Overview of Material

Appendix A: Qualitative Assessment of SBIR context

Appendix B: SBIR Policy Mix & Data Building

Appendix C: Additional Results

Appendix D: References

Appendix A: Qualitative Assessment of SBIR context

Our qualitative work in this empirical context suggests that the different ways in which firms procure multiple certifications (same vs. different central institutional actors; similar vs. novel information) influence how external audiences perceive the firm. While the federal SBIR program is structured in subsequent phases to show progress toward development and commercialization, external audiences have trouble adequately distinguishing between the two certifications. This is even opaque from the regulations that mandate the program. Pursuant to the Small Business Act section 9(e)(4)(A), a firm can receive a Phase I award if the firm demonstrates "*the scientific and technical merit and feasibility of ideas that appear to have commercial potential*." Pursuant to the Small Business Act section 9(e)(4)(B), the firm can receive a follow-on Phase II award if the firm "*will further develop proposals which meet particular program needs, in which awards shall be made based on the scientific and technical merit and feasibility of the proposals, as evidenced by the first phase, considering, among other things, the proposal's commercial potential.*" The differences in technical and scientific merit from the federal Phase I to Phase II and how to distinguish between "appearing to have" commercial potential (Phase I) and having commercial potential (Phase II) are unclear.

Transcripts from congressional hearings on the SBIR program further suggest that Phase I awards seem adequate to demonstrate technical merit and signal commercial potential to VCs. In a statement to Congress, Dr. Ron Cohen, CEO for Acorda Therapeutic who received SBIR Phase I funding, testified, "*Indeed, if one looks at the SBIR program, to get a Phase II grant, which is where you begin to get substantial funds, a million dollars or two, rather than the Phase I grants, which are about $100,000 to $200,000, one of the requirements is that the recipient has proved the ability to raise private funding"* (2005, p. 19). Further corroborating this, the Small Business Act notes that a way to demonstrate "commercial potential" for Phase I or Phase II awards is "*the existence of second phase funding commitments from private sector or non-SBIR funding sources*" (Section 9(e)(4)(B)(ii)). These archival insights only heighten uncertainty as to what is additionally revealed to VCs as firms apply for the follow-on federal Phase II award, especially if some ventures already get private backing after Phase I. This suggests that unlike the more conventional view that more certifications are better (Baum and Oliver 1991; Chen, Hambrick and Pollock 2008; Rao 1994), multiple certifications may not necessarily confer added value about the firm to external audiences.

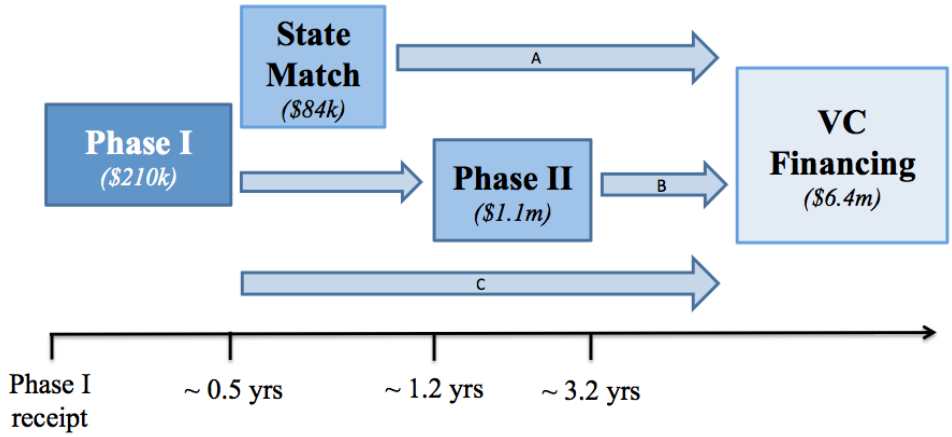
However, in this empirical context, the qualitative research indicates that this external perception of value changes when firms acquire multiple certifications from *different* central institutional actors. External audiences view the State Match as providing an additional and more localized signal of the firm's quality beyond the original Phase I funding. In particular, and as with prior work, while federal government entities are focused on vetting technical merits (Cox-Pahnke, Katila and Eisenhardt 2015), state governments seek to back initiatives with potential for growing the local commercial activity (Wallsten 2004). An illustrative example comes from GreatWall Systems, Inc., a tech startup focused on network security that was spun-off from Wake Forest University. The founder noted that the State Match "*made our company look good in the analysis by private investors when they saw the federal agency funding along with the state funding*" (Hardin 2012, p. 29). This qualitative insight suggests that local certification offers novel value beyond that of an additional national (i.e. Phase II) certification.

