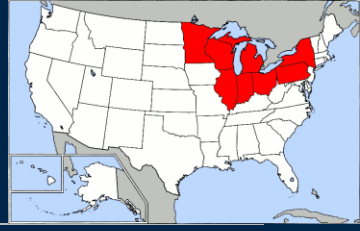

State Governments as Financiers of Technology Startups: Evidence from the Great Lakes Region

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20th Anniversary Uddevalla Symposium
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The Broader Context

- VC is agglomerated in bicoastal states…

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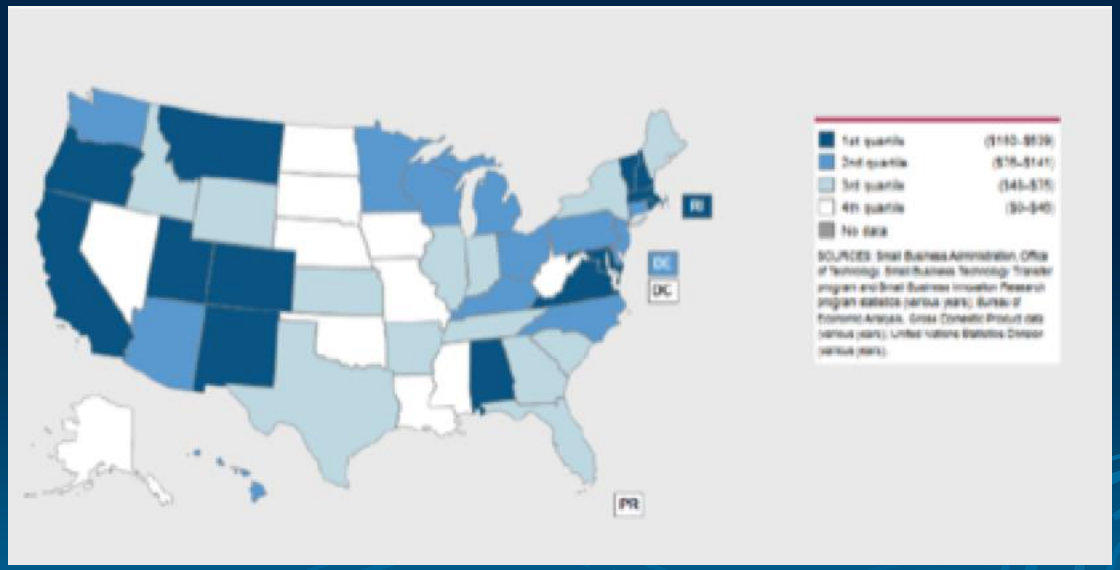
VC funds dispersed by startup location		
	1995	2014
CA	39%	56%
MA	9%	10%
NY	4%	9%
Combined Share	52%	75%
Median	0.31%	0.23%

Source: National Science Board Science & Engineering Indicators 2016; based on PwC/NVCA data

The Broader Context

- …yet science and technology companies spawn from research labs, universities & established firms across U.S. states & regions

SBIR/STTR grants per $1m GSP in 2012



Source: National Science Board Science & Engineering Indicators 2016, Fig 8-53.

Increased State-Level Activism

- Common concerns (Feldman et al., 2014):
  - Funding gaps in local markets for entrepreneurial capital
  - Under-developed clusters (funds + management talent + services)
  - Do “good projects” go unfunded? Do “good startups” leave the state?
- Common solutions: directly fund and/or support for young science and technology companies
  - Utah Science & Technology Research (USTAR) subsidized ~570 startups between 2002 and 2008 (SRI, 2009)
  - The Ohio Third Frontier Program funded “hundreds” of startups by 2010 (Duran 2010)
- Most state funding programs = competition-based, modeled after federal SBIR program
  - Useful data on the applicant pool & project scores exist!
    - but are buried & hard to access…

The Evaluation Challenge

- **Ideal: Random Assignment**

- **Not ideal but more feasible:**
  - Case studies
  - Follow firms that are "treated" (surveys, analysis)
  - Match to "similar" firms
  - Use "close-call" applicants than win or fail by small margin (Jaffe 2002; "regression discontinuity"-based designs)
    - Often used to test effects of public $ on individual and team-level outcomes (e.g., Jacob and Lefgren 2011)
    - Recently used to test effects of R&D grants on firm-level outcomes (e.g., Bronzini & Iachini 2014; Wang Li & Furman 2017; Howell 2017)

