Why is government subsidizing commercially promising business projects?

The R&D Boondoggle

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Most people appreciate the economic importance of research and development (R&D). Society benefits greatly from R&D as scientists and engineers make new discoveries and find innovative, unanticipated ways to apply research results. Numerous studies show that investment in R&D is a leading contributor to economic growth and the quality of life.

Despite these benefits to society, firms generally underinvest in R&D because the innovator often receives considerably less benefits than society. Government can counter this market failure by subsidizing research efforts that promise great potential gains for society but are unlikely to yield profits to the innovator.

The federal government has traditionally supported R&D directed at government needs, such as the development of large weapons systems and computer networks. This research sometimes yields commercial benefits — usually resulting from unintentional spillovers as firms find unexpected uses for new discoveries — but the government primarily intends for these programs to produce public goods.

In recent years, however, the federal government has become increasingly supportive of R&D intended to yield commercial products. Supporters justify these subsidy programs by arguing that government funds increase the profitability of this research, encouraging firms to undertake R&D that would otherwise be unprofitable and risky.

This justification sounds reasonable, but do such programs, in practice, rectify the market failure? In some cases where government attempts to mitigate such failures, it unintentionally generates incentives that undo many of the programs' intended benefits. These unintentional incentives may be especially prevalent in today's government-industry technology programs, in which firms typically apply for subsidies for research aimed at commercializing products and the government chooses which research proposals to subsidize. If government agencies choose to fund the most commercially promising proposals they receive, then they will support projects that firms are inclined to finance on their own. In other words, government subsidies could crowd out private R&D spending. Subsidizing these projects could thus create an illusion of success by producing lots of commercial products and anecdotal "success stories," but the subsidies would not succeed in their intended purpose of supporting R&D that firms would not finance privately.

SUBSIDIZING THE RIGHT PROPOSALS

A government-industry technology program increases innovation if it funds projects with relatively high spillovers and low private returns. Unfortunately, it does not appear that government identifies and subsidizes such projects. Federal technology programs usually require industry to propose projects that the government then evaluates to determine which projects to fund. Because government subsidies often cost less than capital from other sources, firms may be tempted to look to government before turning to other sources for financial support. Government, thus, must determine which proposed research projects would benefit society but would not attract private funding. This means that government should not fund the best, most commercially appealing proposals it receives.

To encourage this selection, government should reward its program managers who choose to subsidize socially beneficial proposals, and it should punish (or at least not reward) managers for funding projects that firms would undertake without a subsidy. Unfortunately, this mechanism of rewards and punishments would be difficult to implement.

First, observers must recognize that R&D is inherent-

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ly risky and many projects will fail. Indeed, if the program subsidizes only successful projects, then program managers are probably not taking enough risks. But government-industry R&D programs — especially those aimed at commercialization — are controversial. Program supporters may be reluctant to allow many failures for fear that opponents will point to individual *project* failures as evidence of *program* failure. Likewise, managers may not feel comfortable rejecting the most promising proposals because they want to increase the chances of achieving commercial success or because it puts them in the position of rejecting proposals that are "too good."

Second, political factors decrease the likelihood that government can implement these programs efficiently. The politics of technology spending are similar to those of other issues. In their book *The Technology Pork Barrel*, professors Linda Cohen and Roger Noll point out that politicians face incentives to treat technology programs like they do other government spending: as a way to reward constituents, not to correct market failures. Cohen and Noll conclude "that the goal of economic efficiency — to cure market failures in privately sponsored commercial innovation — is so severely constrained by political forces that an effective, coherent national commercial R&D program has never been put in place." Politicians who favor allocating technology funds on the basis of constituencies may object to comprehensive evaluations that have the potential to highlight funds allocated for reasons other than economic efficiency.

My point is not that government subsidies of industrial R&D are necessarily wasteful. The government plays an important role in funding research and ample evidence suggests that more R&D spending could increase economic growth. My point is that subsidy programs for commercial R&D may offer the appearance of success, but in reality they may subsidize projects that need no subsidy.

A CASE STUDY: THE SMALL BUSINESS INNOVATION RESEARCH PROGRAM

THE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR) typifies apparent problems with government-subsidized commercial R&D. Passed by Congress in 1982 and implemented in 1983, SBIR requires every federal agency that doles out $100 million in R&D contracts and grants to set aside a percentage of that budget for SBIR grants. The first year of the program mandated a set aside of two-tenths of a percent. But that percentage has increased several times in the following years and now stands at 2.5 percent, equivalent to more than $1 billion a year.

One of SBIR's goals is to "stimulate technological innovation," which implies that it hopes to address the R&D underinvestment problem. But the program's regulatory guidelines do not encourage managers to fund commercially marginal projects; they instruct managers to select proposals on technical merit and potential for commercial success — the same criteria a private investor might use.

