AN ASSESSMENT OF FEDERAL FUNDING FOR PRIVATE RESEARCH AND DEVELOPMENT

Statement of

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before the

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Committee on Homeland Security and Governmental Affairs
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Mr. Chairman,

I am Charles Wessner, and I direct the program on technology, innovation and entrepreneurship at The National Academies. While the views I offer the Committee today are my own, my testimony also incorporates the specific recommendations contained in the consensus report of the National Academies that reviewed the ATP program.

Today, I would like to talk briefly about what ATP is and what it is not and why it is important to continue supporting this innovative and effective program. In the course of our discussion, we can also explore some myths and realities about innovation in the United States.

ATP's mission is to accelerate the development of innovative technologies for broad national benefit through partnerships with the private sector. A recent National Academies assessment of ATP, under the leadership of Gordon Moore of Intel, found that ATP is meeting its mission goals.[1] In short, the program contributes to our nation's innovation, economic growth, and national security.

Why is the program needed? Very simply because even though we recognize that innovative technologies have the potential to bring enormous benefits to society as a whole, private investors often can not adequately support their development because profits are often too uncertain or too distant.

How does ATP work? The program seeks promising new projects that 1) must be proposed by industry; 2) must be directed and carried out by industry; and 3) must be funded by industry on a cost-shared basis. The awards often serve a catalytic function, often creating new partnerships between large and small companies and universities. The bulk of ATP awards, nearly 70 percent, go to small businesses that drive innovation, employment, and growth in the U.S. economy.

How well does it work? An impartial Academy assessment found ATP to be a proven program, with a positive track record. In fact, ATP has demonstrated over 15 years that is works well. It achieves its goals of stimulating risky, new, high-payoff technology development, by funding small companies and bringing together universities, small firms, and large companies. We can say that with confidence because the ATP program is quite likely the most intensively studied, rigorously scrutinized and carefully assessed U.S. technology program of the past 50 years. By itself, the National Academies review of ATP consumed two years, three major meetings, two major reports and numerous detailed studies. The process involved a 15-person steering committee, including leading economists and wide consultations with the venture community, major corporations, small companies, and government officials. And as with all Academy studies, the findings were then subject to a second independent review as per standard Academy procedure. This rigorous, impartial analysis is the basis for our positive view of the program.

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[1] National Research Council, *The Advanced Technology Program, Assessing Outcomes*, C. Wessner, ed. Washington, D.C.: National Academy Press, 2001.

Our work on innovation also brought to light a set of common myths about markets and the innovation process that must be overcome if we are to successfully meet intense global competition, especially in high-tech manufacturing, and, by doing so, maintain the economic strength that sustains our national security.

The National Academies finds that ATP Works

Based on this thorough National Academies' assessment, we can report to you that the ATP is definitively meeting its Congressional mandate to provide cost-shared funding to industry to accelerate the development and broad dissemination of challenging, high-risk technologies that promise broad-based economic benefits for the nation.

The Academies complimented ATP for the rigor and quality of the assessment program, suggesting that other programs might see it as a best practice model. The ATP assessment program includes

- A rigorous selection process, where companies must prove a need for government support, as well as demonstrate the technical and commercial merit of their project;
- Real time project monitoring, with a demonstrated willingness to stop funding for projects that are not performing; and
- Follow-up evaluations to ensure that funded projects are achieving technical, commercial, and social goals called for by ATP.

The good news is that ATP investments are already yielding high returns. Innovative technologies for knee repair and early breast cancer detection, for example, not only return our citizens to happier, more productive lives but lower medical costs for all as well. ATP has also helped to fund work to support U.S. manufacturing, such as on printed wiring boards, and supported promising technologies such as fuel cells and DNA diagnostics that will contribute to our nation's growth and security.

