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Industrial Competitiveness and Technological Advancement: Debate Over Government Policy

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SUMMARY

There is on-going interest in the pace of U.S. technological advancement due to its influence on U.S. economic growth, productivity, and international competitiveness. Because technology can contribute to economic growth and productivity increases, congressional interest has focused on how to augment private-sector technological development. Legislative activity over the past decade has created a policy for technology development, albeit an ad hoc one. Because of the lack of consensus on the scope and direction of a national policy, Congress has taken an incremental approach aimed at creating new mechanisms to facilitate technological advancement in particular areas and making changes and improvements as necessary.

Congressional action has mandated specific technology development programs and obligations in federal agencies that did not initially support such efforts. Many programs were created based upon what individual committees judged appropriate within the agencies over which they had authorization or appropriation responsibilities. The use of line item funding for these activities, including the Advanced Technology Program and the Manufacturing Extension Program of the National Institute of Standards and Technology, as well as for the Undersecretary for Technology at the Department of Commerce, is viewed as a way to ensure that the government encourages technological advance in the private sector.

The Clinton-Gore Administration articulated a national technology policy during its first term and continues to follow its guidance. This policy included both direct and indirect governmental support for private sector activities in research, development, and commercialization of technology. Many of the ideas reflected past congressional initiatives.

Some legislative activity in the 104th Congress was directed at eliminating or significantly curtailing many of these federal efforts. Although this approach was not successful, the budgets for several programs declined. Similar questions were raised concerning the proper role of the federal government in technology development and the competitiveness of U.S. industry during the 105th and 106th Congresses, yet all on-going activities were funded, some at increased levels. As the 107th Congress develops its budget priorities, how the government encourages technological progress in the private sector again may be explored and/or redefined.

MOST RECENT DEVELOPMENTS

The Clinton Administration adopted a strategy for technological advancement as part of a defined national economic policy. This approach was initially supported by various congressional initiatives that supplemented funding for various technology development activities including the Advanced Technology Program (ATP) and the Manufacturing Extension Partnership (MEP) at the National Institute of Standards and Technology. However, many of these efforts were revisited in the 104th Congress given the Republican majority's statements in favor of (1) indirect measures such as tax policies, intellectual property rights, and antitrust laws to promote technological advancement; (2) increased government support for basic research; and (3) decreased direct federal funding for private sector technology initiatives. While no program was eliminated, several were financed at reduced levels. During the 105th Congress on-going activities continued to be supported; legislation extended the research and experimentation tax credit, reauthorized the Small Business Technology Transfer Program, and funded ATP and MEP. In the first session of the 106th Congress, P.L. 106-113, the Consolidated Appropriations Act, provided $142.6 million for ATP and $104.2 million for MEP (after the mandated recision). The appropriation for ATP was 28% below the FY1999 level, but substantially more than the zero funding in the original bill as passed by the House. For FY2001, the President's budget requested $175.5 million for the Advanced Technology Program (an increase of 23%) and $114.1 million for the Manufacturing Extension Partnership (almost 9% above the previous fiscal year). The initial version of the appropriations bill that passed the House provided no financing for ATP. However, P.L. 106-553 does fund the program at $145.7 million (a 2% increase) as well as provide $105.1 million for MEP. Also enacted by the 106th Congress was Title V of P.L. 106-170, the Ticket to Work and Work Incentives Act, which extends the research and experimentation tax credit through June 30, 2004. The Technology Transfer Commercialization Act, P.L. 106-404, was signed into law on November 1, 2000. This legislation is intended to make changes in existing law to facilitate government licensing of federally-owned inventions. The Small Business Innovation Research Program was reauthorized through September 30, 2008 by P.L. 106-554.

BACKGROUND AND ANALYSIS

Technology and Competitiveness

Interest in technology development and industrial innovation increased as concern mounted over the economic strength of the nation and over competition from abroad. For the United States to be competitive in the world economy, U.S. companies must be able to engage in trade, retain market shares, and offer high quality products, processes, and services while the nation maintains economic growth and a high standard of living. Technological advancement is important because the commercialization of inventions provides economic benefits from the sale of new products or services; from new ways to provide a service; or from new processes that increase productivity and efficiency. It is widely accepted that technological progress is responsible for up to one-half the growth of the U.S. economy, and is one principal driving force in long-term growth and increases in living standards.

Technological advances can further economic growth because they contribute to the creation of new goods, new services, new jobs, and new capital. The application of technology can improve productivity and the quality of products. It can expand the range of services that can be offered as well as extend the geographic distribution of these services. The development and use of technology also plays a major role in determining patterns of international trade by affecting the comparative advantages of industrial sectors. Since technological progress is not necessarily determined by economic conditions — it also can be influenced by advances in science, the organization and management of firms, government activity, or serendipity — it can have effects on trade independent of shifts in macroeconomic factors. New technologies also can help compensate for possible disadvantages in the cost of capital and labor faced by firms.

Federal Role

In the recent past, American companies faced increased competitive pressures in the international marketplace from firms based in countries where governments actively promote commercial technological development and application. In the United States, the generation of technology for the commercial marketplace is primarily a private sector activity. The federal government traditionally becomes involved only for certain limited purposes. Typically these are activities which have been determined to be necessary for the "national good" but which cannot, or will not, be supported by industry.

