The exploitation of publicly funded technology.

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Abstract:

In this paper we focus on technology that resulted from R&D projects funded by US Small Business Innovation Research (SBIR) Phase II awards. We ask: Is there evidence that strategic commercial agreements allow foreign firms to exploit the technologies developed through the SBIR program and funded by US taxpayers? Based on descriptive information from Phase II SBIR-funded project data collected by the National Research Council within the National Academies, we conclude that SBIR funds for Phase II projects and the technologies associated with those projects are not, to a pronounced extent, benefitting foreign firms through agreements with SBIR firms or investors. In that sense, there is no evidence that the technologies developed with funds from US taxpayers are, to any significant extent, being exploited by foreign firms through commercial agreements with SBIR firms.

Keywords: technology | small entrepreneurial firms | SBIR program | strategic agreements | public funding | research and development | publicly funded technology | exploitation

Article:

1 Introduction

Technology-based firms adopt a portfolio of strategies to maximize profits. Examples include, but are certainly not limited to, the development of a new technology with the expectation of selling or licensing it to other firms or even an expectation of being acquired by or merging with other firms. Alternatively, firms might pursue further research through R&D agreements. Firms might also attempt to realize more fully the profit potential of their developed technology by entering into manufacturing or marketing or distribution agreements, customer agreements, or joint ventures. Any or all of these strategic commercial agreements can be viewed as a rational effort to maximize profits.

The consequences for spillovers of technology associated with these strategies are, from a policy perspective, important if the underlying R&D project is publicly funded. For example, consider a firm that pursues a research project funded with public US moneys and develops a technology, but it sells the rights to the technology to another firm, say an international firm. Thus, part of the economic impact of the award will then not only occur outside of the funded firm but also outside of the United States.

In this paper we focus on technology that resulted from R&D projects funded by US Small Business Innovation Research (SBIR) Phase II awards.1 We ask whether there is evidence that strategic commercial agreements allow foreign firms to exploit the technologies developed through the SBIR program and funded by US taxpayers.2

The remainder of the paper is outlined as follows. In Sect. 2 we briefly overview the SBIR program and the data used in the analysis presented in Sect. 3. Section 4 concludes the paper with brief summary remarks.

2 The Small Business Innovation Research (SBIR) program

The SBIR program is a set aside program created by the Small Business Innovation Development Act of 1982 (P.L. 97–219; hereafter, the 1982 Act).3 The 1982 Act required all government departments and agencies with external research programs of greater than $100 million to establish their own SBIR program and to set aside funds equal to 0.20 % of the external research budget. Thus, the program redirects R&D funds for competitive awards to small, and often entrepreneurial firms rather than appropriating new monies for R&D.4

As part of the 1982 Act, SBIR program awards were structured and defined by three phases. The purpose of Phase I awards is to assist firms as they assess within a 6 month period the feasibility of an idea's scientific and commercial potential in response to the funding agency's objectives. Phase II awards generally last for 2 years. These awards are for the firm to develop further its proposed research, ideally leading to a commercializable product, process, or service. Further work on the projects launched through the SBIR program occurs in what is called Phase III, which does not involve SBIR funds. At this stage, firms needing additional financing—to ensure that the product, process, or service can move into the marketplace—are expected to obtain it from sources other than the SBIR program.

The program has been reauthorized several times and the set aside has increased to 2.50 % of an agency's external research budget.5 The program was most recently reauthorized on December 31, 2011 for a period of 6 years (P.L. 112–81). Phase I 6-month awards are now capped at 150,000 and Phase II 2- year awards are capped at 1,000, 000, although the latter cap is often exceeded.

