SBIR, RENEWAL AND U.S. ECONOMIC SECURITY

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Congress will shortly consider some changes in the federal SBIR and STTR programs including venture capital participation and renewal of the legislation. These are important to consider. More important is the need to increase the participation of innovative small high tech firms in government R&D. In contrast to other government R&D, they focus on technological innovation and technology breakthroughs that the nation needs for economic growth and security. Consider our continuing loss of manufacturing, millions of related jobs, and a trade deficit at record levels with no apparent solution in sight. Many economists and industrial leaders have spoken out on the importance of technology-based innovation.

The Small Business Innovation Research program was designed specifically to increase technology-based innovation in 1977 at NSF. It was extended government-wide by Congress and signed by President Reagan to the 11 largest R&D agencies in 1982. SBIR has grown steadily and received favorable performance reviews by GAO, Dr. Josh Lerner of Harvard Business School, and the National Research Council of the National Academy of Sciences.

Total scientists and engineers employed in R&D in industry	10,920,523	100%
Employed by firms with 500 or less employees	5,986,524	54.8
Employed by firms with more than 500 employees	4,933,999	45.2
	(000)	%
Total Extramural Federal R&D Expenditures (net of R&D Plant $)	$ 81,675,000	100.0
Industry expenditures of federal R&D dollars total	44,577,000	54.6
By firms with 500 or less employees	3,527,000	4.3
By firms with more than 500 employees	41,050,000	50.3
By firms with more than 500 employees directly	39,411,000	48.3
Plus FFRDC R&D by firms with more than 500 employees	1,639,000	2.0
Total federal R&D performed by large firms	41,050,000	50.3
By universities	23,900,000	29.2
Plus FFRDC's R&D administered by universities	4,955,000	6.1
Total university R&D	28,855,000	35.3
By non-profits	5,972,000	8.1
Plus FFRDC R&D administered by non-profits	1,464,000	1.9
Total non-profit R&D	7,436,000	10.0
States and Foreign	$807,000	1.0
Source: "Science and Engineering Indicators 2006" figures for 2005		

Small technology firms with 500 or less employees now employ 54.8 percent of all scientists and engineers in US industrial R&D. However, these nearly 6 million scientists and engineers are able to obtain only 4.3 percent of extramural government R&D dollars. In contrast, large and medium firms with more than 500 employees combined employ only 45.2 percent but receive 50.3 percent of government R&D funds. Universities receive 35.3 percent, non-profit research institutions 10.0 percent, and states and foreign countries 1.0 percent. Of the 4.3

percent that goes to small firms 2.5 percent is from SBIR and the related Small Business Technology Transfer (STTR) program. Together they receive less than 10 percent of the funding that large firms receive.

Paul Romer, Stanford University economist, has said that his research shows that the key determinant of economic growth is not tax rates or monetary policy, but the pace of technological innovation. Small firms have clearly been a significant factor in US technological innovation.

A major question is -- Why do Federal agencies continue to severely limit their funding to small firms? It is the small firm that moves quickly into new and emerging areas, that can raise tens of millions of venture capital, are more innovative, efficient and lower cost. We need to think about what firms founded since 1960 have done -- in Silicon Valley, around Route 128 near Boston, in San Diego, Austin, Atlanta, Minneapolis, Seattle and in most major cities and research university locations. Many of these startups have become world leaders in their field. Their technology and products have made an enormous impact on our quality of life, and the world's. They are also responsible for many billions of dollars of investment and sales, and millions of quality jobs directly and much more indirectly. In contrast, our large industrials are moving their manufacturing jobs rapidly to China and other low wage countries.

Why is it that with this track record in innovation, our technological competitiveness in new areas and related economic growth that federal funding to small tech firms is so limited? After 24 years at NSF working with most federal R&D agencies, I believe it is the direct result of continuous opposition from the traditional recipients of government R&D, their associations and lobbies, to get more and retain or increase their percentage of federal R&D dollars. It is not all technical merit or the importance of their research to the country. New economy-related technology breakthroughs are at least as important in our current environment. It is political power that wins. Many federal agencies seem to be wedded to this same tradition and also oppose increasing the proportion going to thousands of small high tech firms that have little political power to improve their situation. Some of this difference is understandable, but the enormous degree of difference is not.