To date, the U.S. government has funded research and development (R&D) to meet the mission requirements of the federal departments and agencies. It also finances efforts in areas where there is an identified need for research, primarily basic research, not being performed in the private sector. Federal support reflects a consensus that basic research is critical because it is the foundation for many new innovations. However, any returns created by this activity are generally long term, sometimes not marketable, and not always evident. Yet the rate of return to society as a whole generated by investments in research is significantly larger than the benefits that can be captured by the firm doing the work.

Many past government activities to increase basic research were based on a "linear" model of innovation. This theory viewed technological advancement as a series of sequential steps starting with idea origination and moving through basic research, applied research, development, commercialization, and diffusion into the economy. Increases in federal funds in the basic research stage were expected to result in concomitant increases in new products and processes. However, this linear concept is no longer considered valid. Innovations often occur that do not require basic or applied research or development; in fact most innovations are incremental improvements to existing products or processes. In certain areas, such as biotechnology, the distinctions between basic research and commercialization are small and shrinking. In others, the differentiation between basic and applied research is artificial. The critical factor is the *commercialization* of the technology. Economic benefits accrue only when a technology or technique is brought to the marketplace where it can be sold to generate income or applied to increase productivity. Yet, while the United States has a strong basic research enterprise, foreign firms appear more adept at taking the results of these scientific efforts and making commercially viable products. Often U.S. companies are competing in the global marketplace against goods and services developed by foreign industries from research performed in the United States. Thus, there has been increased

congressional interest in mechanisms to accelerate the development and commercialization processes in the private sector.

The development of a governmental effort to facilitate technological advance has been particularly difficult because of the absence of a consensus on the need for an articulated policy. Technology demonstration and commercialization have traditionally been considered private sector functions in the United States. While over the years there have been various programs and policies (such as tax credits, technology transfer to industry, and patents), the approach had been ad hoc and uncoordinated. Much of the program development was based upon what individual committees judged appropriate for the agencies over which they have jurisdiction. Despite the importance of technology to the economy, technology-related considerations often have not been integrated into economic decisions.

There have been attempts to provide a central focus for governmental activity in technology matters. P.L. 100-519 created within the Department of Commerce a Technology Administration headed by a new Under Secretary for Technology. In November 1993, President Clinton established a National Science and Technology Council to coordinate decisionmaking in science and technology and to insure their integration at all policy levels (see more below). However, technological issues and responsibilities remain shared among many departments and agencies. This diffused focus has sometimes resulted in actions which, if not at cross purposes, may not have accounted for the impact of policies or practices in one area on other parts of the process. Technology issues involve components which operate both separately and in concert. While a diffused approach can offer varied responses to varied issues, the importance of interrelationships may be underestimated and their usefulness may suffer.

Several times, Congress has examined the idea of an industrial policy to develop a coordinated approach on issues of economic growth and industrial competitiveness. Technological advance is both one aspect of this and an altogether separate consideration. In looking at the development of an identified policy for industrial competitiveness, advocates argue that such an effort could ameliorate much of the uncertainty with which the private sector perceives future government actions. It has been argued that consideration and delineation of national objectives could encourage industry to engage in more long-term planning with regard to R&D and to make decisions as to the best allocation of resources. Such a technology policy could generate greater consistency in government activities. Because technological development involves numerous risks, efforts to minimize uncertainty regarding federal programs and policies may help alleviate some of the disincentives perceived by industry.

The development of a technology policy, however, would require a new orientation by both the public and private sectors. There is widespread resistance to what could be and has been called national planning, due variously to doubts as to its efficacy, to fear of adverse effects on our market system, to political beliefs about government intervention in our economic system, and to the current emphasis on short- term returns in both the political and economic arenas. Yet proponents note that planning can be advisory or indicative rather than mandatory. The focus provided by a technology policy could arguably provide a more receptive or helpful governmental environment within which business can make better decisions. Advocates assert that it could also reassure industry of government's ongoing commitment to stimulating R&D and innovation in the private sector.

Consideration of what constitutes government policy (both in terms of the industrial policy and technology policy) covers a broad range of ideas from laissez-faire to special government incentives to target specific high-technology, high-growth industries. Suggestions have been made for the creation of federal mechanisms to identify and support strategic industries and technologies. Various federal agencies and private sector groups have developed critical technology lists. However, others maintain that such targeting is an unwanted, and unwarranted, interference in the private sector which will cause unnecessary dislocations in the marketplace or a misallocation of resources. The government does not have the knowledge or expertise to make business-related decisions. Instead, they argue, the appropriate role for government is to encourage innovative activities in all industries and to keep market related decisionmaking within the business community that has ultimate responsibility for commercialization and where such decisions have traditionally been made.