Appendix B: SBIR Policy Mix & Data Building

Section B.1. SBIR Policy Mix

Figure B1 illustrates the SBIR policy mix with VC financing serving as the outcome of interest. All firms in the study secure the Phase I award. While firms are eligible to seek private financing at any stage (denoted by Arrow C), firms that progress forward typically draw upon one of multiple pathways of follow-on certification before securing private financing. We are primarily interested in the two paths with follow-on certification. For those eligible, the State Match is offered immediately following Phase I receipt. Arrow A denotes the timeframe with which we expect the State Match to have an initial impact on private financing outcomes – notably one year after securing the initial Phase I award. Secondly, competitive firms that secure the Phase II award are certified for two years. This extends to the third and possibly fourth year of the original project. Arrow B denotes the timeframe that we expect the Phase II to have an initial effect on private financing – notably three or more years after securing the Phase I.

Figure B1: Federal and State SBIR Policy Mix



Note: The narrow black line denoting time is not drawn to scale. Arrow A denotes the timeframe we expect the State Match to have an initial impact on private financing. Arrow B denotes the timeframe we expect the Phase II to have an initial effect on private financing. Arrow C presents a baseline given that firms are able to seek private financing at any stage.

Section B.2 Data Building

Overview

We draw upon six sources to construct this dataset. The SBA's public repository of Phase I and II awards provides detailed, project-level federal SBIR activity. The KY Science and Technology Corporation and NC Department of Commerce provide comprehensive project-level State Match data for each state, respectively. Firm-level VC financing activity was drawn from two proprietary data sources – PrivCo and Thomson Reuter's VentureXpert. Lastly, we rely on the National Establishment Time Series (NETS) database for additional firm level controls (these include panel data on employment and age). In cases with missing NETS data, we relied on additional online searches.

Original Sample Selection

For this analysis, we began with an original sample of firms that met the following conditions: (i) the firm secured at least one federal Phase I award; (ii) the firm is located in the contiguous geographic region delimited by the following U.S. states: AR, KY, MO, NC, SC, and VA (sans NoVA); and (iii) the Phase I award was administered between 2001 and 2010. 800 private firms met these specifications.

Additional Data Sources

We identified the Dun & Bradstreet DUNS number for Phase I firm recipients and used this information to match the firms to the National Establishment Time Series (NETS) database. The former is tied to firm credit ratings, while the latter provides comprehensive panel data on private U.S. firms. This provided additional firm level characteristics of the SBIR Phase I recipients.

To improve the match rate for the NAICS classification, which had a higher rate of missing data from NETS, we relied on the detail presented in the SBIR abstract. The abstract provides approximately 300 – 500 words detailing the technical and commercial aims of the firm's project. Two independent coders reviewed the SBIR award abstract and identified the 3-digit NAICS code. Their overlap in coding was 85 percent. We then had one of the senior researchers review the set of records where the coding diverged to make a final decision on the classification.

Lastly, we merged firm level private financing activity from PrivCo and VentureXpert. Twelve percent secured private financing following public certification. We provide more detail on the matching and overlap of these two sources below.

In total, we gathered firm level detail for 92 percent of the original sample of firms (736). Those with missing data do not have a DUNS ID and did not have additional information available online. Given the scope of the SBIR program – to support early stage, small, private, high-tech firms – we anticipate that these firms exited the market.

Certification Sequence and Level of Analysis

By tracing the path of public certification from Phase I to State Match (if eligible) to Phase II (if competitive) we measure private financing over a series of annual increments after the *last* certification of each certification sequence. To be clear, for the certification redundancy and certification broadening constructs, we trace the sequence of certifications initiated by each Phase I award (refer to Figure B1). The project level data was critical for understanding the sequence of certifications. However, given that private financing cannot be traced to the individual project within the firm, we collapsed the data to the firm level for analysis.

Private Financing Data

PrivCo: We relied on two teams of researchers – one at PrivCo and another group of research assistants at the first author's institution. Both teams relied on variations of the firm name from the SBIR, State Match, NETS databases, as well as address information to ensure accurate matches. 7.6 percent of the firms in the sample had private financing.[1]

After matching the sample, we examined the match rate and trends. PrivCo confirmed that state affiliation does not factor into their data retrieval. Nevertheless, upon close inspection of the data, we realized that their data was less complete prior to 2005. PrivCo claims to have complete private financing data for more recent activity; however, this presents potential limitations given the nature of the DD analysis – specifically for the earlier years (i.e. the pre-period).

