Evaluation of Small Business Innovation Research Programs in Japan

Inoue, Hiroyasu and Yamaguchi, Eiichi

24 February 2014

Evaluation of Small Business Innovation Research Programs in Japan

Abstract

Subsidizing small high-technology firms is now considered to be important in stimulating economies throughout the world. This is because fast growing small firms create new markets and jobs. The Small Business Innovation Research (SBIR) program has played an important role in the United States in subsidization providing two billion dollars every year. Japan started its own SBIR program inspired by that in the United States.

This paper examined the direct effects of Japan's SBIR program by using attributes of firms. First, we compared the overall changes in sales, employment, and the number of patents between SBIR awardees and matching firms. However, SBIR awardees did not demonstrate better performance in those changes. Therefore, it seems that the overall effect of Japan's SBIR program has not produced positive results. Second, we examined regression models to control other effects. As a result, we found SBIR awardees outperform matching firms when they are in high technology industries and in areas with abundant venture capital investments.

Keywords

Research policy, Innovation, SBIR, Japan

1 Introduction

Japan has suffered from a serious long-term recession that began in 1991 and the Japanese government has tried, by various means, to solve the problem. One way has been to subsidize small, high-technology firms, which are now considered to play important roles in stimulating economies throughout the world (Organization for Economic Cooperation and Development, 2010). This is because fast growing small firms have created new markets and jobs (Phillips & Kirchhoff, 1989).

There are two rationales to justify such subsidization. First, the social benefits are greater than the expenditure that firms spent on research and development (R&D) (Griliches, 1992). Second, private investors can tap into information that subsidized companies are authorized in the sense of promising technology. This can be rephrased as an information gap between firms and investors (Myers & Majluf, 1984).

The Small Business Innovation Research (SBIR) program that was started in 1982 in the United States has played an important role in subsidization providing two billion dollars for U.S. companies every year. The program requires (currently) eleven federal agencies to set aside (also currently) 2.9 percent of their extramural R&D funds for the program. The program consists of three phases and only winners can proceed to the next phase. The program is one of the largest innovation programs in the U.S. (Wessner, 2008). Japan started its own SBIR program in 1999 inspired by that in the U.S.

The cost-effectiveness of all policies should be monitored but this is difficult to do for the most of them because the effect spreads into society, making the problem more complex. Even so, Lerner studied firms that won awards of U.S. SBIR program and demonstrated that the firms grew significantly faster in comparison with other matched firms and attracted venture financing (Lerner, 1999). Although Japan's SBIR program was studied by Eshima (Eshima, 2003), his study

was limited compared to the coverage of analyses done by Lerner and his analyses had bias that led readers to a different conclusion from one in this paper. The details on the problems will be explained later.

We analyzed Japan's SBIR program by introducing data obtained from firms. The analyses followed those of Lerner. More concretely, we assessed the growth of firms which won awards of the SBIR program from 2006 to 2010. The analyses were done by comparing of matching firms that were chosen to closely resemble the awardees. Growth was measured by sales, employees, and the number of patents. The analyses also included patent data to examine characteristics specific to R&D. The analyses had two clear limitations. The first one was that they did not include social welfare, which was the eventual goal of the policies. This means we only found the primary effect of the subsidies. The second limitation was that they could not provide alternative policies because we only studied one policy.

This paper is organized as follows. A brief explanation of the SBIR program is given in Section 2. Section 3 explains how we constructed the data we used in the analyses. Section 4 discusses empirical analyses and Section 5 concludes the paper.

2 SBIR programs

2.1 U.S. SBIR program

The United States' Congress enacted the SBIR Development Act in 1982 and established the SBIR program, which mandated that all federal agencies spend more than $100 million to set aside 0.2 percent of their funds for the program. Over the next six years, the funds that were set aside grew to 1.25 percent. This act was reauthorized in 1992, as the Small Business Research and Development Enhancement Act. At this time, the funds that were set aside were doubled to 2.5

percent (Wessner, 2008). Congress passed numerous extensions, the most recent of which extended the act through 2017. Also, the current funds that were set aside were set to 2.9 percent. The set-aside will increase each year.