The relationship between government and industry is a major factor affecting innovation and the environment within which technological development takes place. This relationship often has been adversarial, with the government acting to regulate or restrain the business community, rather than to facilitate its positive contributions to the nation. However, the situation is changing; it has become increasingly apparent that lack of cooperation can be detrimental to the nation as it faces competition from companies in countries where close government-industry collaboration is the norm. There are an increasing number of areas where the traditional distinctions between public and private sector functions and responsibilities are becoming blurred. Many assumptions have been questioned, particularly in light of the increased internationalization of the U.S. economy. The business sector is no longer be viewed in an exclusively domestic context; the economy of the United States is often tied to the economies of other nations. The technological superiority long held by the United States in many areas is being challenged by other industrialized countries in which economic, social, and political policies and practices foster government-industry cooperation in technological development.

The Clinton-Gore Approach

A major divergence from the past was evident in the approach suggested by President Clinton and Vice President Gore in two reports issued in February 1993; *A Vision of Change for America and Technology for America's Economic Growth, A New Direction to Build Economic Strength*. Their proposals called for a national commitment to, and a strategy for, technological advancement as part of a defined national economic policy. This detailed strategy offers a policy agenda for economic growth in the United States, of which technological development and industrial competitiveness are critical components.

In articulating a national technology policy, the approach initially recommended and subsequently followed by the Administration is multifaceted and provides a wide range of options while for the most part reflecting current trends in congressional efforts to facilitate industrial advancement. This policy increases federal coordination and augments direct government spending for technological development. While many past activities focused primarily on research, the new initiatives shift the emphasis toward *development* of new products, processes, and services by the private sector for the commercial marketplace. In addition, a significant number of the proposals aim to increase both government and private sector support for R&D leading to the commercialization of technology.

To facilitate technological advance, the Clinton-Gore approach focused on increasing investment; *investment* in research, primarily civilian research, to meet the Nation's needs in energy, environmental quality, and health; investment in the development and commercialization of new products, processes, and services for the marketplace; investment in improved manufacturing to make American goods less expensive and of better quality; investment in small, high technology businesses in light of their role in innovation and job creation; and investment in the country's infrastructure to support all these efforts. To make the most productive use of this increased investment, the Administration supported increased *cooperation* between all levels of government, industry, and academia to share risk, to share funding, and to utilize the strengths of each sector in reaching common goals of economic growth, productivity improvement, and maintenance of a high living standard.

On November 23, 1993, President Clinton issued Executive Order 12881 establishing a National Science and Technology Council (NSTC), a cabinet-level body to "...coordinate science, space, and technology policies throughout the federal government." According to the Fact sheet issued by the White House, the NSTC is to help establish clear national goals for federal R&D, assist in the implementation of the President's science and technology agenda, and insure that R&D considerations be integrated into decisionmaking at all policy levels. Membership includes the President, as chair; the Vice President; the Assistant to the President for Science and Technology; the Secretaries or Directors of the major R&D agencies; the Director of the Office of Management and Budget; the National Security Advisor; the Assistant to the President for Economic Policy; and the Assistant to the President for Domestic Policy. In addition, the National Economic Council offers expert advice and helps formulate policy proposals on issues related to economic growth, international competitiveness, and technological advancement. Thus, it appears that the Administration was attempting to view the activities of the federal R&D agencies and the executive branch advisory bodies comprehensively and not independently by mission.

Despite the continuing debate on what is the appropriate role of government and what constitutes a desirable government technology development policy, it remains an undisputed fact that what the government does or does not do affects the private sector and the marketplace. The various rules, regulations, and other activities of the government have become de facto policy as they relate to, and affect, innovation and technological advancement. It has been argued that these actions are not sufficiently understood or analyzed with respect to the larger context within which economic growth occurs. According to critics, these actions also are not coordinated in any meaningful way so that they promote an identifiable goal, whether that goal is as general as the "national welfare" or as specific as the growth of a particular industry.

Legislative Initiatives and Current Programs

Over the past several years, legislative initiatives have reflected a trend toward expanding the government's role beyond traditional funding of mission-oriented R&D and basic research toward the facilitation of technological advancement to meet other critical national needs, including the economic growth that flows from new commercialization and use of technologies and techniques in the private sector. An overview of recent legislation shows federal efforts aimed at (1) encouraging industry to spend more on R&D; (2) assisting small high-technology businesses; (3) promoting joint research activities between companies; (4) fostering cooperative work between industry and universities; (5) facilitating the transfer

of technology from the federal laboratories to the private sector; and (6) providing incentives for quality improvements. These efforts tend toward removing barriers to technology development in the private sector (thereby permitting market forces to operate) and providing incentives to encourage increased private sector R&D activities. While most focus primarily on research, some also involve policies and programs associated with technology development and commercialization.

Increased R&D Spending

To foster increased company spending on research, the 1981 Economic Recovery Tax Act (P.L. 97-34) mandated a temporary incremental tax credit for qualified research expenditures. The law provided a 25% tax credit for the increase in a firm's qualified research costs above the average expenditures for the previous three tax years. Qualified costs included in-house expenditures such as wages for researchers, material costs, and payments for use of equipment; 65% of corporate grants towards basic research at universities and other relevant institutions; and 65% of payments for contract research. The credit applied to research expenditures through 1985.

