Asian Journal of Innovation and Policy (2016) 5.002:146-184
DOI: http//dx.doi.org/10.7545/ajip.2016.5.2.146

Understanding Entrepreneurial Process and Performance: A Cross-National Comparison of Alumni Entrepreneurship Between MIT and Tsinghua University

Charles E. Eesley[*], Delin Yang[**], Edward B. Roberts[***], Tan Li[****]

Abstract This paper analyzes the major comparisons and contrasts in entrepreneurship among technology-based university alumni over multiple decades from Tsinghua University in China and the Massachusetts Institute of Technology in the United States. In doing so, we ask two related research questions: (1) Who enters entrepreneurship and with what types of ideas and founding teams? (2) How do the innovation and other firm performance outcomes compare? We find that the sources of venture ideas and the composition of founding teams differ as well as the initial capital levels and revenues. This research provides a step toward a better understanding of high-tech entrepreneurship in developing vs. developed institutional environments. Furthermore, while MIT and Tsinghua University are unique in the programs they offer and in their historical cultures of entrepreneurship, both Tsinghua University and MIT provide benchmarks by which other institutions can gauge their alumni entrepreneurs and the types of ventures that they create.

Keywords MIT, Tsinghua University, alumni entrepreneurship, startup

I. Introduction

The way in which the business environment affects organizations is a central question for strategy scholars. Organizational theorists and sociologists have generated a long line of scholarship examining how aspects of the institutional and opportunity structure impact organizations

Submitted, July 3, 2015; 1st Revised, April 5, 2016; Accepted, June 27, 2016
[*] Department of Management Science & Engineering, Stanford University, Ortega Stanford, CA 94305-4121, U.S.A.; cee@stanford.edu
[**] Coresponding Author, Department of Innovation, Entrepreneurship & Strategy, Tsinghua University, Beijing, 100084, China; yangdl@sem.tsinghua.edu.cn
[***] Technological Innovation, Entrepreneurship and Strategic Management, MIT Sloan School of Management, Cambridge, MA 02142, U.S.A.; eroberts@mit.edu
[****] Department of Innovation, Entrepreneurship & Strategy, Tsinghua University, Beijing, 100084, China; litan2015@foxmail.com

(Stinchcombe, 1965; Romanelli, 1989). Institutional theory has frequently been a useful lens for examining how the environment interacts with individuals to produce organizational strategies and outcomes (Scott, 2008). Yet, scholars have mainly focused on topics at two extreme ends of the spectrum of organizations: founding rates and the behavior of well-established firms. Our understanding of how the environment shapes what happens to organizational processes and performance in between founding and joining the comparatively elite ranks of the publicly-owned, established incumbents is more limited. This paper seeks to highlight and explain the differences in entrepreneurial processes and outcomes across countries, accumulate knowledge based on comparable situations, and take a step forward in understanding how the external environment shapes entrepreneurship.

Work by institutional theorists has shed light on the ways in which the institutional environment shapes founding rates for new organizations (Aldrich, 1999; Sine, Haveman and Tolbert, 2005; Russo, 2001). For example, Eesley, Li and Yang, (2016) show how Project 985 in China resulted in increased levels of technology-based entrepreneurship. However, relative to its importance, little research examined the ways in which the environment affects the development and performance of entrepreneurial firms. As a result of this gap, our view of how different life courses, types, and sizes of entrepreneurial firms may result from different institutional or cultural environments across regions and countries is limited due to this gap in the literature. Addressing this gap is important for focusing on the role of the environment in entrepreneurship, without which, we may be missing a number of the most significant effects of the external context on organizations.

Much of the research that examines entrepreneurial processes and performance has primarily expanded our view of how individual founders, top management team members, and their career experiences affect firm outcomes (Thornton, 1999; Beckman, 2006; Burton et al., 2002). This line of work has focused less on the environmental context around the founding team (for an exception, see Eisenhardt and Schoonhoven, 1990). The current state of affairs may largely be driven by the fact that few datasets exist with sufficient variation in environmental factors and detail on firm performance, due to a dearth of detailed cross-national, firm-level data. Our surveys of two top technical universities provide us with the data needed to take a close look at the characteristics of entrepreneurship in different environments.

It is clear that the U.S. and China are at very different stages of economic, market, and technology development. A large middle class exists in the United States with significant disposable income, whereas China has a few well-developed cities, but large rural areas where people's livelihoods are largely the same as they have been for centuries. On the whole, the GDP per

capita in China was under $5,000 (constant PPP) whereas that figure in the U.S. was $35,000 (constant PPP). [1] Furthermore, new technological opportunities may differ across countries, as new knowledge does not appear to flow easily across geographic borders.

Many important policy and institutional differences exist across the American and Chinese contexts as well. With economic transition, financial reform, and growing openness in China, these differences have narrowed over the years. However, numerous institutions, including financial systems, universities, legal systems, and culture, may explain the differences in entrepreneurial process and firm outcomes between the two countries. In different countries, faced with different economic, legal, and institutional environments, an intriguing possibility is that different start-up processes exist across companies.

II. Data and Methods

Understanding the differences in entrepreneurship between advanced and developing economies by sampling alumni of specific universities is important for at least three reasons. First, international variation helps to inform the debate about underlying drivers of entrepreneurship and the environmental influences on entrepreneurial behavior. Second, it informs our understanding of the institutions that may shape the frequency and types of entrepreneurship. This is important both for policy makers in developing countries, as well as those in advanced economies seeing increasing competition on the horizon. Finally, focusing on entrepreneurial behavior emerging from specific universities helps to inform university administrators of factors they may be able to influence to affect entrepreneurship among their students and alumni, and perhaps faculty and staff as well.

The empirical context for our specific comparative study is a sample of alumni from a top research and technology university in China (Tsinghua) and a top research and technology university in the United States (MIT). While little work has been done focusing on the university's impact on entrepreneurship among alumni and students over the years, even less work has been done on this topic by examining leading research universities outside of the United States.

One rationale for choosing to study a sample of individuals trained at top technical universities was that these alumni are more likely to found technology-based firms. In theory, this should impose some desired similarity

[1] OECD website, accessed May 29, 2009.

on the founders' educational background and their human and social capital as well as opportunity costs.

1. MIT Survey

The MIT firm dataset was generated from an individual-level dataset composed of 43,668 records of MIT alumni who responded to a 2001 survey of all living alumni (105,928 surveys were sent out for a response rate of 41.2%). This dataset has been reported on previously (Hsu, Roberts and Eesley 2007). Of the respondents to the 2001 survey, 7,798 individuals (17.9% of the respondents) indicated that they had founded at least one company. These individuals were then mailed a second survey in 2003 asking more detailed questions about them and their firms. A total of 2,111 founder surveys were completed, representing a response rate of 27.1%. Eliminating duplicates for which more than one founder reported on the same firm brings the total number of unique firms to 2,067. One of the key features of this dataset is its long time horizon in the cross-section (graduates from 1930-2001). We also observe wide variation in firm size, number of operating years, and outcome. For the purposes of most of the analysis, all firms located outside the United States were dropped from the MIT alumni survey so that we can more straightforwardly compare U.S. and Chinese firms. However, we separately analyze some MIT alumni firms founded in China to further shed light on the underlying factors of the differences.

2. Tsinghua Survey

To collect data in China, we have undertaken a survey of alumni from the top engineering university in China, Tsinghua University. Since Tsinghua University is likely to be less familiar to the reader than MIT, a brief overview of the university may be helpful. Located in Beijing, China, and established in 1911, Tsinghua University is regarded as one of the best and most selective universities in China. In 1952, it was reorganized according to the Soviet model of organizing universities by specialization. Rather than teaching all disciplines, Tsinghua was to focus on engineering. During the Cultural Revolution (1966-1976), campus activities were disrupted as Tsinghua's campus became a battlefield. The university did not resume normal operations until 1977. In 1978, Tsinghua restored departments in the sciences, economics and management, and the humanities, abandoning the Soviet model. In 1984, Tsinghua established the first graduate school in China.

A survey was sent to all Tsinghua University alumni who had an address on record (a total of 30,000 according to the Alumni Association).[2] The Tsinghua firm dataset was generated from an individual-level dataset composed of 2,966 records of Tsinghua alumni who responded to a 2007 survey of all living alumni (~30,000 surveys were sent out for a response rate of about 10%). Of the respondents to the survey, 718 individuals (24% of the respondents) indicated that they had founded at least one company. These individuals were then asked more detailed questions about themselves and their firms.[3]

III. Descriptive Statistics

Table 1 MIT: summary statistics and variable definitions (1950-1998)

Dependent Variables			
Variable[4]	Definition	Mean	SD
Public	= 1 if venture went public by '03	0.16	0.37
Acquired	= 1 if venture was acquired by '03	0.26	0.44
L Years Survival	Number of years in operation	2.74	0.65
L Employees	Number of employees	3.40	2.10
L Revenues	Inflation-adjusted revenues in $ M	1.78	1.73
Used VC	= 1 if received VC funding	0.13	0.33

[2] The sampling frame for both the MIT and Tsinghua alumni databases was likely to have been fairly accurate given the university alumni associations' efforts to maintain an accurate database, but both the 105,000 MIT alumni and the 30,000 Tsinghua alumni records may have included old addresses and deceased alumni. In this case the response rates should be higher than those reported.

[3] In addition to the survey data, the Tsinghua study includes extensive notes from interviews with 42 people (including entrepreneurs, investors, and government officials). The interviews included 26 Tsinghua alumni entrepreneurs, 2 Tsinghua staff (TLO, Science Park), 5 Chinese venture capitalists (VCs), 2 government officials, 3 other Chinese entrepreneurs (non-Tsinghua), 2 MIT alumni (non-entrepreneurs), and 2 Tsinghua alumni (non-entrepreneurs). Unfortunately, the interview selection procedure could not be randomized. The Tsinghua Alumni Association set up interviews for us and we specifically asked to speak with high-tech entrepreneurs and some who were not successful. Undoubtedly, our interview population is weighted towards more successful entrepreneurs and those whose ventures are more high-tech than the average alumni. The majority of our interviews were in Beijing, though some also took place in Shanghai and Xi'an.

[4] "L" preceding the variable name in the regression tables denotes natural log.