Eleven federal agencies have been participating in the program and they have individual responsibility for the program. Therefore, they have been subsidizing and conforming to the guidelines set by the SBIR program.

A document published by the Small Business Administration (Office of Investment and Innovation, Small Business Administration, 2012) provides current practical information. Here, we present a plain explanation of the process for the program.

The SBIR program has three phases.

- Phase I: This phase is aimed at checking the technical advantages, feasibility, commercial potential, and the quality of awardee performance prior to support in Phase II. Phase I awards normally do not exceed $150,000 total costs for six months.
- Phase II: The main objective of this phase is to continue and enhance the R&D efforts initiated in Phase I. Only Phase I awardees are eligible for a Phase II award. Phase II awards normally do not exceed $1,000,000 total costs during two years.
- Phase III: This phase, where appropriate, is for small businesses to pursue commercialization objectives resulting from Phase II activities. The SBIR program does not fund Phase III. Some federal agencies promote the introduction of private investments or provide awardees with production contracts for products such as procurements of agencies.

Eligibility for the SBIR program is mainly assessed as follows.

1. Owned independently and at least 51% by U.S. citizens.
2. No more than 500 employees, including affiliates.

3. Organized for profit and located in the United States

The achievements of the SBIR program are worth admiring. The SBIR program assessment done in 2008 (Wessner, 2008) found that it was mainly effective in three areas.

1. Stimulating technological innovation

2. Increasing private sector commercialization of innovations

3. Providing widely distributed support for innovation activities

2.2 Japan's SBIR program

Japan has been in a serious long-term recession since 1991. The Ministry of International Trade and Industry enacted a law in 1999 to facilitate the creation of new businesses that included Japan's SBIR program to break out of the recession and secure more employment opportunities. Apparently, Japan had considered the SBIR program in the U.S. to be successful. Then, the Ministry of Economy, Trade and Industry enacted an act in 2005 to facilitate new business activities by small and medium-sized enterprises that retained the SBIR program in Japan.

Although the program in Japan was naturally quite similar to that in the U.S., there were three considerable differences.

1. Awards by most ministries and agencies do not have phase systems. Only approximately 5% of awards have phase systems that began in 2007.

2. Ministries and agencies mainly support awardees from finances in their own budget. However, the U.S. program helps awardees to access private investments and procurements by governments.

3. The budget is much smaller. The ratio is from one fifth to a half that of the U.S.

Note that Japan has other initiatives for nurturing small high-technology businesses. For example, the New Energy and Industrial Technology Development Organization has a number of their own initiatives other than the SBIR program. This paper only discusses the SBIR program and its effects but naturally does not cover all initiatives for small high-technology businesses.

3 Data

Since we followed Lerner's analyses, we constructed data almost identical to his and added additional data for further discussion. As primary data, we acquired published data from SBIR awardees obtained from the Small and Medium Enterprise Agency. Table 1 summarized the number of constructed data. The data included 3,559 SBIR awardees from 1998 to 2010. However, since many firms won more than one award, there were 1,640 firms. There were 507 awardees from 2004 to 2006. Even individuals can win awards in Japan unlike the SBIR program in the U.S. We omitted individuals since they were not appropriate to the analyses in this paper. Finally, 301 firms were chosen as awardees from 2004 to 2006 to analyze their growth. Basically, Japan's SBIR program does not have phase systems, and as phase II started from 2007 with only 5%, we ignored it as was mentioned earlier.

We then constructed matching sets to compare means and percentiles and conducted regression analyses. We selected firms that closely resembled awardees from Teikoku Data Bank (TDB) data, which has one of the most comprehensive data on firms in Japan.

