic weakness overseas may dampen exports.

In any event, American industry continues to be challenged, in domestic as well as in foreign markets, by a growing variety of European and Asian companies. Some of these foreign competitors are benefitting from the diffusion of technology across the global economy. This is especially true in Asian-rim nations, such as Thailand and Malaysia, which are joining the ranks of rapidly developing nations. In other cases, the economic consolidation of the European Community is beginning to develop economies of scale and other efficiencies resulting from the elimination of numerous national barriers to commerce.

In this global economy, American firms cannot rest on their oars. U.S. companies must continue to develop a competitive advantage through constant improvement of products

and manufacturing processes — which means in large part applying the results of science and technology. Nevertheless, the steady U.S. trade surplus in high-tech products belies the need for special government help because of a supposed lack of technological competitiveness (see Figure 2).[7]

Existing Science and Technology Policy

Given the great variety of missions assigned to federal agencies, it is difficult to identify precisely the nature of federal policy toward science and technology. In effect, that policy must be inferred by the expenditures and other actions of many different parts of the federal government.

For example, several major departments of the federal government are large financial supporters of research and development, notably the Departments of Defense, Energy, and Health and Human Services. Altogether, federal departments and agencies financed $69 billion of R&D in 1990, almost one-half of all of the R&D performed in the United States.

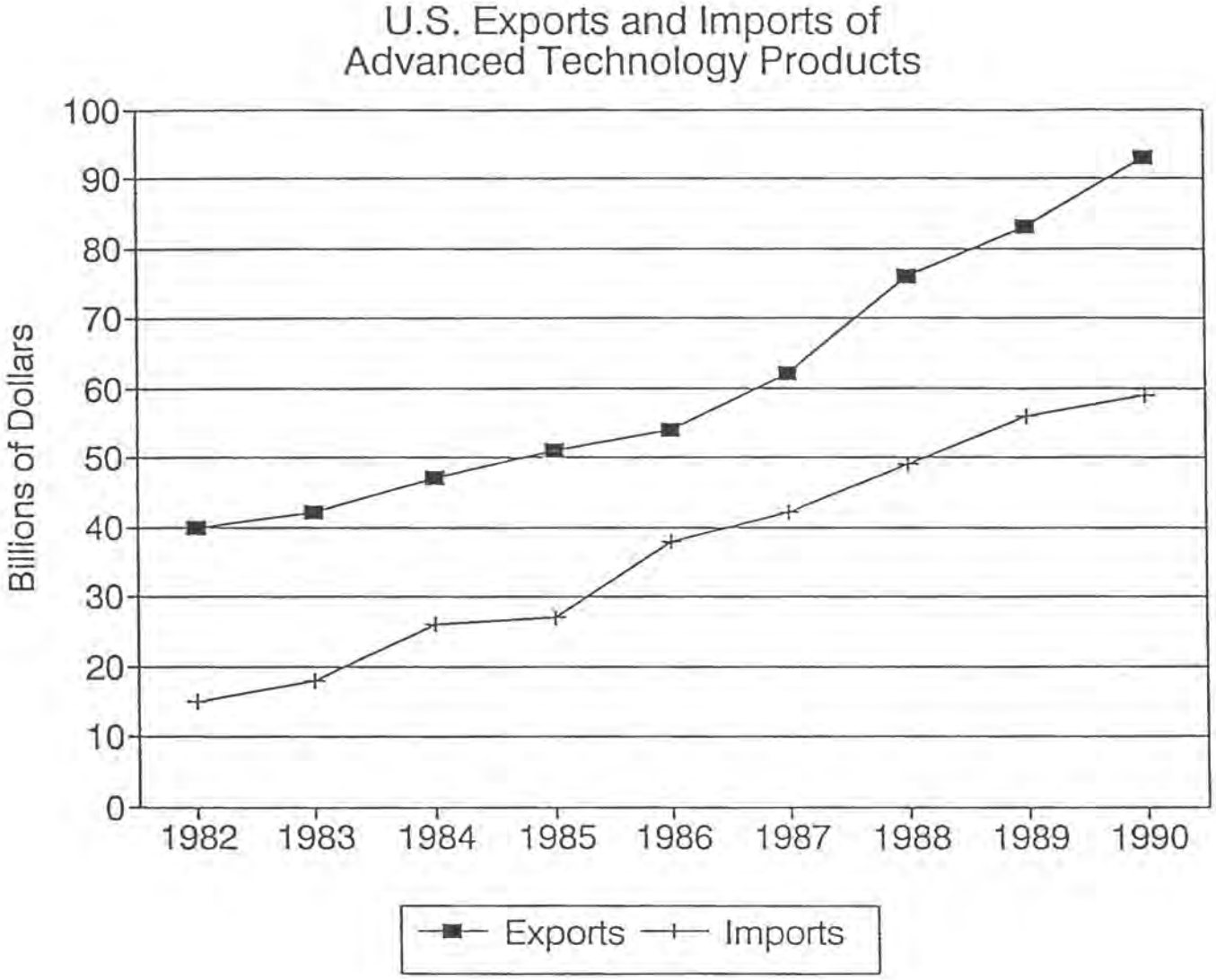
However, the President does not present an overall budget for R&D nor does Congress enact one. As in many other areas, such as education and retirement benefits, analysts must discover science and technology priorities indirectly — by adding up the many parts of departmental budgets that are devoted to research and development.