Thousands of small firms and their research scientists and engineers are brilliant, extremely innovative, competent and motivated. They and the firm must be innovative to succeed and survive. They want to pursue technological innovations and breakthrough ideas, particularly in emerging areas. Seeking innovation and technology breakthroughs is high risk, probably equal to that in basic research and much other government R&D, too high for most private investors, large firms and venture capitalists.

I believe there is a national need for our economic security to seek technology breakthroughs. I also believe that small high tech firms are the most effective and efficient strategy to do this. The very high risk requires a source for funding cutting-edge research for new breakthrough ideas at the idea stage where there is financial market failure. The risk is simply too high, as it is for basic research, for private sources.

This is what SBIR and STTR were designed to do. The goal is to find promising new ideas, select the most promising, fund early research to explore technical feasibility and lower the risk to levels more acceptable to private investors. It is extremely difficult for small high tech companies to find initial funding for innovative ideas, particularly in new and emerging fields, in areas extremely important to the nation's future. The computer, software and biotech revolutions are good examples.

As problems have become more challenging, initial funding at the idea level has become steadily more difficult to obtain from venture capital firms and others. The stock market crash of 2000 increased the resistance of potential investors to this type of funding. VC's generally want to see that the idea is technically feasible before investing and better yet, that is on the market and looks promising.

The SBIR approach may be the most effective and efficient way to fund small high tech firms to meet this need. It is a legislated program now embedded in 11 agencies, with significant collaboration with research universities and the venture capital industry. It is known and understood by tens of thousands of scientists and engineers in small firms, government and universities, and by others in venture capital, large firms, Congress, and all 50 states. The 3-phase program is extremely competitive with only about one of 16-20 original proposals submitted in Phase I receiving the larger funding in Phase II. Phase III support must come from private investors or from non-SBIR/STTR funds from such agencies as Defense and NASA.

Most breakthroughs in emerging fields do not come from large firms. This was the case with smaller computers, software, Internet applications, and biotech. Individuals and small high tech firms contribute disproportionately to innovation and technology breakthroughs. Large firms focus more on improving their competitiveness, sales and profit margin of existing products or services and adding related new items. Most small high tech firms were founded to chase a new idea or need. They seldom can compete with large firms in their product areas. However, breakthrough ideas from startups in emerging fields created most of the industry leaders such as Intel, Microsoft, Apple, Dell, Cisco Systems, FedEx, Amgen, Medtronic, Genentech, Ebay, Amazon and thousands of others of all sizes. Symantec started with an SBIR award. Qualcomm received 12 SBIR awards totaling $1.6 million when it had about 35 employees. SBIR also creates acquisitions such as Orincon, now Lockheed Martin Orincon. It received 130 SBIR awards over 16 years totaling $35 million. By 2003 sales had increased to $60 million, it had four suitors. Some 800 firms with SBIR awards have been acquired by other companies.

Small technology firms are often more creative and faster at converting innovative ideas into new products. More importantly, they stimulate billions of private investment, millions of quality jobs (6 million scientists and engineers alone as stated earlier) and enormous economic impact. They also become a valuable national farm-system for acquisitions by other firms and for the venture capital industry investment. Many large companies, such as DuPont, for example, have acquired more than 100 companies, most of them small.

Response time is increasingly important. We are living in a faster changing and far more competitive economic world that favors the innovativeness, speed and lower costs, all features of the small company, particularly in emerging fields. The most critical problem they face is the unwillingness of investors to fund cutting-edge research at the idea level as mentioned before. Our small high tech firms are still a unique national asset but not if they cannot find investors at the idea stage. Government investment in stimulating high risk innovative and breakthrough ideas would appear to be appropriate to strengthen our economic security -- and a useful strategy. SBIR does this by funding the gap between promising ideas and private investment. It focuses directly on the key problem -- the shortage of initial funding needed to explore thousands of promising new ideas and lower the risk to levels acceptable to follow-on private investors, often VC firms. Further success can lead to Initial Public Offerings (IPO), secondary offerings or even acquisition by another firm as frequently happens.