VentureXpert: To augment the PrivCo data, the authors pulled private financing data for the set of firms from Thomson Reuters' VentureXpert database. This data source provides private financing data over an extended period of time: 1985 – 2017. As with our matching approach for PrivCo, we relied on variations of the firm name from the SBIR, State Match, NETS databases, as well as address information to ensure the accuracy of the collected data. We merged private financing activity to the firm-level dataset based on the last certification of follow on public certification. 8.4 percent of firms in the sample had private financing.[2]

Diagnostics of Overlap Between Two Private Financing Sources – PrivCo and VentureXpert

PrivCo and VentureXpert report overlapping information on private financing (corr = 0.85, on private financing amount). However, each source offers unique information as well. Notably, VentureXpert provides more historical data while PrivCo reports more detailed activity on recent funding. Table B1 denotes the overlap in the match rates between the two samples.

Table B1: Comparison of PrivCo (PC) to VentureXpert (VX) data

	PrivCo	*VentureXpert*	*Complete Overlap*	*Overlap from 2003 - 2015*
Firm	73	91	42 matched (31 PC; 49 VX)	41 matched (32 PC; 35 VX)
Firm year	177	365	98 matched (79 PC; 267 VX)	97 matched (79 PC; 161 VX)
Firm year round	220	495		
Years reported	2001, 2004 – 2015	1985 - 2016		

Notes: Results presented in parentheses are the activity for each source that does *not* overlap.

The average size[3] of the funding round is $6.5 million (reported from PrivCo) and $6.4 million (reported from VentureXpert). Benchmarking these levels to a recent study (Howell 2017), which found private funding levels at $9 million, we infer that the majority of private financing is VC given the comparable size.

[1] This statistic is at the firm level rather than firm-year; the latter is used for the empirical analysis.
[2] Ibid.
[3] We adjust all financing values to account for inflation.

Final Computation of Private Financing Data

To track the population of private financing activity across this sample of firms, we derive the private financing measures using data from both PrivCo and VentureXpert. Most notably, if the firm received private financing within the given window (e.g. one year) as reported by either PrivCo or VentureXpert, we coded the outcome as one. Regarding levels and round count, we selected the larger of the two values. When considering the overlap within firm, the average difference in levels between the two sources is $17,000; the average difference in round count is 0.17 rounds. This technique was used to compute both prior and follow on private financing activity.[4]

Descriptive Statistics of Private Financing

In drawing upon both sources, 12 percent of firms in the sample secured private financing following the public certification. Among the set of ventures that secured private financing, they secured 535 rounds of funding. The average funding amount per round was $6.4 million (SD = $8.5 million; min = $4,700[5]; max = $54 million). Moreover, the median round amount is $3.8 million, which indicates a right skew.

Among the set of ventures with private financing, there is variation in the level of success. Table B2 overviews the frequency of subsequent rounds of financing for the sample with any private financing. While three-quarters of the set of firms secured up to five rounds of funding, this level drops off as the number of rounds increase.

Table B2: Distribution of Private Financing Rounds for Sample of Ventures with Private Financing

Number of Rounds	*Frequency (Percent)*	*Cumulative*
1	29.41	29.41
2	13.45	42.86
3	10.08	52.94
4	7.56	60.50
5	12.61	73.11
10	3.36	92.44
> 15	1.68	98.32

[4] Given the discrepancies between PrivCo and VentureXpert – notably, they do not report funding type at the same level of granularity – we do not examine variation in private funding types.
[5] This outlying observation reports a private seed grant.

