

Understanding the Incentives for Small Businesses to Participate in the Acquisition Process for R&D Intensive Products

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How can the DOD encourage small businesses to participate in R&D?

- Small business participation in acquisition is imperative for broadening the industrial base and maintaining a competitive edge
- Optimal design of programs depends on whether incentives are **internal** or **external** to the program
 - Internal: Prospect of success through the program itself
 - External: Prospect of using success in the program to win contracts and “payoffs” outside the program (contracts, subcontracts, M&A, etc.)
- Internal incentives → reforms to the program itself can have a substantial effect

Is effort in the DOD SBIR program motivated by internal or external incentives?

Overview of Methodology

- Small Business Innovation Research (SBIR) program is organized into narrowly-defined “topics” which go through three phases
- Strong correlation between success in one phase and success in subsequent phases will be evidence of importance of internal incentives
- Correlation between success in one topic and future outcomes (other SBIR, non-SBIR, or M&A) is evidence of external incentives
 - Conduct comparisons both across and within-firm

Largely find evidence for strong internal incentives but limited external ones.

Data

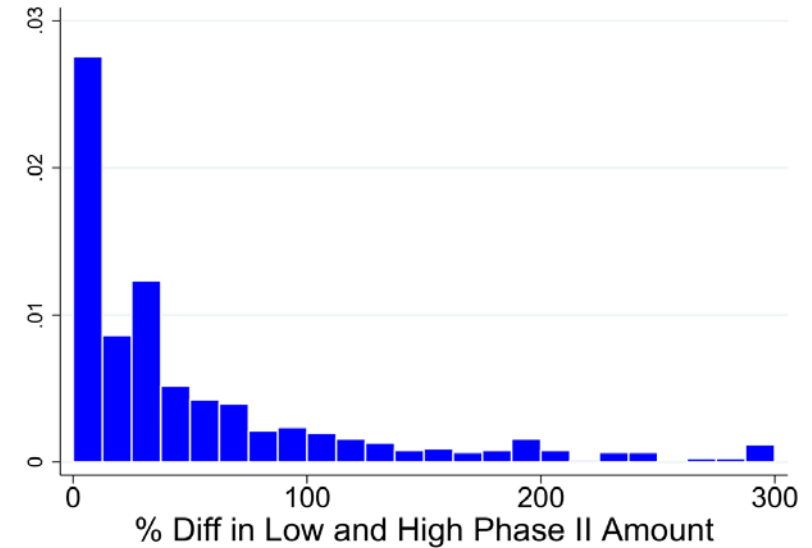
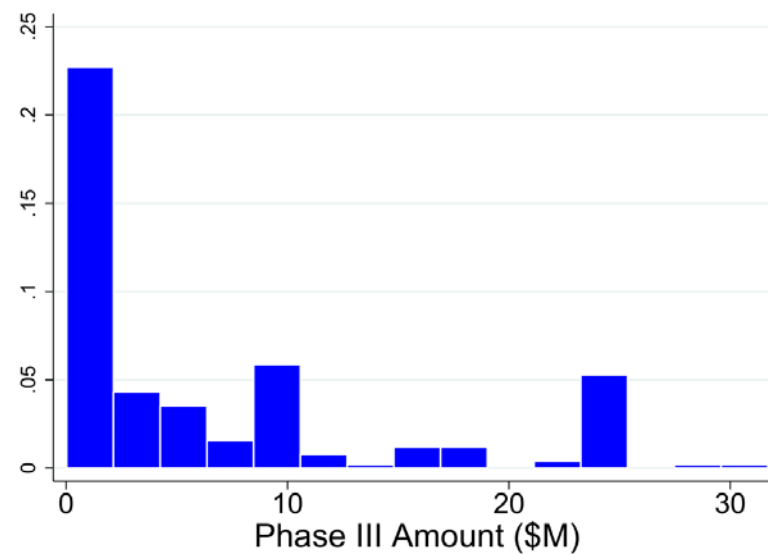
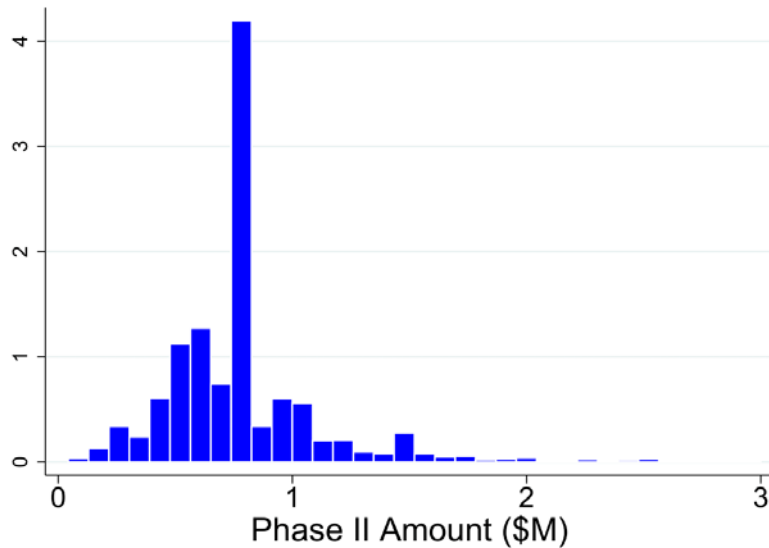
- Contract-level data from Federal Procurement Data System
 - Contract amount (initial, final, modifications), agency letting the contract, winning firm, etc.
- Topic-level data from `sbir.gov` and `navysbirsearch.com`
 - More information about specific product (control for heterogeneity)
 - Navy data is clearer about tracking Phase III
- M&A data from DACIS (Defense and Aerospace Competitive Intelligence System), a commercial data vendor tracking deals in the defense space