Michigan R&D Loan Study
(Zhao & Ziedonis, 2017)

- Leverages data on startups that seek but do not necessarily receive state R&D awards & scores of their projects
  - Sample: 297 proposals from 241 startups, 2002-2008
- Tests effect of award receipt on firm-level outcomes
  - Survival (based on state business registry data)
  - Follow-on financing (SBIR & VC)
  - Business expansion (proxy: news articles of business activity)
  - Production of patents
- Finds that, among close-call applicants, award receipt...
  - Reduces likelihood of business failure
  - Is a greater stimulus to follow-on financing & business expansion for startups when information challenges are more severe
  - Has an indiscernible effect on patent-based outcome measures
- Has obvious limitations: 1 program in 1 state; small-n; lack reliable time-varying data on R&D, employment or sales

The Program(s)

MICHIGAN Economic Development Corporation

Michigan Life Science Corridor (MLSC)

Michigan Technology Tri-corridor (MTTC)

21st Century Jobs Fund Program (21CJF)

Competitive R&D loan program, with added ‘services’ for winners

Overview

- Competitive R&D Loan Program, 2002-2008
  - Fund allotment = pre-determined
  - Location, Sector, & Matching-Funds Requirements
  - Multi-stage selection process
  - Merit-based scores by external reviewers

- Typical applicant: 4-year old life science company

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  - Merit-based scores by external reviewers

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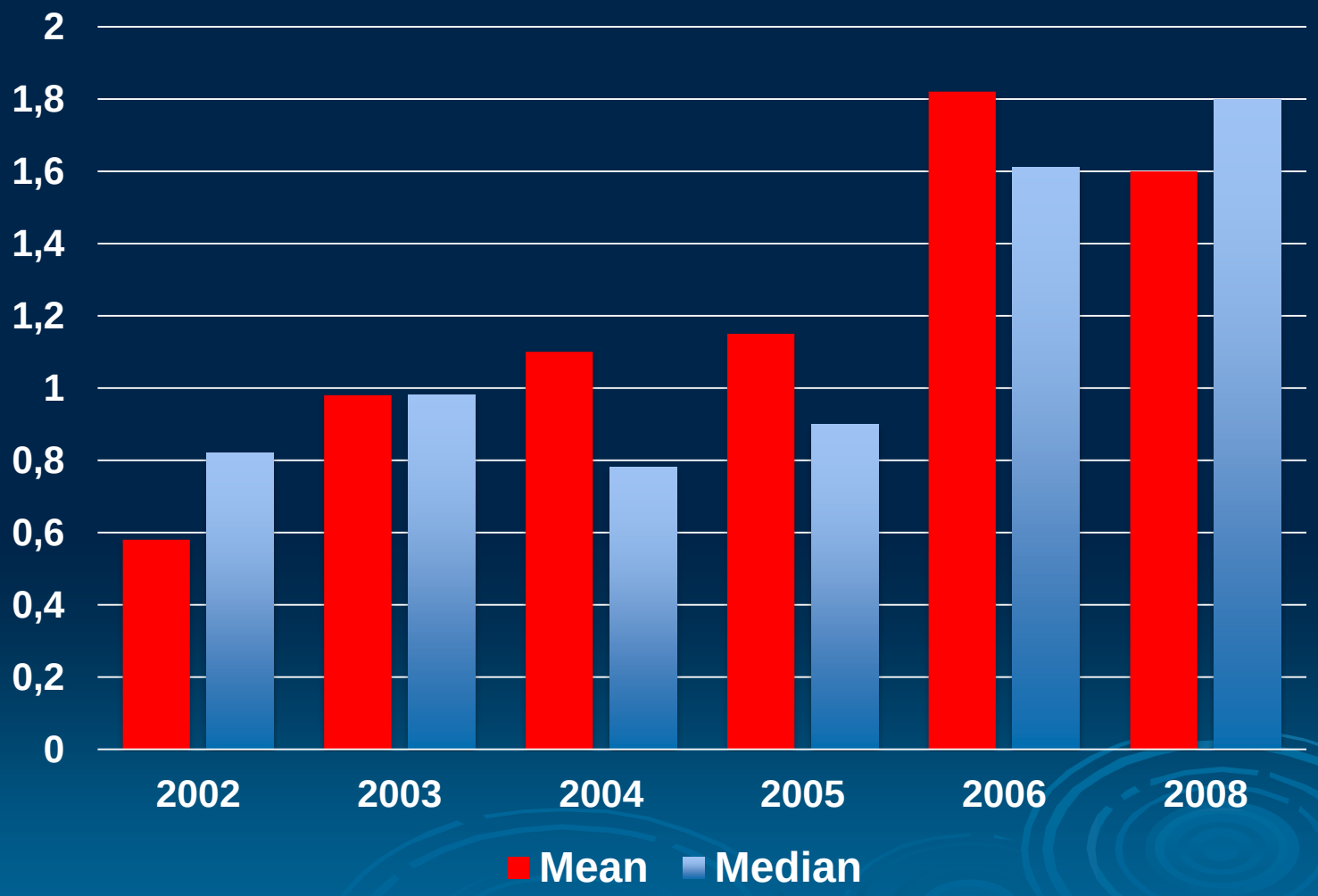
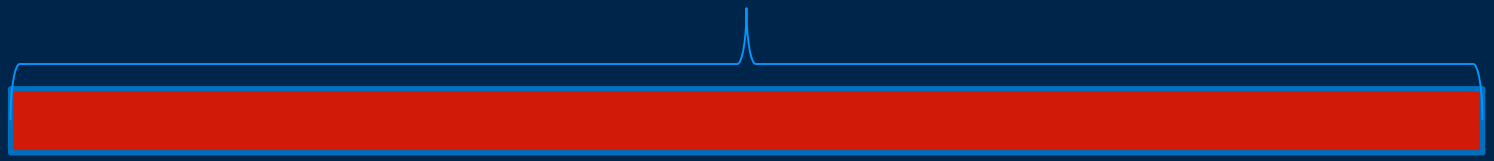
- Typical “treatment”:
  - Financing: $1 million loan with 3 year payback period
  - Added services