In effect, therefore, a change in overall budget priorities can result in an inadvertent expansion — or reduction — in federal support for science and technology.[8] A shift from defense (with a very high R&D content) to entitlements (with no R&D component) will invariably mean a decrease in federal financing of R&D. As can be seen in Table 2, there is great variation in the R&D-intensity of federal agencies.

However, it is difficult to identify any significant benefit from changing the way that the Executive Branch and the Congress traditionally budget mission-oriented R&D. The Department of Defense and the requisite defense committees of the Congress are in the best

Figure 2

U.S. Exports and Imports of Advanced Technology Products



Source: Computed from data of the U.S. Bureau of the Census.

Table 2

Federal Agency R & D and Total Outlays in 1988

Department or Agency	R&D Outlays (in billions)	Total Outlays (in billions)	R&D Percentage of Total
Above-average R&D Ratios			
National Science Foundation	$1.5	$1.9	78.9%
NASA	4.8	9.1	52.7
Energy Department	5.1	10.5	48.6
Commerce Department	.4	2.5	16.0
Defense Department (military)	36.5	299.6	12.2
Interior Department	.4	5.4	8.2
Environmental Protection Agency	.4	4.9	7.4
Below-average R&D Ratios			
Agriculture Department	1.0	50.7	2.0
Health and Human Services Department	7.1	375.1	1.9
Transportation Department	.3	26.3	1.1
Veterans Affairs Department	.2	27.6	.7
Agency for International Development	.1	5.2	.2
All other	.7	237.1	.3
Total: Federal Government	$58.5	$1055.9	5.5%

Source: Compiled from data prepared by the U.S. National Science Foundation and the Office of Management and Budget.

position to determine how much and what kind of R&D is needed to carry out the national defense mission. Ditto for the Departments of Agriculture, Transportation, etc. There is no need for a "master plan" of total federal R&D. NASA should not expand its activities just because some official in the White House is anxious to support technology.

But, as a practical matter, neither Congress nor the Executive Branch should blithely ignore the adverse effects the major defense cutbacks that are underway will have on the size and composition of R&D performed in the United States. Basic research merits special attention because of a limiting characteristic: the organization doing the work cannot prevent

others from benefitting from the results; indeed, public policy encourages the widest use of this type of "public good." Thus, business firms tend to underinvest in this category of R&D. The desirable response is not to grant the Defense Department a special budget for basic research, but to provide offsetting increases to such civilian-oriented agencies as the National Science Foundation.

Proposed Support for Commercially Relevant Technology

There are few, if any, advocates of socialism in the federal government. However, people often want to add a "teeny weeny" bit of government guidance to help the business system work better. Over the years, numerous government subsidies have been enacted.[9] Most of these interventions in the private sector — farm subsidies, shipping subsidies, credit subsidies, synthetic-fuel subsidies — have been shown to be wasteful or outright counterproductive. Despite their surface attractiveness, proposals for direct government support of commercially relevant technology fall into this category. Government has demonstrated no capacity for choosing among promising new technologies. Witness the space shuttle still seeking to define its mission or the financially hemorrhaging superconducting super collider.