Basic Venture Characteristics			
Variable	Definition	Mean	SD
Year Founded	Year founded	1988.6	11.86
Number of Co-Founders	No of co-founders	0.99	1.23
Total Team Sources	No of team sources listed	1.34	0.61
Total Secondary Idea Sources	No of secondary idea sources	0.77	1.24
US-Located	= 1 if located in the US	0.92	0.28
Massachusetts	= 1 if located in Massachusetts	0.31	0.46
California	= 1 if located in California	0.18	0.39

Human Asset (Team) Formation Characteristics			
Variable	Definition	Mean	SD
Functional Diversity	No of functions of founding team	1.22	0.47
Role of MIT Faculty	= 1 if MIT faculty played a role	0.05	0.22
Team Met via Work	= 1 if met through work	0.54	0.50
Team Met via Research	= 1 if met through research	0.22	0.41
Team Met via Socializing	= 1 if through social networking	0.37	0.48
Team Met via Extracurricular	= 1 if extracurricular activities	0.02	0.13
Team Met via Family	= 1 if the venture team was related	0.09	0.29
Num. Prior Foundings	Number of prior foundings	1.35	0.71
Num. Prior Acquired	No of prior foundings acquired	0.13	0.41

Non-Human Asset (Idea) Formation Characteristics			
Variable	Definition	Mean	SD
Role of MIT Research	= 1 if MIT research played a role	0.05	0.23
Role of MIT Groups	=1 if MIT groups played a role	0.09	0.29
Idea from Work	= 1 if through working in industry	0.60	0.49
Idea from Socializing	= 1 if through social networking	0.14	0.34
Idea from Research	= 1 if through research	0.13	0.33
Idea from Military/Govt.	= 1 if military or government	0.03	0.18
Idea from Other Source	= 1 if through some other source	0.10	0.29
Held at Least 1 Patent	= 1 if held at least 1 patent	0.25	0.44

Table 2 MIT: summary statistics and variable definitions (1950-1998)

Variable[5]	Definition	Mean	SD
First Start-Up Founded	Year of 1st firm (censored if not by 2003)	1985.1	12.30
Second Start-Up Founded	Year of 2nd firm (censored .. by 2003)	1990.0	10.43

Individual Characteristics			
Graduation Year	Year of MIT graduation	1973.2	15.04
Bachelor's Degree	=1 if highest degree	0.43	
Master's Degree	=1 if highest degree	0.41	
Doctorate Degree	=1 if highest degree	0.16	-
Male	= 1 if the individual is male	0.93	-
Academic Major	Dummies: engineering (53%), management (14%), social science (5%), architecture (4%)		
Country of Citizenship	Dummies: Latin America (2%), Asia (7%), Europe (6%), Middle East (1%), Africa (1%)		

First Firm Level Characteristics			
Age at First Firm	Age of the entrepreneur 1st firm founded	37.5	10.27
Recession Year	= 1 if founded during recession	0.22	0.41
Lag to First Firm	Lag (in years) from graduation to 1st firm	14.28	9.95
VC Funded	= 1 if received venture capital funding	0.14	0.35
Angel Funded	= 1 if received funding from angel	0.09	0.29
L Initial Capital	Capital "the company off the ground"	11.97	2.71
Acquired	= 1 if the firm was acquired	0.21	0.41
Public	= 1 if the firm had an IPO	0.13	0.33
L Revenues	Firm revenues for a specific year	14.24	3.03
# Cofounders	Number of cofounders	2.15	1.78
Out of Business	= 1 if the firm closed	0.33	--
Operating Years	No. of years	15.27	12.01

[5] "L" preceding the variable name in the regression tables denotes natural log.

Table 3 Tsinghua: summary statistics and variable definitions

Variable	Definition	Mean	SD
Panel A: Individual-Level Measures (Tsinghu, Entrepreneurs Only)			
Work in R&D	=1 if R&D position	0.60	-
Work as Tech Manager	=1 if technical manager position	0.71	-
Ever Job in Academia	=1 if an academic job	0.23	-
Overseas Experience	=1 if traveled outside of China	0.21	-
Master's Degree	=1 if entrepreneur	0.59	-
Ph.D.	=1 if parents were entrepreneurs	0.09	-
Graduation Year	Year of graduation (Bachelor's)	1990	9.69
Family Economic Status	4=top 10%, 3=10-25, 2=25-50, 1=bottom 50	3.63	1.01
Age	= Individual's age	40.03	9.86
Gender	=1 if male	0.94	-
Communist Party	=1 if member the Chinese Communist Party	0.54	-

Panel B: Firm-Level Measures (Tsinghua)			
First Start-Up Founded	Year founded (censored if not by 2007)	2000.4	5.20
Firm Age	Age of the firm	4.12	3.69
Employees	=Number of employees in recent year	628.43	6424.9
R&D / Revenue	R&D as a percentage of revenues	22.36	37.21
Initial Capital	Capital registered	2005.9	10391.4
Venture Capital Funded	=1 if received from venture capital	0.07	-
Angel Investor Funded	=1 if received from angel investors	0.07	-
Num. Co-Founders	=Number of co-founders	3.35	1.85
Privatized	=1 if firm was privatized	0.06	-

Panel C: Macro-Economic Measures (China)			
Stock Exchange Market Cap	Shanghai stock market capitalization	11185	39921
VC Disbursements	Venture capital disbursements	807.3	657.8
R&D Expenditure	Total public R&D expenditures (100M RMB)	484.4	748
Total SE Pubs	Total number of S&E publications	12414	7325.9
GDP	GDP (PPP, constant US$)	10918	177895

Table 4 Tsinghua: summary statistics and variable definitions

Variable	Definition	Mean	SD
Panel A: Firm and Individual-Level Measures			
First Start-Up Founded	Year founded (censored if not by 2007)	2000.4	5.20
Firm Age	Age of the firm	3.50	2.44
Privatized	=1 if firm was privatized	0.10	0.47
Entrepreneur	=1 if the individual was an entrepreneur	0.26	0.46
Entrepreneur Parents	=1 if parents were entrepreneurs	0.09	0.29
Graduation Year	Year of graduation (Bachelor's)	1980.7	17.80
Family Economic Status	4=top 10%, 3=top 10-25, 2=top 25-50, 1=bottom 50	49.82	1.01
Age	Individual's age	3.78	18.35
Gender	= 1 if male	0.88	0.32
Panel B: Work History-Level Measures			
Recent Salary	Most recent pre-founding salary (5 categories)	3.32	1.43
Avg. Tenure	Average number of years in each job	7.11	9.45
Number of Positions	Number of different positions that were held	2.37	1.26
High Government	=1 if ever had job in government	0.03	0.17
Low Government	=1 if ever had job in gov't (below municipal level)	0.17	0.38
Last Job Academia	= 1 if last job was in academia	0.19	0.39
Last Job Business	= 1 if last job was in business	0.62	0.49
Ever Job Academia	= 1 if ever had job in academia	0.23	--

1. Comparisons of Datasets

Hsu, Roberts, and Eesley (2007) reported on basic demographic statistics such as age, gender, and country of citizenship, as well as trends over time for the MIT alumni dataset. Tables 1 and 2 show variable definitions and summary statistics for the MIT dataset. Tables 3 and 4 show variable definitions and summary statistics for the Tsinghua dataset. From these tables, the reader can see that there are many variables in common between the two datasets. There are also elements that differ between the two surveys, both because of the history of each country and university. Two significant differences are worth mentioning. The first is that MIT has a much longer history of admitting foreign students, and so many more of the MIT alumni are non-U.S. citizens. The second is that the Tsinghua respondents are much younger on average. The average year of bachelor's graduation for the MIT

alumni is 1973, while for the Tsinghua alumni it is 1990. There appear to be two reasons for this difference. First, a difference in the populations who were sent surveys and a slight difference in response rates by age for the Tsinghua survey, with older respondents being less likely to respond. While we have some respondents from both universities who graduated in the 1930s, the Tsinghua Alumni Association appears to have kept fewer details or less accurate contact information for the older graduates. Also, since Tsinghua was disrupted by the Cultural Revolution, admissions (and thus alumni) fell off in the 1970s. The range of coverage for both surveys is impressive, with graduates from the 1930s through 2007 (Tsinghua) and 2001 (MIT). The Tsinghua founders are markedly younger than the MIT founders. This is likely due in part to labor market changes in China, where earlier generations were assigned to job positions and entrepreneurship was illegal. The cohort born in 1960 would have been 18 in 1978, when many of the economic reforms began to take place. Consistent with the older age of the alumni respondents, the firms founded by MIT alums are on average older than those founded by Tsinghua alumni. Since entrepreneurship was illegal until the economic reforms of the late 1970s, for the earlier graduation cohorts in China, there was a long lag between graduation and their first firm founding (if they became founders at all). While the MIT alumni respondents are older on average (more of them come from older graduating classes), once one holds constant the graduating class cohort, there are longer lags from graduating to founding a firm for the Tsinghua alumni. Consistent with the younger age of the average Tsinghua alumni respondents, overall the median age at founding for the MIT founders is 37.5, whereas for the Tsinghua founders it is 32.

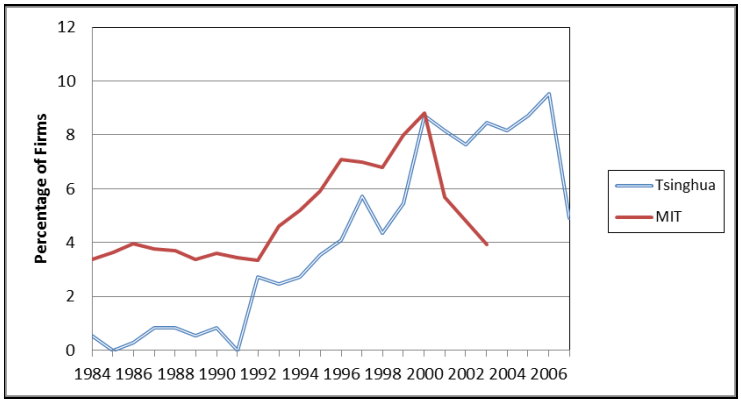


Figure 1 Distribution of firms by founding year

2. Founding Trends over Time

Figure 1 shows the distribution of firms by founding year for the United States (MIT alumni) and China (Tsinghua alumni). Overall, there is a similar pattern, particularly when looking at firms founded between 1984 and 2000. The MIT sample stops at 2001 in year of degree reception and the Tsinghua sample ends at 2007. We see similar upward trends over time, in part due to graduating classes being added each year, so that the number of individuals "at risk" for entrepreneurship increases in the sample with each year.