Mean and Median Loan Amounts ($m)



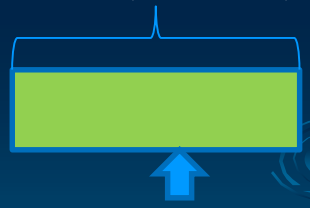
Data

First Round (297 obs)



Second Round (154 obs)

Recommended for funding (88 obs)



Received funds (64 obs)

Data:

Program administrative data from MEDC

- **All for-profit company applicants and awardees, 2002-2008**

Information includes

- **Organization name, industry sector, application category, age, 1st and 2nd round scores, amount of funding requested and whether (and how much) they are funded**

Outcome variables:

- **(1) Firm survival (Michigan LARA database)**
- **(2) Funding from other sources**
  - **SBIR/STTR Awards (SBA TECH-Net Database)**
  - **Venture Capital Investment (VentureXpert)**
- **(3) News Articles (Factiva)**
- **(4) Patents (Delphion)**

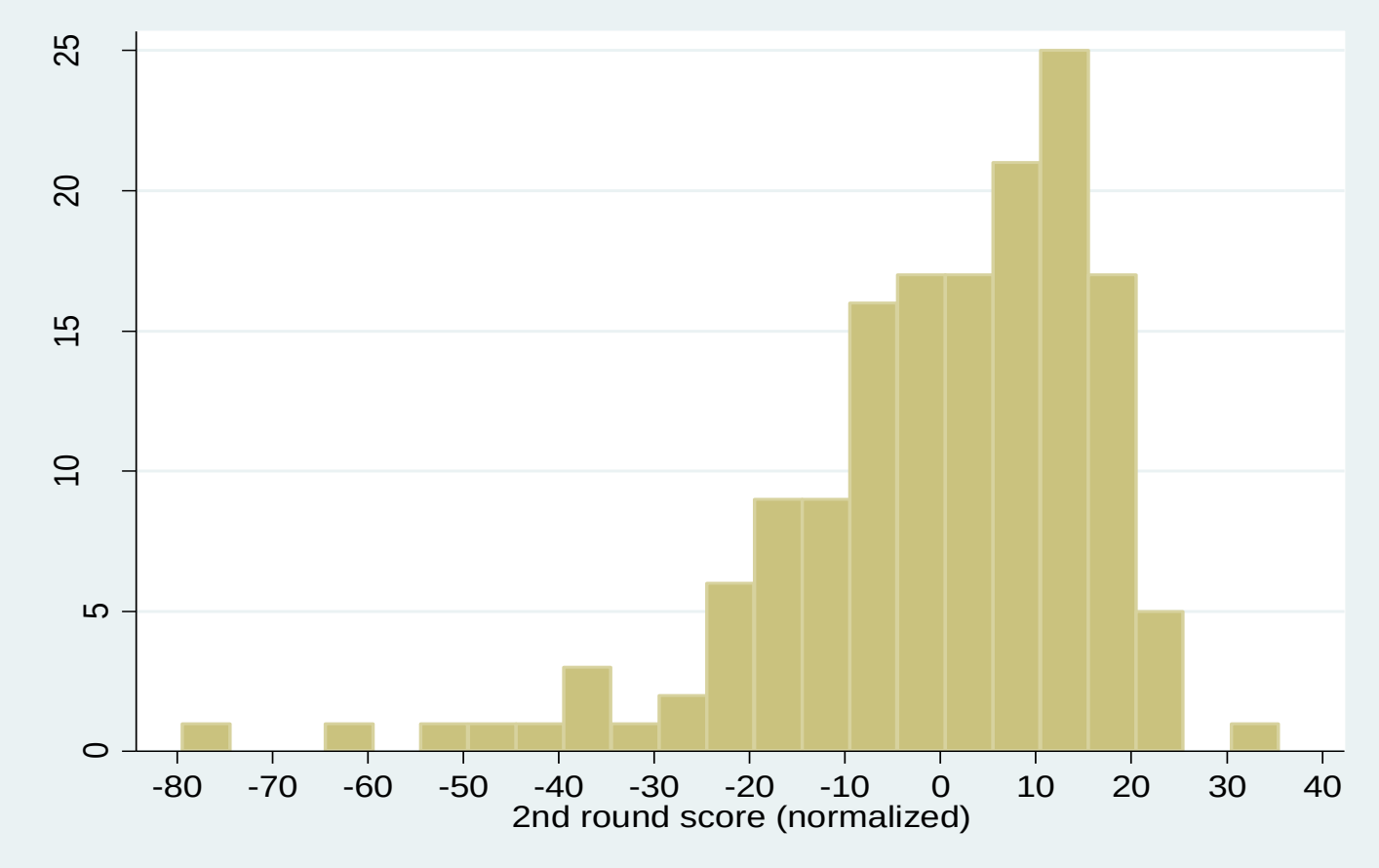
Sample - 297 applications from 241 firms

Empirical Approach

- Does award receipt improve the outcomes of entrepreneurial firms? Are the effects amplified when informational challenges in the resource markets are more severe?