I have been asked - Why can't large firms or universities solve our innovation problem just as well? The answer is the eventual need for large amounts of high-risk investment to move an

idea all the way to the marketplace. Large firms usually will not take this risk in new or emerging areas because the risk is too high. Only small firms with low stock values and capitalization can attract the needed investment. With success a small company's stock can multiply in value and time by 10-50 or more times. The investor in high-risk projects needs the potential for the stock to multiply many times, sufficient to offset the risk. A major success can result in enormous increases in stock value and personal wealth for many that are involved. Most large firms cannot take such risks. Their appreciated stock cannot multiply in value enough even if the idea is successful. They also cannot afford failure and what it would do to their profit projections. Seldom do they invest large amounts in ideas outside their existing product lines or in new fields. Instead, they may wait and buy or merge with a firm that has made a breakthrough in a field of interest, after it has proven successful.

Interestingly, many of our most creative scientists and engineers prefer to work in small high tech firms. They want to work on "their" ideas without being controlled by layers of superiors, team effort compromises, or other corporate priorities. Bill Gates is an excellent example some of the best and the brightest prefer to work in or start their own small company. He knew what was necessary and IBM did not, in his opinion. He also intended to do what he felt needed and do it faster, more effectively, and at far lower cost. It is an example of why many small firms have been the best vehicle for converting breakthrough ideas into successful new products and services. That is the opportunity that SBIR and STTR funding provide to thousands of scientists and engineers.

There are good reasons for increasing the funding of SBIR increasing with the renewal of legislation. We face an enormous loss of manufacturing jobs and significantly increased competition in technology and innovation. We must consider our problems with our trade deficit and increase our interest in our economic security and competitiveness. There is a need to accelerate our research seeking technology breakthroughs, particularly in new fields. Raising large amounts of high risk capital to finance cutting-edge research is critical to this process. Universities or large firms are not ideal because they cannot raise the required follow-on capital.

The three key players are small high tech companies, venture capital firms, and research universities. The SBIR and STTR design involves all three. Currently we have an advantage as the US now leads the world in each category. SBIR/STTR funding of the initial cutting-edge research to explore the technical feasibility of the idea, often in collaboration with university scientists, is the key factor to start the process. VC firms are interested in the results and often will invest in the firm if results are promising. STTR requires joint-university collaborative projects to increase needed university/small tech firm collaboration. The approach also is aimed at increasing the economic return on our investment in basic research. However, the problem is that - **If there is no initial investment at the idea stage, there is no economic result.**

The SBIR design is a result of my reading about 50 articles and papers on innovation, technology breakthroughs, and best R&D practices. I also had discussions with many economists including some specializing in innovation, many VC people, some in large firms, universities, federal government specialists, and others. There were a number of visits to Silicon Valley and Route 128 firms, to VC people and to 12 or so major technical universities both before and after I joined NSF. I talked at length with people from MIT, Harvard Business School and Stanford and have had many discussions with many specialists in NSF, SBA, Defense, NASA and NIH. In the federal program there was careful coordination with SBA and later the Small Business Committee staff in the House and Senate, in GAO, and with intellectual property experts. Prior to joining NSF I had been VP of two small to medium-sized

technology companies for 13 years and a founder and director of Allied Capital. I was well aware of the problems of small tech firms in obtaining financing for new ideas.

SBIR was carefully designed to increase the opportunity for small firms to participate in federal R&D. It has but 2.5 percent spread over 11 agencies when there are more scientists and engineers in R&D in small firms than large is probably not what is best for the country. It was also to increase the economic return from government research and R&D. Another objective is from the beginning was to prevent the funding of marginal research. It is a three-phase program that stops continued spending on less promising ideas. First, It is very competitive with only one out of 8-10 Phase I proposals funded. This provides an initial investment limited to $100,000 for six months of research to determine as quickly as possible if an idea appears to be technically feasible -- and the quality of the research. It requires a new more comprehensive proposal for Phase II based on Phase I results. The objective is still technical feasibility l but also its commercial potential. About 40-50 percent are funded for research or R&D up to $750,000 and two years. No further SBIR funds are spent. Phase III must be privately funded unless Defense or NASA, for example, is the customer, and they fund Phase III with non-SBIR funds. SBIR money only funds advanced high-risk research of interest to the agency. Private investment then funds the product development and commercialization. The quality of research has been high.