Table 5 Basic information comparison

Tsinghua	Non-Founders (n=2152)	Founders (n=670)	
Variable	Mean		t-stat
Age	52.829	42.967	12.388***
Master's Degree	0.397	0.552	-7.161***
Doctorate Degree	0.100	0.115	-1.121
Entrepreneur Parents	0.036	0.031	0.614
Privatized	0.000	0.260	--
Gender	0.879	0.933	-3.931***
Family Economic Status	3.834	3.639	4.348***
Recent Salary	2.317	2.045	3.686***
Avg. Tenure	8.074	4.813	7.554***
Overseas	0.126	0.212	-5.525***
Number of Pos.	2.115	3.109	-18.605
Ever Job High Gov.	0.036	0.042	-0.713
Ever Job Low Gov.	0.242	0.176	3.574***
Last Job Academia	0.166	0.081	5.475***
Ever Job Academia	0.233	0.207	1.402*
Last Job Business	0.399	0.687	-13.451***
Student Leader	0.674	0.903	-5.314***
MIT	Non-Founders (n=35,870)	Founders (n=7,798)	
Variable	Mean		t-stat
Age	57.69	61.95	-20.196***
Master's Degree	0.321	0.290	5.498***
Doctorate Degree	0.082	0.066	-4.986***
Gender	0.823	0.928	-23.404***

The increase that appears between 1992 and 2000 is largely due to the fact that, with each year, additional cohorts of graduates are added to the sample and become "at-risk" for firm founding. The fact is that we are not following a single cohort of graduates, but successive cohorts of alumni and there is typically a long lag from graduation to firm founding. This can be a source of confusion for those unaccustomed to seeing data from alumni surveys or similar sampling methodologies. There is almost no entrepreneurial activity in this population prior to 1982. After the economic reforms in the early 1990s and in the late 1990s, we see increases in the levels of entrepreneurial activity.

3. Who Becomes an Entrepreneur?

Table 5 shows the mean characteristics and t-statistics for founders compared to non-founders. Overall, the Tsinghua entrepreneurs are 10 years younger, more likely to be male, from wealthier families, have a lower average tenure in each job, are more likely to have gone overseas for education or work experience, and have a higher number of job positions. Consistent with having higher opportunity costs, the non-entrepreneurs had higher salaries than the entrepreneurs (pre-firm founding), were more likely to have worked in lower levels in government or to have worked in academia, and were less likely to have been student leaders at Tsinghua. Some of the non-founders may eventually found firms. For the MIT alumni, founders are just slightly older than non-founders and also more likely to be male. However, for MIT, those with a master's degree or a doctorate are slightly less likely to found firms. This is most likely due to higher opportunity costs. The other work history variables are not available in the MIT dataset.

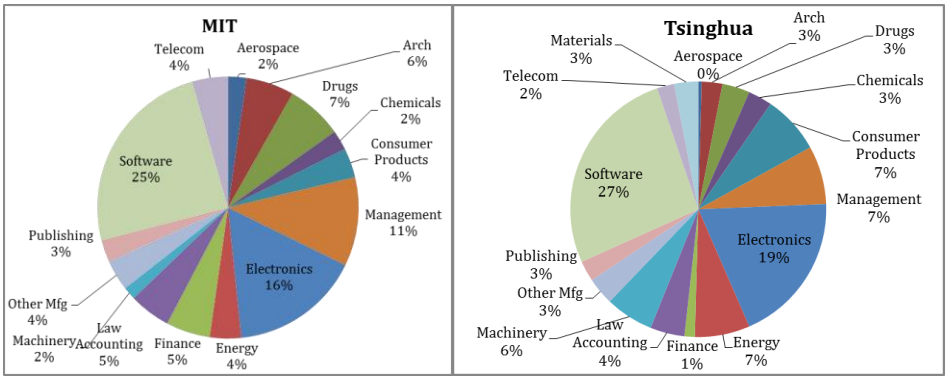


Figure 2 Industry

Table 6 Academic department

	MIT				Tsinghua			
School	Freq.	%	Founder	%	Freq.	%	Founder	%
Engineering	21714	51.28	3483	16.04	1771	69.72	456	25.75
Sciences	9086	21.46	1984	21.84	406	15.98	79	19.46
Management	6365	15.03	1634	25.67	100	3.94	31	31.00
Social Sciences	2838	6.70	265	9.34	163	6.42	27	16.56
Architecture	2339	5.52	487	20.82	100	3.94	27	27.00
Department	Freq.	%	Founder	%	Freq.	%	Founder	%
Elect. E. & Comp. S.	7445	19.18	1541	20.70	578	24.62	179	30.97
Civil & Env. Eng.	2122	5.47	456	21.49	458	19.51	84	18.34
School of M'gt	6331	16.31	1634	25.81	100	3.94	31	31.00
Mechanical Eng.	4124	10.63	767	18.60	545	23.21	142	26.06
Chemical Eng.	4730	12.19	461	9.75	155	6.60	44	28.39
Aero/Astro	2074	5.34	358	17.26	70	2.98	14	20.00
Architecture	1554	4.00	487	31.34	100	4.26	27	27.00
Math/Physics	3877	9.99	651	16.79	187	7.96	35	18.72
Materials	1347	3.47	193	14.33	64	2.73	16	25.00
Biology/Ocean Eng.	2704	6.97	315	11.65	16	0.68	3	18.75
Humanities	2293	5.91	146	6.37	138	5.88	22	15.94
Psychology	211	0.54	23	10.90	2	0.09	0	0.00

4. Academic Department and Industry

We took a close look at the academic departments from which the entrepreneurs emerged, which to a large extent is affected by the technological and entrepreneurial opportunities of each country, in order to provide insights into the academic backgrounds of entrepreneurs and whether these backgrounds differ across business environments. Table 6 shows the breakdown of graduates from each university by department and then the proportion who become entrepreneurs in every department. Tsinghua breaks down the academic departments using a slightly different system than MIT, so we created a procedure to map Tsinghua departments onto their corresponding MIT departments and schools. Because both universities are primarily focused on engineering, 51.3% of the MIT alumni and 69.7% of the Tsinghua alumni come from the Engineering Department. Overall, Tsinghua has more graduates from engineering and fewer from management, as their School of Economics and Management was founded much more recently. Table 5 shows the comparison of founders and non-founders on basic

information and personal experiences. Among the Tsinghua graduates, 59% held a master's degree as their highest degree and 9% held a doctorate (not necessarily from Tsinghua). There are slightly more doctorate holders among the MIT alumni (16%) and 41% had a master's degree as the highest degree (not necessarily from MIT). Consistent with many years of admitting primarily men at both institutions, 94% of the Tsinghua sample is male (compared to 93% of the MIT sample).

Table 7 Primary idea source

Primary Idea Sources	MIT	Tsinghua
In School- Doing outside-funded research	2.4	1.66
In School- Graduate thesis	4.64	3.96
In School- In class	1.98	5.88
In School- Informal discussion with students	3.41	11
In School- Other research	2.28	1.92
In School- Professional literature	1.73	4.48
In School- Visiting scientists, engineers etc.	1.77	4.86
In School- Working with outside company	3.2	4.86
Other Sources- Discussions in social/professional conferences	21.54	17.65
Other Sources- Research conference	2.66	4.48
Other Sources- Working in the industry	41.44	24.81
Other Sources- Working in the military (gov. experience)	4.01	2.94
Other Sources- Doing outside-funded research	2.07	0.77
Other University- Graduate thesis	1.05	1.28
Other University- In class	1.01	1.53
Other University- Informal discussion with students	1.43	3.45
Other University- Other research	1.26	0.9
Other University- Professional literature	1.05	2.05
Other University- Working with an outside company	1.05	1.53
Total	100	100
Number of Observations	1284	110

A higher percentage of the Tsinghua engineering and social sciences graduates reported having founded firms. These divergences appear to be driven mainly by differences between the chemical engineering and humanities alumni of these universities. Among Tsinghua alumni, 28.4% of alumni with a degree in chemical engineering became entrepreneurs, compared to only 9.8% of MIT alumni with the same degree. It is possible

that the social sciences graduates are less likely to found product-oriented firms, opting instead for services.

The industry breakdown is shown in Figure 2, where we find that electronics and software firms make up the majority in each sample. In addition, each sample has similar but smaller percentages of firms in energy, consumer products, telecommunications, and management consulting.

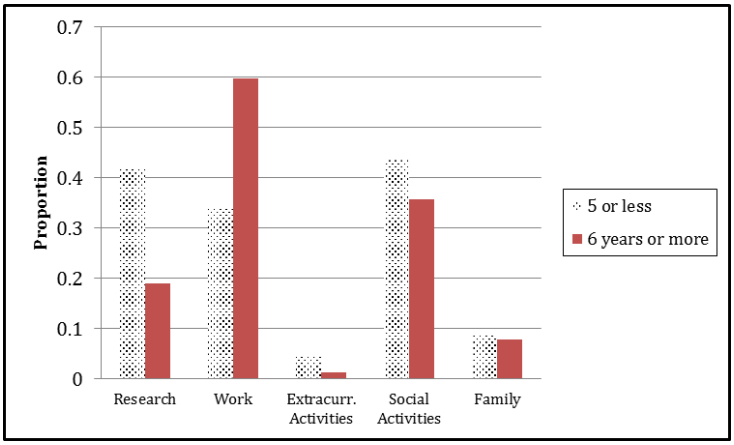


Figure 3a Team sources (MIT) by years since graduation

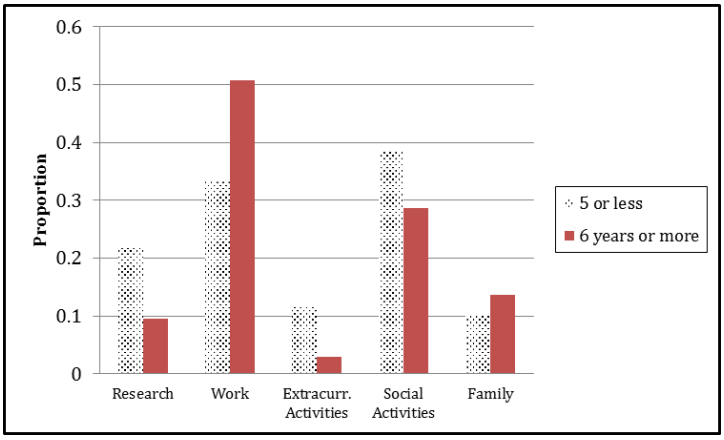


Figure 3b Team sources (Tsinghua) by years since graduation

The industry breakdown is strikingly similar between the two pools of alumni, providing a reassuring level of similarity in industrial sector distribution. Both universities are primarily focused on engineering, and the industries in which firms were founded reflect this fact, with software and

electronics constituting the first and second largest categories (25% vs. 27% software and 16% vs. 19% electronics for MIT and Tsinghua firms respectively). Both finance and drugs/biotech are made up a smaller proportion of the Chinese firms (5% vs. 1% and 7% vs. 3%), which may be due to the fact that these are heavily regulated industries in China and entries have traditionally been strictly controlled by the government.