The Tax Reform Act of 1986 (P.L. 99-514) extended the research and experimentation (R&E) tax credit for another 3 years. However, the credit was lowered to 20% and is applicable to only 75% of a company's liability. The 1988 Tax Corrections Act (P.L. 100-647) approved a 1-year extension of the research tax credit. The Omnibus Budget Reconciliation Act (P.L. 101-239) extended the credit through September 30, 1990 and made small start-up firms eligible for the credit. The FY1991 Budget Act (P.L. 101-508) again continued the tax credit provisions through 1992. The law expired in June 1992 when former President Bush vetoed H.R. 11 that year. However, P.L. 103-66, the Omnibus Budget Reconciliation Act of 1993, reinstated the credit through July 1995 and made it retroactive to the former expiration date. The tax credit again was allowed to expire until P.L. 104-188, the Small Business Job Protection Act, restored it from July 1, 1996 through May 31, 1997. P.L. 105-34, the Taxpayer Relief Act of 1997, extended the credit for 13 months from June 1, 1997 through June 30, 1998. Although it expired once again at the end of June, the Omnibus Consolidated Appropriations Act, P.L. 105-277, reinstated the tax credit through June 30, 1999. During the 105th Congress, various bills were introduced to make the tax credit permanent; other bills would have allowed the credit to be applied to certain collaborative research consortia. On August 5, 1999, both the House and Senate agreed to the conference report for H.R. 2488, the Financial Freedom Act, which would have extended the credit for 5 years through June 30, 2004. This bill also would have increased the credit rate applicable under the alternative incremental research credit by one percentage point per step. While the President vetoed this bill on September 23, 1999, the same provisions are included in Title V of P.L. 106-170 signed into law on December 17, 1999.

The Small Business Development Act (P.L. 97-219), as extended (P.L. 99-443), established a program to facilitate increased R&D within the small-business, high- technology community. Each federal agency with a research budget was required to set aside 1.25% of its R&D funding for grants to small firms for research in areas of interest to that agency. P.L. 102-564, which reauthorized the SBIR program, increased the set-aside to 2.5%, phased in over a 5-year period. Funding is, in part, dependent on companies obtaining private sector support for the commercialization of the resulting products or processes. The authorization for the program was set to terminate October 1, 2000. However, the SBIR activity was

reauthorized through September 30, 2008 by P.L. 106-554, signed into law on December 21, 2000. A pilot effort, the Small Business Technology Transfer (STTR) program, also was created to encourage firms to work with universities or federal laboratories to commercialize the results of research. This program is funded by a 0.15% (phased in) set-aside. Set to expire in FY1997, the STTR originally was extended for one year until P.L. 105-135 reauthorized this activity through FY2001. (See CRS Report 96-402, *Small Business Innovation Research Program*.)

The Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418) created the Advanced Technology Program (ATP) at the Department of Commerce's National Institute of Standards and Technology. ATP provides seed funding, matched by private sector investment, for companies or consortia of universities, industries, and/or government laboratories to accelerate development of generic technologies with broad application across industries. The first awards were made in 1991. To date, 522 projects have been funded representing approximately $1,638 million in federal dollars matched by more than $1,651 million in financing from the private sector. Over one-half of the awardees are small businesses or cooperative efforts led by such firms.

The first four competitions (through August 1994) were all general in nature. However, in response to large increases in federal funding, NIST, in conjunction with industry, identified various key areas for long-range support including: information infrastructure for healthcare; tools for DNA diagnostics; component-based software; manufacturing composite structures; computer-integrated manufacturing for electronics; digital data storage; advanced vapor-compression refrigeration systems; motor vehicle manufacturing technology; materials processing for heavy manufacturing; catalysis and biocatalysis technologies; advanced manufacturing control systems; digital video in information networks; tissue engineering; photonics manufacturing; premium power; microelectronics manufacturing infrastructure; selective-membrane platforms; and adaptive learning systems. A general competition also was held each year. Since FY1999, NIST has decided to curtail the focused programs and has held one competition open to all areas of technology. (For more information, see CRS Report 95-36, *The Advanced Technology Program*.)

Appropriations for the ATP include $35.9 million in FY1991, $47.9 million in FY1992, and $67.9 million in FY1993. FY1994 appropriations increased significantly to $199.5 million and even further in FY1995 to $431 million. However, P.L. 104-6, rescinded $90 million from this amount. There was no FY1996 authorization. The original FY1996 appropriations bill, H.R. 2076, which passed the Congress was vetoed by the President, in part, because it provided no support for ATP. The appropriations legislation finally enacted, P.L. 104-134, did fund the Advanced Technology Program at $221 million. For FY1997, the President's budget request was $345 million. Again, there was no authorizing legislation. However, P.L. 104-208, the Omnibus Consolidated Appropriations Act, provided $225 million for ATP, later reduced by $7 million to $218 million by P.L. 105-18, the FY1997 Emergency Supplemental Appropriations and Rescision Act. For FY1998, the Administration requested $276 million in funding. P.L. 105-119, appropriated FY1998 financing of ATP at $192.5 million, again at a level less than the previous year. The Administration's FY1999 budget proposal included $259.9 million for this program, a 35% increase. While not providing such a large increase, P.L. 105-277 did fund ATP for FY1999 at $197.5 million, 3% above the previous year. This figure reflected a $6 million recision contained in the same

law that accounted for "deobligated" funds resulting from early termination of certain projects.