Eleven agencies currently participate in the SBIR program: the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Departments of Agriculture (USDA), Commerce (DoC), Defense (DoD), Education (ED), Energy (DOE), Health and Human Services (HHS, particularly the National Institutes of Health (NIH)), Transportation (DoT), and, most recently, Homeland Security (DHS).6

The Small Business Reauthorization Act of 2000 mandated that, among other things, the National Research Council (NRC) within the National Academies conduct an evaluation of the economic benefits achieved by the SBIR program and make recommendations to Congress for improvements to the program. As part of its evaluation, the NRC conducted an extensive and balanced survey in 2005 of 6,408 Phase II funded and completed projects from a population of 11,214 project awards made between 1992 and 2001 by five agencies: DoD, NIH within HHS, NASA, DOE, and NSF. These five agencies accounted for nearly 97 % of total awards in 2005.

The number and percentage of respondents from these 6,408 surveyed projects is shown in Table 1.7 The total number of responding projects was 1,916, and the average response rate across all five agencies was 30 %. Also shown in Table 1 is the total number of projects in the final random sample of completed Phase II projects, by agency. For these projects, the project data are summarized below.

Table 1

Descriptive statistics on the National Research Council survey of phase II awards

Agency	**Phase II sample size**	**Respondents**	**Response rate (%)**	**Random sample[a]**
DoD	3,055	920	30	891
NIH	1,678	496	30	495
NASA	779	181	23	177
DOE	439	157	36	154
NSF	457	162	35	161
All agencies	6,408	1,916	30	1,878

[a]The NRC surveyed a number of non-randomly selected projects because they were projects that had realized significant commercialization, and the NRC wanted to be able to describe such interesting success stories. These non-randomly selected projects are not considered

3 The formation of strategic commercial alliances

Consider the descriptive data in Table 2; several generalizations can be inferred. One, commercial agreements by SBIR-funded firms are more common with other US firms and investors than with foreign firms and investors. There are only two instances where finalized agreements with foreign firms or investors are greater than with US firms or investors. Among the NASA sample, 8.0 % of the firms had formalized a licensing agreement with foreign firms or investors compared to 6.2 % with domestic firms or investors. And, 1.7 % of the firms in the NSF sample had formalized a merger with foreign firms or investors compared to 0 % with US counterparts.

Table 2

Agreements with other firms or investors: percentage of the random sample of phase II projects answering the question: “As a result of the technology developed during this project, which of the following describes your firm’s activities with other firms and investors? (Select all that apply.)”

	US Firms/investors		**Foreign Firms/investors**	
Agreement	**Finalized agreements**	**Ongoing negotiations**	**Finalized agreements**	**Ongoing negotiations**
DoD (n = 594)				
Licensing agreement(s)	15.5	16.5	2.9	5.2
Sale of company	1.2	4.9	0.3	1.0
Partial sale of company	0.8	4.2	0.0	1.5
Sale of technology rights	4.4	9.9	1.0	2.9

	US Firms/investors		Foreign Firms/investors	
Agreement	**Finalized agreements**	**Ongoing negotiations**	**Finalized agreements**	**Ongoing negotiations**
Company merger	0.3	3.2	0.2	0.7
Joint venture agreement(s)	3.7	8.1	1.2	2.2
Marketing/distribution agreement(s)	10.8	8.6	4.5	4.2
Manufacturing agreement(s)	3.4	8.8	2.7	2.4
R&D agreement(s)	13.8	13.8	2.5	3.4
Customer alliance(s)	13.1	14.5	4.2	3.0
Other	1.9	2.2	0.3	0.8
NIH (n = 338)				
Licensing agreement(s)	19.2	16.0	8.9	6.2
Sale of company	0.9	3.6	0.3	1.5
Partial sale of company	2.1	4.4	0.0	0.6
Sale of technology rights	5.6	7.4	0.6	0.9
Company merger	0.3	3.0	0.0	0.6
Joint venture agreement(s)	3.0	8.9	0.9	2.7
Marketing/distribution agreement(s)	21.3	10.4	12.4	6.5