Past experience with government trying to force technological innovation is not comforting. The billions of dollars that 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.[10] Unfortunately, it is only the latest example of the basic failure of "industrial policy" efforts that extend back to the days of the Reconstruction Finance Corporation scandals in the 1950s.[11]

Thus, it is easy to answer the question: "How would the government decide which industries, technologies, and projects to support?" On the basis of experience, government will favor politically powerful firms, which usually means older, labor-intensive companies. Over the years, these firms have invested substantial amounts of resources in improving their

presence in Washington. Moreover, these firms are the "squeaky wheels," suffering the most from competitive forces.

New and growing firms may be economically strong, but they usually are politically weak. They possess neither a record of extended financial contributions to political candidates nor a detailed knowledge of lobbying techniques nor a large group of agitated employees/voters. The result is a very uneven contest that favors old-line businesses over new enterprises, and old technology over new. Former Senator William Proxmire was fond of saying, "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."

To be fair, it should be noted that every business going to Washington for financial help detests and resents the term "subsidy." Their executives always describe what they seek as an investment in future economic growth or some such worthy pursuit. Each supplicant industry fervently believes in competition, especially on the part of its suppliers. But when other companies attempt to sell similar products at lower prices or better products at the same price, that is "unfair competition" or "predatory pricing" or, worse yet, "foreigners capturing our markets." Thus, supposedly government needs to respond.

The U.S.-Japanese semiconductor agreement illustrates the danger that such rhetoric creates. The agreement surely helped some firms, but at the expense of the U.S. computer manufacturing industry. The results are typical of special-interest legislation, benefitting some industry or company or region, but at the expense of the national interest.

As recently as the early 1980s, the U.S. semiconductor industry outsold Japanese firms. Japanese companies responded by investing more heavily than their American counterparts — at a time when U.S. firms could have afforded to stay ahead of the foreign competition. Not surprisingly, by the middle 1980s, Japanese semiconductor producers began to outsell U.S. firms.[12] Today, the American companies are asking for a generous handout from the taxpayer. That would be an unjustified reward for poor business judgment. It also

would be a terrible precedent that other companies would be encouraged to follow. The answer should be clear: "Sorry fellows, welfare is for poor people."

A more fundamental response to the advocates of direct federal support for commercially oriented science and technology is that such outlays would be unfair to the many other companies that pay the taxes to finance these subsidies and who would see the money go to their competitors. Nevertheless, it is necessary to respond to the concern that society as a whole may underinvest in applied research and development because of various imperfections in the market economy. For example, potential entrepreneurs and financiers of new high-tech ventures may lack adequate information about the opportunities in and returns from such investments. Indeed, studies show that the overall returns on applied research and development are quite high in relation to traditional economic activity.[13]

Under the circumstances, government action to lower the private sector's decision-making threshold on R&D would be useful, provided it would be done in a manner that preserves the entrepreneurial nature of the individual firm's decision making (this would not be the case with large-scale direct subsidies).

An alternative to expenditure subsidies is available and it would be more equitable and more effective: the federal government should provide generalized tax incentives for private-sector investment, including such activities as R&D. There are several attractions of this approach. It would be available to all private companies that pay U.S. income taxes. Those private companies receiving the incentive would choose the projects they wish to undertake. Finally and most relevant, the private firms doing the R&D would continue to bear most of the financial risk; the government's share would be much smaller.

A reduction in the corporate income tax would be a fundamental change. Such action would lower the cost of capital to American business and thereby lengthen the time horizon for economically attractive investments in R&D and capital equipment.

Alternatively, the existing R&D tax credit could be improved. Researchers in this field continue to debate the benefits and costs of the existing R&D tax credit.[14] There is one

aspect, however, that is not controversial: the reluctance of Congress to enact this provision on a permanent basis sharply reduces its effectiveness. Grudgingly extending the credit a year or two at a time makes it much less likely that companies will take account of this incentive in their decision making on long-range commitments to R&D, such as building expensive new laboratories.

The Proper Boundary between Government and Private Initiative

Much of the pressure for more federal subsidies of private business, including its use of science and technology, comes from citing 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 the details are not as convincing. MITI 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 that it set up. At the same time, however, 160,000 illegal looms came into production. In fact, more textile companies were operating in Japan after MITI's efforts than before.[15]

On a more positive note, the Japanese response since 1987 to the rising 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 adopted vigorous campaigns to improve productivity. Efforts to upgrade quality were made. 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.