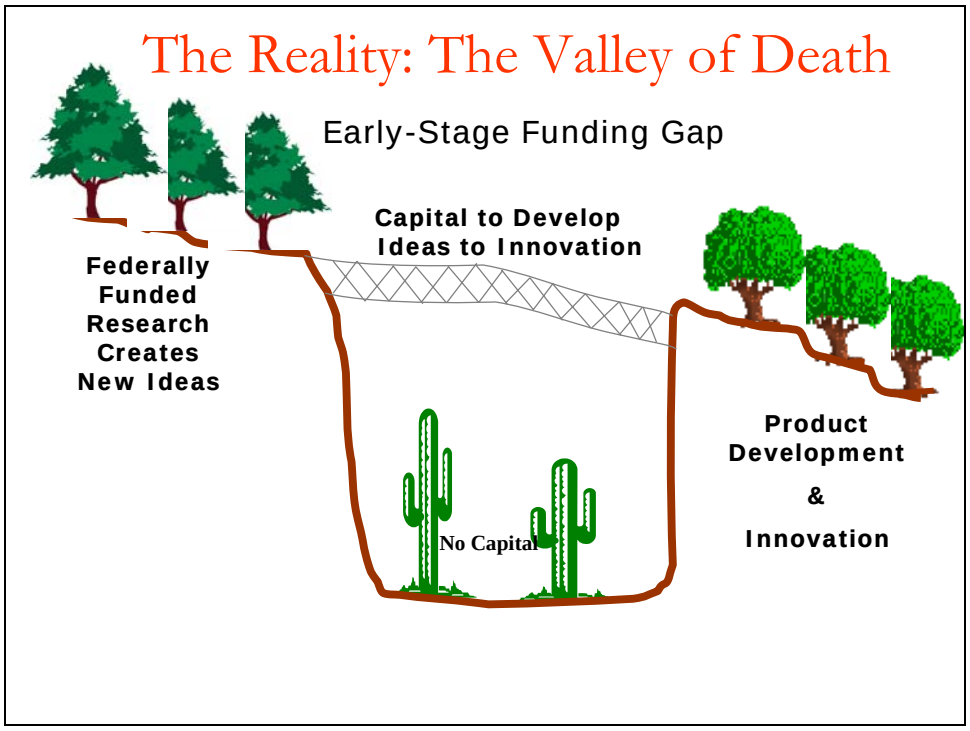
In short, ATP is a specific example of what works well in the general area of government-industry-university technology partnerships. The ATP program is a rather unique part of the overall complex of technology programs that the U.S. Government supports. It is exceptional in several ways, including its intelligent design and its remarkably thorough assessment program. But keep in mind that ATP is part of a family of long-standing U.S. programs, whether it is military research at ONR, new concepts funded by DARPA, or the two-phase SBIR program that helps bring new technologies to the war-fighter. In all these cases, the government is really helping to plant long-term technology seeds where private markets hesitate to go or to address acute public needs. Some of those technology seeds will sprout, others will not. But the planting, as an activity on the whole, must go forward if long-term economic gains are to be effectively harvested.

Let me talk for a moment about a few myths about the U.S. innovation system.

The Myth of Perfect Markets

The first major myth is that "if it is a good idea, the market will fund it." In reality, market participants nearly always have less than perfect knowledge, especially about innovative new

ideas. This "asymmetric information," as economists call it, makes it difficult for small firms to obtain funding to develop new ideas for the market. The reality facing firms in the early stages of their development is what Congressman Vernon Ehlers referred to as "the Valley of Death" between federal funding for basic research that creates new ideas and closer-to-market product development that can be attractive to venture capitalists and other private investors.