	US Firms/investors		Foreign Firms/investors	
Agreement	**Finalized agreements**	**Ongoing negotiations**	**Finalized agreements**	**Ongoing negotiations**
Manufacturing agreement(s)	7.1	3.8	2.4	2.1
R&D agreement(s)	14.8	10.7	4.1	3.0
Customer alliance(s)	8.3	10.1	2.7	0.9
Other	2.1	2.1	0.3	0.9
NASA (n = 112)				
Licensing agreement(s)	6.2	11.6	8.0	5.4
Sale of company	0.9	2.7	0.0	0.0
Partial sale of company	1.8	0.9	0.0	0.0
Sale of technology rights	0.9	7.1	0.9	2.7
Company merger	0.0	0.0	0.0	0.0
Joint venture agreement(s)	0.9	4.5	0.0	1.8
Marketing/distribution agreement(s)	7.1	5.4	6.2	1.8
Manufacturing agreement(s)	1.8	6.2	1.8	0.0
R&D agreement(s)	15.2	9.8	3.6	0.9
Customer alliance(s)	10.7	8.9	6.2	0.0

	US Firms/investors		Foreign Firms/investors	
Agreement	**Finalized agreements**	**Ongoing negotiations**	**Finalized agreements**	**Ongoing negotiations**
Other	2.7	3.6	0.9	0.9
DOE (n = 114)				
Licensing agreement(s)	15.8	15.8	5.3	8.8
Sale of company	0.9	0.9	0.9	0.9
Partial sale of company	2.6	1.8	0.0	1.8
Sale of technology rights	5.3	6.1	0.9	3.5
Company merger	0.0	0.9	0.0	0.9
Joint venture agreement(s)	2.6	7.0	0.0	2.6
Marketing/distribution agreement(s)	9.6	7.0	8.8	2.6
Manufacturing agreement(s)	6.1	6.1	0.9	4.4
R&D agreement(s)	7.9	10.5	1.8	6.1
Customer alliance(s)	7.9	13.2	4.4	5.3
Other	2.6	0.0	0.9	0.0
NSF (n = 121)				
Licensing agreement(s)	19.8	21.5	9.9	6.6

	US Firms/investors		Foreign Firms/investors	
Agreement	**Finalized agreements**	**Ongoing negotiations**	**Finalized agreements**	**Ongoing negotiations**
Sale of company	2.5	3.3	0.0	0.8
Partial sale of company	2.5	5.8	1.7	1.7
Sale of technology rights	5.0	15.7	4.1	3.3
Company merger	0.0	4.1	1.7	0.8
Joint venture agreement(s)	3.3	9.9	0.8	2.5
Marketing/distribution agreement(s)	15.7	12.4	8.3	2.5
Manufacturing agreement(s)	8.3	9.9	3.3	2.5
R&D agreement(s)	17.4	17.4	5.0	6.6
Customer alliance(s)	11.6	18.2	3.3	4.1
Other	1.7	2.5	0.8	0.0

The overall percentage of projects that have agreement activities is less than would be the case if the percentages of projects were additive across the types of categories. They are not additive. Thus, for example for DoD, it will not in general be the case that 16 % of the Phase II projects have finalized US licensing agreements while a completely different set of 14 % have finalized US R&D agreements and then yet another distinct 13 % have finalized US customer alliances. To determine the percentage of the random sample of Phase II projects with US agreements, with foreign agreements, and with both US and foreign agreements, we constructed the qualitative variables defined in the note to Table 3. Those variables are defined for all agencies

Two, among US firms and investors, mergers and sale of the company are the least used strategies across all of the funding agencies. This compares to licensing agreements being the most used strategy by SBIR firms funded by DoD, NIH, DOE, and NSF. Following licensing agreements by firms and investors in these four agencies are R&D agreements—R&D agreements rank first among NASA firms. In addition, licensing agreements with US firms and

investors are at least twice as common as those with foreign firms and investors, with the exception of the NASA sample.

Three, licensing agreements and marketing/distribution agreements are the more common strategies with foreign firms or investors.