In FY2000, the President requested $238.7 million for ATP, an increase of 21% over the previous year. S. 1217, as passed by the Senate, would have appropriated $226.5 million for ATP. H.R. 2670, as passed by the House, provided no funding for the activity. The report to accompany the House bill stated that there was insufficient evidence to ". . .overcome those fundamental questions about whether the program should exist in the first place." Yet, P.L. 106-113, the Consolidated Appropriations Act, eventually did finance the program at $142.6 million, 28% below prior year funding.

The Administration's FY2001 budget included $175.5 million for the Advanced Technology Program, an increase of 23% over the earlier fiscal year. Once again, the original version of the appropriations bills that passed the House did not contain any financial support for the activity. However, P.L. 106-553 provides $145.7 million in FY2001 support for ATP, 2% above the previous funding level.

Industry-University Cooperative Efforts

The promotion of cooperative efforts among academia and industry is aimed at increasing the potential for the commercialization of technology. (For more information, see CRS Issue Brief IB89056, *Cooperative R&D: Federal Efforts to Promote Industrial Competitiveness*.) Traditionally, basic research has been performed in universities or in the federal laboratory system while the business community focuses on the manufacture or provision of products, processes, or services. Universities are especially suited to undertake basic research. Their mission is to educate and basic research is an integral part of the educational process. Universities generally are able to undertake these activities because they do not have to produce goods for the marketplace and therefore can do research not necessarily tied to the development of a commercial product or process.

Subsequent to World War II, the federal government supplanted industry as the primary source of funding for basic research in universities. It also became the principal determinant of the type and direction of the research performed in academia. This resulted in a disconnect between the university and industrial communities. The separation and isolation of the parties involved in the innovation process is thought to be a barrier to technological progress. The difficulties in moving an idea from the concept stage to a commercial product or process are compounded when several entities are involved. Legislation to stimulate cooperative efforts among those involved in technology development is viewed as one way to promote innovation and facilitate the international competitiveness of U.S. industry.

Several laws have attempted to encourage industry-university cooperation. Title II of the Economic Recovery Tax Act of 1981 (P.L. 97-34) provided, in part, a 25% tax credit for 65% of all company payments to universities for the performance of basic research. Firms were also permitted a larger tax deduction for charitable contributions of equipment used in scientific research at academic institutions. The Tax Reform Act of 1986 (P.L. 99-514) kept this latter provision, but reduced the credit for university basic research to 20% of all corporate expenditures for this over the sum of a fixed research floor plus any decrease in non-research giving.

The 1981 Act also provided an increased charitable deduction for donations of new equipment by a manufacturer to an institution of higher education. This equipment must be used for research or research training for physical or biological sciences within the United States. The tax deduction is equal to the manufacturer's cost plus one-half the difference between the manufacturer's cost and the market value, as long as it does not exceed twice the cost basis. These provisions were extended through July 1995 by the Omnibus Budget Reconciliation Act of 1993, but then expired until restored by the passage of P.L. 104-188, P.L. 105-277, and P.L. 106-170 as noted above.

Amendments to the patent and trademark laws contained in P.L. 96-517 (commonly called the "Bayh-Dole Act") also were designed to foster interaction between academia and the business community. This law provides, in part, for title to inventions made by contractors receiving federal R&D funds to be vested in the contractor if they are small businesses, universities, or not-for-profit institutions. Certain rights to the patent are reserved for the government and these organizations are required to commercialize within a predetermined and agreed upon time frame. Providing universities with patent title is expected to encourage licensing to industry where the technology can be manufactured or used thereby creating a financial return to the academic institution. University patent applications and licensing have increased significantly since this law was enacted. (See CRS Report RL30320, *Patent Ownership and Federal Research and Development* and CRS Report 98-862, *R&D Partnerships and Intellectual Property: Implications for U.S. Policy.)*

Joint Industrial Research

Private sector investments in basic research are often costly, long term, and risky. Although not all advances in technology are the result of research, it is often the foundation of important new innovations. To encourage increased industrial involvement in research, legislation was enacted to allow for joint ventures in this arena. It is argued that cooperative research reduces risks and costs and allows for work to be performed that crosses traditional boundaries or expertise and experience. Such collaborative efforts make use of existing and support the development of new resources, facilities, knowledge, and skills.

The National Cooperative Research Act (P.L. 98-462) encourages companies to undertake joint research. The legislation clarifies the antitrust laws and requires that a "rule of reason" standard be applied in determinations of violations of these laws; cooperative research ventures are not to be judged illegal "per se." It eliminates treble damage awards for those research ventures found in violation of the antitrust laws if prior disclosure (as defined in the law) has been made. P.L. 98-462 also makes changes in the way attorney fees are awarded. Defendants can collect attorney fees in specified circumstances, including when the claim is judged frivolous, unreasonable, without foundation, or made in bad faith. However, the attorney fee award to the prevailing party may be offset if the court decides that the prevailing party conducted a portion of the litigation in a manner which was frivolous, unreasonable, without foundation, or in bad faith. These provisions were included to discourage frivolous litigation against joint research ventures without simultaneously discouraging suits of plaintiffs with valid claims. Over 700 joint research ventures have filed with the Department of Justice since passage of this legislation.

