Series No. 97-09

FUSION SCIENCE AND TECHNOLOGY: THE BROADER CONTEXT

THOMAS M. DAVIS III
Member of Congress
U.S. House of Representatives

This article is one in a series of occasional papers published by the Center for Science, Trade, and Technology Policy of George Mason University and the Science and Technology Policy Institute of Korea as part of their U.S.-Korea Science and Technology Cooperation Program. This article is drawn from Mr. Davis' presentation at the U.S.-Korea Forum on Fusion Science and Technology held on February 18-19, 1997 in Washington, D.C.
STEPI-GMU/CSTP Occasional Paper 97-09

The U.S.–Korea Forum on Fusion Science and Technology provided an important opportunity for far-reaching discussions covering a mix of scientific, technical, and policy issues, with speakers from the United States federal government, industry, and academia along with their Korean counterparts. The dialogue provided participants with valuable insights into the status of fusion research and development in both nations, and also provided a continued basis for discussions on international collaboration. I was pleased to be able to contribute to the proceedings by reporting on the dramatic political changes which have occurred in the United States which set the context for all discussions of federal spending, including research and development (R&D). This article further explores these changes and how they determine, in part, our needs, willingness, and ability to participate in large international collaborative science projects.

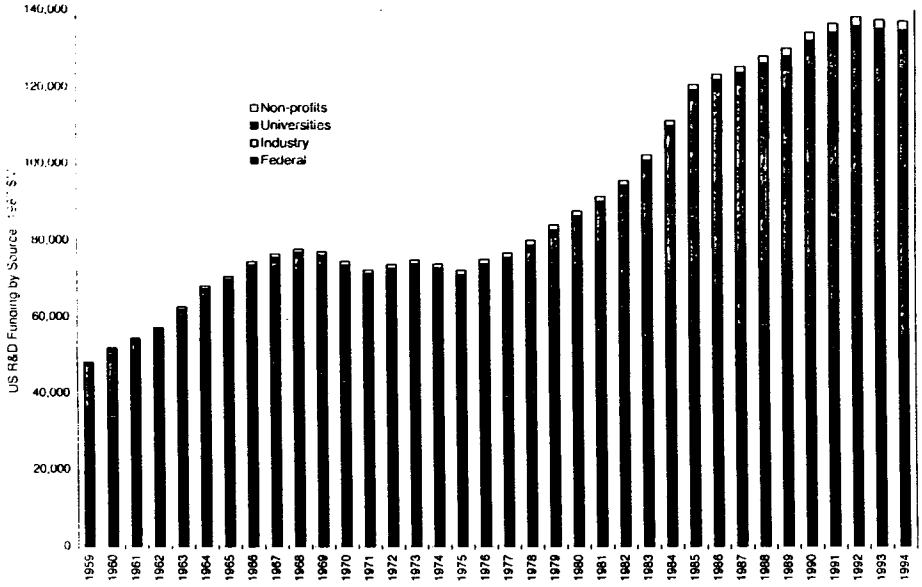
First and foremost, the end of the Cold War (albeit not the end to national security issues requiring substantial science and technology involvement) has weakened societal support for federal R&D, including substantial non-military R&D. No alternate societal goal (e.g., international economic competitiveness) has emerged with the equivalent political support. At the same time, the American public has grown increasingly dissatisfied with the government's performance. Second, there is an inherent suspicion of bureaucracy as inefficient and ineffective, and the federal R&D bureaucracy is sizable—a $73 billion effort per year. Third, there is the increasing perception (and dissatisfaction) that the government and science have not solved many of our societal problems. Perhaps science and technology have a limited role to play in crafting solutions to reduce crime, improve healthcare, combat racism and drug abuse, and address community and family breakdowns, or perhaps proposed solutions have been ignored or incompletely implemented by policymakers. But these are some of the perceptions of the electorate of the United States to which lawmakers must respond.

The U.S. Congress has led a national debate over the past two years on the future role of the federal government in American society. This past November, the voters in the United States

reaffirmed their desire for continuing this debate by returning President Clinton to the White House and leaving the Congress in the hands of the opposition (Republican) party. The voters also continued to send new Representatives with what they feel is a clarion call to dramatically reduce the growth in federal spending, balance our federal budget, and downsize the federal government.