5. Idea and Team Characteristics

Another set of entrepreneurial process variables worth noting are the sources of the ideas and cofounder teams. Compared to Tsinghua, the MIT alumni entrepreneurs more frequently get their ideas from work experience. Table 7 shows the responses to the question, "What was the primary source of the idea [that led to the founding of the firm]?" Overall, the patterns are strikingly similar with ideas from industry or discussions at social or professional events forming the largest two categories in each sample. We observe that more of the U.S. firms were founded based on ideas discovered while working in the industry (41.4% vs. 24.8%) or doing outside-funded research (2.1% vs. 0.8%). More of the Chinese firms resulted from informal discussions with students at school (11% vs. 3.4%), from classes at the university (5.9% vs. 2%), and from the professional literature or visiting scientists and engineers.

The fact that fewer of the Tsinghua entrepreneurs' ideas stemmed from work experience fits with the trends of alumni founding firms sooner after graduation and having less work experience. However, it argues against the idea that Tsinghua alumni are less likely to take advantage of technological opportunities. This difference may be due to graduate students having ideas while studying in the United States, or differences in the Chinese labor market. Historically, many Chinese graduates worked in government institutions or public research institutes. Another possibility is that many industries that have been present in the United States for many years have only come to China relatively recently and rather quickly; software and the internet are two areas that come to mind. If this scenario is relevant, then one could imagine that opportunities for work experience in these new industries are rare, but that individuals can discover possible opportunities through discussions with peers or overseas colleagues.

Team size is significantly larger for the Tsinghua firms. For the MIT firms, the mean team size is 2.15 (median=2) vs. 3.35 (median=3) for Tsinghua. However, this difference may largely be due to the family business model contributing to a relative lack of single-founder teams in China, with 38.0% of the MIT alumni firms being founded by one individual vs. 9.7% for

Tsinghua. Breaking down the Tsinghua data by the first co-founder (as designated by the respondent) only, and then by all co-founders, we see that if there was only one co-founder, then there is a higher likelihood that it was a relative than for firms with multiple co-founders or larger teams. There are significantly more family-based teams among the Tsinghua alumni (19.5% vs. 7.9%). This was also consistent with our interviews, which indicated that, while things are rapidly changing, the family business model is still common in China. In particular, family is more often entrusted with bookkeeping by some of the Tsinghua entrepreneurs we interviewed.

Figures 3a and 3b show the similarities in co-founding team sources across MIT and Tsinghua. Most of the teams came from work experience, followed by social activities, and then research. As graduates get older, they tend to form their teams more from work experience and less from research or social activities. For the Tsinghua case, it is interesting that, while many of the ideas came from research, a smaller percentage of the teams were formed in a research setting. Teams formed from research were less likely among Tsinghua co-founders than among MIT co-founders. For both the team and idea sources, the respondents could indicate more than one source. The MIT alumni appear to have identified slightly more diverse sources for the founding team than the Tsinghua alumni did, despite the fact that the Tsinghua teams were more often co-founded. Older Tsinghua alumni were more likely than MIT alumni to identify family members as co-founders.

Table 8a Tsinghua repeat founders by decade of graduation

Decade	1950s	1960s	1970s	1980s	1990s	2000s
Total # Firms = 1	17	30	12	89	145	64
% Repeat	32	54	63	58	49	26.5
=2	5	20	11	61	91	17
=3	1	7	4	38	29	6
=4	1	6	1	5	12	0
=5	1	1	4	8	4	0
=6	0	1	0	2	2	0
=7	0	0	0	0	1	0
=8	0	0	0	1	1	0
=9	0	0	0	0	0	0
=10	0	0	0	13	0	0
>10	0	0	0	2	0	0
Totals	25	65	32	219	285	87

Note: "Total # Firms = 1" shows the number of respondant who have founded only one firm.

Table 8b MIT repeat founders by decade of graduation

Decade	1950s	1960s	1970s	1980s	1990s	2000s
Total # Firms = 1	161	231	238	242	182	19
% Repeat	44.5	46.2	52.3	43.3	38.9	40.6
=2	60	85	115	92	69	9
=3	29	47	79	49	27	3
=4	19	28	30	23	9	1
=5	10	14	16	9	6	0
=6	4	7	7	3	0	0
=7	0	5	2	3	3	0
=8	5	2	3	0	0	0
=9	0	5	2	1	0	0
=10	0	2	1	1	1	0
>10	2	3	6	4	1	0
Totals	290	429	499	427	298	32

Note: "Total # Firms = 1" shows the number of respondant who have founded only one firm.

6. Serial Entrepreneurs

Saxenian (1994) argues that differences in the work culture between Silicon Valley and Boston Route 128 (specifically a culture of job-hopping in California) has led to differences in entrepreneurship. In both locations, it appears that a culture of risk-taking and serial entrepreneurship has emerged and perpetuated itself over the years. The culture of entrepreneurship where risk-taking founders continuously start new firms, take them public or sell them, and then create a new firm is often thought to be specific to the United States. In both the MIT and Tsinghua surveys, we asked respondents about the total number of firms founded. In both cases, we found substantial numbers of entrepreneurs who had founded multiple firms. In the case of China, this came as a surprise since we had been told that the distinctly American culture of founding a firm and then selling it was not part of the Chinese culture, where individuals founded firms that they wanted to run themselves rather than sell and move on. In addition, liquidity events, such as initial public offerings and acquisitions, have been rarer in China, but are typical transition points for U.S. entrepreneurs. Eesley and Roberts (2012) find that firms started by individuals with previous founding experience tend to be more successful, particularly if the individual has had a success in the past and remains within the same industry. A similar pattern appears to hold in China where third firms have higher median revenues ($54,593) and

employment (36.5 people) relative to first firms ($9,369) and (20 people). Future analysis should determine whether the serial entrepreneurship we observe in China is more likely to be due to first firm failures, and if Chinese entrepreneurs are more likely to stay with the business after a success. Overall, 45.7% of the MIT alumni entrepreneurs had made more than one founding attempt and 48.1% of the Tsinghua alumni entrepreneurs claimed more than one founding attempt. Table 8a shows the Tsinghua repeat founders (or serial entrepreneurs) by decade of their bachelor's graduation. We can see that several individuals made as many as 10 or more firm founding attempts. The most recent cohorts of graduates from the 1990s and 2000s have lower rates of repeat entrepreneurship, no doubt due to the fact that they have had less time since graduation for even one founding, never mind two. Table 8b displays the same figures for the MIT alumni. The MIT alumni appear to have higher rates of repeat entrepreneurship among both the older alumni and the most recent graduates.

Interviews with Tsinghua entrepreneurs paint a picture consistent with these tables, in that many of them told stories of having founded multiple firms. Their stories also shed light on their motivations. In some of the cases the first firm had been unsuccessful and went out of business. In other cases, they were simply searching for a new firm idea that better fit them and their passions. One entrepreneur had been in the business of importing electronics and said that this business had been so lucrative that life was too easy and became boring. He left the business to start his current company, an extremely successful children's clothing retail business. Overall, Tsinghua alumni are just as likely to become serial entrepreneurs as the MIT alumni entrepreneurs.

Table 9 Innovation

	MIT			Tsinghua		
	Yes	Total	%	Yes	Total	%
IP Author?	602	1366	44.07	91	144	63.19
IP Owner?	455	862	52.78	95	180	60.51
IP Important?	504	1544	32.64	110	273	40.29

	R&D /Rev ratio(%)	Elect.	Software /Internet	Law & Accounting	Total
MIT	Mean	14.1	16.5	5.8	9.4
	25p	0	0	0	0
	Median	10	10	0	0
	75p	18	25	5	12
	Obs.	363	376	283	1923

Tsinghua	Mean	10.83	15.75	3.7	9.91
	25p	0	0	0	0
	Median	0	0.2	0	0
	75p	10	20	0	10
	Obs.	70	65	22	383

Table 10 Patents

A: Tsinghua alumni (Entrepreneurs and non-entrepreneurs)

Number of Patents per Individual	Foreign Patents		Domestic Patents	
	Freq.	%	Freq.	%
0	2924	98.58	2565	86.48
1	18	0.61	163	5.50
2	14	0.47	90	3.03
3	3	0.10	56	1.89
4	3	0.10	24	0.81
5	0	0.00	27	0.91
6 or More	4	0.13	41	1.38
Total	2966	100	2966	100

B: Comparison – number of patents

Number of Patents per Firm	MIT		Tsinghua	
	Freq.	%	Freq.	%
0	1263	74.91	66	20.12
1	112	6.64	33	10.06
2	64	3.80	58	17.68
3	40	2.37	52	15.85
4	20	1.19	56	17.07
5	16	0.95	53	16.16
6 or More	171	10.14	10	3.05
Total	1686	100	328	100

C: Comparison – firm age ≤ 15 years

MIT		Tsinghua	
Freq.	%	Freq.	%
755	78.00	20	7.72
73	7.54	31	11.97
37	3.82	49	18.92
25	2.58	50	19.31
11	1.14	52	20.08
6	0.62	47	18.15
61	6.30	10	3.86
968	100	259	100