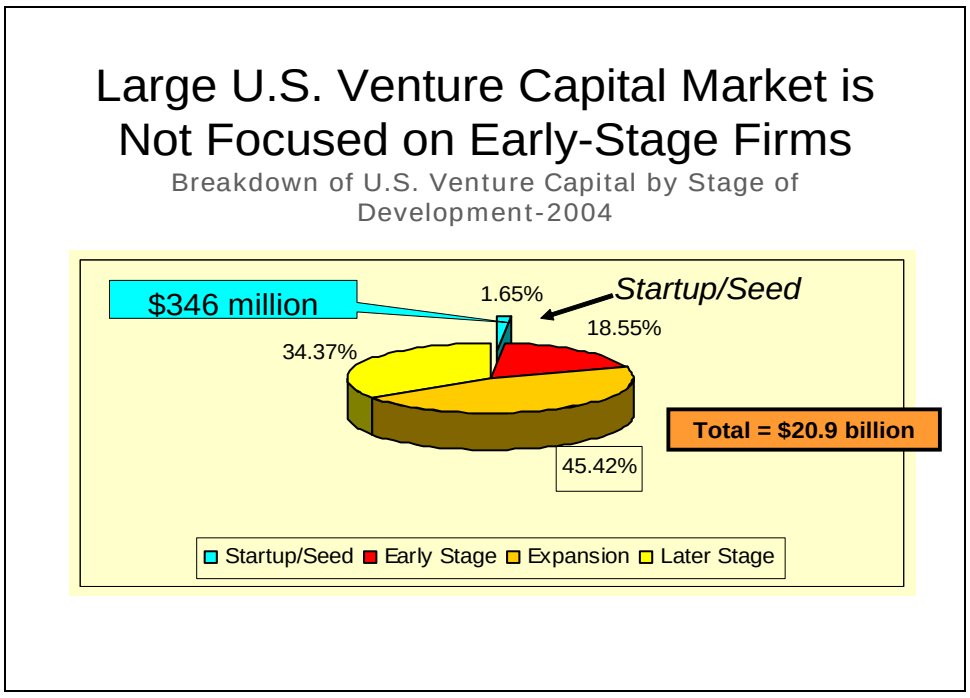


The Valley of Death results from the different levels of information that exists between an entrepreneur and potential investors and partners. Lacking full appreciation of the technology, investors hesitate to provide the funds that would permit the entrepreneur to demonstrate the concept. These funding gaps matter because equity-financed small businesses are one of the most effective mechanisms for capitalizing on new ideas and brining them to market. Small businesses are also a leading source of growth and employment in the United States

The Myth of the Venture Capital Solution

While almost every small businessperson who has brought an innovative product to market can tell you about his or her experience with the Valley of Death, many in the policy world still believe that because we have a robust venture capital market, VC finance alone is the solution to the many challenges of early-stage finance. This is not the case. For a variety of reasons, private capital markets tend to both over- and under-invest in new technologies. Venture funding can also be quite unpredictable. You recall that venture funding soared to some $100 billion in 2000 and then, after a dramatic fall, stabilized just over $20 billion last year.

Why does this happen? Because early-stage technology capital markets are prone to numerous imperfections including herd behavior among investors, information asymmetries, institutional imperatives focused on the later stages of technology development, and early exit--all of which were amply on display during the collapse of the dot-com technology bubble. As a result, some new technology domains may get too much attention from private investors while other promising areas may get comparatively little. After all, the goal of venture capitalists is not to develop the U.S. economy with long-term investments but to obtain a timely and significant return for the funds' investors. The key point is that the large U.S. venture capital market is not focused on early-stage firms with promising but unproven technologies. Reflecting this reality, the amount of early-stage financing available from venture capitalists is quite small, around $346 million of the $20.9 billion noted earlier.



These problems are especially severe for promising but risky new technical approaches. These approaches often require intensive collaboration across multiple technical disciplines, requiring the coordination among companies and, increasingly, universities. Even with promising technologies, it is sometimes hard for company managers to see a clear, reasonably short-term path to the necessary return on their investment. In those cases, public-private partnerships like ATP can play an essential, catalytic role in helping to foster technical innovation to the point where private capital markets can sustain further development.

Reflecting these realities, influential venture capitalists have spoken positively about the program. For example, as you can see, David Morgenthaler, a past President of the National Venture Capital Association, has affirmed the value of the program. He emphasizes that its focus is not on the same financial space as venture funds and welcomes these types of leveraged public-private investments in potential platform technologies of the future.

"[The ATP] is an excellent program for developing enabling, or platform, technologies, which can have broad applications but are long-term, risky investments. Venture capitalists are not going to fund these opportunities, because they will feel that they are at too early a stage of maturity. Government can and should fund these technologies. In fact, it should do more than it is doing."

David Morgenthaler
Morgenthaler Ventures[2]

The Myth of Crowding Out

Still, some ask, "Wouldn't private capital support an ATP project anyhow?" The short answer is "usually not." Why? Because it is too risky, the technology requires competencies not controlled by one firm, and/or the cost is simply too high. ATP addresses these factors. Our research supports this view. Looking at the 1998 ATP applicants one year after the funding decisions, NRC researchers found that most of the non-winners (70%) had not proceeded with their proposed R&D project.[3] Of those that did, most were working at a smaller scale than initially proposed. This result suggests that firms are not seeking ATP funding for projects they would conduct anyway—ATP is not "crowding out" the market. Crowding out is theoretically possible but our research from some of the country's leading economists, Stanford's Paul David and Berkeley's Bronwyn Hall, found that evidence for crowding out was problematic at best. The NRC research actually shows that[4] ATP award winners were more likely to actually receive additional funding from private sources. This suggests that the ATP award creates a "halo effect" for recipients.