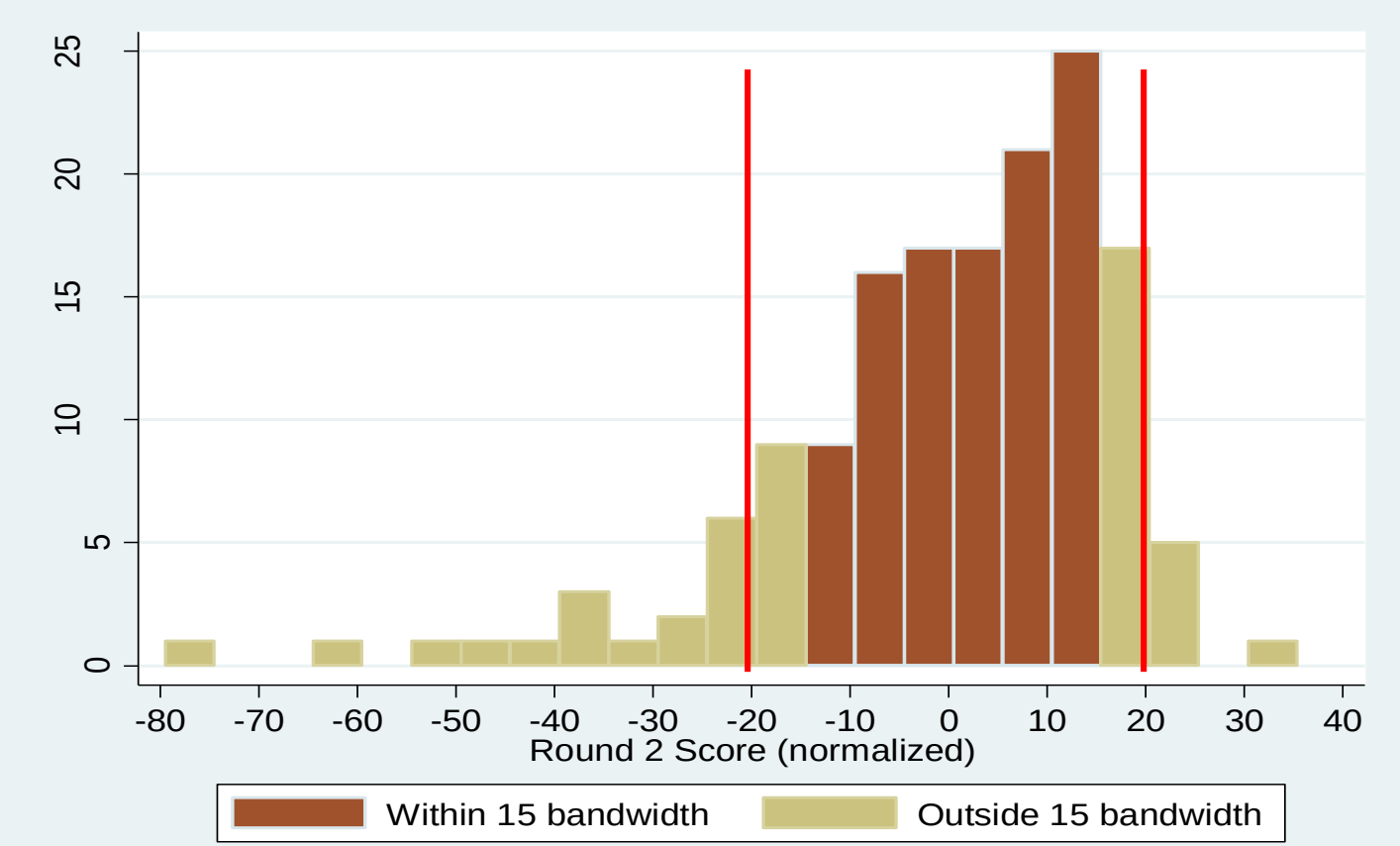
	Sample	Method
Approach 1	Round 1 sample (all applicants)	Controlling for observables
Approach 2	Round 2 sample	Using scores as proxies for unobservable characteristics
Approach 3	Sample of firms near the discontinuity border (20 and 15 bandwidths)	Regression Discontinuity Design