Appendix C: Additional Results

Section C.1 Detail of data and preliminary results

Table C1: Indicators for Primary Empirical Models

Variables	Unit of Analysis	Source; Calculation
Outcome		
Private Financing$_{it+n}$		PrivCo & VentureXpert; private financing within $1 \leq n \leq 5$ years after last public certification
	Binary	Any private financing
	Continuous	Private financing, deflated in level ($1m) and log form
Key Explanatory Variables		
Post$_t$	Binary	Post = 1 if firm in NC, SC, or VA and year ≥ 2006; Post = 1 if firm in KY, AR, or MO and year ≥ 2007
Treat$_k$	Binary	Treat = 1 if firm in NC or KY
Post$_t$ * Treat$_k$ (H1)	Binary	Derived (denotes State Match)
Active Phase II$_{it}$ (H2)	Binary	SBIR.gov; 1 if Phase II certification is active[6]
Controls		
I. R&D Activity		
Prior Phase I Count$_{it}$	Count	SBIR.gov; prior cumulative Phase I count (since 1992)[7]
Prior Phase II Count$_{it}$	Count	SBIR.gov; prior cumulative Phase II count (since 1992)
Prior State Match Activity$_{it}$	Binary	KY S&T Corporation; NC Dept. of Commerce
Prior Private Financing$_{it}$	Count	PrivCo & VentureXpert; Cumulative prior number of private financing rounds
II. Firm Characteristics		
Minority$_i$	Binary	SBIR.gov; 1 if woman-owned, minority-owned, or located in Historically Underutilized Business Zone
Age$_{it}$	Count	NETS; reported in years; age as of 2015
Employment$_{it}$	Count	NETS; annual number of FTE
III. Regional Characteristics		
SBIR CBSA Phase I Count$_{jt}$	Count	Derived from SBIR.gov; count of Phase I in CBSA
Region$_i$	Binary	Dummy indicator for "Atlantic" region (NC, SC, and VA) and "South" region (AR, KY, and MO)
IV. Additional Dummy Indicators		
State$_i$	Binary	State location of firm (AR, KY, MO, NC, SC, and VA)
Recession$_t$	Binary	Coded 1 if year ≥ 2008 and 0 otherwise
Year$_t$	Binary	Calendar year of public certification (2001 – 2010)
NAICS$_i$	Binary	NETS & SBIR award record; 2-digit NAICS classification (32*, 33*, 42*, 51*, 54*, 56*, and other)
SBIR Mission Agency$_i$	Binary	Most common SBIR mission agency, 2000 – 2010[8]

Notes: i denotes the firm, j denotes the core based statistical area (CBSA), k denotes the state, t denotes the year of public certification, and n denotes the number of years after the last public certification.

[6] The Phase II certification provides support for a two-year project. We match the private financing following the second year of the Phase II certification.

[7] While we define the sample of firms that secure a Phase I from 2001 to 2010, for prior activity we pull from 1992.

[8] Although firms are not precluded from securing SBIR awards across multiple agencies, most secure from one agency given the match between the agency and firm's innovative research agenda.

Table C2: Descriptive Statistics

Variables	Mean	S.D.	Min	Max
Outcome: Private Financing (Binary)				
By 1 year	0.07	0.26	0	1
By 2 years	0.09	0.28	0	1
By 3 years	0.10	0.30	0	1
By 4 years	0.11	0.31	0	1
By 5 years	0.12	0.32	0	1
Outcome: Private Financing (Continuous, $1m deflated)[9]				
By 1 year (n=106)	7.99	8.82	0.10	53.47
By 2 years (n=136)	10.01	11.42	0.10	53.47
By 3 years (n=163)	11.14	13.55	0.00	81.46
By 4 years (n=186)	12.42	15.31	0.00	86.06
By 5 years (n=201)	13.76	16.98	0.00	86.06
Key Explanatory Variables				
Post	0.52	0.50	0	1
Treat	0.40	0.49	0	1
Post * Treat (H1)	0.22	0.42	0	1
Active Phase II (H2)	0.53	0.50	0	1
Controls				
Prior Phase I Count	4.96	14.49	0	267
Prior Phase II Count	1.57	5.11	0	99
Prior State Match Activity	0.02	0.15	0	1
Prior Private Financing Count (Rounds)	0.18	0.79	0	9
Minority	0.16	0.37	0	1
Age (as of 2015)	17.30	10.68	4	198
Employment	13.35	29.17	1	400
SBIR CBSA Phase I Count	17.16	11.64	0	44
Region (Atlantic)	0.73	0.45	0	1
Firm location: Arkansas	0.06	0.25	0	1
Firm location: Kentucky	0.08	0.27	0	1
Firm location: Missouri	0.13	0.33	0	1
Firm location: North Carolina	0.32	0.47	0	1
Firm location: South Carolina	0.07	0.26	0	1
Firm location: Virginia	0.34	0.47	0	1
Recession	0.35	0.48	0	1
NAICS (32* Non-metal Related Manufacturing)	0.05	0.21	0	1
NAICS (33* Metal-related Manufacturing)	0.14	0.34	0	1
NAICS (42* Wholesale Trade)	0.03	0.18	0	1
NAICS (51* Information)	0.03	0.16	0	1
NAICS (54* Professional, Scientific, & Technical)	0.64	0.48	0	1
NAICS (56* Administrative Support & Remediation)	0.03	0.17	0	1
NAICS (Other)	0.08	0.28	0	1
SBIR: Department of Homeland Security	0.01	0.11	0	1
SBIR: Department of Commerce	0.01	0.09	0	1

[9] All financing variables are deflated (2009 base yr). We report financing levels for the set of firm-observations *with* private financing activity; the number of observations is reported in parentheses.