One set was matched on industry and firm size. The TDB data included its own industry code. The middle classification has 91 different codes and we used this to categorize firms. Three hundred one firms in the same classification with the closest sales in 2006 were selected from the TDB data to pair them with 301 awardees.

Another set was matched on geographic location and firm size. The procedure was similar to

that for the industry matching set. We used the two digits at the head of the zip code. The two digits approximately correspond to prefectures. In the same way, three hundred one firms having the closest sales in 2006 with the same zip code were selected.

The data construction in Lerner's work also included the investigations into acquiring investments by venture capitals. In line with it, we introduced data of investments by venture capitals to areas in Japan (Venture Enterprise Center, 2010).

Thus far, we followed the protocol of the data creation conducted by Lerner. In addition, we added supplemental data using the Institute of Intellectual Property data (Goto & Motohashi, 2007) for further analyses. We could add the number of registered patents in each year by firms.

The sample data are summarized in Table 2. The matching firms resembled the awardees closely in sales. The employments of matching firms were higher than those of the awardees. This is because the definition of a small firm is a firm with less than 300 employees in manufacturing or less in other industries. Since SBIR awardees are small firms, this limitation lowers the number of employees. The matching firms are not limited in small firms. The number of registered patents by the awardees were seemingly larger than that by the matching firms.

4 Empirical analyses

4.1 Overall effect of subsidies

This section shows the overall comparison of growth for the awardees and the matching firms. Table 3 lists the results. Panel A shows the change in sales from 2006 to 2011. The t-test and the Mann-Whitney test are used to compare the two groups. If we consider 5% significance level, the tests indicate no significance. 5% significance level will also be used in other analyses.

Panel B shows the change in employment. Although the t-test in panel B does not indicate

significance, the Mann-Whitney test indicated significance and it seems that employment of the awardees is better.

If we think of the direct effect of awards, especially their direct commercial effect, the results in panel A mean the SBIR program is disappointing. Although employment is somewhat better for the awardees, better employment with not better sales makes us doubt overall growth.

The overall results in panels A and B are different from the SBIR program studied by Lerner. The overall results for the SBIR program in the U.S. were significantly positive.

Panel C has the change in the numbers of patents between from 2004 to 2006 and from 2007 to 2009. According to the t-test and the Mann-Whitney test, we cannot see the advantage of the awardees. If the awardees demonstrated more possibilities of growth in terms of seeds of commercialization, the awardees should have shown better performance. Although, intellectual property cannot be considered to be direct growth, it is doubtful that firms, especially small firms, can grow without intellectual property.

Comparing societies in two different countries is difficult at any time. Furthermore, there is a convincing cause for comparing the results in Japan and the U.S. Lerner repeatedly emphasized functions of private investments, which are almost equal to venture capital. He delved into the details on what effect the private investments had and found that the success of awardees was dependent on their ability to attract venture capital (Lerner, 1999).

Venture capital under management in the U.S. was worth 267 billion dollars in 2012 (Thomson Reuters, 2013). However, that in Japan was worth approximately one billion dollars (one hundred billion yen) in 2012 (Venture Enterprise Center, 2013). (We assume one U.S. dollar is equal to 100 Japanese yen.) The relative size of Japanese venture capital is 0.0037. This means that the relative size of venture capital for each Japanese SBIR awardees is substantially small. In this situation, small firms mainly rely on loan from banks or public agencies. This situation is far from the goal

of the SBIR program and can be likened to a rocket without a fuel tank. Furthermore, as we saw in panel C of Table 3, Japanese SBIR program has a problem to produce intellectual property.

It should be noted here that commercialization assistance, which is the most important part of the program, seemed to have a problem in Japan. The SBIR program in the U.S. methodically supports the commercialization of seeds grown by the program (Wessner, 2008). The support includes a committee made up of researchers at universities, national institutes, or those who were finance professionals. In comparison, we could not find any similar support available in Japan as is the case in the U.S. Although it is reasonable to assume that commercialization is the most difficult part of R&D, it seems that Japan has not properly budgeted for commercialization.