Overview of SBIR Program (Evidence from Navy SBIR, 2000-2012)

Fairly small contests with substantial attrition before Phase III

	0	1	2	3	4	≥ 5
# Phase I Competitors		12.9%	41.8%	32.8%	8.9%	3.6%
# Phase II Competitors	16.9%	61.1%	19.0%	2.3%	0.6%	0.2%
# Phase III Competitors	91.3%	8.8%				

... but Phase III is lucrative, and substantial heterogeneity across contests



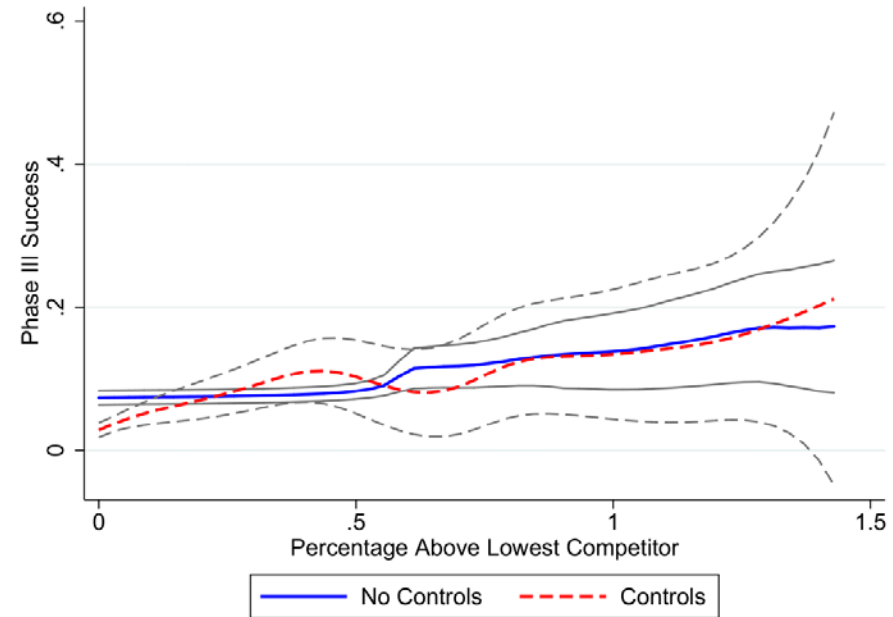
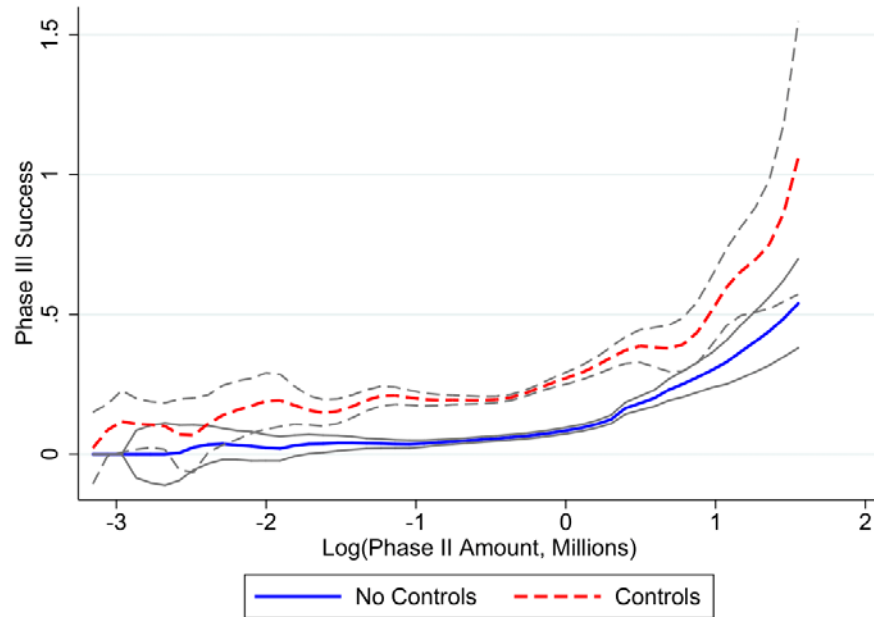
Within-Topic Correlations Between “Effort” and Outcomes