SBIR: Department of Defense	0.39	0.49	0	1
SBIR: Department of Energy	0.04	0.20	0	1
SBIR: Department of Transportation	0.00	0.05	0	1
SBIR: Department of Education	0.01	0.10	0	1
SBIR: Environmental Protection Agency	0.01	0.08	0	1
SBIR: Department of Health and Human Services	0.34	0.47	0	1
SBIR: National Aeronautics and Space Administration	0.05	0.22	0	1
SBIR: National Science Foundation	0.10	0.30	0	1
SBIR: United States Department of Agriculture	0.04	0.19	0	1
Year of Certification: 2001	0.08	0.27	0	1
Year of Certification: 2002	0.08	0.27	0	1
Year of Certification: 2003	0.09	0.29	0	1
Year of Certification: 2004	0.10	0.30	0	1
Year of Certification: 2005	0.10	0.30	0	1
Year of Certification: 2006	0.10	0.30	0	1
Year of Certification: 2007	0.10	0.30	0	1
Year of Certification: 2008	0.11	0.31	0	1
Year of Certification: 2009	0.12	0.32	0	1
Year of Certification: 2010	0.12	0.32	0	1
Firms		736		
Firm-year Observations		1,908		

Section C.2 Empirical Estimations for H1: DD Results

Table C3: DD Model – Differential effect of certification broadening (H1) on the likelihood of securing private financing over various annual timeframes (Eq. 1)

Binary Outcome: Any Private Financing	(1) 1 year	(2) 2 years	(3) 3 years	(4) 4 years	(5) 5 years
Prior Cumulative Phase I Count	0.000	-0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Prior Cumulative Phase II Count	0.001	0.001	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)
Prior State Match, Binary	-0.026	-0.027	-0.051	-0.030	-0.036
	(0.066)	(0.068)	(0.070)	(0.073)	(0.073)
Prior Private Financing Round Count	0.155***	0.168***	0.177***	0.176***	0.177***
	(0.029)	(0.027)	(0.025)	(0.025)	(0.025)
Minority Firm	-0.025**	-0.031**	-0.041***	-0.049***	-0.049***
	(0.011)	(0.014)	(0.015)	(0.016)	(0.018)
Firm Age	-0.001**	-0.002**	-0.002**	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Employment Count	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SBIR CBSA Phase I Count	0.001*	0.002***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Post	0.050**	0.039	0.053*	0.060*	0.055*
	(0.025)	(0.028)	(0.030)	(0.031)	(0.032)
Treat	0.007	0.004	0.022	0.031	0.028
	(0.032)	(0.038)	(0.041)	(0.045)	(0.046)
Post * Treat (H1)	0.065***	0.072**	0.065**	0.041	0.037
	(0.025)	(0.030)	(0.033)	(0.034)	(0.035)
Constant	0.009	-0.023	-0.050	-0.065	-0.076
	(0.067)	(0.077)	(0.082)	(0.086)	(0.088)
Year Dummies	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes
NAICS Dummies	Yes	Yes	Yes	Yes	Yes
SBIR Dummies	Yes	Yes	Yes	Yes	Yes
Observations	1,908	1,908	1,908	1,908	1,908
R-squared	0.292	0.297	0.300	0.285	0.272

Notes: Regression type – OLS linear probability model; key outcome variable – any private financing (binary); primary explanatory variables: Post * Treat (binary). Standard errors are in parentheses and are clustered at the firm level (*** p<0.01, ** p<0.05, * p<0.1).

Table C4: DD Model – Differential effect of certification broadening (H1) on the amount private financing over various annual timeframes (Eq. 1)