This call from the electorate has also been heard by the President, who embraced the need for a balanced budget in his campaign. There are, however, substantial differences yet to be worked out between the President and the Congress on how to balance the United States budget by 2002. Whatever final agreement the Congress and the President work out in the upcoming months on the future role of the U.S. government and federal spending, it will represent a fundamentally different direction for the federal government and its role in U.S. society.

Figure 1



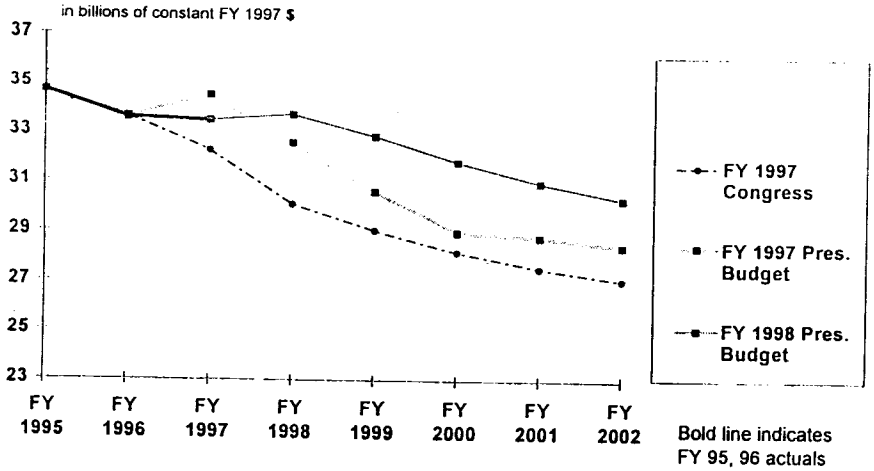
What are the broad implications of these actions on the U.S. science and technology enterprise? Simply stated, they are sobering. The aggregate, annual federal contribution—currently 73 billion dollars—to the U.S. science and technology enterprise will diminish over the next several years. Aggregate contributions have been declining in real, inflation-adjusted dollars for nearly nine

years already. Indeed, it is useful to examine the history of federal funding for R&D since World War II. As you can see from Figure 1, federal R&D support in inflation-adjusted dollars, first rose annually through 1966, and then declined in the aftermath of the manned-moon landing program and the Vietnam War. The trough occurred in 1975, and was approximately 21 percent below the 1966 peak. Federal support then rose steadily from the 1975 trough to a new peak in 1987, and has been declining since then. This is nine successive years of declining support, through three presidents and five congresses. The decline has been approximately 19 percent to date. The recent debate in Washington has not been over the *direction* of federal R&D support, but rather the *pace*, as well as the ratio of research versus development, and military versus civilian spending.

In reviewing Figure 1, there is one other trend worth noting. As can be seen clearly, the non-federal spending for R&D (almost all of which is from industry) has grown steadily as a proportion, to where it now represents nearly 60 percent of the total. Of course, just as our defense R&D spending is heavily weighted toward development, so too is industry focused on three- to five-year horizon research support. This trend is of particular importance because it places a heavier burden on the federal government to assure that basic research, which is essential to both our innovation system as well as our advanced educational system, be given priority support.

Figure 2

Nondefense R&D - FY 1995 - FY 2002



Source: AAAS analyses of outyear projections in budget plans

Having reviewed the history of U.S. R&D funding, what then is its probable future? Simply stated, until we have achieved control of our mandatory federal spending through a balanced budget agreement, it will continue to decrease in real dollars under nearly every proposed long-term scenario under consideration—whether that of the Congress or the President. Figure 2 shows three projections for future non-defense R&D based on analyses by the American Association for the Advancement of Science (AAAS). As can be seen, the President (using more optimistic economic assumptions) has twice in the past year proposed a slight increase in spending, followed by decreases in the successive years to achieve a balanced budget by 2002. The current Congress has not yet made its counterproposal, but in comparing the estimates from the previous Congress (using more conservative economic assumptions), you can see that the Congress's approach is more linear downward with spending reductions occurring earlier. I predict that the ultimate compromise will continue the real decline in federal R&D, observable in Figure 1, for several more years.