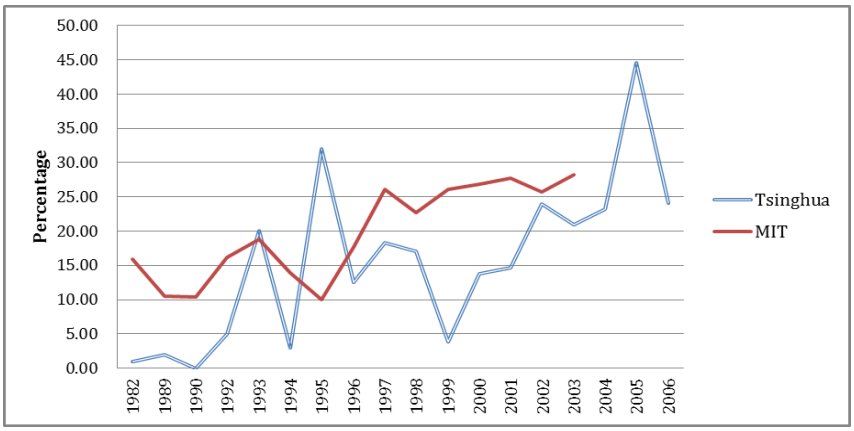


Figure 4 R&D Spending as a proportion of revenue (Mean)

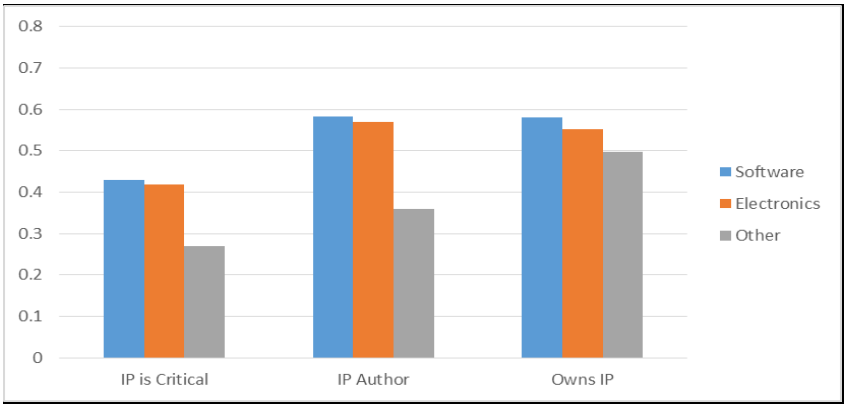


Figure 5a Percentage of MIT entrepreneurs innovation measures

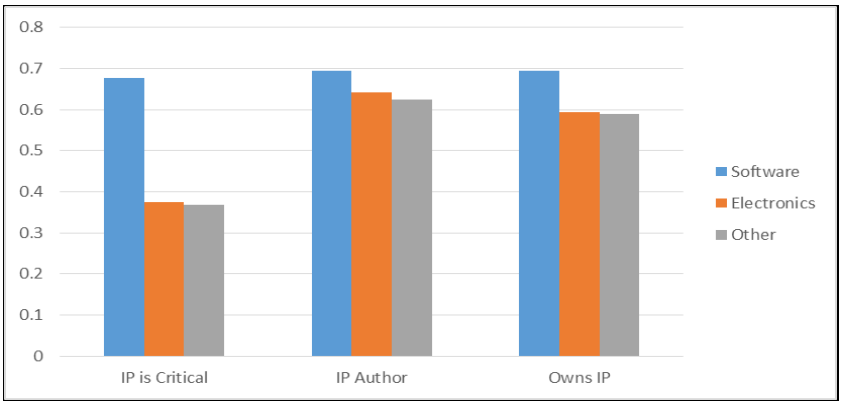


Figure 5b Percentage of Tsinghua entrepreneurs innovation measures

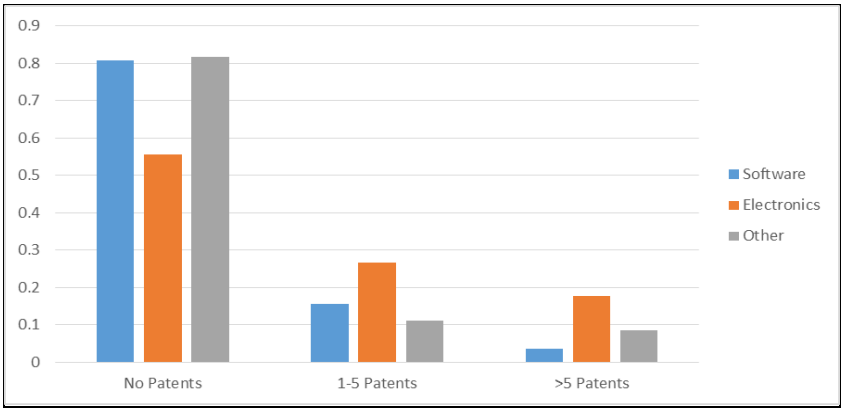


Figure 6a Percentage of MIT entrepreneurs patenting by sector

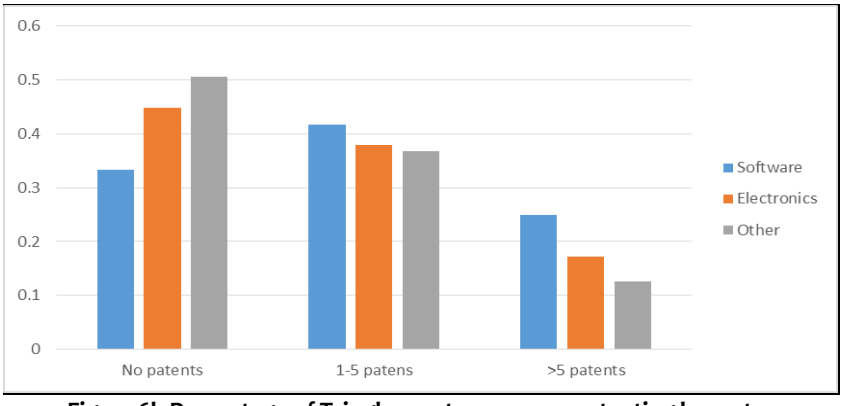


Figure 6b Percentage of Tsinghua entrepreneurs patenting by sector

7. Innovation

In examining differences in entrepreneurial opportunities based on technological innovation, one of the advantages of these data is that we have multiple measures (particularly in the Chinese survey) of the importance of innovation in these firms. We have a number of innovation measures (both patent-based and non-patent based) including: whether the start-up owned or licensed any intellectual property (IP), whether IP was considered critical for the success of the business, if one of the co-founders was the creator of the innovation (the source of the idea), if there were any patents (foreign or domestic for the Tsinghua firms), and how much of the firm's revenue was

spent on R&D activities. We have also linked the MIT firms with the USPTO patent database to merge the number of patents and patent characteristics.[6]

Figure 4 presents the most recent year's R&D spending (as a percentage of revenue) reported by firms that were founded in a given year.[7] The levels are roughly similar for both the MIT and Tsinghua firms over the years. However, the MIT alumni firms consistently spend more on R&D than the Tsinghua alumni firms. Furthermore, this appears to be due to higher R&D spending by R&D performers rather than a lower proportion of R&D performers among the Tsinghua alumni firms. Higher R&D spending could be due to the relatively higher salaries for scientists and engineers (a key R&D input) in the United States compared to China.

Table 9 displays the responses to questions about whether the founder was the creator (author) of the intellectual property that the firm is using, whether the firm owns the IP, and whether they consider intellectual property to be important for the venture. A higher proportion of the Tsinghua alumni report having created the intellectual property (a finding that is consistent with weaker IP protection in China, where selling or licensing IP is more difficult or starting firms requires higher IP). Similar percentages between the schools report owning IP (52.8% MIT vs. 60.5% Tsinghua) and a lower percentage from MIT report that IP is important for their businesses (32.6% MIT vs. 40.3% Tsinghua). It is interesting to note from these responses that a subset of the IP owners (or authors) consider the IP to be important for their start-up. The bottom panel shows the breakdown of R&D investment as a percentage of revenues. We see very similar aggregate patterns between the two countries, even when broken down by the 25th percentile, the median, and the 75th percentile. As expected, we see higher levels of R&D spending in electronics and software than in law and accounting (chosen as a low-tech contrast). Also, we find slightly higher R&D spending in the MIT electronics and software firms than in the Tsinghua firms in those industries.

Figures 5a and 5b break down the percentage of MIT and Tsinghua entrepreneurs' innovation measures by sector. While the percentages of

[6] Patents are typically used as a measure of innovation because they offer extremely detailed and rich data. However, patents have limitations as a measure of technical change or innovation (Comanor and Scherer 1969; Graham and Higgins, 2007). There are problems with great skewness in quality and differences in propensity to patent across industries, countries, and firm types. The range of patentable innovations constitutes just a sub-set of all research outcomes. It is unclear whether patents should be seen as a research input (like a working paper) or an output. Patenting is a strategic decision, and not all patentable innovations are actually patented.

[7] For inactive or failed firms, this was reported for the most recent year in operation.

entrepreneurs who consider IP to be critical to the success of the business are similar for MIT and Tsinghua as a whole, Tsinghua software firms have a much higher percentage of entrepreneurs considering IP to be critical, compared to both MIT software firms and other Tsinghua firms. A higher proportion of Tsinghua entrepreneurs have created IP than MIT among software, electronics and other sectors. This may be due to the difficulties in licensing IP and thus a more limited market for IP in the Chinese context. Compared to other industries, more software and electronics firms in both MIT and Tsinghua own IP, although the gap relative to other sectors is small for Tsinghua electronics firms.

Table 10 shows the breakdown of patenting as a measure of innovative activity. Panel A shows that, out of the sample of all Tsinghua alumni, just under 1.5% hold at least one foreign (non-Chinese) patent and 15.5% hold at least one Chinese patent. In Panel B, we report the number of patents per firm. This includes only USPTO patents for the U.S. firms, but includes any foreign or domestic patents for the Chinese firms. Fewer than 20 of the Chinese firms reported holding foreign (non-Chinese) patents. The first set of columns report patents for all firms. The results show that while only 25.1% of the U.S. firms hold at least one patent, 79.9% of the Chinese firms report holding at least one patent. Since many of the U.S. firms hold many patents due to their older average firm age compared to the Chinese firms, the next set of columns restricts the firms to only those less than 15 years old. We see that the proportions are now 12% (U.S.) and 92.3% (China). While it may be true that there is a stronger orientation to starting firms with IP, the Chinese firms likely have such high patenting rates because there are many government incentives and subsidies for firms that hold patents, particularly in the science parks. Some of these results may be due to filing a patent simply in order to qualify for one of these benefits. Based on the response to whether intellectual property (broadly defined) will be important for the firm, then roughly 30% of the firms were innovating in each country. There do not seem to be large differences across countries in the proportion of firms taking advantage of technological opportunities. From the results on patenting, we could then conclude that patenting activity undercounts innovating firms in the U.S. environment, but drastically over-counts innovating firms in the Chinese context. Patenting appears to be a poor proxy for innovating firms in an international comparison.

