

The Performance of University Spin-offs: Evidence from Venture Capital Data

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Definitions

- A university spin-off (USO) is defined as a firm founded or co-founded by a university employee
 - Not including start-ups licensing university technology but not founded by university employees
 - “Employee” does not include students and post-doctorial fellows
- The founder of a university spin-off is referred to as an academic entrepreneur

Outline

- **Introduction**
- **Related literature**
- **Data**
- **Descriptive statistics**
- **Performance of university spin-offs**
- **Conclusion**

Observation: Many Companies Are Founded by University Employees

- In biotechnology industry:
 - Genentech (UCSF: Boyer); Amgen (UCLA: Salser); Chiron (UCSF: Rutter, Valenzuela; UCB: Penhoet); Calgene (UCD: Valentine); Biogen (a group of scientists including Walter Gilbert and Philip Sharp), etc.
- In IT industries:
 - Silicon Graphics Inc., Netscape, ... (UCSC/Stanford: Clark); Lycos (CMU: Mauldin); Cisco (Stanford: Bosack & Lerner); SDA Systems, PIE Design Systems (both now part of Cadence), Simplex Solutions, Crossbow, and Synopsys (UCB: Richard Newton), etc.

University Spin-offs Serve as an Efficient Channel for Technology Transfer

- **Technology transfer is a “people process” (Tom Allen)**
 - People must be in direct contact and understand each other to transfer knowledge
 - Human mind is the best “package” for knowledge
 - Moving people is the most effective way to move knowledge
- **“Technology transfer is the movement of ideas in people” (Donald Kennedy)**

Spin-offs Are Expected to Perform Better

- **In the context of company spin-offs**
 - “Employee founders” inherit knowledge from previous employers, which should help their start-ups to succeed (Klepper, 2001)
- **No systematic study of the performance of university spin-offs**

Existing Literature

- **Paucity of data restrict studies of university spin-offs; researchers rely on small-scale survey, interview, and case studies**
 - McQueen and Wallmark (1982): Chalmers U;
 - Smilor et al. (1990): UT Austin
 - Steffensen et al (2000): U New Mexico
 - Kenney and Goe (2004): UC Berkeley and Stanford
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- **Related literature: study university spin-offs as start-ups licensing university inventions using survey data from AUTM**
 - Shane and Stuart (2002)
 - Di Gregorio and Shane (2003)
 - Nerkar and Shane (2004)
 - Allen et al. (2004)

VentureOne Data, 1992-2001

- **VentureOne: “the most comprehensive database on venture-backed companies”**
- **Detailed Information on venture-backed start-ups throughout the nation**
 - Address, start date, industry, ownership status, business status, employment, etc.
 - Information on venture capital deals: deal size, deal class, closing date, etc.
- **Recent empirical work using VentureOne data**
 - Gompers and Lerner (2000), Cochrane (2005), Gompers et al. (2005), and Zhang (2003, 2005a, 2005b).

The VentureOne Founder Data

- **Work experience of start-up founders**
 - Founder information available for 6,629 of 11,029 venture-backed firms
 - A total of 10,530 firm founders
- **Identified 903 academic entrepreneurs, who founded/co-founded 704 university spin-offs**

Descriptive Statistics (1):

Distribution of Academic Entrepreneurs by Specialty

Academic Discipline	Number of Entrepreneurs	Percentage of Total, %
Engineering	304	45.44
Medical sciences	175	26.16
Bioscience	96	14.35
Business	29	4.33
Chemistry	23	3.44
Other	42	6.28
Total	669	100

Descriptive Statistics (2): Venture Backed Companies by Industry

Industry	Number of Companies in Sample	Number of University Spin-offs	Percentage of Industry Total, %
Adv/Spec Material and Chemical	30	8	26.67
Biopharmaceutical	355	182	51.27
Communication	801	72	8.99
Consumer/Business Products	71	7	9.86
Consumer/Business Services	1,426	69	4.84
Electronics	194	20	10.31
Healthcare	106	7	6.60
Information Services	696	37	5.32
Medical Devices	252	47	18.65
Medical Information Services	187	35	18.72
Retailing	182	2	1.10
Semiconductor	264	36	13.64
Software	1,768	179	10.12
Other
Total	6,359	704	11.07

Why University Spin-offs Concentrate in the Biopharmaceutical Industry?