It should also be noted that this paper focuses on the direct effects of subsidies, and not their social benefits. Even if we had focused on the direct effects, we still have difficulty in estimating them. First, since people in charge of ministries and agencies may want to show how successful the SBIR program is, they may tend to choose their own favorite firms. This situation may inhibit fair competition. Second, similar to the first perspective, technological tasks presented by ministries and agencies may only be overcome by some specific firms that are more familiar with the tasks than others. Finally, subsidies themselves may not help skyrocket R&D in small high-tech firms. This is because the small firms are organized by one key scientist or engineer and other members to help him/her. This means that subsidies cannot help to scale the project up even if they hire more members to help the key person. The most probable scenario here is that awardees just substitute awards for their own budget for R&D and prolong the time for R&D. Bearing in mind the purpose of the SBIR program, this is a crucial concern.

As we mentioned in Section 1, Eshima carried out the same overall analyses in Japan (Eshima, 2003) and said that SBIR awardees yielded positive results. His work is important as the first attempt toward the SBIR program analyses in Japan but the analyses seem to have the three

problems. First, he made matching sets in a different way from that by Lerner, nevertheless he could. Since he started from Lerner's work, as we did, avoiding comparisons of results without any explanation seems to be unfair. Second, he mentioned he used phase II awardees' data, the same as Lerner had done, but until 2007, the SBIR program in Japan did not have a phase system. Finally, there was no regression analysis that Lerner had done. Regression analysis is important to see what effect the SBIR program has by controlling other variables. Therefore, our paper can provide fuller analyses and comparisons.

4.2 Effect of subsidies controlled by firms' attributes

We discussed previously the overall effect of the SBIR program. We next delve into more precise analyses by introducing regression analyses. Table 4 lists the variables used in the regression analyses. Most of them have been used in the previous analyses.

Table 5 examined the change in sales as well as the percentage change in sales. The independent variables were sales in 2006, volume of venture capital investments in areas, a dummy variable whether the firm received SBIR award, and an interaction between the volume of venture capital investments and a dummy variable of SBIR award. This examination was conducted in Ordinary Least Squares regressions. The results said SBIR award and the interaction term were not significant. This means that we could not find neither solitary effect of SBIR award for growth nor joint effect of SBIR award for venture capitals. In Lerner's work, however, the interaction term was significant. This means SBIR award in the U.S. has worked with venture capital financing.

The result of Table 5 negated the effectiveness of the SBIR program in Japan. However, we can expect that the SBIR program in Japan works in some limited condition. Therefore, we divided the data according to two industrial types. Those types are high and low technology industries. This is because high technology industries generally have more potential to grow largely

than low technology industries. We employed the division of industries proposed by Okamuro (Okamuro, 2006). Table 6 examined the industrial difference of the change in employment. (We used employment instead of sales to follow Lerner's work.) The independent variables are the same as Table 5 but sales in 2006 was replaced with employment in 2006. We could not find significance of SBIR award and the interaction term in low technologies. However, we found that the interaction term showed significance in high technologies, though volume of venture capital and SBIR award are negatively significant. On the other hand, Lerner also showed that the interaction term was significant in high technology industry. In addition, the dummy variable of SBIR award in high technology industries was significant. It can be said that U.S. SBIR awards strongly affects high technology industries.

Next, we examined the effect of multiple awards using the awardees as well as those in high technology industry. We can understand whether more awards promote growth of awardees through this examination. That is, if it is true, volume of financing is important. If it is false, SBIR award works as a certification to attract financing. Table 7 lists the results. As was mentioned earlier, the data consist of the awardees and those in high technologies. The dependent variables are the change in sales and the percentage change in sales. The independent variables are the sales in 2006, volume of venture capital investments in areas, a dummy variable whether the firm received multiple SBIR awards, and an interaction term between the venture capital and the multiple SBIR awards variables. The result says that neither multiple SBIR awards nor its interaction term is significant. We saw high-tech SBIR awardees have the positive and significant interaction term in the previous examination. Therefore, the significance disappeared in this examination. We can say SBIR awards have a certification effect to attract financing from the examinations.