The Myth about Awards for Large Companies

A persistent myth is that ATP pays businesses to perform activities they would naturally do anyway. The reality is that new ideas, by definition, lack champions. This means that researchers within larger corporate organizations often have difficulty getting funding within their company to develop innovative but risky new products. An ATP award can help validate and provide seed funding for these ideas, when they promise widespread societal benefits. While over sixty-eight percent of ATP awards go to small businesses that are seeking to commercialize innovative ideas, government awards are also sometimes necessary to attract internal funding within larger firms.

For example, between 1995 and 2000, ATP co-funded a joint venture project with General Electric Corporate R&D and EG&G Reticon on a cost share basis to develop a low-cost manufacturing process for digital mammography and radiography systems.[5] The project lowered the cost of mammograms and, because they were digitized, permitted easier second opinions and reduced false positives with the expensive and nerve-racking biopsies. As costs

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[2] See National Research Council, *The Advanced Technology Program: Assessing Outcomes*, *op.cit*, p. 66.
[3] Maryann P. Feldman and Maryellen R. Kelley, "Leveraging Research and Development: The Impact of the Advanced Technology Program," in National Research Council, *The Advanced Technology Program, Assessing Outcomes*, *op. cit*.
[4] Ibid.
[5] See National Research Council, *The Advanced Technology Program: Assessing Outcomes*, *op.cit*, pp. 90 and 96.

for equipment fell, distribution to rural areas rose, with the attendant benefits. ATP's investment in this technology resulted in a productive alliance between large and small firms. This successful joint venture illustrates both the positive synergies resulting from small and large firm cooperation and the reality that there is a valley of death for new technologies, even in the largest companies.[6]

The Myth about Picking Winners and Losers

As we have seen, public-private partnerships like ATP—involving cooperative research and development activities among industry, government laboratories, and universities—can play an instrumental role in accelerating the development of new technologies from idea to market.[7] Yet many believe that the government should not be in the business of supporting new technologies, claiming that the government should not be picking winners and losers. This easy statement is also a myth, one that ignores U.S. history and current practice. This myth appears in several different forms, often mixed together. The claim is that--

- The government cannot successfully make judgments about new firms or technologies, or
- The government should not substitute its judgment for that of the market, or
- Government intervention in the market is unwarranted and therefore constitutes corporate welfare.

The historical reality is that the government often has to make technology choices through its research allocations, regulatory decisions, and procurement choices. The reality, as noted by Vernon Ruttan, Emeritus Professor of Applied Economics at the University of Minnesota and one of the world's leading development economists, is that "government has played an important role in the technology development and transfer in almost every U.S. industry that has become competitive on a global scale."[8] The table below highlights some of key game changing technologies that came about through government sponsorship.

Precedents for Public Role in Commercialization of Science in the U.S.

- 1798 - Grant to Eli Whitney to produce muskets with interchangeable parts, founds first machine tool industry
- 1842 - Samuel Morse receives award to demonstrate feasibility of telegraph
- 1903 – Wright Brothers fly, fulfilling the terms of an Army contract.
- 1915 – National Advisory Committee for Aeronautics plays an instrumental role in the rapid advance in commercial and military aircraft technology
- 1919 – Radio manufacturing (RCA) founded on the initiative (Equity and Board Membership) of the U.S. Navy with commercial and military rationales.
- 1940s, '50s, '60s – Government investments in Jet Aircraft, Semiconductors, Computers, Satellites, Nuclear Energy lay the "Foundations of the Modern Economy," (Cohen & Noll, 1992)

[6] See remarks of Dr. Bruce Griffing, "Between Invention and Innovation: Mapping the Funding for Early Stage Technologies," Carnegie Conference Center, Washington, D.C., 25 January 2001.
[7] See National Research Council, *Government-Industry Partnerships for the Development of New Technologies: Summary Report*, C. Wessner, ed. Washington, D.C.: National Academies Press, 2003, page 23.
[8] Vernon Ruttan, *Technology, Growth, and Development: An Induced Innovation Perspective*, Oxford: Oxford University Press, 2000.