Continuous Outcome: Private Financing Amount (deflated, scaled $1m's)	(1) 1 year	(2) 2 years	(3) 3 years	(4) 4 years	(5) 5 years
Prior Cumulative Phase I Count	-0.026	-0.024	-0.017	-0.018	-0.009
	(0.020)	(0.026)	(0.031)	(0.031)	(0.030)
Prior Cumulative Phase II Count	0.031	0.011	-0.019	-0.025	-0.059
	(0.043)	(0.061)	(0.073)	(0.073)	(0.074)
Prior State Match, Binary	-0.334	-0.861*	-1.336**	-1.724**	-1.719*
	(0.369)	(0.472)	(0.575)	(0.689)	(0.992)
Prior Private Financing Round Count	1.498***	2.050***	2.474***	2.812***	2.945***
	(0.545)	(0.766)	(0.914)	(1.023)	(1.073)
Minority Firm	-0.092	-0.178	-0.274	-0.401	-0.590
	(0.139)	(0.240)	(0.275)	(0.315)	(0.363)
Firm Age	-0.002	-0.006	-0.006	-0.010	-0.014
	(0.003)	(0.005)	(0.007)	(0.008)	(0.010)
Employment Count	0.002	0.002	0.000	-0.001	-0.002
	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)
SBIR CBSA Phase I Count	0.003	0.018	0.029**	0.039**	0.051***
	(0.008)	(0.011)	(0.013)	(0.016)	(0.018)
Post	0.520*	0.207	0.411	0.963	1.046
	(0.297)	(0.332)	(0.526)	(0.632)	(0.701)
Treat	-0.175	-0.385	-0.560	-0.478	-0.565
	(0.234)	(0.318)	(0.397)	(0.537)	(0.614)
Post * Treat (H1)	0.483*	0.939**	1.282***	1.461**	1.412**
	(0.281)	(0.369)	(0.482)	(0.587)	(0.669)
Constant	-0.381	-0.792	-1.398	-2.519**	-3.118**
	(0.548)	(0.753)	(1.013)	(1.251)	(1.463)
Year Dummies	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes
NAICS Dummies	Yes	Yes	Yes	Yes	Yes
SBIR Dummies	Yes	Yes	Yes	Yes	Yes
Observations	1,908	1,908	1,908	1,908	1,908
R-squared	0.212	0.208	0.205	0.192	0.179

Notes: Regression type – OLS; key outcome variable – private financing amount (scaled, $1m's; deflated); primary explanatory variables: Post * Treat (binary). Standard errors are in parentheses and are clustered at the firm level (*** p<0.01, ** p<0.05, * p<0.1).

Table C5. Fixed Effects Model – Differential effect of certification broadening (H1) on the likelihood of securing private financing (Panel A) and amount of private financing (Panel B) over various subsequent annual timeframes

	(1) 1 year	(2) 2 years	(3) 3 years	(4) 4 years	(5) 5 years
Panel A – Binary Outcome: Any Private Financing					
Post * Treat (H1)	0.038*	0.046**	0.034*	0.011	-0.004
	(0.020)	(0.019)	(0.018)	(0.017)	(0.016)
Constant	-0.019	0.057	0.069	0.116	0.125
	(0.204)	(0.196)	(0.189)	(0.172)	(0.166)
R-squared	0.821	0.863	0.888	0.914	0.923
Panel B – Continuous Outcome: Private Financing Amount (deflated, scaled $1m's)					
Post * Treat (H1)	0.115	0.399	0.660**	0.520*	-0.210
	(0.186)	(0.261)	(0.284)	(0.310)	(0.348)
Constant	-0.201	0.106	-0.565	-0.461	0.571
	(1.916)	(2.691)	(2.929)	(3.194)	(3.589)
R-squared	0.864	0.871	0.904	0.921	0.924
Additional detail for both regressions (Panels A and B)					
Time-varying Controls	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,909	1,909	1,909	1,909	1,909

Notes: Regression type – Firm fixed effects model; Panel A key outcome variable – any private financing (binary); Panel B key outcome variable – private financing amount (scaled, $1m's; deflated). Primary explanatory variables: Post * Treat (binary). Standard errors are in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Time-varying Controls include: Prior Cumulative Phase I Count; Prior Cumulative Phase II Count; Prior State Match; Prior Private Financing Cumulative Round Count; Firm Age; Employment Count; SBIR CBSA Phase I Count; and Post. Complete regression results with time-varying controls are available upon request.

Section C.3: Empirical Extensions for H2: CEM Results

Table C6: Difference in means and distribution for *original* sample by control – without Active Phase II – and treatment – with Active Phase II