	Phase I	Phase II	Phase I	Phase II	Phase II	Phase III
	(1)	(2)	(3)	(4)	(5)	(6)
# Phase I Competitors	0.066	-0.018	-0.128	-0.023	0.016	0.234
	(0.009)	(0.008)	(0.008)	(0.008)	(0.012)	(0.110)
# Phase II Competitors		0.076		0.028	-0.002	-0.429
		(0.016)		(0.010)	(0.016)	(0.176)
Log(Avg Phase II Amount)		0.157				
		(0.018)				
Log(Phase II Amount)				0.250		0.330
				(0.031)		(0.195)
R ²	0.083	0.128			0.133	0.422
N	2,773	2,292	2,773	2,292	2,292	151

- Regressions of **outcomes** on competition and **effort**
 - Outcomes: Topic-level success in a phase (Col 1 and 2), individual-level success in a Phase (Col 3 and 4), and funding in a Phase (Col 5 and 6)
 - Variation in Phase II funding used as a proxy for effort
- Controls for year differences, differences in topics, and SYSCOM differences

Interpretation of Results

- Higher within-topic effort is correlated with more success (higher likelihood of transitioning to future stages) and with higher funding in those stages
- Within-topic analysis confirms this pattern without cross-topic comparisons
 - Better-funded projects (likely more effort overall) are significantly more likely to yield successful future contracts within the same topic



Internal incentives are likely significant.

Does SBIR Participation Improve Outcomes in Other SBIR Topics?

	Air Force	Army	DARPA	NASA	Navy	Other
Air Force	0.201 (0.001)	0.124 (0.001)	0.00002 (0.00001)	0.023 (0.001)	0.041 (0.001)	0.034 (0.0003)
Army	0.002 (0.0002)	0.009 (0.0002)	0.000 (0.000)	-0.001 (0.0002)	0.003 (0.0002)	0.002 (0.0001)
DARPA	-0.430 (0.046)	0.001 (0.045)	-0.0001 (0.001)	0.840 (0.047)	-1.582 (0.050)	-0.468 (0.022)
NASA	0.010 (0.001)	0.011 (0.001)	-0.00001 (0.00001)	0.467 (0.001)	-0.035 (0.001)	-0.001 (0.001)
Navy	0.032 (0.001)	0.093 (0.001)	0.00002 (0.00001)	-0.004 (0.001)	0.280 (0.001)	0.016 (0.0003)
Other	0.129 (0.002)	0.178 (0.002)	-0.0001 (0.00002)	0.049 (0.002)	0.045 (0.002)	0.261 (0.001)
Adjusted R ²	0.579	0.556	0.0001	0.501	0.614	0.455
N	312,569	312,569	312,569	312,569	312,569	312,569

- Regression at firm-year level of number of current-year SBIR contracts (from each agency) on number of past SBIR contracts
- Limited effects cross-agency for the most part, but strong within-agency
- However, these effects disappear when adding firm fixed effects to try to control for heterogeneity in quality across firm → likely correlational, not causal

Does SBIR Participation Improve Outcomes in Non-SBIR Contracts?