- 1969-1990s - Government investments create the forerunners of the Internet (Arpanet) and build the Global Positioning System
- **Today: Current investments in promising research and technologies are found in genomic and biomedical research, as well as advanced computing and new materials, (e.g., the government's nanotechnology initiatives).**

The Global Competition in Innovation

The technologies enabled by ATP investments are particularly relevant in the new international competitive environment that the United States faces today. The increasing offshore movement of R&D, software development, and manufacturing poses a profound challenge to U.S. technical preeminence, and therefore on military preeminence. Private R&D by U.S. firms is increasingly spent in countries like China and India, where they are conducted increasingly by non-captive, independent organizations. Outsourced R&D is also moving up from lower-end research to the operation of major branch offices integrated into the worldwide operations of U.S. multinationals.[9] This represents a new competitive paradigm for the United States and one for which we need an effective policy response.

The challenges do not stop with R&D. Most other nations have created new, well funded programs to develop new technologies and new industries for their national economies. This is a global phenomenon. China is the most striking example. It has a broad array of programs designed to develop new technologies and to attract and grow leading industries such as semiconductors. While Chinese efforts are massive, they are by no means unique. For example, Finland, a country of five million, has a program similar to ATP, called Tekes; it is funded at $540 million. Belgium, a nation of ten million, has a consortium for microelectronics research called IMEC that is budgeted at $157 million. The EU is spending $22 billion in its Framework Programme of applied research, and there are proposals to double it. Taiwan has a superb series of programs at ITRI, funded at over $500 million. Other nations in Europe and Asia similarly have well-funded technology programs.[10] Cooperative technology programs, like ATP and SBIR, have emerged as key elements in national competition for the high-technology industries of the future.

Many corporate leaders are concerned about these trends. Dr. Mark Myers, the former head of R&D for Xerox, was quoted in the *Wall Street Journal* recently that "this is an increasingly global game, and how the U.S. fares in that [game] is uncertain."[11] A well-funded ATP would help the United States better capitalize on its investments in basic science and R&D, help develop technologies with high economic and social pay-offs, and bring small businesses and large businesses together to collaborate on the competitive technologies of the future. We need to work harder and better to compete, and ATP is and should be an integral part of that competitive strategy.

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[9] See *The Economist*, "Innovative India," August 1, 2004.
[10] For a review of regional and national programs in semiconductors, see National Research Council, *Securing the Future, Regional and National Programs to Support the Semiconductor Industry*, C. Wessner, ed., Washington, D.C.: National Academies Press, 2003.
[11] *Wall Street Journal*, 7 January 2005.

Conclusion

To better understand ATP and its contributions, it is important that we recognize certain realities, namely:

- We need to capitalize on our research investments. We need to convert research dollars into products and processes that enhance the health, welfare, economic growth, and security of U.S. citizens.
- We need to understand the inherent challenges of early-stage finance, and the concomitant limitations of venture capital, both in terms of when it invests and what it will invest in.
- In a global economy, we need to remember that we are not alone. The rest of the world has many large, well funded programs focused on capturing new technologies for their national economies. These programs, especially when combined with a vibrant and efficient private sector, can be remarkably effective.
- We should keep in mind that the U.S. government has long played a major role in developing the U.S. economy, whether it's aircraft frames, turbines, nuclear power, semiconductors, computers, or the Internet. Not a bad track record.
- Perhaps most important, we should recall that these contributions to our economy are in turn central elements of our national security. ATP can and does make contributions to Homeland Security through, for example, container inspection technology, DNA diagnostics, and new fuel cell technologies. Appropriately funded, ATP can make major contributions both for homeland security and for the industrial base on which U.S. military strength ultimately relies.

In sum, the National Academies "…finds that the Advanced Technology Program is an effective federal partnership program. The selection criteria applied by the program enable it to meet broad national needs and help ensure that the benefits of successful awards extend across firms and industries. Its cost-shared, industry-driven approach to funding promising new technological opportunities has shown considerable success in advancing technologies that can contribute to important societal goals…."[12]

With your help and support, the ATP program will continue to contribute to the nation's growth and security.

Mr. Chairman, thank you for this opportunity to address your Committee.

[12] See National Research Council, *The Advanced Technology Program: Assessing Outcomes*, *op.cit*, p. 87.