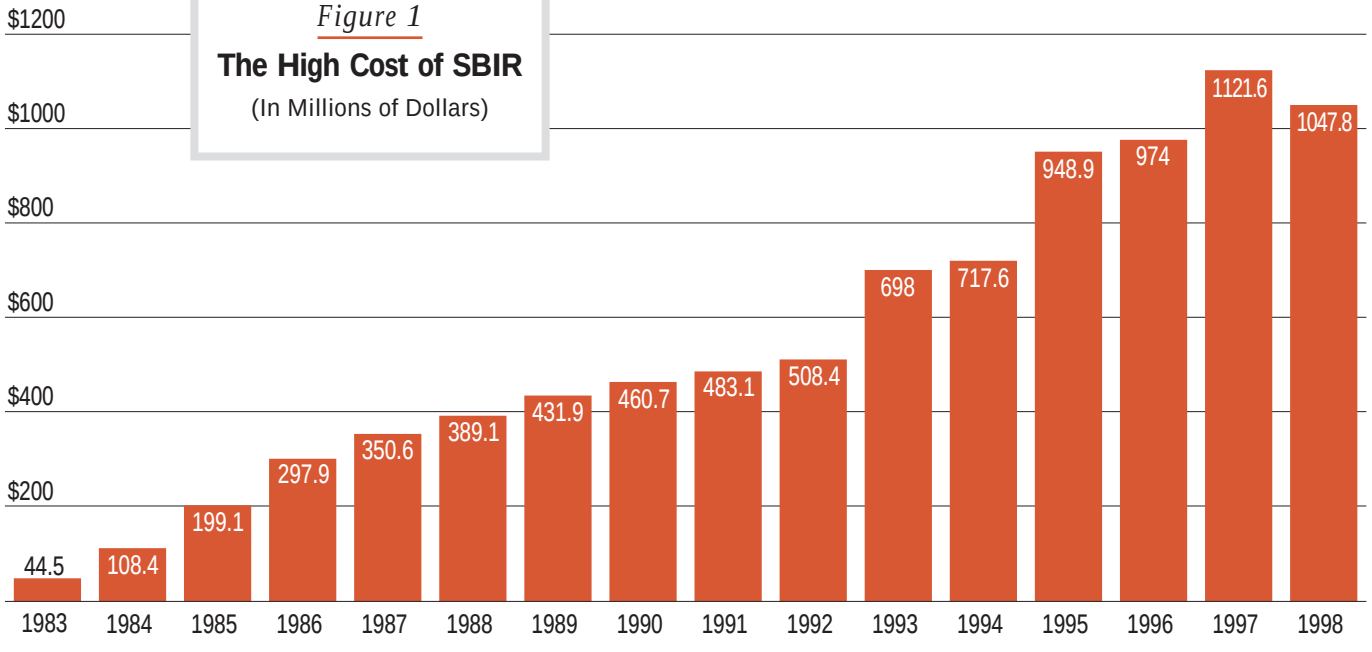
If SBIR is properly addressing the underinvestment problem, then the federal government should only subsidize research in which the total expected benefits to society exceed the costs, but the benefits to the innovating firm do not. At the same time, the program should not disturb the private financing of commercially promising research. That way, the program would expand overall R&D and the benefits it brings to society.

However, an empirical study that I conducted of 513 firms involved in SBIR showed little evidence that the pro-

Figure 1

The High Cost of SBIR

(In Millions of Dollars)



Federal outlays under the Small Business Innovation Research program since it began in 1983. The program was renewed in 1992 and 2000, and is authorized through 2008.

gram increased R&D. I found that, on average, the grants had no effect on the firms' employment and appeared to crowd out privately funded research dollar-for-dollar. That is, for each dollar the firm received in SBIR subsidies, its own R&D spending decreased by approximately a dollar. (See box.) This appears to be an example of the unintentional incentive problem discussed above; the subsidy program seems to provide an incentive for companies to cut their research budgets and pass R&D costs on to the government.

Government evaluations of SBIR do not test for this problem. The U.S. General Accounting Office (GAO) conducts the only official evaluations of the program, and it does so primarily by surveying grant recipients to determine whether funded projects succeeded in the market. The GAO reports that funded projects tend to succeed in the market, but it does not evaluate whether the projects would have been carried out without subsidy. The fact that many projects have commercial success says nothing about whether SBIR truly stimulated innovation and commercialization.