	All Other Contracts			Other R&D Contracts		
	(1)	(2)	(3)	(4)	(5)	(6)
Past # SBIR Phase I	0.005	0.01	-0.01	0.01	0.01	0.005
	(0.02)	(0.02)	(0.03)	(0.001)	(0.0003)	(0.0004)
Past # SBIR Phase II	0.03	0.03	0.10	0.03	0.03	-0.02
	(0.04)	(0.05)	(0.06)	(0.001)	(0.001)	(0.001)
Past # SBIR Phase III	0.25	0.25	-0.95	0.02	0.03	-0.01
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Year FE	Y	Y	Y	Y	Y	Y
Firm FE			Y			Y
Only Small Firms		Y			Y	
Adjusted R ²	0.01	0.01	0.46	0.01	0.02	0.27
N	5555391	4431180	4431180	5459061	4347124	4347124

- Regression at firm-year level of number of current-year non-SBIR contracts on number of past SBIR contracts, with or without firm fixed effects
- Successful SBIR firms are also more successful outside SBIR! (Cols 1, 2, 4, and 5)
- But, controlling for firm heterogeneity through firm fixed effects (Cols 3 and 6), this correlation disappears for the most part

No evidence that success in SBIR causes success outside SBIR.

Are SBIR Contracts Used More Frequently Early in the Life Cycle?

$$\frac{(\text{total non-SBIR contracts by that firm}) - (\text{cumulative non-SBIR contracts up to that point})}{(\text{total non-SBIR contracts by that firm})}$$

SBIR Quantile	Mean # SBIR	All FPDS Contracts			Only R&D Contracts		
		Mean # FPDS	Mean % SBIR	% SBIR Before	Mean # FPDS	Mean % SBIR	% SBIR Before
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1.0	36.0	62.2	57.2	2.8	76.6	54.7
2	1.2	29.5	60.4	57.8	2.9	76.4	57.1
3	2.3	18.4	61.6	59.4	4.0	76.1	57.5
4	4.6	34.9	58.1	56.0	8.2	71.3	54.1
5	31.5	61.0	60.3	56.2	44.8	70.9	54.1

- Metrics near 1 if SBIR always happens before non-SBIR, and 0 if reverse
- In general, we see something in the middle, across many different types of firms, and for both R&D and non-R&D contracts

SBIR and non-SBIR contracts seem to be used as substitutes.

Does SBIR Participation Lead to M&A?

	(1)	(2)
Value of Past SBIR Phase I	0.001	-0.01
	(0.001)	(0.002)
Value of Past SBIR Phase II	0.001	-0.01
	(0.0004)	(0.001)
Value of Past SBIR Phase III	0.0002	0.0001
	(0.0001)	(0.0001)
Year FE	Y	Y
Firm FE		Y
Adjusted R ²	0.0001	0.04
N	5,546,947	5,546,947

- Regression at firm-year level of whether the firm is acquired on past SBIR performance, with and without firm fixed effects.
- Acquisitions are rare (< 0.5% of firms are acquired), but productive firms are indeed the ones acquired (comprise 6% of total contracts)
- Strong cross-firm correlations (Col 1), but no evidence of effects within-firm

No evidence that SBIR participation causes M&A, except perhaps for Phase III.

Limitations and Future Work

- Main difficulty with interpretation is controlling heterogeneity across observations
 - In internal incentive study, use fine controls for topics + within-topic analysis
 - In external incentive study, use firm fixed effects to do within-firm analysis over time, but this may be heavy-handed
- Using scores from SBIR program could be a promising avenue forward → regression discontinuity approach to compare firms on either side of cutoff
- Does not address the question of whether the narrowness of the topics allow for “big ideas” to thrive → could be the goal of the Defense Innovation Unit

Conclusion

- Fairly robust evidence that success in a phase is correlated with success in future phases of the same SBIR topic → **strong internal incentives**
- Successful SBIR firms are successful outside the topic, but evidence suggests this is likely due to heterogeneity → **limited external incentives**
- Caveats as discussed in the previous slide

Encouraging small businesses to participate in the SBIR program may boil down to providing stronger internal incentives, as those likely drive decisions

Contact Information (and a plea for collaboration!)

Many academic economists are especially interested in understanding various aspects of defense procurement

- Decades of research in auctions, procurement, and contracting that could be applied to this especially important sector
- But constrained by lack of institutional knowledge
- ... and, perhaps more importantly, lack of data access!

Please contact me if you have comments on this work, or if you are interested in talking about other aspects of procurement. I can put you in touch with other economists interested in this sphere as well.

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