In any event, U.S. policy should be based on U.S. institutions and experience. Thus, there is a modest role for government in connection with commercially oriented technology, such as operating a patent office and setting technical standards. Basically, under our private

enterprise form of economy, the private sector makes the decisions as to where to invest, what risks to take, and what technologies to spur and which to discard.

Government can — and should — facilitate the flow of technology from the laboratory to the commercial marketplace by creating a favorable economic climate. That role can stand considerable improvement.

To start with, government should reduce the numerous government-erected obstacles which discourage private firms from investing in risky long-term ventures. As is well known, a basic way of reducing the cost of long-term investments is to lower the cost of capital (which over the years has been higher in the United States than in Japan). The most direct way for the federal government to do that is to reduce the extent to which the Treasury competes for the limited supply of private saving via deficit financing.

The task here is more than a simple-minded reduction in budget deficits. Some approaches — such as tax increases which reduce the funds available for private investment — would do more harm than good. In contrast, bringing down the deficit by curtailing the government's consumption-oriented outlays would be a real plus.

Moreover, numerous regulatory restrictions inhibit the growth of corporate R&D. After all, what good would it do for the federal government to pour vast sums into high-tech enterprises if at the same time federal, state, and local governments erect statutory and administrative roadblocks to the application of new technology?

The fact is that the deregulating trend of the late 1970s and early 1980s has been replaced by a major expansion of government regulation of business.[16] Consider America's world-class pharmaceutical industry, which generates a substantial excess of exports over imports. Congressional committees are responding to that positive situation by "cracking down" on the industry via proposed new legislation that would grant the U.S. Food and Drug Administration police powers unprecedented for a regulatory agency.[17] Any effect on the flow of new technology resulting from this "crackdown" is bound to be negative, especially since the committees seem oblivious to such impacts of their actions.

It is intriguing to note that, in a large number of cases — chemicals, pharmaceuticals, and biotechnology — the potential supply of venture capital appears to be quite adequate. The major constraints on commercializing the advances in technology arise from government actions.[18] The hysterical reaction to the use of the protein BST in increasing the production of milk is, unfortunately, not a unique experience. Witness the spectacle of "consumer advocates" vehemently opposing the move because it would reduce the price of milk — and state legislatures following their lead by preventing the use of this advance in biotechnology.

Because many regulatory agencies exempt existing facilities, products, and processes from their directives, the main burden of rapidly expanding regulation falls on new enterprises, new undertakings, and new technology. The concern over the proper federal role in promoting new technology should extend to at least reducing if not eliminating many of those new burdens.

There is a modest direct role for government in supporting commercially oriented technology and, here too, some reforms would be desirable.[19] 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. Often, the capital requirements to develop what is termed "generic" or "pre-competitive" technology are beyond the financial capability of a single firm. Waiving or amending the antitrust statutes would be a far more sensible approach than urging the federal government to provide the necessary financial support.

The Future Role of Defense and Other Federal Agencies

The question has been raised as to the role of the Department of Defense in promoting commercial competitiveness. The direct role, properly, should be zero. A potential indirect

role might be quite constructive, both for the military and civilian sectors: it is for the Pentagon and the Congress to reduce the obstacles to military procurement of state-of-the-art products available in commercial markets.[20]

Some historical perspective on developments in military R&D and its relation to the civilian sector is necessary. For much of the period since the end of World War II, the scientific and technological efforts of the U.S. military establishment have set the pace for the American economy. The Department of Defense has been a major financier of R&D as well as the largest purchaser and developer of new scientific applications. In the absence of an explicit federal technology policy in the 1950s and the 1960s, the practices of the Pentagon became, to a very large extent, the de facto U.S. technology policy.

Past spinoffs from military technology constitute an impressive group — computers, jet airliners, composite materials, communications equipment, and scientific instruments. For decades, many companies primarily oriented to civilian markets benefitted from commercial use of "spin offs" from high-powered defense research and development.

Indeed, for much of the period since the end of World War II, a major attraction of defense work was the ability of commercial firms to keep abreast of the latest developments in military science and technology. The Raytheon Corporation adapted radar technology to develop the microwave oven (first called the "Radarange"). Boeing drew on its military aircraft design work on the B-47 and KC-135 in developing the 707 commercial airliner, although the 707 and the KC-135 were both descended from a common company-sponsored prototype (the "dash 80").