Finally, we examined the change and the percentage change in the number of patents registered. The number of patents are certainly a reliable proxy of innovative activities. Therefore, if the

awardees have right ability to invent new products, we expect that the number of patents applied by them increase. In other words, we see whether the Japanese ministries and agencies chose proper SBIR awardees or not. Table 8 lists the results. We examined two datasets. One is the entire data and the other is the firms of high technology industries. The dependent variables are the change and the percentage change in the number of patents. The independent variables are prior patents, which means patents during period from 2004 to 2006, volume of venture capital investments in areas, a dummy variable whether the firm received any SBIR award, and an interaction term between the venture capital and the SBIR awards variables. We could not see the dummy variable of SBIR and the interaction terms are significant in the models. Therefore, we can say the awardees did not register more patents than non-awardees. It should be noted that we saw the interaction term was significant for high technology industries in the examination of employment (Table 6). If the SBIR program properly affect awardees, we expect not only the growth in sales or employment, but the growth in intellectual property. The results, however, negated it. It has to be said impact of the SBIR program in Japan is suspicious.

5 Conclusion

We examined the direct effects of the SBIR program in Japan through firms' attributes. First, we compared changes in sales, employment, and the number of patents between SBIR awardees and matching firms. The SBIR awardees did not perform better in sales, employment, and patents. Therefore, it seems that the overall effects of the SBIR program are not positive. Next, we examined the SBIR program by using regression models. Although Japan's SBIR program is beneficial for firms in high technology industries and in areas with large venture capital investments, the negative results were sustained.

In closing, we need to suggest some ideas to improve the program. First, it is important to

rigorously assess the program. Although most countries have recognized that small businesses are the key to economic growth, and where Japan is no exception, its ministries and agencies have not assessed the program. We have to say they are not sincere. Even when budgets are not fully available, it is easy to "set aside" some of the budget to assess the program. Second, appropriate exits for awardees should be clear. We could not find any publication that showed ministries and agencies had strategies to create new markets after successful R&D projects were completed by awardees. Therefore, the program has just been prolonging the life of small firms. Since these ideas are not new but written on the document of the U.S. of assessment (Wessner, 2008), they can be carried out.

References

Eshima, Y. (2003). Impact of public policy on innovative smes in japan. *Journal of Small Business Management*, *41*(1), 85–93.

Goto, A., & Motohashi, K. (2007). Construction of a Japanese Patent Database and a first look at Japanese patenting activities. *Research Policy*, *36*(9), 1431-1442.

Griliches, Z. (1992). The search for r&d spillovers. *Scandinavian Journal of Economics*, *94*, 29-47.

Lerner, J. (1999). The government as venture capitalist : The long-run impact of the SBIR program. *Journal of Business*, *72*(3).

Myers, S., & Majluf, N. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*(2), 187–221.

Office of Investment and Innovation, Small Business Administration. (2012). *Small business innovation research (SBIR) program policy directive.*

Okamuro, H. (2006). *Seizougyou no kaihaigyouritsu heno chiiki youinn no eikyou (in Japanese).* RIETI Discussion paper series 06-J-049.

Organization for Economic Cooperation and Development. (2010). *High-growth enterprises: What governments can do to make a difference.*

Phillips, B., & Kirchhoff, B. (1989). Formation, growth and survival; small firm dynamics in the us economy. *Small Business Economics*, *1*(1), 65-74.

Thomson Reuters. (2013). *National Venture Capital Association Yearbook 2013.*

Venture Enterprise Center. (2010). *Annual report on japanese startup business 2010 (in japanese).*

Venture Enterprise Center. (2013). *2013 survey on venture capital investment trends in japan - preliminary.*

Wessner, C. (Ed.). (2008). *An assessment of the SBIR program.* National Academies Press.