P.L. 103-42, the National Cooperative Production Amendments Act of 1993, amends the National Cooperative Research Act by, among other things, extending the original law's

provisions to joint manufacturing ventures. These provisions are only applicable, however, to cooperative production when (1) the principal manufacturing facilities are "...located in the United States or its territories, and (2) each person who controls any party to such venture...is a United States person, or a foreign person from a country whose law accords antitrust treatment no less favorable to United States persons than to such country's domestic persons with respect to participation in joint ventures for production."

Commercialization of the Results of Federally Funded R&D

Another approach to encouraging the commercialization of technology involves the transfer of technology from federal laboratories and contractors to the private sector where commercialization can proceed. Because the federal laboratory system has extensive science and technology resources and expertise developed in pursuit of mission responsibilities, it is a potential source of new ideas and knowledge which may be used in the business community. (See CRS Issue Brief IB85031, *Technology Transfer: Utilization of Federally Funded Research and Development*, for more details.)

Despite the potential offered by the resources of the federal laboratory system, however, the commercialization level of the results of federally funded R&D remained low. Studies indicated that only approximately 10% of federally owned patents were ever utilized. There are many reasons for this low level of usage, one of which is the fact that some technologies and/or patents have no market application. However, industry unfamiliarity with these technologies, the "not-invented-here" syndrome, and perhaps more significantly, the ambiguities associated with obtaining title to or exclusive license to federally owned patents also contribute to the low level of commercialization.

Over the years, several governmental efforts have been undertaken to augment industry's awareness of federal R&D resources. The Federal Laboratory Consortium for Technology Transfer was created in 1972 (from a Department of Defense program) to assist in transferring technology from the federal government to state and local governments and the private sector. To expand on the work of the Federal Laboratory Consortium, and to provide added emphasis on the commercialization of government technology, Congress passed P.L. 96-480, the Stevenson-Wydler Technology Innovation Act of 1980. Prior to this law, technology transfer was not an explicit mandate of the federal departments and agencies with the exception of the National Aeronautics and Space Administration. To provide "legitimacy" to the numerous technology activities of the government, Congress, with strong bipartisan support, enacted P.L. 96-480 which explicitly states that the federal government has the responsibility, "...to ensure the full use of the results of the nation's federal investment in research and development." Section 11 of the law created a system within the federal government to identify and disseminate information and expertise on what technologies or techniques are available for transfer. Offices of Research and Technology Applications were established in each federal laboratory to distinguish technologies and ideas with potential applications in other settings.

Several amendments to the Stevenson-Wydler Technology Innovation Act have been enacted to provide additional incentives for the commercialization of technology. P.L. 99-502, the Federal Technology Transfer Act, authorizes activities designed to encourage industry, universities, and federal laboratories to work cooperatively. It also establishes incentives for federal laboratory employees to promote the commercialization of the results

of federally funded research and development. The law amends P.L. 96-480 to allow government-owned, government-operated laboratories to enter into cooperative R&D agreements (CRADAs) with universities and the private sector. This authority is extended to government-owned, contractor-operated laboratories by the Department of Defense FY1990 Authorization Act, P.L. 101-189. (See CRS Report 95-150, *Cooperative Research and Development Agreements (CRADAs*).) Companies, regardless of size, are allowed to retain title to inventions resulting from research performed under cooperative agreements. The federal government retains a royalty-free license to use these patents. The Technology Transfer Improvements and Advancement Act (P.L. 104- 113), clarifies the dispensation of intellectual property rights under CRADAs to facilitate the implementation of these cooperative efforts. The Federal Laboratory Consortium is given a legislative mandate to assist in the coordination of technology transfer. To further promote the use of the results of federal R&D, certain agencies are mandated to create a cash awards program and a royalty sharing activity for federal scientists, engineers, and technicians in recognition of efforts toward commercialization of this federally developed technology. These efforts are facilitated by a provision of the National Defense Authorization Act for FY1991 (P.L. 101-510), which amends the Stevenson-Wydler Technology Innovation Act to allow government agencies and laboratories to develop partnership intermediary programs to augment the transfer of laboratory technology to the small business sector.

Amendments to the Patent and Trademark law contained in Title V of P.L. 98- 620 make changes which are designed to improve the transfer of technology from the federal laboratories — especially those operated by contractors — to the private sector and increase the chances of successful commercialization of these technologies. This law permits the contractor at government-owned, contractor-operated laboratories (GOCOs) to make decisions at the laboratory level as to the granting of licenses for subject inventions. This has the potential of effecting greater interaction between laboratories and industry in the transfer of technology. Royalties on these inventions are also permitted to go back to the contractor to be used for additional R&D, awards to individual inventors, or education. While there is a cap on the amount of the royalty returning directly to the lab in order not to disrupt the agency's mission requirements and congressionally mandated R&D agenda, the establishment of discretionary funds gives contractor-operated laboratories added incentive to encourage technology transfer.