Over the past decade, the relationship between military and civilian R&D has changed very substantially. The roles of the public and private sectors often have been reversed in the military sphere itself. If a technology has both civilian and military use, the more advanced models are more likely now to be seen in Radio Shack than in military systems.

Dr. William Perry, former Undersecretary of Defense, cites the example of semiconductors, where the differences between defense and commercial technologies are not

very great. Extremely detailed military specifications have isolated defense production, dividing the U.S. industrial base between defense and commercial uses. Perry believes that, due to the rigidity of military specifications and requirements, chips made for the Defense Department are 10 times more expensive and nearly two generations behind their commercial counterparts.[21]

Many currently deployed defense systems use technologies dating to the 1970s or earlier. The existing acquisition process, which often requires as much as 20 years to move a major weapon system from R&D to deployment, increases costs and limits technological innovation. This drawn out development process also reduces the return on contractor-financed investments in defense R&D and thus reduces the incentives for such undertakings.[22]

The B-2 Stealth bomber and the Seawolf submarine both have computer chips in key components that are merely run-of-the-mill, rather than the latest state-of-the-art. The design of electronic parts in these weapons had to be frozen years ago in order to meet the requirements of the lengthy military production cycle. But, since then, the civilian computer industry has continued to innovate at a rapid pace.

Increasingly, the ability of the armed services to develop advanced weaponry depends on how well they and their contractors can "spin on" civilian advances to military products. Military research in electronics, for example, is now so exotic and slow that it offers little commercial use. The tables have turned. DOD has become a net user of civilian research.[23]

Many barriers impede the transfer of advanced technology from the civilian economy to the military establishment. The military acquisition process has become increasingly cumbersome, costly, and onerous. To prevent their civilian-oriented divisions from becoming "contaminated" by the military's bureaucratic approach, many companies selling to the armed services go out of their way to insulate their military work.

Thus, fiber optics companies doing business with the Department of Defense have set up special divisions to do so. In that way, the military's special accounting, auditing, and personnel requirements do not apply to the rest of the company. In the case of computer

software, the Department of Defense has set up a standard for weapons, committing itself to use of software written in its Ada computer language whenever possible. As a consequence, the software industry increasingly is being divided into separate civilian and military sectors and innovations in one sector are not quickly transferred to the other.

Some regulatory changes can help. Because American technology is increasingly oriented to civilian needs, federal acquisition regulations should be modified to encourage, or at least permit, the defense establishment to economize on its spending by drawing more on commercial product developments. That, of course, is much easier said than done.

The people in the Pentagon who make a career out of writing military specifications can be expected to object to any attempt to buy more off-the-shelf commercial products, whether they provide the DOD with superior technology or not. Such a shift in government purchasing on a large scale would put many regulation writers and acquisition reviewers out of work.

Also, "Buy American" provisions of the federal procurement laws inhibit purchasing from the open market. Officials responsible for acquisition must carefully check whether any one of the numerous components of a product contains a single forbidden foreign element. Other obstacles to buying more off-the-shelf commercial products include the rules on steering a certain percentage of procurement to small, handicapped, and minority firms and the onerous "do-it-by-the-numbers" provisions of the Competition in Contracting Act.

Some suggestions for utilizing the results of civilian R&D in military activities would go much further than merely liberalizing procurement procedures. When they view the absolute size of the military budget (even after the currently contemplated reductions), many people who are concerned with the lagging international competitiveness of American industry see a new source of financing for their proposals. That is, they would have the Department of Defense directly finance civilian technology.

Some who urge the Department of Defense to subsidize civilian science and technology use as a justification the fact that the armed services are important users of society's pool of

scientific and technical knowledge.[24] 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.

Lewis Branscomb, Director of the Science Technology and Public Policy Program at Harvard, warns, moreover, that defense R&D tends to be too slow, too centralized, and too micro-managed to be transferred successfully to the private sector. Defense researchers tend to be too far removed from the product development process of private industry and from commercial markets to have much impact.[25]

These concerns have led to proposals to expanding the role of the Defense Advanced Research Projects Agency (DARPA) as a convenient way of bypassing traditional military procurement procedures. Little known and small in size by Washington, D.C., standards, DARPA awards contracts totalling over $1 billion each year to over 300 corporations and universities to conduct high-risk research. Over the past 30 years, DARPA-funded projects have led to the development and commercialization of computer time-sharing, advanced aeronautics, new types of software and new telecommunications procedures.