	(1) Means (Control)	(2) Means (Treatment)	(3) p-value (t-test)	(4) Distribution Difference	(5) p-value (KS-test)
Prior Cumulative Phase I Count	1.813	7.713	0.000	0.482	0.000
Prior Cumulative Phase II Count	0.422	2.583	0.000	0.414	0.000
Prior State Match, Binary	0.006	0.038	0.000	0.033	0.690
Prior Private Financing Round Count	0.157	0.205	0.180	0.022	0.970
Minority Firm	0.184	0.137	0.005	0.048	0.234
Firm Age	16.146	18.306	0.000	0.198	0.000
Employment Count	11.597	14.875	0.015	0.191	0.000
SBIR CBSA Phase I Count	16.677	17.584	0.091	0.092	0.001
AR	0.063	0.067	0.727	0.004	1.000
KY	0.094	0.067	0.029	0.027	0.866
MO	0.153	0.107	0.003	0.046	0.277
NC	0.352	0.290	0.003	0.063	0.048
SC	0.065	0.080	0.222	0.014	1.000
VA	0.273	0.390	0.000	0.117	0.000
NAICS (32*)	0.048	0.048	0.985	0.000	1.000
NAICS (33*)	0.131	0.139	0.609	0.008	1.000
NAICS (42*)	0.037	0.030	0.426	0.007	1.000
NAICS (51*)	0.030	0.021	0.182	0.010	1.000
NAICS (54*)	0.625	0.660	0.108	0.035	0.591
NAICS (56*)	0.043	0.019	0.003	0.024	0.947
NAICS (other)	0.085	0.083	0.821	0.003	1.000
Observations	890	1018			

Notes: The difference in means and difference in distributions is estimated with the full sample, 1908 firm-year observations. Columns 1 and 2 report the mean measures for the control and treated group, respectively. Column 3 reports the p-value from the t-test. Column 4 reports the difference in distributions and Column 5 reports the p-value from the Kolmogrov-Smirnov test of the equality of distributions.

Table C7: Coarsening Exact Match Statistics for Non-Binary Variables

Pretreatment Variables	(1) *Control Mean*	(2) *Treatment Mean*	(3) *Difference in Mean*	(4) *p-value (t-test)*	(5) *Difference in Distributions*	(6) *p-value (KS-test)*
Prior Cumulative Phase I Count	6.085	5.678	0.407	0.709	0.027	1
Prior Cumulative Phase II Count	1.803	1.413	0.390	0.308	0.052	0.943
Prior Private Financing Round Count	0.025	0.025	-0.000	1	0.000	1
Firm Age	18.808	18.667	0.141	0.878	0.030	1
Employment Count	12.78	12.241	0.539	0.852	0.041	0.995
SBIR CBSA Phase I Count	16.865	17.075	-0.210	0.851	0.045	0.987
Observations	211	197				

Note: The coarsened sample represents 408 firm-year observations. We manually set the bins to reflect the natural distribution of the data with continuous or count functional form to reduce imbalance. For both the comparison of means and distributions, weights – derived from the coarsening sampling technique – are used in the computations of these differences. Column 3 reports the difference in means between the treated and control group; the p-value is reported in Column 4. Column 5 reports the difference in distributions between the treated and control group; the p-value is reported in Column 6. We do not report the statistics for the binary variables as we directly match across all binary indicators such that they are equivalent within strata.

Section C.4 Falsification Tests – Empirical Extensions of Both Models with Continuous Functional Form

We re-estimate the two primary models with the monetary levels rather than count or binary forms for the certification constructs. Moreover, for the prior private financing variable, we include the monetary level rather than the cumulative round count. With the explanatory variables now in continuous form – namely, the State Match amount and Phase II amount – we estimate all of the variables with funding levels in logged form (deflated) to allow for ease of interpretation of the results. This yields level-log and log-log models depending on whether the private financing outcome is binary or continuous, respectively. Regarding the set up for the certification broadening falsification test, we replace the DD variables (Treat, Post, and Post*Treat) with the level of the noncompetitive State Match. As for the certification redundancy falsification test, selection remains an issue, thus we use the CEM procedure. For the coarsening, we utilize the binary indicator – Any Active Phase II – to distinguish between the treatment and control groups given that we are precluded to coarsen on continuous measures. We use the same set of pretreatment variables included in the primary model; however, we draw upon the logged functional form of the prior certification and private financing variables. As with the primary model, we ensure balance in means and distributions with the coarsening procedure along all pretreatment variables. For the regression, we include the logged form of the Phase II amount as the key explanatory variable in the OLS model.