Under P.L. 98-620, private companies, regardless of size, are allowed to obtain exclusive licenses for the life of the patent. Prior restrictions allowed large firms use of exclusive license for only 5 of the 17 years (now 20 years) of the life of the patent. This should encourage improved technology transfer from the federal laboratories or the universities (in the case of university operated GOCOs) to large corporations which often have the resources necessary for development and commercialization activities. In addition, the law permits GOCOs (those operated by universities or nonprofit institutions) to retain title to inventions made in the laboratory within certain defined limitations. Those laboratories operated by large companies are not included in this provision.

P.L. 106-404, the Technology Transfer Commercialization Act, alters current practices concerning patents held by the government to make it easier for federal agencies to license such inventions. On May 6, 1999, similar legislation again passed the House. The law amends the Stevenson-Wydler Technology Innovation Act and the Bayh-Dole Act to decrease the time delays associated with obtaining an exclusive or partially exclusive license.

Previously, agencies were required to publicize the availability of technologies for 3 months using the *Federal Register* and then provide an additional 60 day notice of intent to license by an interested company. Under the new legislation, the time period is shorten to 15 days in recognition of the ability of the internet to offer widespread notification and the necessity of time constraints faced by industry in commercialization activities. Certain rights are retained by the government. The bill also allows licenses for existing government-owned inventions to be included in CRADAs.

The Omnibus Trade and Competitiveness Act (P.L. 100-418) mandated the creation of a program of regional centers to assist small manufacturing companies to use knowledge and technology developed under the auspices of the National Institute of Standards and Technology and other federal agencies. Federal funding for the centers is matched by non-federal sources including state and local governments and industry. Originally, seven Regional Centers for the Transfer of Manufacturing Technology were selected. Later, the initial program was expanded in 1994 to create the Manufacturing Extension Partnership (MEP) to meet new and growing needs of the community. In a more varied approach, the Partnership involves both large centers and smaller, more dispersed organizations sometimes affiliated with larger centers as well as the NIST State Technology Extension Program which provides states with grants to develop the infrastructure necessary to transfer technology from the federal government to the private sector (an effort which was also mandated by P.L. 100-418) and a program which electronically ties the disparate parties together along with other federal, state, local, and academic technology transfer organizations. There are now centers in all 50 states and Puerto Rico. Since the manufacturing extension activity was created in 1989, awards made by NIST have resulted in the creation of approximately 400 regional offices. [It should be noted that the Department of Defense also funded 36 centers through its Technology Reinvestment Project (TRP) in FY1994 and FY1995. When the TRP was terminated, NIST took over support for 20 of these programs in FY1996 and funded the remaining efforts during FY1997.]

Funding for this program was $11.9 million in FY1991, $15.1 million in FY1992, and $16.9 million in FY1993. In FY1994 support for the expanded Manufacturing Technology Partnerships was $30.3 million. The following fiscal year, P.L. 103-317 appropriated $90.6 million for this effort, although P.L. 104-19 rescinded $16.3 million from this amount. While the original FY1996 appropriations bill, H.R. 2076, was vetoed by the President, the $80 million funding for MEP was retained in the final legislation, P.L. 104-134. The President's FY1997 budget request was $105 million. No FY1997 authorization legislation was enacted, but P.L. 104-208 appropriated $95 million for Manufacturing Extension while temporarily lifting the six-year limit on federal support for individual centers. The Administration requested FY1998 funding of $123 million. Again no authorizations were passed. However, the FY1998 appropriations bill, P.L. 105-119, financed the MEP program at $113.5 million. This law also permitted government funding, at one-third the centers total annual cost, to continue for additional periods of one year over the original six-year limit, if a positive evaluation is received. The President's FY1999 budget included $106.8 million for the MEP, a 6% decrease from current funding. The Omnibus Consolidated Appropriates Act, P.L. 105-277, appropriated the $106.8 million. The decrease in funding reflects a reduced federal financial commitment as the centers mature, not a decrease in program support. In addition, the Technology Administration Act of 1998, P.L. 105-309, permits the federal government to fund centers at one-third the cost after the 6 years if a positive, independent evaluation is made every two years.

For FY2000, the Administration requested $99.8 million in support for the MEP. Again, the lower federal share indicated a smaller statutory portion required of the government. S. 1217, as passed by the Senate, would have appropriated $109.8 million for the Manufacturing Extension Partnership, an increase of 3% over FY1999. H.R. 2670, as passed initially by the House, would have appropriated $99.8 million for this activity. The version of the H.R. 2670 passed by both House and Senate provided FY2000 appropriations of $104.8 million. While the President vetoed that bill, the legislation that was ultimately enacted, P.L. 106-113, appropriated $104.2 million after the mandated recision.

The Administration's FY2001 budget requested $114.1 million for the Partnership, an increase of almost 9% over current support. Included in this figure was funding to allow the centers to work with the Department of Agriculture and the Small Business Administration on an e-commerce outreach program. P.L. 106-553 appropriates $105.1 million for FY2001, but does not fund any new initiatives.(For additional information see: CRS Report 97-104, *Manufacturing Extension Partnership Program: An Overview.*)

A New Approach?