DARPA already is financing private sector R&D in a variety of areas — superconductivity, advanced semiconductors, high-definition television (HDTV), and very sophisticated types of integrated circuits. While DARPA justifies its sponsorship of these 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 such dual-use technologies that have both civilian and military applications.[26]

However, DARPA has experienced 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.[27]

Some compare DARPA with the Japanese Ministry of International Trade and Industry (MITI). Unlike DARPA, MITI is a cabinet-level agency charged with the broader mission of

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 much of the Pentagon bureaucracy. If it gets much larger, it likely would lose that 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 which technologies and which firms to receive its funds provides opportunity and incentive for exerting political pressures. History tells us that such opportunities will not go unused for long.

We need to go no further than the Army Corps of Engineers for an illustration of this concern. The Corps' military functions are first rate. Its civilian dam building, in contrast, is embroiled in politics and generates numerous projects with little economic justification. The Corps' sorry record of generating "pork" for powerful legislators is hardly a precedent to justify expanding the promotional role of the Department of Defense in the civilian economy.

Rather than having the Defense Department serve as an agency of industrial policy, some analysts have urged that the role be given to a strengthened Department of Commerce to invest more heavily in the development of the nation's technology base. Indeed, in late 1988, Congress converted the staid old National Bureau of Standards into the National Institute of Standards and Technology (NIST). The expanded agency is gearing up to hand out $10 million in seed money to the private sector to develop high-tech proposals in areas ranging from fire prevention to HDTV. Current proposals being considered in Congress would raise NIST's subsidy kitty to $250 million a year by 1992. That approach — where a federal civilian agency determines which new areas of commercial technology will be subsidized by government — is only marginally better than giving the role to the Pentagon.

However, none of these proposals for greater federal financing of civilian technology deals with the fundamental conditions that encourage investments in civilian technology —

such as lower cost of capital and expanding economic opportunities. To the contrary, the increase in budget deficits — and in Treasury borrowing in financial markets — resulting from these ambitious spending plans would make it more difficult to achieve those favorable conditions.

The justification for receiving government handouts are, on occasion, quite ingenious. According to a former Commerce Department official, business executives do not advocate an industrial policy; "they want the government involved in high-risk, long-term, expensive, high-technology research projects."[28] Or, in the words of one academic supporter, "The government should not give handouts, but it should help strategically placed industries at strategic times."[29] But inevitably the political process would decide which "high-risk, long-term," "strategic" industries and projects are to be selected. The lucky few chosen would, by definition, meet those subjective requirements. Politically weak companies by default would not be "strategic" or "high-risk" or "long-term." The results would be indistinguishable from a federal spending program formally labeled "industrial policy."

Conclusion

There are many important tasks that only government can perform, ranging from ensuring the national security to providing a system of justice. But one thing that democratic political systems cannot do well at all is to make critical choices between particular firms and competing technologies.

A far more satisfying answer to the desire to generate a higher level of technological effort in the private sector than government subsidy is to reduce the existing obstacles facing high-tech firms in the American economy. Many of the barriers to commercializing technology, it turns out, have been erected by governmental policies in the tax, regulatory, and antitrust areas. It is foolish to attempt to offset those negative effects through another round of federal spending.

Governmental 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. The most cursory examination of past and current large-scale efforts of the federal government 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.

Identifying new shortcomings in the private sector does not automatically justify another round of governmental intervention in the economy. The well-publicized "market failure" may be overshadowed by even larger "government failure." Perhaps the best response to government officials who want to solve problems in the market economy is to reply, "Physician, heal thyself."

Notes

1. For a contrary view, see *Technology and Economic Performance: Organizing the Executive Branch for a Stronger National Technology Base* (New York: Carnegie Commission on Science, Technology, and Government, September 1991).

2. *Economic Report of the President* (Washington, D.C.: U.S. Government Printing Office, 1990); Handbook of *Economic Statistics* (Washington, D.C.: Central Intelligence Agency, 1988); "World Output in the 1980s," *Economic Insights*, July/August 1990, p. 19.

