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To the
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on the
Small Business Innovation Research Program

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My name is Donald Siegel and I am Dean of the School of Business at the University at Albany, SUNY. I also serve as President of the Technology Transfer Society, a non-profit organization dedicated to identifying and disseminating best practices in technology commercialization. The Society hosts an annual conference, linking academics, practitioners, and policymakers, and also publishes the *Journal of Technology Transfer*, the only academic journal devoted to the public policy and managerial implications of technology commercialization. I am a co-editor of this journal.

For the past 15 years, I have studied technology transfer to existing firms and start-up companies, resulting from research activity at universities, federal laboratories, incubators, and science/technology parks. I was trained as academic economist, which means that I am not very practical. President Reagan once said that an economist is someone, who upon observing that something works in *practice*, wonders whether it works in *theory*. Therefore, in the remainder of my testimony, I will provide both theoretical and empirical support for this worthy program.

In 2003, I was asked to join a team of researchers commissioned by the National Research Council to conduct a Congressionally-mandated evaluation of the Small Business Innovation Research Program (henceforth, SBIR) across federal agencies. At first, I was quite skeptical. Like many economists, I was greatly influenced by the late Milton Friedman. I mention this because of Friedman's famous adage regarding the four ways to spend money. First, you can spend your own money on yourself, in which case, the funds are spent quite wisely. Next, you can use your own money to purchase goods or services for others whom you know, such as buying someone a Christmas gift. In this instance, your ability to spend astutely is limited by your ability to match the recipient's preferences. A quick visit to a department store on the day after Christmas illustrates the difficulties of successfully completing that mission. A third method of expenditure occurs when we spend other people's money on ourselves, which transpires when we are on an expense account. In this case, we have little incentive to economize, since others are footing the bill. The final case is spending other people's money on other people (people we do not know personally). According to Friedman, this is exactly what politicians do and thus, he was highly skeptical regarding the ability of government to spend its funds wisely. The lesson I learned from this

adage is that government programs should be rigorously evaluated, since they may not always be meeting their objectives (e.g., spending the taxpayers money wisely).

Despite my inherent skepticism regarding the effectiveness of government programs, I was buoyed by the fact that the NRC had convened a group of scholars who could actually conduct the type of systematic evaluation that was warranted for this particular government program. This was quite a challenging assignment for us, but one that is extremely vital for accountability to the taxpayers. Please note that a fundamental rationale for government intervention in the marketplace is the existence of a "market failure." The SBIR Program, in theory, addresses two types of market failures: (1) innovation market failure (for early-stage technologies) and (2) market failure with respect to the provision of financial capital for new enterprises seeking to commercialize early-stage technologies. Based on comprehensive evidence collected by the NRC team, I am convinced that SBIR is alleviating these market failures and additional study will help us further understand how to make this program even more effective.

SBIR AND THE PHASE 1 NRC SBIR STUDY

First, let me provide some specific information about the program. SBIR is designed to provide financial assistance to firms during the initial stages of their development. It was established in 1982 as a "set-aside" program. In its current version, SBIR requires eleven federal R&D funding agencies with extramural research programs to allocate 2.5 percent of their extramural research budgets to fund through a peer-review process R&D in small (less than 500 employees) firms and organizations.

SBIR awards consist of three phases. Phase I awards fund the firm to undertake proof of concept; that is, to research the feasibility and technical merit of a proposed research project. A Phase I award lasts for six months (maximum $150,000). Phase II awards extend the proof of concept to a technological product/process that has a commercial application (maximum $1,000,000). A Phase II Award is granted to only the most promising of the Phase I projects based on scientific/technical promise, the expected value to the funding agency, the firm's research capability, and the commercial potential of the resulting innovation. The duration of the award is a maximum of 24 months and generally does not exceed $750,000. Approximately 40 percent of the Phase I Awards continue on to Phase II. Phase III involves private funding to the firm for the commercial application of a technology; no financial award from SBIR is made in Phase III.

The first phase of the NRC study assessed the SBIR program at five federal agencies, the Department of Defense (DoD), the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), the Department of Energy (DoE), and the National Science Foundation (NSF). These five agencies constitute approximately 96 percent of SBIR program expenditures. Specifically, the NRC committee was charged by Congress with evaluating whether the Program was advancing four key societal objectives: (a) stimulating technological innovation; (b) increasing commercialization of innovation in the private sector; (c) using small business to meet federal research and development needs; and (d) fostering and encouraging participation by minority and disadvantaged persons in technological innovation. The committee was also asked to assess the effectiveness of managerial practices, with respect to agency SBIR programs. That is, the committee attempted to determine whether there are "best practices" in certain agency SBIR programs that could be adopted by other agencies.