While the goal was to focus directly on the critical problem in obtaining initial funding at the idea stage, there were other important objectives, too. These included opening up almost all federal R&D to small high tech firms. This was not possible prior to SBIR. It provided quality small companies with a potential source of cutting-edge research funding that is critical for high tech firms. It was often impossible for a small firm to obtain prior to SBIR. Other goals included focusing more government R&D on innovation and emerging areas, particularly those that have economic and commercial potential. There is a continuing need to encourage university/small tech firm collaboration that needs to be expanded. It was also critical to insure a first-rate and efficient review process in order to select the best proposals and to provide the company with intellectual property rights. SBIR gave small firms (and universities) that right and was the basis for the Bayh-Dole Bill in 1980, three years after SBIR began at NSF in 1977.

A major objective of the program as stated earlier was to provide the initial funding for ideas prior to venture capital to reduce the severe financing gap that faced almost all small high tech firms. It has done so for those that received awards and significantly increased the interest of VC's, large firms and other potential Phase III investors. A technology breakthrough in a promising area can result in significant growth and profit wealth for the company, and wealth for key employees and investors and the related taxes from this government investment. SBIR/STTR not only help companies interested in breakthroughs find capital, but also it helps attract creative and brilliant scientists and entrepreneurs to start or join small high tech firms.

When the technical risk is too high to attract private investment, as it is for most breakthrough ideas, government funding should be appropriate, as it is for basic research, defense, space, health, and home security. Why not for economic security as well?

SBIR is a valuable lever to stimulate technological innovation and technology breakthroughs, faster, more effectively and at lower cost than possibly any other approach.

I suggest the following changes be considered on renewal:

1. There is a need to increase the size limit of awards to $150,000 in Phase I and $1 million in Phase II with no exceptions for agencies. To allow higher limits for some will be exploited by some companies and unfair to others. If a small firm cannot attract follow-on private or non-SBIR funding after spending $1,150,000 of government funds on a project, it should fund other promising projects. If an agency feels that a project's merit justifies more investment, then it can do so in Phase III with non-SBIR funds. Larger awards significantly reduce the number of awards and therefore the number of ideas and companies that can be funded, such as $2 million Phase II's would reduce the number of awards by one-half. If higher limits are allowed for one agency the same limits will soon be requested and often approved by others. Innovation and breakthrough R&D is increasingly expensive and salaries have increased since 1996. SBIR is not intended to cover all costs but rather fund early research on technical feasibility to reduce the risk and increase the interest of follow-on investors. The limit is also necessary to prevent exploitation by some companies and VC firms. Larger award limits will encourage many firms to seek the maximum simply to obtain as much funding as possible from government, rather investing private funding. If started, this practice would be difficult to stop by SBA or other agencies. I suggest that NIH, and maybe only NIH, should be able to use additional SBIR funding for project-related efficacy, toxicology and other studies required by law.

2. A successful small firm should not be denied eligibility to propose ideas to SBIR as long as the total number of employees in all affiliated firms, including all companies controlled by the VC firm, is 500 or less employees. SBIR is designed to attract venture capital. VC firms at times acquire more than 50 percent ownership in an SBIR firm, particularly with follow-on investments and this should not deny participation. However, SBIR awards must be made to legitimate small companies to be fair to all competitors and SBIR firms must not be directly or indirectly controlled by large venture capital firms or by any large companies.

3. I suggest that SBIR be increased by 0.5 percent annually until it reaches at least 5. 0 percent over the next five years and STTR by 1.0 percent annually until it reaches 5.0 percent also over same five years. We need to significantly increase university/small tech firm collaboration to achieve technology breakthroughs. STTR must be significantly larger to attract research universities' collaboration. This would mean that about 40 percent of STTR funding would be going to universities or 2 percent of the 5 percent of STTR. STTR firms would receive 60 percent of STTR awards funding equal to 3 percent of extramural federal R&D. Therefore total federal R&D going to SBIR and STTR would gradually increase to 8.0 percent by 2012. Our 6 million small technology firm scientists and engineers in small technology firms are an important US asset and we need to increase their participation in federal R&D.

4. There is great need to increase the number of SBIR/STTR staff in SBA. No program of this size can be administered with 5-6 employees. The criticism of SBIR performance when grossly understaffed is unfair. It has been steadily reduced to 5-6 people, about half of what it was when the program was half its current size. SBA must have more resources to conduct the program properly as Congress intended. This should be reviewed and evaluated by an independent specialist in this field.

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