3. James R. Schlesinger, "We Sometimes Forget . . . How Powerful This Nation Is," *New York Times Magazine*, June 18, 1988, p. 27.

4. Susan Chira, "With Mixed Emotions, Japan Sees U.S. in Decline," *International Herald Tribune*, July 1, 1988, p. 4.

5. Fernand Roll, "An Economist's Perspective on the Future of Europe," address given at Miami University, Oxford, Ohio, September 30, 1988, p. 2.

6. Murray Weidenbaum, *Rendezvous With Reality: The American Economy After Reagan* (New York: Basic Books, 1990), pp. 110-111, 120.

7. A product category must meet three requirements in order for the Census Bureau to classify it as "advanced technology": (1) the product must contain technology from "a recognized high technology field," (2) it must represent "leading edge" technology in its field, and (3) the technology must constitute a "significant" part of the product. *Trade in Advanced Technology Products*, SB-2-89 (Washington, D.C.: U.S. Bureau of the Census, August 1989), p. 2.

8. Murray Weidenbaum, "A Note on R&D and Changing National Priorities," *Technology in Society*, Vol. II, 1989, pp. 331-334.

9. See Congressional Budget Office, *Federal Support of U.S. Business* (Washington, D.C.: U.S. Government Printing Office, 1984).

10. *Synthetic Fuels: An Overview of DOE's Ownership and Divestiture of the Great Plains Project* (Washington, D.C.: U.S. General Accounting Office, 1989).

11. Arthur T. Denzau and Clifford M. Hardin, *A National Development Bank: Ghost of the RFC Past* (St. Louis, Mo.: Washington University, Center for the Study of American Business, 1984).

12. *A Strategic Industry at Risk* (Washington, D.C.: U.S. National Advisory Committee on Semiconductors, 1989), p. 9.

13. See Zri Griliches, "Introduction," in Zri Griliches, editor, *R&D, Patents and Productivity* (Chicago: University of Chicago Press, 1984), p. 4.

14. See Kenneth M. Brown, *The R&D Tax Credit: An Evaluation of Evidence on Its Effectiveness*, Joint Economic Committee Staff Study (Washington, D.C.: U.S. Government Printing Office, 1985).

15. Arthur T. Denzau, *Will An "Industrial Policy" Work for the United States?* (St. Louis, Mo.: Washington University, Center for the Study of American Business, 1983), pp. 3-5.

16. Murray Weidenbaum, *The New Wave of Business Regulation* (St. Louis, Mo.: Washington University, Center for the Study of American Business, December 1990).

17. See, for example, H.R. 2597, The Food, Drug, Cosmetic, and Device Enforcement Amendments of 1991.

18. See Joyce Tait et al, *The Status of Biotechnology-Based Innovations* (London: Centre for Technology Strategy, 1990).

19. See Richard C. Levin, Alvin K. Klevorick, Richard R. Nelson, and Sidney G. Winter, "Appropriating the Returns from Industrial Research and Development," *Brookings Papers on Economic Activity*, 1987, No. 3, pp. 783-820.

20. See *New Thinking and American Defense Technology* (New York: Carnegie Commission on Science, Technology, and Government, August 1990).

21. *May 22, 1990 Task Force Minutes*, Task Force on Defense Spending, the Economy and the Nation's Security, Washington, D.C., p. 2.

22. Joseph F. Pilat and Paul C. White, "Technology and Strategy in a Changing World," *Washington Quarterly*, Spring 1990, p. 87.

23. Jacques S. Gansler, *Affording Defense* (Cambridge: MIT Press, 1989), p. 91.

24. See *Technology and Economic Performance*.

25. Quoted in *Technology and Competitiveness* (New York: Japan Society, 1990), p. 17.

26. B. R. Inman and Daniel F. Burton, "Technology and Competitiveness: The New Policy Frontier," *Foreign Affairs*, Spring 1990, p. 131.

27. Evelyn Richards, "Should Uncle Sam Be Technology's Godfather?", *Washington Post Weekly*, May 7, 1990, p. 71.

28. Quoted in Fred Barnes, "Bushwhacking," *Business Month*, January 1990, p. 71.

29. Gary H. Anthes, "Economist Supports Fed High-Tech Involvement," *Federal Computer Week*, February 19, 1990, p. 28.