- **Market for more effective drugs is salient**
- **Asymmetric information between entrepreneurs and investors**
 - **Solid work in hard sciences as a signal of credentials / screening device**
- **Complexity and patent system slower the diffusion of biotechnology**
 - **The original inventor has a better chance to commercialize the technology**

Descriptive Statistics (3):

Geographic Distribution of University Spin-offs

State	# of USOs by University Location	# of USOs by Company Location	Net Gain
California	195	290	95
Massachusetts	132	119	-13
New York	46	30	-16
North Carolina	33	31	-2
Pennsylvania	31	24	-7
Illinois	25	16	-9
Texas	25	31	6
Georgia	15	17	2
Washington	15	21	6
Colorado	11	11	0
Maryland	10	9	-1
Michigan	9	9	0
Ohio	9	6	-3
Arkansas	8	0	-8
Indiana	8	2	-6
All other states	87	88	1
Total	659	704	45*

Top Schools by University Spin-offs

Institution	# of Academic Entrepreneurs	Institution	# of Academic Entrepreneurs
Stanford	91	Yale	12
MIT	76	UCLA	11
Harvard	53	Chicago	10
UC Berkeley	37	Boston U	10
CMU	19	NYU	10
UCSF	17	NC State	10
UC San Diego	17	Georgia Tech	9
CalTech	15	USC	8
Duke	14	U Minnesota	8
UT-Austin	14	Cornell	8
U Washington	13	Northwestern	8
Michigan	13	U Colorado	7
Columbia	12		

Spin-offs vs. Other Companies: A Simple Comparison

	Non-Spin-offs (1)	University Spin-offs (2)	T-Test Statistic $H_0: (1) = (2)$
VC money raised per round (\$million)^a	11.05	10.09	2.12*
Sample Size	(17.33) 12,113	(14.11) 1,582	
Total VC money raised (\$million)^a	27.02	24.94	1.32
Sample Size	(37.02) 4,663	(30.80) 606	
Survival Rate^a	0.878	0.944	-4.96**
Sample Size	(0.327) 5,110	(0.231) 655	
Percentage completed IPO^a	0.0765	0.0763	0.016
Sample Size	(0.266) 5,110	(0.266) 655	
Average employment^b	83.81	58.22	3.26**
Sample Size	(169.1) 3,150	(84.78) 483	

Venture Capital Financing, OLS

(DV: Venture capital raised in any round)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Constant	0.132 (0.496)	-4.750** (2.404)	-0.440** (2.375)	2.879 (2.977)	2.251 (2.979)
University spin-off	-0.936* (0.450)	-0.230 (0.468)	-0.025 (0.456)	-0.293 (0.447)	-0.307 (0.447)
Started after 1995	8.422** (0.424)	8.150** (0.424)	6.732** (0.417)	3.000** (0.560)	3.019** (0.560)
Start-up age at VC deal closing date	0.158** (0.007)	0.170** (0.007)	0.075** (0.008)	0.030** (0.009)	0.034** (0.009)
Industry dummies	N	Y	Y	Y	Y
VC round dummies	N	N	Y	Y	Y
VC deal closing date dummies	N	N	N	Y	Y
High-tech center dummies	N	N	N	N	Y
R ²	0.041	0.082	0.127	0.164	0.167
Number of observations	13,502	13,502	13,502	13,502	13,502

Venture Capital Financing, OLS

(DV: Total venture capital raised)