Table C8: Certification broadening falsification test with continuous functional form estimating the incremental effect of the amount of the State Match on private financing activity – Level-Log (Panel A) and Log-Log (Panel B) – over various annual timeframes

	(1) 1 year	(2) 2 years	(3) 3 years	(4) 4 years	(5) 5 years
Panel A: Binary Outcome – Any Private Financing					
State Match Amt (deflated, logged)	0.004**	0.005**	0.004*	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.042**	0.056**	0.055**	0.066**	0.077***
	(0.019)	(0.024)	(0.026)	(0.028)	(0.028)
R-squared	0.325	0.342	0.339	0.327	0.315
Panel B: Continuous Outcome – Private Financing Amount (deflated, logged)					
State Match Amt (deflated, logged)	0.053**	0.056*	0.048	0.054*	0.051
	(0.025)	(0.030)	(0.034)	(0.033)	(0.033)
Constant	0.635**	0.804**	0.604*	0.830**	0.922**
	(0.274)	(0.332)	(0.331)	(0.397)	(0.410)
R-squared	0.278	0.309	0.311	0.307	0.293
Additional detail for both regressions (Panel A and B)					
Controls	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Observations	1,909	1,909	1,909	1,909	1,909

Notes: Regression type – OLS; key outcome variable – any private financing (binary) reported in Panel A; private financing amount (deflated, logged) reported in Panel B. Primary explanatory variable: State Match amount (deflated, logged). Panel A estimates a level-log model;[10] Panel B estimates an elasticity model. Controls include: Prior Cumulative Phase I Amount; Prior Cumulative Phase II Amount; Prior State Amount; Prior Private Financing Amount; Minority Firm; Firm Age; Employment Count; SBIR CBSA Phase I Count; State Location of Firm (6 dummy variables); 2-digit NAICS Indicator (7 dummy indicators); and Annual Year Dummies. All financial variables are estimated in logged, deflated form (base yr 2009). For observations with no financing, we adjust the amount to 1 so that the log form is equivalent to 0. Standard errors are in parentheses and are clustered at the firm level (*** p<0.01, ** p<0.05, * p<0.1).

[10] Interpretation of beta-coefficients for level (y) – log (x) models are as follows: $\Delta y=(\beta_1/100)\%\Delta x$ (Wooldridge 2009, p. 46). The level in this case refers to the binary outcome indicator.

Table C9: Certification redundancy falsification test with continuous functional form estimating the incremental effect of the amount of the Phase II on private financing activity – Level-Log (Panel A) and Elasticity (Panel B) – over various annual timeframes

	(1) 1 year	(2) 2 years	(3) 3 years	(4) 4 years	(5) 5 years
Panel A: Binary Outcome – Any Private Financing					
Phase II Amt (deflated, logged)	-0.009	-0.026	-0.023	-0.026	-0.025
	(0.007)	(0.019)	(0.025)	(0.032)	(0.032)
Constant	-0.008	0.127	-0.095	-0.814	-0.928
	(0.070)	(0.355)	(0.425)	(1.001)	(0.984)
R-squared	0.704	0.498	0.374	0.372	0.436
Panel B: Continuous Outcome – Private Financing Amount (deflated, logged)					
Phase II Amt (deflated, logged)	-0.001	-0.002	-0.001	-0.002	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.018	0.031	0.003	-0.048	-0.039
	(0.012)	(0.027)	(0.028)	(0.065)	(0.071)
R-squared	0.531	0.479	0.382	0.377	0.417
Additional detail for both regressions (Panel A and B)					
Pretreatment Controls for Coarsening Sample †	Yes	Yes	Yes	Yes	Yes
Controls					
Strata Dummies	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Observations	371	371	371	371	371
CEM Weights	Yes	Yes	Yes	Yes	Yes

Notes: Regression type – OLS; key outcome variable – any private financing (binary) reported in Panel A; private financing amount (deflated, logged) reported in Panel B. Primary explanatory variable: Active Phase II Amount (deflated, logged). Panel A estimates a level-log model;[11] Panel B estimates an elasticity model. Cem weights are incorporated when estimating the regression; standard errors are in parentheses and are clustered at the firm level (*** p<0.01, ** p<0.05, * p<0.1). All financial variables are estimated in logged, deflated form (base yr 2009). For observations with no financing, we adjust the amount to 1 so that the log form is equivalent to 0. † Pretreatment controls are used to coarsen the sample between firms with and with an active Phase II. These include Prior Cumulative Phase I Amount; Prior Cumulative Phase II Amount; Prior State Amount; Prior Private Financing Amount; Minority Firm; Firm Age; Employment Count; SBIR CBSA Phase I Count; State Location of Firm (6 dummy variables); 2-digit NAICS Indicator (7 dummy indicators); and Recession Indicator. Balance across the pretreatment variables (means and distributions) is achieved.

[11] Interpretation of beta-coefficients for level (y) – log (x) models are as follows: $\Delta y=(\beta_1/100)\%\Delta x$ (Wooldridge 2009, p. 46). The level in this case refers to the binary outcome indicator.

Appendix D: References

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