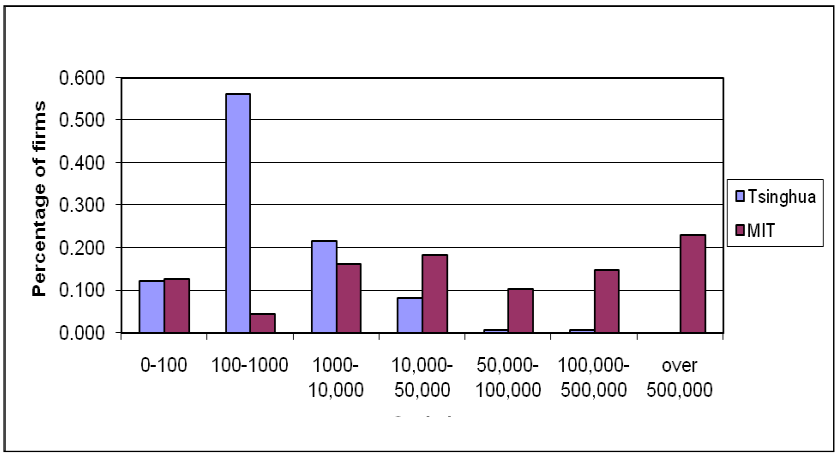
Consistent with the overall picture analyzed previously, Tsinghua firms have higher sector-specific patenting rates than MIT across all sectors as presented in Figures 6a and 6b. However, the difference is highest in software. For MIT the highest patenting rate is observed for electronics firms, while for Tsinghua the highest patenting rate is amongst software firms. Again, this result may imply that MIT alumni firms have a ready market to license-in IP

and so do not always need to apply for their own patents. Another explanation could be high incentives or a lower bar for applying for a patent in the Chinese context in order to qualify for R&D tax incentives or science parks. It could also imply technology opportunity differences exist between the two countries, where perhaps more MIT alumni software firms are using existing technology for new market applications.

Many additional non-patent measures of innovation are available in the Tsinghua survey, including responses to the question of whether the products or services offered by the firm were available on the market three years ago (83.4% indicate that their products were not). Some would argue that many of the MIT firms are likely to be doing work at the world's technological frontier, whereas the Chinese entrepreneurs are mostly adapting existing technologies to their markets. Yet the comparative data suggest that the situation may not be so simple and straightforward. Admittedly, innovation is a difficult concept to measure empirically. Both the Tsinghua and MIT entrepreneurs appear to be reporting that they rely on innovation (where innovation might be defined as something new for their country's market) at similar rates. Nonetheless, the most basic observation we found is that the levels of innovation depend on how the question is asked and the pattern of these differences appears to match the incentives facing the Tsinghua alumni entrepreneurs. However, once non-patent based measures are examined, there is evidence for similar levels of innovation in the Tsinghua firms the MIT firms. While this may not be innovation at the world's cutting edge of technology, it nonetheless represents innovation in the eyes of these entrepreneurs and in comparison to their home market.

Table 11 Source of initial capital

	MIT		Tsinghua	
Source	No. of Companies	%	No. of Companies	%
Savings	782	53	141	42
Venture Capital	180	12	25	8
Family / Friends	129	9	48	14
Cash Flow	114	8		
Angel Investor	112	8	22	7
Credit	70	5	28	8
Customers	42	3		
Gov. Federal	25	2	25	8
Gov. State	11	1		
University	6	0	11	3
Suppliers	6	0	32	10
Total	1477	100	332	100



Note: Purchasing power parity converted to constant 2005 U.S. dollars

Figure 7 Initial capital

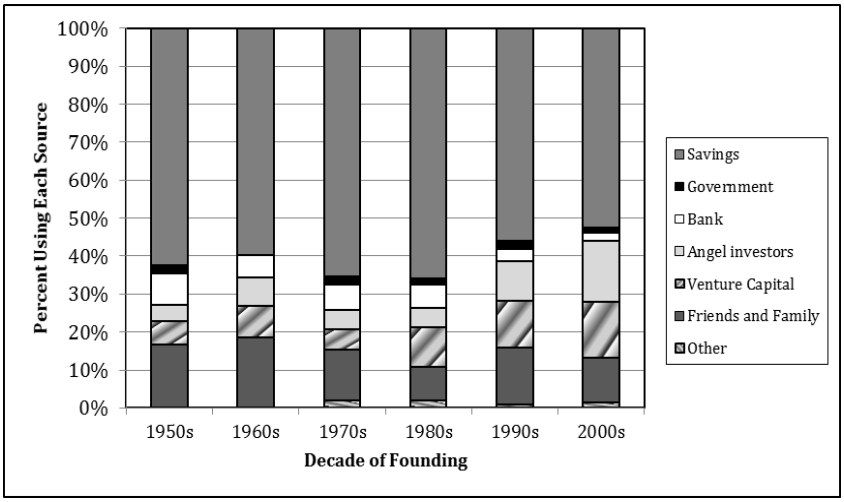


Figure 8a MIT: sources of capital funding for MIT firms

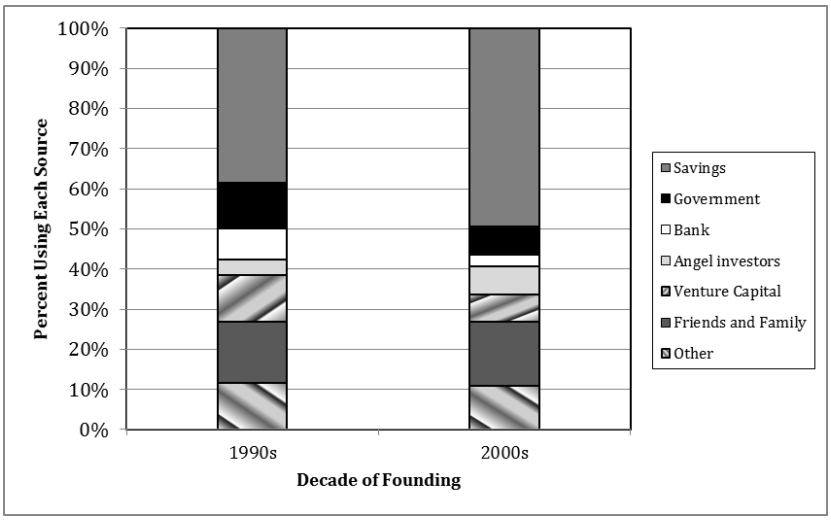


Figure 8b Tsinghua: sources of capital funding for Tsinghua firms

8. Financing

Entrepreneurs need capital to survive and expand. Figure 7 shows the distribution of initial capital raised for the business (in the first year). The figures have all been converted to constant U.S. dollars (2005) using purchasing power parity (PPP) as calculated by the 2005 World Bank International Comparison Program.[8] The Chinese firms appear to be raising (or reporting) considerably smaller amounts of initial capital.[9] Table 11 shows the number and percentage of companies using each source of capital for the firms. We find that the most common source for the MIT alumni by far is the savings of the founding team, followed by venture capital, and then friends and family. For the Tsinghua alumni, savings is also the most important source, followed by friends and family. The Tsinghua survey did not break out state government, cash flow, or customers separately as sources.

[8] A detailed review of the methodological difficulties in constructing PPP indices is beyond the scope of this paper (see Kravis, Heston, and Summers, 1982 for a discussion of these issues).

[9] For the Chinese firms, we asked about "registered capital," which is the initial capital that firms are required to report when registering the founding of a new firm. While this is not perfectly symmetric to the MIT survey question of "initial capital in the first year of the company," it is close and the best we currently have available.

Figures 8a and 8b show the pattern of the breakdown of the sources of capital for the MIT and Tsinghua firms. Overall, the MIT and Tsinghua firms appear roughly similar in their financing, with savings making up the largest category. The "other" category is made up largely of capital from suppliers. High use of supplier credit has in other studies been used as a measure of financial constraints on firms. The Tsinghua firms appear to use founders' savings less frequently than the MIT firms, and capital from friends and family slightly more frequently. The proportion of firms using loans from banks is similar across the two countries. In recent decades, the proportion of MIT firms raising money from angel investors or venture capitalists has increased and is higher than that proportion for Tsinghua firms. We do see an increase in the use of venture capital among the MIT firms over the decades. It is likely that this is restricted to those firms that are raising large amounts of initial capital.

At first glance, the patterns of financing for the firms are similar overall. The savings of the founders is the single most frequent source of early capital in both countries. It is clear that the Tsinghua firms raise lower amounts of initial capital than the MIT firms. It is difficult to know whether differences in the legal environment and financial institutions are leading to financial frictions and lowering amounts of capital being raised by the Tsinghua firms. An alternative explanation is that the types of entrepreneurs and firms being created do not need or merit larger amounts of capital. In our interviews, we asked many of the Tsinghua alumni entrepreneurs about the fundraising for their own firms and about their perceptions of the entrepreneurial finance environment in general. Many expressed frustration, saying that it was extremely difficult to raise capital in China, particularly from domestic banks; however, the proportion of firms using loans from banks is similar across the two countries. Nonetheless, the Tsinghua alumni appear to be using money from friends and family or from supplier credit more frequently than the MIT firms. Heavy use of these sources could be interpreted as a sign of financial constraint or perhaps reflect cultural differences with regard to family ties. The Tsinghua entrepreneurs also tend to be much younger than the MIT entrepreneurs, so they may not have as much in personal savings on average.

Again, it is difficult to know from these data whether these forms of external capital are as yet unavailable to Tsinghua alumni or whether their firms do not meet investment criteria. While we do not have similar data on the MIT firms, the Tsinghua survey data does tell us that, while 25 firms obtained venture capital, 80 firms sought VC money. Similarly, 43 firms reported seeking angel investor funding, but only 22 received it. Similar ratios are likely present in the U.S. as well.