Table 1: Construction of sample of SBIR awardees and matching firms: The table lists the number of samples we constructed. Basic data is 301 SBIR awardees. For each awardee, we chose a firm that was industry-matched and closest in sales and a firm that was location-matched and closest in sales. TDB in the table means Teikoku Data Bank data, which includes data on Japanese firms.

Firms	No. of firms
SBIR awardees that received one or more awards	
in 1998-2010 (including individuals)	1,640
in 2004-2006 (including individuals)	507
in 2004-2006 having valid data in TDB (firms)	301
Matching firms selected from TDB paired with SBIR awardees	
Industry-matched and closest sales	301
Location-matched and closest sales	301

Table 2: Comparison of SBIR awardees and matching firms: Sample data are compared to check validity of matching firms. Unit for sales is in millions of yen. Matching firms were selected according to 2006 sales and industries, or 2006 sales and locations.

	Mean	SD	Minimum	Maximum
SBIR awardees:				
2006 sales	2,446	4,510	0.72	31,567
2006 employment	82	129.7	2	1,003
Patents during period from 2004 to 2006	4.9	12.8	0	182
Matching firms:				
2006 sales	2,444	4,503	0.90	31,818
2006 employment	1,155	26,533.6	1	650,000
Patents during period from 2004 to 2006	1.1	6.2	0	85

Table 3: Growth of SBIR awardees and matching firms: Changes in sales and the number of patents indicate no significant differences between SBIR awardees and matching firms. Unit for sales is in millions of yen. Differences in changes in employment are significant with median. Since data do not seem to have a normal distribution, the significance is more reliable than that with mean. Three hundred one observations were made for SBIR awardees and 602 for matching firms.

	SBIR awardees	Matching firms	*p*-value of comparison
A. Change in sales, 2006-2011:			
Mean	-197.41	-100.98	
75th percentile	92.05	62.54	
Median	-27.77	-29.89	
25th percentile	-270.35	-253.20	
SE	113.78	10.95	
p-value of t test			0.54
p-value of Mann-Whitney test			0.63
B. Change in employment, 2006-2011:			
Mean	-2.1	-1,094	
75th percentile	9.0	4.0	
Median	0	0	
25th percentile	-4.0	-4.0	
SE	2.2	1,090.5	
p-value of t test			0.31
p-value of Mann-Whitney test			0.01
C. Change in patents, between 2004-2006 and 2007-2009:			
Mean	-4.5	-7.6	
75th percentile	0.0	0.0	
Median	-3.0	-2.0	
25th percentile	-6.0	-5.0	
SE	0.90	3.84	
p-value of t test			0.42
p-value of Mann-Whitney test			0.72

Table 4: Variables used in regression analyses: The table lists variables used in regression analyses in this paper.

Dependent variable	
Change in sales	Change in sales from 2006 to 2011. Unit is in millions of yen.
% Change in sales	% of change in sales from 2006 to 2011
Change in employment	Change in the number of employee from 2006 to 2011
Change in patent	Change in the number of patents between a period from 2004 to 2006 and one from 2007 to 2009.
% Change in patent	% of change in the number of patents between a period from 2004 to 2006 and one from 2007 to 2009.
Independent/control variables	
2006 sales	Sales in 2006. Unit is in millions of yen.
2006 employment	The number of employee in 2006.
Prior patent	The number of patents during period from 2004 to 2006.
Any SBIR award	Dummy variable that is set to one if a firm is given at least one award in the period from 2004 to 2006. In other cases, it is set to zero.
Multiple SBIR awards	Dummy variable that is set to one if a firm is given more than one award in the period from 2004 to 2006. In other cases, it is set to zero.
Value of venture capital	Value of venture capital financings in area in 2010. Unit is in millions of yen.