	Model (1)	Model (2)	Model (3)	Model (4)
Constant	-3.024** (1.019)	-40.17** (3.817)	-41.88** (7.622)	-42.61** (7.629)
University spin-off	-2.276 (1.390)	-2.471 (1.362)	-0.705 (1.396)	-0.705 (1.399)
Start-up age at last VC round	-0.053* (0.023)	0.259** (0.032)	0.265** (0.032)	0.277** (0.032)
Total rounds of VC completed	12.56** (0.312)	15.73** (0.398)	15.30** (0.388)	15.27** (0.388)
Start year dummies	N	Y	Y	Y
Industry dummies	N	N	Y	Y
High-tech center dummies	N	N	N	Y
R ²	0.249	0.284	0.333	0.335
Number of observations	5,141	5,141	5,141	5,141

Survival of Venture-Backed Start-ups, Logit

(DV: 1 if survived)

	Model (1)	Model (2)	Model (3)	Model (4)
Constant	1.912** (0.098)	6.423** (1.612)	5.586* (1.703)	5.616** (1.705)
University spin-off	0.877** (0.185)	0.839** (0.186)	0.497** (0.192)	0.486* (0.192)
Start-up age	-0.0005 (0.002)	-0.038** (0.013)	-0.040** (0.013)	-0.040** (0.013)
Start-up age at closing date of first round VC	0.008** (0.003)	0.010** (0.003)	0.013** (0.003)	0.012** (0.003)
Money raised at first round VC	-0.004 (0.004)	-0.006 (0.004)	-0.004 (0.005)	-0.005 (0.005)
Start year dummies	N	Y	Y	Y
Industry dummies	N	N	Y	Y
High-tech center dummies	N	N	N	Y
Pseudo R ²	0.011	0.028	0.056	0.058
Number of observations	5,339	5,339	5,324	5324

Why University Spin-offs Have a Higher Survival Rate?

- Technological advantage gives a competitive edge
- Academic entrepreneurs' higher opportunity costs impose a higher standard for screening entrepreneurial opportunities
- Not enough controls?

Initial Public Offering, Logit

(DV: 1 if completed IPO)

	Model (1)	Model (2)	Model (3)	Model (4)
Constant	-4.931** (0.156)	-1.472 (1.894)	-0.476 (2.179)	-0.765 (2.197)
University spin-off	-0.075 (0.173)	-0.0002 (0.171)	0.116 (0.187)	0.141 (0.189)
Start-up age	0.047** (0.002)	-0.011 (0.015)	-0.005 (0.015)	-0.003 (0.016)
Start-up age at closing date of first round VC	-0.039** (0.003)	-0.036** (0.003)	-0.038** (0.003)	-0.037** (0.004)
Money raised at first round VC	0.022** (0.005)	0.037** (0.006)	0.034** (0.006)	0.035** (0.006)
Start year dummies	N	Y	Y	Y
Industry dummies	N	N	Y	Y
High-tech center dummies	N	N	N	Y
Pseudo R ²	0.190	0.202	0.229	0.240
Number of observations	5,339	4,580	4,580	4,580

Employment of Privately-Held Start-ups, OLS

(DV: Number of employees)

	Model (1)	Model (2)	Model (3)	Model (4)
Constant	-5.693 (6.038)	-11.98 (7.809)	20.00 (103.0)	29.77 (103.0)
University spin-off	-24.05** (7.812)	-23.49** (8.034)	-3.855 (8.010)	-3.663 (8.024)
Start-up age	1.888** (0.130)	1.512** (0.769)	1.322 (0.746)	1.318 (0.746)
Start-up age at closing date of first round VC	-1.581** (0.178)	-1.514** (0.181)	-1.385** (0.181)	-1.465** (0.183)
Money raised at first round VC	4.373** (0.302)	4.423** (0.302)	4.026** (0.296)	4.025** (0.296)
Start year dummies	N	Y	Y	Y
Industry dummies	N	N	Y	Y
High-tech center dummies	N	N	N	Y
R ²	0.098	0.108	0.170	0.173
Number of observations	3,437	3,437	3,437	3,437

Conclusions

- **University spin-offs concentrate in biotech and IT industries**
- **University spin-offs have a higher survival rate**
- **University spin-offs also appear to raise less VC and have fewer employees, but these differences disappear once we control for industry**