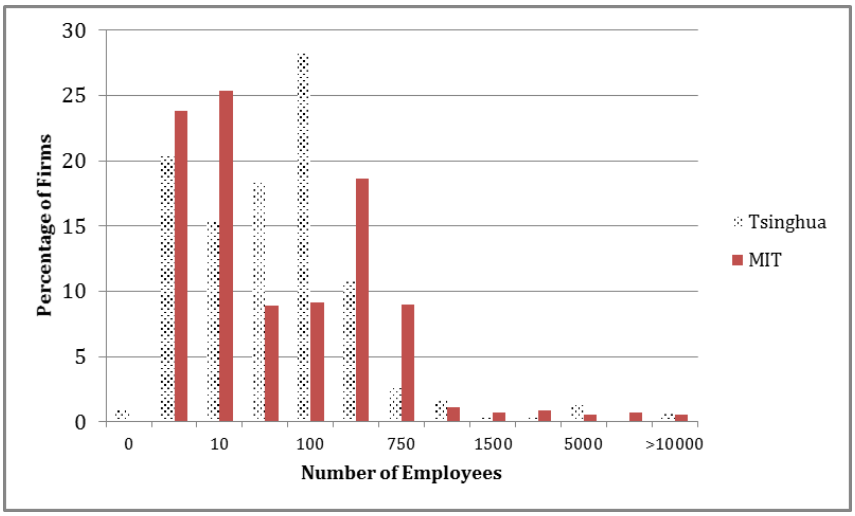


Figure 9 Distribution of firms by size (Employees)

Table 12 Revenues

Revenues	25th	50th	75th	99th	Mean
MIT	53,742	465,725	2,953,308	140,000,000	10,100,000
Tsinghua (constant PPP)	345	1,241	6,893	386,014	15,710
Tsinghua (exchange rate)	788	2,836	15,756	882,317	35,909

Note: All revenues exclude financial firms and firms older than 15 years. All revenues are for the most recent year that the firm was in operation. Tsinghua revenues have been converted for the exchange rate and for purchasing power parity (PPP). The former can be thought of as an upper bound while the PPP conversion gives a lower bound. MIT revenues have been adjusted for inflation.

9. Performance

To explore the characteristics of entrepreneurship in different economic and institutional environments, we begin with descriptive statistics showing firm performance. Several performance measures are included in both the MIT and Tsinghua surveys, including survival, number of employees, revenues, acquisitions, and initial public offering (IPO). Figure 9 shows a comparison of the distribution of firm size (measured by the number of employees) for the MIT and Tsinghua firms. Despite the fact that the Tsinghua firms are younger on average, the distributions are fairly similar with the exception of the 20-100 employee range, where there appear to be relatively more Tsinghua firms;

however, there are more U.S. firms in the 500-750 employee range. In terms of employees, there are similar proportions of MIT and Tsinghua firms represented at the very smallest size of 5-10 employees (and the larger 5,000 and above employee size). However, the MIT alumni firms are significantly older than the Tsinghua firms. Entrepreneurship was all but illegal in the earlier years of the Communist regime, making older private firms very rare. Even after that time, foreign-invested firms and state-owned enterprises continued to be privileged in many ways and encouraged to grow larger than emerging private enterprises. However, once we stratify by age, the Tsinghua firms are not significantly smaller in terms of the number of employees. In fact, among the firms younger than five or ten years, the Tsinghua firms tend to have more employees. This result may be due to lower wage labor costs in China. Further analysis is needed to say for sure, but interviews with the Chinese entrepreneurs also indicated that this was the case. One pair of founders reported that they had located the firm in Shanghai rather than in the U.S. partially because of lower wages for scientists and lower cost for lab space, and that they had been able to expand the lab much more quickly as a result.

Table 12 shows a comparison of the revenues for the MIT and Tsinghua firms. All revenues exclude financial firms and firms older than 15 years to make them slightly more comparable. All revenues are for the most recent year that the firm was in operation (or for 2006 for those still in operation). Tsinghua revenues have been converted for the exchange rate and for purchasing power parity (PPP). The former can be thought of as an upper bound while the PPP conversion gives a lower bound. MIT revenues have been adjusted for inflation. We can see that overall the MIT firms are significantly larger, both on average and across quartiles.[10] Both surveys contain data on acquisitions and IPOs, though these were rare in China until very recently. Among the MIT alumni, 19.2% of their firms had been acquired, whereas only 1.9% of the Tsinghua alumni firms had. Looking at IPOs, 11.2% of the MIT firms had undergone an IPO, compared to 5% of the Tsinghua firms. The number of IPOs and acquisitions are slightly higher among Tsinghua alumni who had overseas work or educational experience (3.3% of returnee entrepreneurs had acquisitions and 6.6% had IPOs). The Tsinghua dataset also contains the revenue numbers for each of the first three years and the revenues (plus employees) for the second to last year that the firm was in operation (or for 2005 for those still in operation). These data allow us to look at a few growth trends over time.

[10] There is some concern that the largest Chinese firms may be reluctant to share revenue data even in an anonymous, non-government survey.

Across industries, the Tsinghua firms are much smaller in terms of revenues and in the likelihood of a liquidity event such as an acquisition or IPO. The differences in size in terms of employees are not as large. This may be due to lower labor costs in China, which causes a corresponding increase in hiring. It may also be that Chinese entrepreneurs underreport revenues (to avoid taxation or expropriation), but do not underreport employee size to the same extent.

IV. Limitations and Future Research

Although the statistical results are fairly well-presented, we find it difficult to pin down causal explanations. To be more specific, how do the entrepreneurship processes in general, and outcomes in particular, differ because of the external environment? We expect that many of these differences are due to differences in the legal, institutional, or policy environments for businesses between the two countries. Eesley (2016) reviews the massive policy changes in China related to entrepreneurship; namely, entrepreneurship was once an illegal activity, and now it is actively supported and encouraged. Eesley (2016) explored one particular institutional change, the idea that lowering barriers to growth encouraged more highly-educated individuals to become entrepreneurs and create larger, more successful firms. However, systematically determining the causes of cross-national differences in firm performance is difficult and will require more sophisticated future analysis.

V. Discussion and Conclusions

Prior work at the intersection of institutions and entrepreneurship has examined the impact of institutional change in a single country and industry (Sine et al., 2005). For example, Eesley (2016) shows how lowering barriers to growth may increase the likelihood of higher human capital individuals to found firms. Prior work in entrepreneurship shows that founding team composition, strategy and industry context jointly shape venture performance (Eesley, Hsu and Roberts, 2013; Eesley and Roberts, 2012). Other work shows the importance of the university context for entrepreneurship (Eesley and Miller, 2012; Roberts and Eesley, 2011; Hsu, Roberts and Eesley, 2007). The MIT and Tsinghua surveys offer a promising and exciting methodology for cross-country comparisons in the entrepreneurial process and outcomes.

The alumni received similar educations in terms of their major fields and the caliber of their universities. They founded firms at roughly similar rates and those firms tend to be in very similar industries. Large differences do not appear in the proportion of firms innovating or in the percentage of revenues invested in R&D activities. However, significant differences exist in entrepreneurial performance for alumni from MIT and Tsinghua. Also, the legal, financial, cultural, and institutional environments encountered in their work experiences and in founding their firms differed dramatically, particularly for the early Tsinghua entrepreneurs. These institutional differences likely account for the observed differences in the data. Below we highlight a few promising avenues for future exploration of the linkages between institutional theory and our findings.

Much of the literature on institutions and entrepreneurship has emphasized institutional barriers to entry in the form of capital constraints, regulatory steps and legitimacy (Meek, Pacheco, and York 2010; Klapper, Laevena and Rajan 2006; Sine and David 2010). However, the overall rates of entrepreneurship we observe do not significantly differ. Barriers to entry certainly were present in the Chinese context (particularly prior to 1988), however the results suggest that in the years since then other types of barriers, such as barriers to growth (Eesley, 2016) or barriers to failure may be more salient in explaining the results we find for these university alumni. There are slight differences in who tends to become an entrepreneur among the MIT and Tsinghua alumni. In particular, trends over time have been different in each country. As we discussed above, recent Tsinghua alumni with master's degrees have been much more likely to found firms. These firms have had higher performance, but tend to be younger firms. The Tsinghua founders also tend to be younger on average and higher percentages of Tsinghua humanities majors found firms compared to MIT alumni.

We found some significant differences in the factors related to the entrepreneurial process, including the sources of ideas and teams, innovation, and fundraising. Recent work has found that institutional change in universities led to greater levels of high-tech entrepreneurship, yet did not yield the expected benefits in terms of firm financial performance, suggesting that other institutions remain inconsistent with innovation in China (Eesley, Li and Yang, 2016). However, there do not appear to be large differences in the proportion of firms using innovation strategies (though there are higher levels of R&D spending for the MIT firms) or specific capital sources. Some evidence indicates capital constraints on the Tsinghua firms, which may indicate that financial institutions, contract enforcement and institutional paths to liquidity (IPO or M&A) may be limiting factors. However, there is not strong evidence that financial constraints are significantly or solely to blame for the smaller size of the Tsinghua firms. The data show that there are

similar relative proportions of serial entrepreneurs in the two samples, but they may be serial entrepreneurs for different reasons.

Institutional barriers to growth, such as industrial policies slanted towards state-owned or foreign-invested firms may be important in the firm performance differences we find (Eesley, 2016; Huang 2008). While firm size in terms of employees is roughly similar, the MIT firms have much larger revenue figures than the Tsinghua firms. Two caveats apply to these statements. The first is the concern about the accuracy of the revenue figures. Respondents could be underreporting or biasing results in the opposite direction, or they may not be responding if they have low revenues. Also, these results include privatized Chinese state-owned enterprises. Even though the government "kept the big and let go of the small," the privatized firms tend to be larger in terms of revenues and older than the newly-founded firms.

Through the comparison of alumni from two top research and technology universities with regard to the type of student who becomes an entrepreneur, the industry of their firm, the source of their founding team and entrepreneurial idea, innovation and firm performance, initial capital source, and serial entrepreneurship, this paper provides a close look at differences in the entrepreneurial process and firm performance in two environments, which contributes to the study of how external environment influences entrepreneurship.

