Appendix F: The Grant Impact for SBIR "Mills"

A small subset of the firms in my data apply more than once. Of the 7,436 applicant firms, 71% applied only once, and a further 14% applied twice. Within my data, seven companies each submitted more than 50 applications. Figure 1 shows the frequency of firms by their number of awards, omitting firms with less than four awards. These companies who win many SBIR awards, sometimes termed "SBIR mills," have raised concerns since the early years of the SBIR program (GAO 1992, Wallsten 2000). Appendix G Table 1 shows the relationship between applicant rank and previous non-DOE SBIR wins. DOE program officials appear to be ranking firms higher that have more previous wins from other agencies. Firms with more previous wins are likely more skilled appliers. They have more application experience and may dedicate more resources to accessing government funding.

Implications for firms with a few awards may be more ambiguous. For example, Oscilla Power (introduced in the main text) had two Phase 1 SBIRs from other agencies prior to applying for its DOE SBIR. For Oscilla, all three Phase 1's funded useful testing work.

These firms, often employing specialized grant application staff, seem unlikely candidates for venture finance. Ineed, I find evidence of decreasing returns to previous non-DOE SBIR awards. Table 1 finds that among firms with no previous SBIRs, an award increases a firm's probability of subsequent VC investment by 14.8 pp, significant at the 1% level. For firms with at least one previous SBIR, the effect is halved to 7.5 pp, also significant at the 1% level. However, the difference betwen these coefficients is insignificant. The left panel of Table 2 interacts treatment with previous awards and finds negative coefficients, although in two of the three models they are significant only at the 10% level. The imprecision could be due to opposing forces: additional SBIRs may produce valuable prototyping, but a significant portion of firms with previous SBIRs are "mills" and not seeking private finance.

When a firm has just one previous non-DOE SBIR award, the Phase 1 impact on reaching revenue drops precipitously - even more so than with financing. Table 2 (right panel) interacts treatment with previous awards and finds strong and highly significant negative effects. Table 3 shows that among firms with no previous SBIR wins, a grantee is 19 pp more likely to reach revenue than a loser (column I), significant at the 1% level. When regressions using zero and positive SBIR wins are estimated jointly, the difference in the coefficients is 14.7 pp, significant at the 1% level (column III). The effect declines further along the intensive margin. Table 4 shows that there may be a similar precipitous

drop for patents by previous SBIR wins, but the coefficients are much more imprecise. This SBIR mill effect accords with Link and Scott's (2010) conclusion that mills are less likely to commercialize their projects, and with Lerner (1999)'s finding that multiple awards are not associated with increased performance for SBIR awardees.

Figure 1:

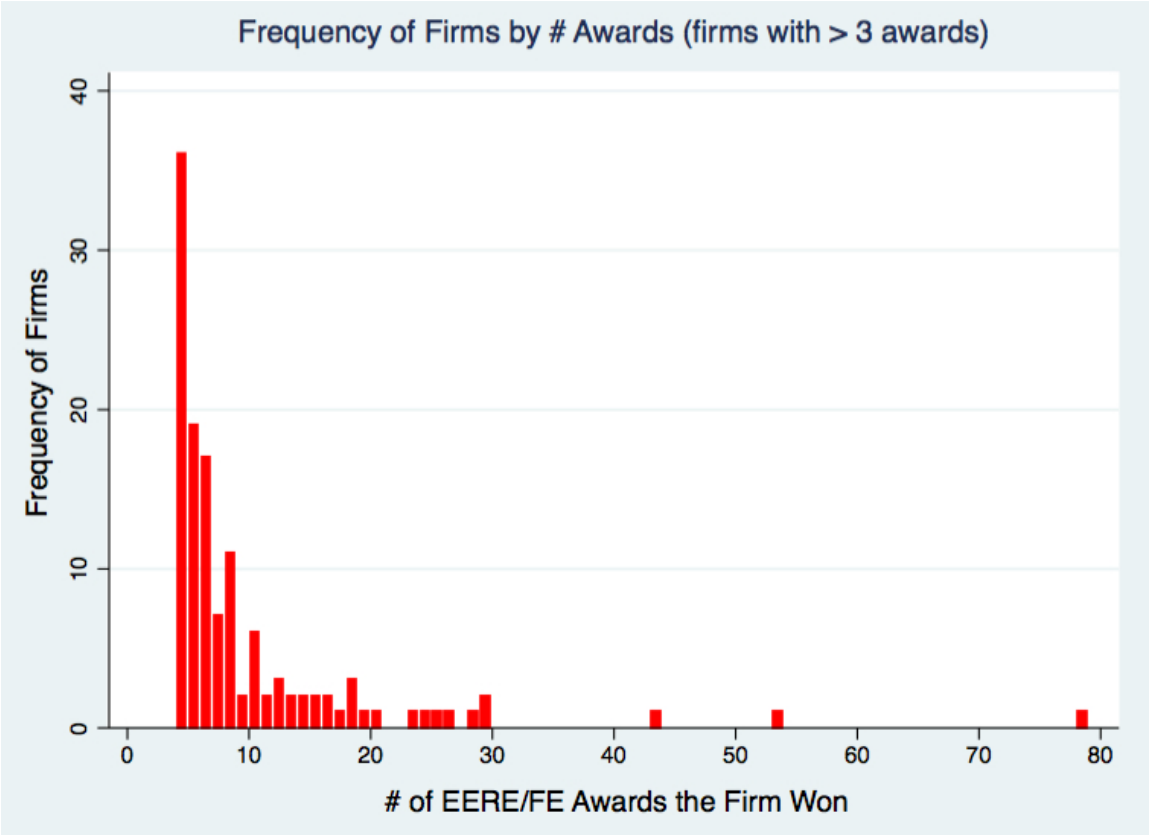

Table 1: Impact of Grant on Subsequent VC by Number of Firm's Previous SBIR Awards

Dependent Variable: VC_i^{Post};	I. $\#SBIR_i^{\text{Prev}} = 0$	II. $\#SBIR_i^{\text{Prev}} > 0$	III. Diff I & II	IV. $\#SBIR_i^{\text{Prev}} < 5$	V. $\#SBIR_i^{\text{Prev}} \geq 5$	VI. Diff IV & V
$\mathbf{1} \mid R_i > 0$	**0.148*****	**0.0748*****	0.0746***	**0.0872*****	**0.0601**	0.0601
	(0.0380)	(0.0260)	(0.0263)	(0.0247)	(0.0385)	(0.0371)
VC_i^{Prev}	0.298***	0.359***	0.358***	0.360***	0.333***	0.333***
	(0.0630)	(0.0506)	(0.0512)	(0.0473)	(0.0626)	(0.0603)
$\#SBIR_i^{\text{Prev}}$		0.000166	0.000177*	0.00555***	0.000145	0.000145
		(0.000102)	(0.000103)	(0.00162)	(0.000115)	(0.000111)
$\mathbf{1} \mid R_i > 0 \cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$			**0.0724**			**0.0270**
			(0.0452)			(0.0449)
$VC_i^{\text{Prev}} \cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$			-0.0598			0.0267
			(0.0823)			(0.0777)
$\#SBIR_i^{\text{Prev}} \cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$						0.00541***
						(0.00166)
$\left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$			-0.0749***			0.136***
			(0.0175)			(0.0151)
Topic f.e.	Y	Y	Y	Y	Y	Y
Topic f.e. $\cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$	N	N	Y	N	N	Y
N	1099	1615	2714	1654	1060	2714
R^2	0.395	0.294	0.335	0.373	0.336	0.367

Note: This table is an RD estimating via OLS the impact of the Phase 1 grant ($\mathbf{1} \mid R_i > 0$) on subsequent VC by number of previous non-DOE SBIR awards (from other gov't agencies, e.g. DOD, NSF), using BW=3. Each column includes only data from firms with the relevant number of wins. In the difference regressions (columns V-VI), all covariates are interacted with a dummy for low SBIRs. Column VI only includes firms with 0 or at least 5 SBIRs. The coefficients on ($\mathbf{1} \mid R_i > 0$) do not precisely match columns III-IV because SBIRs are not controlled for in column I (there are none). Topic dummies permit sufficient within-group observations. Standard errors robust and clustered at topic-year level. *** $p < .01$. Year$\geq$ 1995

Table 2: Impact of Grant on VC & Reaching Revenue Interacted with Number of Firm's Previous SBIR Awards

Dependent Variable:	VC_i^{Post}			$Revenue_i$		
	I. BW=2	II. BW=3	III. BW=all	IV. BW=2	V. BW=3	VI. BW=all
$(\mathbf{1} \mid R_i > 0) \cdot \#SBIR\_d_i^{\text{Prev}}$	**-0.0408***	**-0.0359***	**-0.0411****	**-0.0779*****	**-0.0843*****	**-0.0865*****
	(0.0232)	(0.0202)	(0.0170)	(0.0234)	(0.0219)	(0.0179)
$\mathbf{1} \mid R_i > 0$	0.121***	0.131***	0.146***	0.120***	0.128***	0.158***
	(0.0187)	(0.0177)	(0.0160)	(0.0204)	(0.0189)	(0.0161)
$\#SBIR\_d_i^{\text{Prev}}$	0.0633***	0.0651***	0.0700***	0.00544	0.00965	0.00953
	(0.0179)	(0.0163)	(0.0125)	(0.0199)	(0.0187)	(0.0153)
Competition f.e.	Y	Y	Y	Y	Y	Y
N	3916	4572	7332	3916	4572	7332
R^2	0.285	0.252	0.181	0.262	0.227	0.158

Note: This table is an RD estimating via OLS the impact of the Phase 1 grant ($\mathbf{1} \mid R_i > 0$) on reaching revenue by number of previous non-DOE SBIR awards (from other government agencies, e.g. DOD, NSF) using BW=1. Here the $\#SBIR_i^{\text{Prev}}$ variable has been demeaned and divided by 100 for clarity. Standard errors robust and clustered at topic-year level. *** $p < .01$. Year$\geq$ 1995