Intuition



Distribution of scores centered on funding cutoff, round-2 firms only

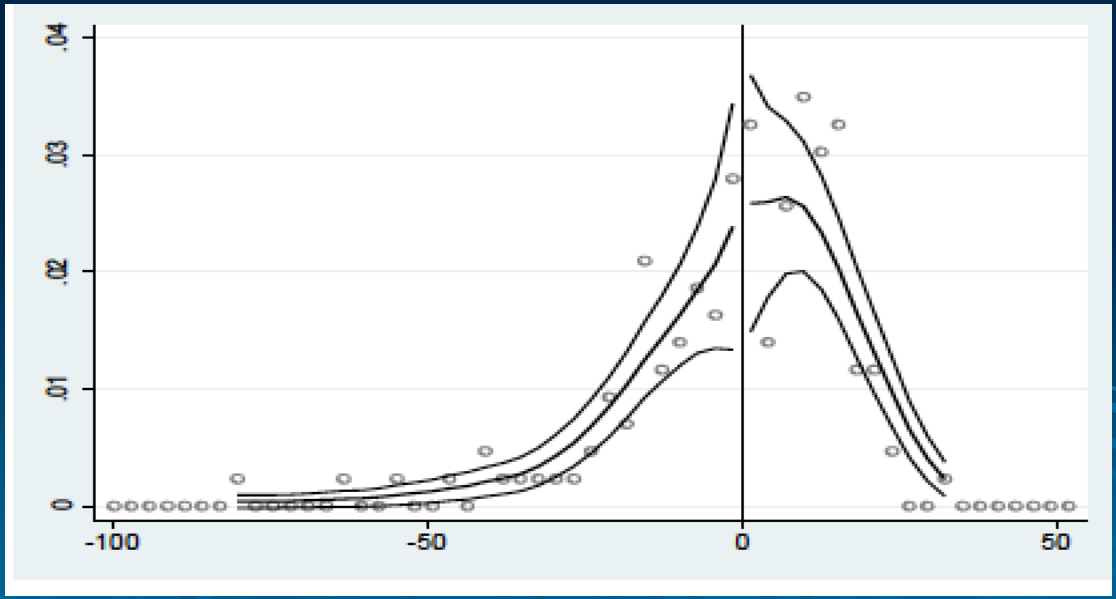
Intuition



Distribution of scores centered on funding cutoff, round-2 firms only

Setup

1. Total funding amount was set prior to requests for proposals and allocated based on evaluator scores
2. Close-call applicants have similar ex ante characteristics
3. No evidence of systematic score manipulation or out-of-order funding



Estimated Effect on Survival

	All startup applicants		Startups within 20 points of the threshold score		Startups within 15 points of the threshold score	
	survives, t+2	survives, t+4	survives, t+2	survives, t+4	survives, t+2	survives, t+4
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Base regression, with application year, category, and sector fixed effects					
Received award ("Funded")	0.120***	0.206***	0.117**	0.204***	0.134**	0.220***
	(0.028)	(0.035)	(0.050)	(0.056)	(0.058)	(0.064)
	Panel B: Panel A, with added controls for applicant-level characteristics					
Received award ("Funded")	0.113***	0.200***	0.109**	0.204***	0.123**	0.210***
	(0.031)	(0.037)	(0.050)	(0.058)	(0.057)	(0.062)
Observations	297	297	127	127	103	103

Notes: This table reports linear probability estimates of the effect of award receipt on venture survival. Columns. 1 and 2 report results for all applicant-startups. Columns 3-6 report results for the subsample of near-threshold applicants. *Received award* equals one if the applicant receives R&D funding through the competition; else, it equals zero. The outcome variable, survival, indicates whether the applicant-company is in operation and in good business standing two years (Cols. 1, 3, and 5) or four years (columns 2, 4, and 6) following the competition. The regressions in Panel A include application-year, application category (applied research or commercialization project), and sector fixed effects. The regressions in Panel B include controls for other applicant characteristics, including age in application year, prior receipt of VC funds and/or SBIR grants, and geographic proximity to the entrepreneurial hub within the state. Table 1 describes the variables in more detail.

Robust standard errors, clustered at the applicant-firm level, are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Average Effect on Startup Outcomes, Conditional on Survival

	# VC investments		# SBIR awards		# media mentions of business activity		# patents	
	t+2	*t*+4	*t*+2	*t*+4	*t*+2	*t*+4	*t*+2	*t*+4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: All Applicants, with application year, category, and sector fixed effects								
Received award ("Funded")	1.020***	0.999***	0.789***	0.809***	1.737***	1.600***	0.515*	0.534**
	(0.290)	(0.307)	(0.214)	(0.263)	(0.242)	(0.247)	(0.299)	(0.254)
# observations	264	236	264	236	264	236	264	236
Panel B: Near-threshold subsample, with application year, category, and sector fixed effects								
Received award ("Funded")	0.850**	0.616	-0.055	0.172	1.590***	1.340***	0.070	0.265
	(0.377)	(0.381)	(0.347)	(0.315)	(0.246)	(0.257)	(0.615)	(0.596)
# observations	95	88	95	88	95	88	95	88
Panel C: Near-threshold subsample, with added controls for applicant-level characteristics								
Received award ("Funded")	0.861**	0.595	0.078	0.153	1.687***	1.300***	-0.308	-0.067
	(0.397)	(0.376)	(0.405)	(0.361)	(0.226)	(0.225)	(0.477)	(0.473)
# observations	95	88	95	88	95	88	95	88