To accomplish these objectives, the committee employed sophisticated quantitative/statistical and qualitative analyses. It is important to note that the use of qualitative methods is highly warranted, given the complex nature of the program and the inability to capture all of its nuances with purely statistical data. A large and diverse team of expert researchers conducted extensive NRC-commissioned surveys and case studies. In addition, agencies were asked to provide program data and documents. The committee also conducted extensive interviews with program managers, program participants, agency "users" of the program, as well as program stakeholders. I am confident that the NRC study is, by far, the most comprehensive assessment of SBIR ever or more generally, of any technology-based program designed to stimulate entrepreneurship.

KEY FINDINGS/RECOMMENDATIONS OF THE PHASE 1 NRC SBIR STUDY

The NRC committee concluded that the program was indeed advancing the goals of stimulating technological innovation, increasing commercialization of innovation in the private sector, using small business to meet federal agency R&D needs, and stimulating participation by minority and disadvantaged persons in technological innovation. Table 1 summarizes the goals, proxies for achieving those goals, and key outcome indicators the committee used to assess whether the SBIR was accomplishing these objectives.

As shown in Table 1, the evidence clearly indicates that the program has been successful in achieving these goals. Success has occurred along several dimensions: job and new firm creation, enabling government agencies to advance their missions (e.g., the development of simulation software for Navy Seals, which has saved lives and costly equipment), creation of new products and various forms of intellectual property, and success in financial markets. The only area where significant improvement is needed is increasing participation by minorities and disadvantaged people in the technological innovation. This is especially true for minority participation, which has actually decreased over time.

The NRC Committee issued a series of recommendations. First and foremost, the SBIR program should be preserved because it is effective. Given that program flexibility (across federal agencies) is a strength, such flexibility should be preserved. The committee commended SBA, which oversees the eleven SBIR programs, for its flexibility in exercising its oversight responsibilities. There was also a strong desire to encourage innovation and experimentation across agencies, while preserving the basic program structure (i.e., the three phase approach of the SBIR program). Another key recommendation was to readjust (increase) award sizes, which have not been increased since 1995.

There were also several recommendations relating to improvements in program processes (i.e., managing the program). The most important of these recommendations is the need to shorten the cycle time from application to award (which will ultimately, accelerate technology commercialization). It is important to note that processing periods for awards vary substantially by agency, which has a significant effect on recipient companies. Agencies should closely monitor and report on cycle times for each element of the SBIR program: topic development and publication, solicitation, application review, contracting, Phase II application and selection, and Phase III contracting. Agencies should also specifically report on initiatives to shorten the decision cycle. The committee also stressed to need to increase participation and success by women and minorities in the SBIR program. They identified a set of tactics to accomplish that strategic goal, in including improve data collection and analysis of factors that may account for the lower success rates of woman-

and minority-owned firms, as compared with other firms, in receiving Phase I awards. Finally, the NRC team also stressed the importance of increasing management funding for SBIR, e.g., by increasing the set-aside to provide for program management and evaluation.

From my perspective (given my concern regarding accountability and evaluation of government programs), by far the most important committee recommendation was emphasizing the need to **conduct regular, rigorous systematic evaluations of the program.** This will require direct annual reports to Congress by program managers on the state of the SBIR program at their agency. The program should be evaluated internally, i.e., within each agency and agencies should be encouraged to develop interoperable standards for data collection and dissemination. Most importantly, there is also a strong need for comprehensive, periodic external evaluations of the program by a non-partisan organization, such as NRC.

OBJECTIVES OF CURRENT NRC SBIR STUDY

The NRC is currently engaged in a second phase of the SBIR study, which is highly critical, given that it will enable us to generate a second "snapshot" of the program (through extensive surveys and case studies). Evaluation must always be an ongoing process and analyzing changes in the SBIR program over time will allow the NRC team to develop better recommendations for improving the program. In sum, a second phase of the SBIR study provides will facilitate a "longitudinal" analysis, rather than a simple "cross-sectional" analysis, which is both more rigorous and more relevant.

Building on the previous study, the NRC committee is currently assessing several important research questions: (1) how the program can be modified to enhance the probability of successful commercialization programs, including the use of "gap funding mechanisms" to address the "valley of death" problem, (2) identifying strategies to encourage participation by minorities and women-led firms in SBIR; (3) how to use existing university-industry partnerships to leverage SBIR; (4) new approaches to streamlining the application and grant/contract awarding processes; and (5) what we can learn from innovative state-level technology commercialization programs and how those can be leveraged at the federal level.