I am sharing this rather sobering message with you so that discussions of cooperation are conducted in a realistic budget environment. The challenge to those of us in the U.S. Congress is to assure that the effects of this funding can first be understood, and then priority decisions can be made to ensure a vital U.S. science and technology enterprise. It is necessary to realize that, at least for the present, aggregate federal funding for science and technology is being treated no worse, nor any better, than funding for most other government programs. I believe that reflects the current wishes of the American electorate. If they wish to see higher priority given to funding for science, they will need to communicate that to their Representatives. This represents a challenge to the American scientific and technological community to begin educating an electorate and their Representatives on why science is an investment in our future warranting higher priority consideration.

What we are seeing in the United States today is the beginning of the passing of the political baton from an older generation comfortable with the notion of federal funding for science and technology as an investment, to a younger generation more skeptical of the role of government in general and awaiting the presentation of persuasive arguments. What then will be the impact of this

new diminished federal role for American science and technology and also for the role of the U.S. scientific community in international scientific collaboration?

The most immediate impact, I believe, will be in the evolving relationships between the troika that performs science and technology development in the United States—the universities, industry, and the government, principally through its laboratories. From the perspective of the United States, I think these inter-relationships are likely to be evolving even faster than before as the mix of public and private research dollars change. Congress is interested in examining mechanisms other than direct federal funding, such as changes to our tax code, to provide incentives for new industrial partnerships for conducting research and development.

Notwithstanding criticisms you may have heard about some government-industry partnerships as "too close to the marketplace," I believe, that on the whole, this Congress strongly supports appropriate, innovative partnerships between government labs, and industrial consortia, and individual companies. The last Congress passed legislation, the National Technology Transfer and Advancement Act of 1995, to broaden and strengthen existing technology transfer statutes. I view the evolving relationships between government labs and industry, as well as the universities, as the area which can and must be pushed to assure that American science and technology continues to perform in the national interest even while the federal dollars in most programmatic areas are flat or declining.

The impact of our new national order on international collaboration in science and technology has not been fully addressed yet in Congress. It is becoming clear that performing scientific research in experimental disciplines that require new large, expensive machines—such as elementary particle physics (high energy colliders) and plasma physics (fusion)—will necessarily require international collaboration in construction and operation. The only alternative is to substantially slow down the performance of research in these areas until after our budget is balanced. The challenge to researchers in the American scientific community is not simply to identify and agree on new research opportunities, but then to justify them to their colleagues in other disciplines and nations.

Additionally, it will be a test for American scientific researchers to choose between more rapid international advancement of their discipline versus "protection" of their national (domestic) enterprise.

Let me now turn to changes in the U.S. magnetic fusion program over the past two years. The United States has been pursuing the magnetic confinement approach to fusion for more than four decades and has spent over $10 billion in this quest. While great progress has been and continues to be made, Congress recognized in the last session that the U.S. program's near-total focus on the tokamak concept would require decades of further development and the expenditure of tens of billions of dollars. Furthermore, there was (and continues to be) concern that the end product may not achieve the levels of economic viability, public acceptance, and regulatory simplicity required of practical power systems. These concerns, combined with the necessity to balance the budget, led the past Congress to cancel the proposed $700 million Tokamak Physics Experiment and to modify the fusion budget strategy based on: (1) continued reduced funding levels; (2) international cooperation and collaboration—including continued participation in the International Thermonuclear Experimental Reactor (ITER) at reduced levels; and (3) greater emphasis on basic plasma science and alternate fusion concepts. I believe that, to its credit, the Department of Energy has been moving in that direction, and that the Department's 1998 budget request of $225 million and accompanying documentation is indicative of the seriousness with which they are carrying out Congressional intent.

The implications of this restructuring of the U.S. fusion program on future U.S.–Korea fusion R&D collaboration are evident. Reduced funding both inhibits the size of U.S. collaboration, yet at the same time dictates that timely future progress in fusion R&D will be a function of international collaborative efforts. Providing an appropriate arena for defining possible future partnerships is an important part of this process.