And four, R&D agreements are significantly more common with US firms and investors than with foreign firms and investors. Perhaps, and this should be viewed as a tentative hypothesis, it is easier to monitor information leakages that are inevitable during collaborative R&D when the partner firms or investors are geographically closer and within the same boundaries of intellectual property protection, that is, with a US partner rather than a foreign partner.

As shown in Table 3, US only agreements are more prevalent than US and foreign firm or investor agreements.8 Foreign only agreements are the least prevalent. Thus, we interpret the data in Tables 2 and 3 as suggestive evidence to conclude that US SBIR funds for Phase II projects and the technologies associated with those projects are not, to a pronounced extent, benefitting foreign firms through agreements with SBIR firms or investors. In that sense, there is no evidence that the technologies developed with funds from US taxpayers are, to any significant extent, being exploited by foreign firms through commercial agreements with SBIR firms. If there were such evidence of a substantial flow of SBIR technology to foreign firms, one could reasonably ask whether the US SBIR firms captured a substantial part of the benefits from the applications of the SBIR technology by the foreign firms.9 But, that question need not be asked.

Table 3 has been omitted from this formatted document.

Finally, in Table 4, we examine the use of alternative strategies by observing the level of sales from the specific technology developed during the Phase II project. Regardless of funding agency, the mean sales (by 2005) for those projects with no agreements—US or foreign agreement—are less than for projects with agreements. And, mean sales are greater when there are agreements with foreign firms or investors than when there are only US agreements. This finding, albeit based only on descriptive evidence and in some cases descriptive evidence based only on a handful of observations suggests that when such technology transfer does occur through commercial agreements among SBIR firms and foreign firms and investors, it is with projects that are relatively more successful as measured in terms of cumulative sales, supporting the belief that, for those cases, the SBIR firms are reaping substantial benefits from the technologies developed with the funds from US taxpayers.

Table 4 has been omitted from this formatted document.

4 Concluding remarks

Descriptively, it appears that often aspects of the economic impact of SBIR funds are seen not completely in the SBIR award-recipient firm, but possibly in other firms because of strategic commercial agreements allowing other firms to use the technologies generated with SBIR Phase II awards. Moreover, the evidence suggests that the economic impacts at times accrue to foreign firms or foreign investors through such agreements, but the extent to which that occurs is small relative to spillovers to other US firms.10

Thus, to answer the question posed in the Introduction: Is there evidence that strategic commercial agreements allow foreign firms to exploit the technologies developed through the SBIR program and funded by US taxpayers?, our conclusion is that the evidence supports the belief that such exploitation is minimal.

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Footnotes

1 This research was funded through a grant from the W.E. Upjohn Institute for Employment Research. The remainder of this paper draws directly from our final report to the Institute with permission of the Institute. That report was published as Link and Scott (2012).

2 We are defining exploitation to mean that the resulting US funded technology is not being entirely used within the United States and that the benefits from the funded R&D are in part being captured by other countries.

3 The 1982 Act amended the Small Business Act of 1953 (P.L. 85–536) which established the Small Business Administration.

4 The economic role of the SBIR program is discussed in detail in Link and Scott (2010, 2012). A more detailed history of the program is in those references and in Link and Scott (2009, forthcoming).

5 The 1982 Act allowed for this percentage to increase over time.

6 DoD maintains the largest program, awarding over 50 % of total funds and accounting for over 50 % of total awards.

7 We thank Dr. Charles Wessner of the NRC for making these data available to us.

8 See the note in Table 3 for the construction of this qualitative summary agreement variable.

9 Of course, there is the possibility of spillovers of the technologies to foreign firms without any payments to the innovating SBIR firms—a possibility the NRC database does not allow us to assess.

10 Link and Scott (2012) show, with respect to one economic impact, that strategic commercial agreements are often negatively associated with greater than projected employment growth within the firm. An SBIR-funded firm develops a technology during a Phase II project, but often sells the rights to the technology to another firm, mostly US firms and investors. Thus, the employment impact of the SBIR award is then realized elsewhere in the economy where the other firm has employment growth to support production using the technology developed in the SBIR project.