Although these are all important research questions, my own research underscores the importance of identifying best practices in university-industry partnering and synergies with SBIR programs. As noted in Siegel and Phan (2005), universities have recently devoted more attention to the entrepreneurial dimension of technology transfer. This has induced the creation of numerous university-based spinouts and connections to local start-up companies founded by academic entrepreneurs or their students. This is important since two recent academic studies (Link and Ruhm (2009); Siegel and Wessner (2011)), based on data collected during the Phase I NRC study clearly demonstrate that a university connection to an SBIR project substantially increases the likelihood of successful commercialization. Note that in this context (see Siegel and Wessner (2011), "success" in the marketplace resulting from SBIR projects includes numerous performance/commercialization indicators, such as:

- Sales to date of products, processes, and services from the project
- Expected future sales
- New employees hired as a result of the SBIR project
- Patents
- Copyrights

- Trademarks
- Domestic/international licensing agreements

NEED FOR ADDITIONAL NRC STUDIES OF SBIR

Innovation and entrepreneurship are important determinants of economic growth. The SBIR Program was established because there was a strong bi-partisan consensus that, in the absence of government intervention, there is under-investment in early-stage research with commercial promise in a free market economy. The NRC study clearly demonstrates that the SBIR Program is effectively addressing this problem and significantly improving the performance of small, technology-based firms.

The quality of the analysis and usefulness of the recommendations provided by the NRC team raises an important issue relating to government accountability. Let's consider three types of government programs: social programs, educational initiatives, and technology programs. Typically, educational and social programs are rigorously evaluated. Indeed, it is quite common for evaluation to be built into the design of an educational or social program. Analysis of these programs has yielded important insights for policymakers, resulting in such important changes as welfare reform, which had broad bi-partisan support.

However, despite wide-spread agreement that innovation and entrepreneurship constitute sources of our global competitive advantage, technology programs are almost never carefully evaluated. I have always found that rather strange. Given the connection inherent in SBIR between innovation and entrepreneurship, it is the most important government program in this realm. Thus, I believe that SBIR needs to be carefully scrutinized on an on-going basis, under the auspices of the NRC. If we are serious about evaluation and accountability, we will continue to support the NRC's efforts to scrutinize this important program.

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Table 1
NRC Assessment of SBIR Program

Goal of SBIR Program	**Proxy for Achieving Goal**	**Key Outcome Indicators/Findings**
Stimulating Technological Innovation	Generation of New Knowledge	Increases in Patents, Licenses, New Products and Processes, Creation of New Firms, Data, Models, Algorithms, and Research Equipment
Stimulating Technological Innovation	Stimulating Technology Transfer/Commercialization From Universities to Firms	Over a Third of Firms Reported University Involvement in Their SBIR Project; More Than Two-Thirds of These Companies Reported That At Least One Founder Was Previously An Academic; 27% Of Projects Used Faculty as Contractors
Increasing Private Sector Commercialization of Innovations	Facilitator of Commercialization For Small Firms.	New Firm Creation-Over 20 % of Companies Were Founded Entirely or Partly Because of a Prospective SBIR Award
Increasing Private Sector Commercialization of Innovations	The Decision to Initiate Research	Companies Reported That Over Two-Thirds of SBIR Projects Would Not Have Taken Place Without SBIR Funding
Increasing Private Sector Commercialization of Innovations	Providing Alternative Development Paths	Companies Often Use SBIR to Fund Alternate Development Strategies
Increasing Private Sector Commercialization of Innovations	Reaching the Market	Just Under Half of SBIR Projects Reach the Market (Highly Impressive, Given The Embryonic Nature of These Technologies and The Market Risk!)
Increasing Private Sector Commercialization of Innovations	A Small Percentage of Projects Account for Most Successes	As Expected, A Small Percentage of Projects Account For Significant Growth in Sales and Employment

Table 1 (cont.)
NRC Assessment of SBIR Program

Increasing Private Sector Commercialization of Innovations	SBIR is an Input, not a Panacea	While SBIR Stimulates Small Business Commercialization Of Research, Most Major Commercialization Successes Require Substantial Post-SBIR Research and Funding From a Variety of Sources
Using Small Businesses to Meet Federal Research and Development Needs	Flexible Adaptation to Agency Mission	The SBIR Program Has Been Adapted Effectively by the Management of the Individual Departments, Services, and Agencies. SBIR Flexibility in Program Management and Modes of Operation is a Key Strength
Using Small Businesses to Meet Federal Research and Development Needs	Meeting Agency Procurement Needs	SBIR Helps to Meet the Procurement Needs of Diverse Federal Agencies (e.g., at the Department of Defense, the Navy has achieved significant success in improving the insertion of SBIR-funded technologies into the acquisition process.
Providing Widely Distributed Support for Innovation Activity	Large Number of Firms	Between 1992 and 2005, Approximately 15,000 Firms Received At Least One Phase II award
Providing Widely Distributed Support for Innovation Activity	Many New Participants	Each Year, Over One Third of The Firms Awarded SBIR Funds Participate in the Program For the First Time
Fostering Participation by Minority and Disadvantaged Persons in Technological Innovation	Mixed Record	Agencies Do Not Have a Uniformly Positive Record, In Terms of Collecting Data and Monitoring Funding Flows for Research by Woman- and Minority-Owned Firms
Fostering Participation by Minority and Disadvantaged Persons in Technological Innovation	Mixed Record	While Support for Woman-Owned Businesses is Increasing, Support for Minority-Owned Firms Has Not Increased