Table 5: OLS regressions, with change and percentage change in sales as the dependent variables

	Dependent variable:	
	Change in sales	% Change in sales
	(1)	(2)
2006 Sales	-0.076^{***}	-0.004
	(0.017)	(0.005)
Value of venture capital	-0.0001	0.001
	(0.009)	(0.003)
Any SBIR award	1.742	1.338
	(3.293)	(1.089)
Value of venture capital * Any SBIR award	-0.016	-0.003
	(0.015)	(0.005)
Constant	1.267	0.877
	(2.001)	(0.662)
Observations	892	892
R^2	0.026	0.003
Adjusted R^2	0.022	-0.001
Residual Std. Error	22.371	7.399
F Statistic	5.940^{***}	0.723
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 6: OLS regressions for firms in industries with high and low technologies with change in employment as the dependent variables

	Dependent variable:	
	Change in employment	
	High-tech	Low-tech
	(1)	(2)
2006 employment	-0.243^{***}	-0.198^{***}
	(0.031)	(0.046)
Value of venture capital	-0.178^{***}	-0.020
	(0.066)	(0.073)
Any SBIR award	-39.672^{*}	-4.195
	(22.821)	(23.831)
Value of venture capital * Any SBIR award	0.233^{**}	0.069
	(0.107)	(0.121)
Constant	51.143^{***}	12.719
	(15.975)	(15.565)
Observations	103	47
R^2	0.416	0.323
Adjusted R^2	0.392	0.259
Residual Std. Error	53.290	35.363
F Statistic	17.443^{***}	5.014^{***}
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 7: OLS regressions with change and percentage change in sales as the dependent variables and additional independent variables for multiple SBIR awardees

	Dependent variable:			
	SBIR awardee		High-tech SBIR awardee	
	Change in sales	% Change in sales	Change in ales	% Change in sales
	(1)	(2)	(3)	(4)
2006 sales	-0.147^{***}	-0.011	-0.376^{***}	-0.054
	(0.024)	(0.016)	(0.084)	(0.091)
Value of venture capital	0.001	0.001	-0.083	-0.011
	(0.019)	(0.013)	(0.137)	(0.149)
Multiple SBIR awards	4.226	1.714	-34.239	3.211
	(5.122)	(3.433)	(29.426)	(31.950)
Value of venture capital * Multiple SBIR awards	-0.022	-0.003	0.092	0.013
	(0.023)	(0.015)	(0.147)	(0.159)
Constant	1.417	1.060	37.966	4.802
	(4.420)	(2.962)	(28.006)	(30.408)
Observations	298	298	46	46
R^2	0.123	0.003	0.348	0.012
Adjusted R^2	0.111	-0.010	0.284	-0.084
Residual Std. Error	18.693	12.529	30.375	32.980
F Statistic	10.249^{***}	0.236	5.462^{***}	0.124
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 8: OLS regressions with change and percentage change in the number of patents as the dependent variable

	Dependent variable:			
	SBIR awardee		High-tech SBIR awardee	
	Change in patents	% Change in patents	Change in patents	% Change in patents
	(1)	(2)	(3)	(4)
Prior patent	−0.547***	−0.004	−0.625***	−0.005
	(0.021)	(0.003)	(0.018)	(0.006)
Value of venture capital	−0.013	0.0003	−0.015	0.001
	(0.012)	(0.002)	(0.017)	(0.006)
Any SBIR award	−5.895*	0.015	−6.486	0.101
	(3.003)	(0.414)	(3.953)	(1.390)
Value of venture capital * Any SBIR award	0.017	0.0004	0.015	−0.002
	(0.013)	(0.002)	(0.019)	(0.007)
Constant	5.895**	0.765**	7.147**	0.981
	(2.680)	(0.369)	(3.459)	(1.216)
Observations	186	186	33	33
R^2	0.792	0.022	0.981	0.021
Adjusted R^2	0.787	0.0001	0.978	−0.119
Residual Std. Error	7.608	1.048	4.270	1.501
F Statistic	172.390***	1.005	363.687***	0.152
Note:				*p<0.1; **p<0.05; ***p<0.01