Because the GAO surveys only SBIR award recipients, the evaluations have no control group of firms against which to compare results. Direct surveys of a program's beneficiaries are not the best way to analyze a program's effectiveness. A rational firm would not be inclined to report that it did not need government funds after it received them, especially if the firm hopes to receive more money in the future. I do not idly speculate when I talk of firms hoping to receive additional SBIR funding; many firms receive multiple awards every year. In my sample of 513 firms, 61 received more than ten awards each over the three-year period I studied. A 1999 GAO report shows 24 firms received more than 100 awards each between 1983 and 1998, led by Foster Miller of Massachusetts who received almost 600 awards.

In the absence of a mechanism to identify marginal

Analyzing SBIR

To test whether the Small Business Innovation Research program supports proposals that would have been undertaken without subsidy, I constructed a dataset of more than 513 firms that applied for Phase II SBIR awards (grants intended to cover the development phase between initial research and commercial development) from 1990 through 1992. Some of these firms received subsidies and some did not. By using this dataset, I was able to control explicitly for the government's choice of which firms to fund.

My analysis faced an initial econometric problem: a simple correlation between SBIR awards and the amount of R&D undertaken by award-winning companies would not, in fact, prove a causal link. The correlation could reveal that the subsidies produced more research, but it could also indicate that companies with considerable initial R&D efforts later received SBIR grants. To overcome this problem, I needed to find an instrumental variable that would correlate with winning awards but not correlate with the firms' underlying, commercially driven innovativeness.

The instrument I used was the total SBIR budget for each agency from which the companies could win awards. Because federal agencies must spend their total SBIR budget, this variable turned out to be a strong predictor of the number of awards that companies would win.

I then estimated a pair of equations simultaneously. The first equation (which includes the instrumental variable

Table 1

Regression Results: Awards and Employment

(Absolute t-statistics in parentheses)

	OLS	Three-stage least-squares	
Dependent Variable	log (employment 1993)	Number of SBIR Awards	log (employment 1993)
Constant	.97 (6.39)	-1.58 (2.66)	.94 (6.27)
Number of SBIR Awards	.02 (3.33)		.01 (.94)
SBIR Budget Instrument ($millions)		3.91 (17.13)	
log (age)	-.20 (3.39)	.20 (.91)	-.19 (3.46)
log (employment 1991)	.85 (35.85)	.16 (1.86)	.85 (39.99)
Patents 1988-1989	-.0007 (.03)	.29 (4.24)	.004 (.23)
Never applied	-.33 (2.47)		-.32 (2.41)
Minority owned?	-.03 (.51)	.19 (.70)	
Publicly traded?	.46 (5.40)	-.22 (.75)	.45 (5.45)
R^2 481 observations	.85	.54	.85

effects, advocates point to any funded project that achieved commercial success as evidence of program success. When Congress considered SBIR renewal in 1991, Representative John LaFalce (D, N.Y.), former chairman of the House Committee on Small Business and a leading SBIR proponent, noted as he opened legislative hearings that:

> [T]he public investment in small business innovation, through the SBIR Program, has been productive beyond anybody's expectations. The General Accounting Office study will document that the federal government's investment of roughly $1 billion in the SBIR program from 1984-87 has, in addition to fulfilling the government's R&D needs, generated more than $1 billion in commercial spinoff of innovative products and additional developmental funding. The Small Business Administration study will indicate that roughly one in four SBIR projects result in the development and sale of a new commercial product — a ratio that is remarkably high in the risky R&D business.

The "commercial spinoff" clearly was not only commercial success on the margin, and the "remarkably high" success ratio of funded projects may actually indicate the program did not take sufficient risks.

The Small Business Administration (SBA) adopts the same anecdotal approach to assessing the program. The SBA Office of Advocacy has claimed that SBIR has the highest commercial success rate of any federal R&D program and that the program is therefore a success. Again, the implication is that any commercialization is evidence of program success, without any thought as to whether the subsidy was responsible for that success. These reports may convey to a government program manager that a high commercialization rate is the key indicator of success.

Conversely, some program reviews implicitly suggest that efforts to fund R&D on the margin may be punished. A 1992 GAO report notes that the Department of Defense

described above) represents the federal agency's decision on how many awards to give a company. The second equation then estimates the effect those awards had on the company. I estimated this pair of equations twice: once to explore the effects on the company's employment (Table 1), and again to explore the effects on the company's R&D spending (Table 2). The estimation also controls for the number of patents a company holds, the company's employment in 1991, the company's age, whether it is minority-owned, and whether it is publicly traded.

Table 1 highlights the importance of controlling for the econometric problem. The first column shows a simple regression that does not deal with the problem. The regression indicates a statistically significant correlation between company employment and SBIR development awards, consistent with reports finding commercial success of SBIR-funded firms and projects. The last two columns show the results when estimating the simultaneous equations while controlling for the econometric problem: the more employees a company has, the more likely it is to win SBIR awards (column 2), but the awards themselves have no effect on employment (column 3).