Table 3: Impact of Grant on Reaching Revenue by Number of Firm's Previous SBIR Awards

Dependent Variable: $Revenue_i$			
	I. $\#SBIR_i^{\text{Prev}} = 0$	II. $\#SBIR_i^{\text{Prev}} > 0$	III. Diff I & II
$\mathbf{1} \mid R_i > 0$	**0.190*** **	**0.0448**	0.0446
	(0.0445)	(0.0272)	(0.0275)
VC_i^{Prev}	0.289***	0.0986**	0.0973**
	(0.0571)	(0.0428)	(0.0432)
$\#SBIR_i^{\text{Prev}}$		-0.000475***	-0.000463***
		(0.0000824)	(0.0000840)
$\mathbf{1} \mid R_i > 0$ $\cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$			**0.147*** **
			(0.0535)
Topic f.e.	Y	Y	Y
Topic f.e. $\cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$	N	N	Y
N	1099	1615	2714
R^2	0.327	0.238	0.294

Note: This table is an RD estimating via OLS the impact of the Phase 1 grant ($\mathbf{1} \mid R_i > 0$) on reaching revenue by number of previous non-DOE SBIR awards (from other government agencies, e.g. DOD, NSF) using BW=1. Each column includes only data from firms with the relevant number of wins. To estimate the difference regressions, all covariates are interacted with a dummy that, for example in Column VIII, takes a value of 1 if the firm has 0 SBIR wins, and 0 if at least 5. The coefficients on treatment ($\mathbf{1} \mid R_i > 0$) in columns VII and VIII do not precisely match because I do not control for previous SBIRs when there are none (column I). Coefficients on $VC_i^{\text{Prev}} \cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$, $\#SBIR_i^{\text{Prev}} \cdot \left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$ and $\left(\mathbf{1} \mid \#SBIR_i^{\text{Prev}} \leq X\right)$ not reported for space concerns. Standard errors robust and clustered at topic-year level. *** $p < .01$. Year$\geq$ 1995

Table 4: Impact of Phase 1 Grant on Subsequent Patenting within 3 Years by Number of Firm's Previous SBIR Awards (All Gov't) (Negative Binomial)

Dependent Variable: $\#Patent_i^{3\text{ yrs Post}}$	I. $\#SBIR_i^{\text{Prev}} < 2$	II. $\#SBIR_i^{\text{Prev}} < 5$	III. $\#SBIR_i^{\text{Prev}} > 0$	IV. $\#SBIR_i^{\text{Prev}} \geq 2$	V. $\#SBIR_i^{\text{Prev}} \geq 5$
$\mathbf{1} \mid R_i > 0$	**0.896***	**0.805***	**-0.405**	**0.120**	**-0.257**
	(0.531)	(0.481)	(0.369)	(0.444)	(0.576)
$\#Patent_i^{\text{Prev}}$	0.479***	0.451***	0.183***	0.158***	0.145***
	(0.0506)	(0.0452)	(0.0201)	(0.0196)	(0.0204)
VC_i^{Prev}	1.210***	1.062***	0.544***	0.647***	0.737***
	(0.251)	(0.238)	(0.170)	(0.170)	(0.191)
$\#SBIR_i^{\text{Prev}}$	0.0330	0.0438***	0.00586***	0.00503***	0.00479***
	(0.0242)	(0.0118)	(0.000827)	(0.000770)	(0.000738)
$R_{i,-}$	0.176***	0.157***	0.0949**	0.0305	0.0444
	(0.0608)	(0.0567)	(0.0476)	(0.0493)	(0.0519)
$R_{i,+}$	0.913*	0.854*	0.827***	0.460	0.339
	(0.483)	(0.441)	(0.298)	(0.385)	(0.569)
$R_{i,-}^2$	0.00717**	0.00581*	0.00287	-0.00275	-0.00148
	(0.00358)	(0.00347)	(0.00324)	(0.00318)	(0.00336)
$R_{i,+}^2$	-0.184**	-0.137	-0.0602	-0.0120	0.0130
	(0.0922)	(0.0835)	(0.0372)	(0.0490)	(0.0733)
Year f.e.	Y	Y	Y	Y	Y
N	4249	4651	1879	1444	1042
Pseudo-R^2	0.097	0.098	0.093	0.096	0.101

Note: This table is an RD estimating via a negative binomial model the impact of the Phase 1 grant ($\mathbf{1} \mid R_i > 0$) on the firm's patent count within three years after grant award by number of previous non-DOE SBIR awards (from other government agencies, e.g. DOD, NSF), using BW=all. Each column includes only data from firms with the relevant number of wins. Unfortunately I could not estimate difference equations due to non-convergence of the Poisson maximum likelihood. Standard errors robust and clustered at topic-year level. *** $p < .01$. Year$\geq$ 1995