Notes: This table reports Poisson quasi-maximum likelihood estimates of the average effect of state R&D award receipt on startup performance, conditioned on survival. Panel A includes all applicants that survive in the time window, while Panels B and C focus on applicants within 15 points of the threshold score. Application-year, application category (applied research or commercialization project), and sector fixed effects are included in the regressions for all three Panels. The regressions for Panel C include controls for other applicant characteristics, including age in application year, prior receipt of VC funds and/or SBIR grants, and geographic distance to the entrepreneurial hub within the state. Table 1 describes the controls and outcome variables in more detail.

Robust standard errors, clustered at the applicant-firm level, are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Heterogeneous Effects on Startup Outcomes, Applicants within 15 points of threshold score

	# VC investments				# SBIR awards				# media mentions of business activity			
	$t+2$		$t+4$		$t+2$		$t+4$		$t+2$		$t+4$	
	(1)		(2)		(3)		(4)		(5)		(6)	
Panel A: Has VC or SBIR funding prior 4 years												
Yes	0.337	(0.630)	0.190	(0.534)	-0.403	(0.413)	-0.405	(0.403)	1.589***	(0.332)	1.204***	(0.333)
No	1.545***	(0.483)	1.039**	(0.530)	1.452*	(0.881)	1.328**	(0.670)	1.851***	(0.337)	1.450***	(0.380)
Panel B: Log Distance to entrepreneurial hub												
Distance = 0	0.401	(0.565)	0.190	(0.425)	-0.490	(0.399)	-0.21	(0.364)	1.403***	(0.404)	1.046***	(0.344)
Distance = 50 miles	1.258***	(0.446)	1.017**	(0.515)	1.177	(0.715)	1.036	(0.665)	1.876***	(0.259)	1.490***	(0.289)
Distance = 100 miles	1.407***	(0.516)	1.160**	(0.587)	1.466*	(0.827)	1.252	(0.769)	1.958***	(0.318)	1.566***	(0.345)
Distance = 150 miles	1.495***	(0.564)	1.245**	(0.632)	1.637*	(0.895)	1.379*	(0.832)	2.007***	(0.358)	1.612***	(0.381)
Distance = 200 miles	1.557***	(0.600)	1.305**	(0.666)	1.758*	(0.945)	1.469*	(0.877)	2.041***	(0.388)	1.644***	(0.409)
Panel C: Age in application year												
Age = 0	1.104***	(0.407)	0.808**	(0.398)	0.363	(0.598)	0.342	(0.540)	1.940***	(0.323)	1.314***	(0.320)
Age = 1	1.017***	(0.350)	0.729**	(0.355)	0.307	(0.545)	0.305	(0.494)	1.860***	(0.260)	1.309***	(0.269)
Age = 2	0.929***	(0.348)	0.650**	(0.354)	0.252	(0.499)	0.268	(0.454)	1.781***	(0.219)	1.305***	(0.234)
Age = 3	0.842**	(0.400)	0.571	(0.398)	0.197	(0.463)	0.231	(0.420)	1.701***	(0.215)	1.301***	(0.223)
Age = 4	0.754	(0.490)	0.492	(0.473)	0.142	(0.439)	0.195	(0.393)	1.621***	(0.250)	1.296***	(0.240)
Age = 5	0.667	(0.601)	0.413	(0.567)	0.087	(0.428)	0.158	(0.377)	1.542***	(0.309)	1.292***	(0.279)

Summary

- Findings suggest Michigan's R&D loan program "added value" to recipient startups
  - Increases likelihood of business survival by ~20-30% four years following the competition
  - Weak stimulus to follow-on VC financing on average
  - "Matters more" for follow-on financing (both VC and SBIR) & business expansion when information challenges are more severe (startup age, prior external $, driving distance of HQ location from innovation hub)
- Leaves many Qs unanswered:
  - Effect due to "added services" rather than money alone?
  - Generalizable? (time period, initial conditions)
  - Other R&D levers more cost-effective? (loans v. grants; VC subsidies)
  - National v. state/local trade-offs?

EXTRA