Table 2 shows similar estimations of effects on a company's private R&D spending. This analysis includes only the companies in the sample that are publicly traded because only those companies are required to reveal R&D spending. The analysis demonstrates that each developmental award is associated with a reduction of approximately $530,000 in privately financed R&D spending. Because each developmental award was worth about $500,000 during this time period, the results strongly suggest a dollar-for-dollar crowding out effect of SBIR grants. That is, government and private funds were completely fungible: for each dollar in subsidy the average company received, it reduced its own private R&D spending by a dollar. Rather than stimulating technological progress, SBIR subsidies appear to crowd out private R&D.

Table 2

Regression Results: Awards and R&D Spending

(Absolute t-statistics in parentheses)

Dependent Variable	Number of SBIR Awards	R&D spending 1992
Constant	.05 (.11)	2746580 (2.04)
Number of SBIR Awards		-530495 (2.30)
SBIR Budget Instrument ($millions)	4.55 (12.02)	
Age	-.02 (1.74)	-35644 (1.02)
Employment 1991	.00 (.38)	-2487.04 (.29)
Patents 1988-1989	.16 (1.96)	373376 (1.59)
R&D Spending 1990	.00 (3.55)	1.01 (4.89)
Never Applied		-1898030 (2.50)
R^2 81 Observations	.81	.70

Taken together, these findings suggest that government is failing to identify and fund proposals that would not be funded without federal support. Instead, it seems that government is selecting the "better" firms whose projects may be funded even absent federal support. R

(DOD) had a lower SBIR commercialization rate than other agencies. While noting that DOD tried harder than other agencies to use SBIR to achieve mission objectives, GAO concluded that the relatively low market success rate of funded projects "raises the question of whether DOD should be placing greater emphasis on private-sector commercialization." A DOD program manager could ensure better evaluations in the future by funding lower-risk projects that yield higher commercialization rates. Those higher commercialization rates, however, would not necessarily indicate a greater economic impact.

WHAT SHOULD BE DONE?

PERHAPS THE GREATEST OBSTACLE PREVENTING THESE PROGRAMS FROM CONTRIBUTING TO ECONOMIC GROWTH is their lack of appropriate built-in evaluation mechanisms. The lack of such mechanisms makes it impossible to know whether the subsidies made any difference and encourages simplistic and uninformative surveys of program winners, analyses based on commercialization rates, and lists of "success stories."

The only way we can learn if these programs are succeeding is by properly evaluating technology programs to discover what works and what does not.

What would be an appropriate evaluation mechanism? Probably the best way to measure the effect of the subsidy is to randomize a small part of the grants process to create a "control group" and "test group" of proposals that government analysts could then compare, as Brandeis University economist Adam Jaffe has proposed. In essence, this evaluation method would randomly not fund some proposals that government project managers identified as worthy of funding, and it would randomly fund some proposals that project managers rejected. Government evaluators could then compare the outcomes of proposals in the different groups to determine whether the subsidies were effective. Such comparisons would determine whether the projects required government subsidy or would have drawn private financing.

Policymakers tend to dismiss this evaluation method as unrealistic. But other areas of public policy regard randomization as absolutely essential to evaluation. For example, the government will not approve any drug without studies that randomly place patients into a test group that receives the treatment and a control group that receives a placebo. Evaluators cannot determine a drug's effectiveness simply by determining whether drug recipients got better. Instead, the evaluators must compare changes in patients' health with the health of patients who were similarly sick and did not receive the treatment. Likewise, evaluators cannot determine a subsidy's effectiveness by only measuring the returns to funded projects. If we are willing to risk human lives for the benefit of future patients, we should be willing to risk a firm's subsidy for the benefit of future economic growth.

While randomized experiments may not occur in the near future, government could implement other, less radical evaluation methods. In particular, federal agencies should make public not only who received subsidies, but who did not. Many programs require proposals to go through rounds of reviews, ultimately leading to "near-winners" and "winners." Evaluators could then compare the outcomes of subsidized and unsubsidized projects that received similar scores in the review process. If highly rated, unfunded projects do not attract private financing, we might conclude that the funded programs would also not receive private funding. However, if the unfunded projects do attract private money, we might conclude that the subsidized projects might have done so as well.

Sadly, political realities will probably prevent the implementation of any real form of evaluation. Program proponents do not want rigorous evaluation that could undermine the program's popularity. Likewise, detractors who dislike any government subsidies may worry that such evaluations would demonstrate that some of these programs are effective.

But government technology programs promote economic growth if they subsidize research that private firms would not fund. The only way we can learn if these programs are succeeding is by properly evaluating technology programs to discover what works and what does not. Avoiding true evaluation may be politically expedient and please program beneficiaries, but it probably prevents these programs from ever having a real economic impact. R

readings

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