As indicated above, the laws affecting the R&D environment have included both direct and indirect measures to facilitate technological innovation. In general, direct measures are those which involve budget outlays and the provision of services by government agencies. Indirect measures include financial incentives and legal changes (e.g., liability or regulatory reform; new antitrust arrangements). Supporters of indirect approaches argue that the market is superior to government in deciding which technologies are worthy of investment. Mechanisms that enhance the market's opportunities and abilities to make such choices are preferred. Advocates further state that dependency on agency discretion to assist one technology in preference to another will inevitably be subjected to political pressures from entrenched interests. Proponents of direct government assistance maintain, conversely, that indirect methods can be wasteful and ineffective and that they can compromise other goals of public policy in the hope of stimulating innovative performance. Advocates of direct approaches argue that it is important to put the country's scarce resources to work on those technologies that have the greatest promise as determined by industry and supported by its willingness to match federal funding.

In the past, while Republicans tended to prefer reliance on free market investment, competition, and indirect support by government, participants in the debates generally did not make definite (or exclusionary) choices between the two approaches, nor consistently favor one over the other. For example, some proponents of a stronger direct role for the government in innovation are also supporters of enhanced tax preferences for R&D spending, an indirect mechanism. Opponents of direct federal support for specific projects (e.g., SEMATECH, flat panel displays) may nevertheless back similar activities focused on more general areas such as manufacturing or information technology. However, the 104th Congress directed their efforts at eliminating or curtailing many of the efforts which previously had enjoyed bipartisan support. Initiatives to terminate the Advanced Technology Program, funding for flat panel displays, and agricultural extension reflected concern about the role of government in developing commercial technologies. The Republican leadership stated that the government should directly support basic science while leaving technology development to the private sector. Instead of federal funding, changes to the tax laws,

proponents argue, will provide the capital resources and incentives necessary for industry to further invest in R&D. During the 105th and 106th Congresses many of the same issues were considered. While funding for several programs decreased, particularly in FY1998, support for most on-going activities continued, some at increased levels. How the debate over federal funding evolves in the 107th Congress may serve to redefine thinking about the government's efforts in promoting technological advancement in the private sector.

LEGISLATION

P.L. 106-113, H.R. 3194

Consolidated Appropriations Act. Provides FY2000 appropriations of $142.6 million for the Advanced Technology Program and $104.8 million for the Manufacturing Extension Partnership at the National Institute of Standards and Technology, among other things. Appropriations for the Departments of Commerce, Justice, and State were included in H.R. 3421 introduced November 17, 1999 and referred to the House Committee on Appropriations. Incorporated into H.R. 3194. Conference report on H.R. 3194 agreed to in the House on November 18 and in the Senate on November 19, 1999. Signed into law November 29, 1999.

P.L. 106-170, H.R. 1180

The Ticket to Work and Work Incentives Act. Title V amends the Internal Revenue Code of 1986 to extend the research tax credit through June 30, 2004 and increases the credit rate applicable under the alternative incremental credit by one percentage point per step, among other things. Introduced March 18, 1999; referred to the Committee on Ways and Means. Passed the House amended on October 19, 1999. Passed the Senate in lieu of S. 331 on October 21, 1999. House agreed to the conference report on November 18, 1999 and the Senate agreed the following day. Signed into law December 17, 1999.

P.L. 106-404, H.R. 209

The Technology Transfer Commercialization Act. Amends the Stevenson-Wydler Technology Innovation Act and the "Bayh-Dole" Act to improve the ability of government agencies to license federally owned inventions. Introduced January 6, 1999; referred to Committees on Science and on the Judiciary. Reported from Committee on Science with amendments May 6, 1999. Discharged from Committee on the Judiciary the same day. Passed House, amended, May 11, 1999. Referred to Senate Committee on Commerce, Science, and Transportation September 29, 1999; discharged from the Committee on October 5, 2000. Passed the Senate, amended, on the same day. The House agreed to the Senate amendment on October 17,2000. Signed into law by the President on November 1, 2000.

P.L. 106-553, H.R. 4942

Provides FY2001 appropriations for the National Institute of Standards and Technology, among other things. Funds the Appropriate Technology Program at $145.7 million and the Manufacturing Extension Partnership at $105.1 million. H.R. 4942 introduced July 25, 2000; referred to the House Committee on Appropriations. Passed the House on September 14, 2000; passed the Senate on September 27, 2000. Subsequently, the H.R. 4942 conference report incorporated H.R. 5548, Commerce Appropriations. House agreed to conference report on October 26,2000; Senate agreed on October 27, 2000. Signed into law by the President on December 21, 2000.

P.L. 106-554, H.R. 4577

Makes appropriations for the Departments of Labor, Health and Human Services, and Education. Also reauthorizes the Small Business Innovation Research Program through September 30, 2008. H.R. 4577 introduced June 1, 2000; referred to the House Committee on Appropriations. Passed House June 14, 2000; passed Senate with amendment on June 30, 2000. House and Senate agreed to conference report on December 12, 2000. Provisions of several bills were incorporated by reference including H.R. 5667, Small Business Reauthorization. Signed into law by the President on December 21, 2000.