To conclude, there are many similarities between the MIT and Tsinghua alumni in terms of the characteristics of entrepreneurs and the start-up process factors. Nonetheless, some relatively subtle differences, in combination with environmental differences for entrepreneurial firms and the institutional history of China, have led to vastly different outcomes for entrepreneurial firms from MIT and Tsinghua. Thus far, this comparative analysis has left relatively unexplored the causal mechanisms through which the factors that affect who becomes an entrepreneur can lead to differences in factors related to the start-up process and firm outcomes. Yet, it is clear that the shorter time frame in which entrepreneurial activity has been occurring in China results in a younger, smaller set of entrepreneurial firms. Similarly, the younger age of Tsinghua entrepreneurs contributes to a different mix of idea and team sources (fewer from work experience) that might also partially explain the differences in firm outcomes. The mix of funding sources and proportions of firms relying on technological innovation are strikingly similar. While firm size in terms of employees is roughly similar, the MIT firms are much larger in revenues than the Tsinghua firms. We hope that this study represents a step toward a better understanding of international differences in technology entrepreneurship.

References

Aldrich, H.E. (1999) Organizations Evolving, Thousand Oaks: Sage.

Beckman, C.M. (2006) The influence of founding team company affiliations on firm behavior, Academy of Management Journal, 49(4), 741-758.

Burton, D.M., Sorensen, J.B. and Beckman, C. (2002) Coming from good stock: career histories and new venture formation, in Lounsbury, M. and Ventresca, M. (eds.) Research in the Sociology of Organizations, 19, Greenwich: JAI Press, 229-262.

Eesley, C. (2016) Barriers to Growth: Human Capital, Entrepreneurship and Institutional Change in China (Appendix) (Provisional acceptance at Organization Science)

Eesley, C.E., Li, Jian Bai and Yang, Delin (2016) Does institutional change in universities influence high-tech entrepreneurship? evidence from china's project 985, Organization Science, 27(2), 446-461.

Eesley, C.E., Hsu, D. and Roberts, E.B. (2013) The contingent effects of top management teams on venture performance: aligning founding team composition with innovation strategy and commercialization environment, Strategic Management Journal, 35(12), 1798-1817.

Eesley, C. and Roberts, E.B. (2012) Are you experienced: when does talent vs. experience drive entrepreneurial performance, Strategic Entrepreneurship Journal, 6(3), 207-219.

Eesley, C.E. and Miller, W. (2012) Impact: Stanford University Economic Impact via Innovation & Entrepreneurship.

Eisenhardt, K.M. and Schoonhoven, C.B. (1990) Organizational growth: linking founding teams, strategy, environment, and growth among U.S. semi-conductor ventures, Administrative Science Quarterly, 28, 274-291.

Hsu, D.H., Roberts, E.B. and Eesley, C. (2007) Entrepreneurs from technology-based universities, Research Policy, 36, 768-788.

Roberts, E.B. and C.E. Eesley (2011) Entrepreneurial impact: the role of MIT - an updated report, Foundations and Trends in Entrepreneurship, 7(1-2), 1-149.

Romanelli, E. (1989) Environments and strategies of organization start-up: effects on early survival, Administrative Science Quarterly, 369-387.

Russo, M.V. (2001) Institutions and early population dynamics: independent power production in America, 1978-1992, Administrative Science Quarterly, 46, 57-86.

Saxenian, A. (1994) Lessons from Silicon Valley, Technology Review, 97, 42-42.

Scott, W.R. (2008) Approaching adulthood: the maturing of institutional theory, Theory and Society, 37(5), 427-442.

Sine, W.D., Haveman, H.A. and Tolbert, P.S. (2005) Risky business? entrepreneurship in the new independent-power sector, Administrative Science Quarterly, 50(2), 200-232.

Stinchcombe, A. (1965) Social structure and organizations, in March, J. (ed.) Handbook of Organizations, Chicago: Rand McNally, 142-193.

Thornton, P.H. (1999) The sociology of entrepreneurship, Annual Review of Sociology, 19-46.

Appendix

Table 13 shows means and t-tests of means for differences between respondents and non-respondents for the MIT 2001 and 2003 Founder surveys. Overall the means are very similar, yet due to the large sample size, some of the differences are statistically significant. In only a few instances do the differences between the sub-samples vary by three percentage points or more in absolute value (and for which the difference is statistically significant). For the 2001 MIT survey, only the variables male, European citizen and Middle Eastern citizen meet these criteria. To foreshadow our statistical results, the regressions reveal only the first and third of these variables as statistically significant after controlling for the remaining factors (Hsu, Roberts, and Eesley, 2007). We therefore further confine our discussion of possible bias to those variables. For both male and Middle Eastern citizen, a smaller fraction of individuals relative to the underlying population responded to the survey. Our estimates imply that belonging to each of these groups increases the hazard of becoming an entrepreneur, and so we are likely being conservative in our estimation (assuming a proportionate likelihood of entering entrepreneurship). For the 2003 survey, only two variables have statistically significant differences between responders and non-responders, engineering major (more likely to respond) and management major (less likely to respond).

Table 14 shows similar means and t-statistics for the Tsinghua survey for all respondents. It shows t-tests of the null hypothesis that the average (observed) characteristics of the responders and non-responders are roughly the same statistically. Only the variables GPA rank, age, entrepreneur, privatized, and high salary show statistically significant differences in means at below the 1% level. It appears that non-respondents were more likely to be entrepreneurs, were slightly older, had higher salaries, were less likely to have been academics, were slightly more likely to have held a greater number of job positions and to have a higher GPA, and were more likely to come from wealthier families. Years of education is significant, but the means are very similar. Older founders appear to have been equally likely as younger founders to respond. The 10th, 25th, 50th, 75th, and 90th percentiles of graduation years were also checked and are similar; offering some reassurance that there were not large differences over time in the response rates. Since there is evidence of some non-response bias, for regression analysis, weights were created using logistic regression and calculated as one over the predicted probabilities of responding.

Table 15 specifically examines the Tsinghua founders, since the first part of the survey asked whether the individual had founded a firm. Only about half

of these individuals completed the founder's section of the survey, so I test for response bias among founders as well. On an absolute basis, the means between the two sub-samples appear to be very well matched by observable characteristics. In only a few cases do the differences between the sub-samples vary by large percentage points or more in absolute value. Only the variables number of jobs, work as a general manager, average tenure, work as an advisor, number of positions, ever job government, and gender show statistically significant differences in means at below the 10% level. For number of jobs, slightly fewer individuals who had held more jobs responded relative to the underlying population who responded to the Tsinghua Founder's survey. Our estimates imply that belonging to this group with more jobs decreases the hazard of becoming an entrepreneur, but has no significant impact on performance, and so it is likely that, compared to our estimation, having more jobs does not decrease the likelihood of becoming an entrepreneur. The lack of differences between these groups gives us further confidence that our results are not driven by respondent bias.

There is no claim that the MIT or Tsinghua datasets are representative samples from the general populations of each country. However, to quantify just how the Tsinghua sample looks compared to a representative sample of the Chinese population, Table 16 compares it to the Chinese Health and Nutrition Survey (CHNS) and the National Bureau of Statistics Household Survey (NBS HH). The Tsinghua alumni primarily live in urban areas once they graduate. The CHNS surveys both rural and urban residents, while the NBS HH is more comparable to the Tsinghua sample in that it surveys primarily urban residents. Overall, the Tsinghua respondents are much more likely to be male (due to the university's historical admissions rates), slightly older (50 vs. 41 or 36), much more highly educated, less likely to have experienced a layoff, and more likely to be a Communist party member. Whereas the CHNS and NBS HH surveys ask about self-employment broadly defined, the Tsinghua survey specifically asks about new firm founding. The entrepreneurship rate for Tsinghua graduates is higher than that in the CHNS survey, but probably not higher once the higher level of education is taken into account (previous studies in the U.S. find that education is a significant predictor of entrepreneurship). Also, when one looks at the percentage of individuals who are founders (or self-employed for the NBS) in a particular year (1999 in this case), we find that the rate is actually much lower for Tsinghua alumni. This is may be due to the narrower definition of entrepreneurship in our survey or the higher opportunity costs (better wage employment opportunities) for Tsinghua alumni. In comparison to a representative sample of rural and urban households from the China Health and Nutrition Survey (Popkin et al., 1993; http://www.cpc.unc.edu/projects/china) the Tsinghua sampled alumnus/a is 8.7 years older on average, much more

likely to be male, more highly educated, and slightly more likely to have founded a firm. The differences in age and education most likely contribute to the differences in entrepreneurship rates. The data were also benchmarked against a representative sample from the National Bureau of Statistics (NBS 1999). The MIT data can be compared to the Current Population Survey (asking about self-employment) or the National Longitudinal Surveys. However, comparing national samples of entrepreneurship is challenging, as data sampling strategies vary depending on the subject matter of study (compare, for example studies of self-employment [e.g. Blau, 1987] and manufacturing [e.g. Dunne et al., 1988]). With these caveats in mind, we note that the percentage of individuals engaging in new firm creation is generally significantly higher in our sample relative to the four to five percent often cited nationally (Dennis, 1997; Reynolds, 1994).

Table 13 MIT

Variable	2001 Survey (N=43,668)	Not 2001 Survey (N=62,260)	t-stat for Means
Male	0.83	0.86	10.11
Engineering Major	0.48	0.47	-4.49
Management Major	0.16	0.15	-5.75
Science Major	0.23	0.23	0.37
Social Sciences Major	0.05	0.06	4.07
Architecture Major	0.06	0.08	11.82
Non-US Citizen	0.81	0.82	3.77
North American (Non-US) Citizen	0.13	0.11	-4.14
Latin American Citizen	0.13	0.12	-1.44
Asian Citizen	0.33	0.34	1.45
European Citizen	0.30	0.26	-5.08
Middle Eastern Citizen	0.05	0.08	6.32
African Citizen	0.03	0.05	6.25
Variable	2003 Survey (N=2,111)	Not 2003 Survey (N=6,131)	t-stat for Means
Male	0.92	0.92	0.12
Engineering Major	0.52	0.47	-3.63
Management Major	0.17	0.21	4.17
Science Major	0.17	0.18	1.09
Social Sciences Major	0.06	0.05	1.18
Architecture Major	0.09	0.09	1.06
Non-US Citizen	0.82	0.81	-1.36
North American (Non-US) Citizen	0.17	0.14	-1.34

Latin American Citizen	0.19	0.19	0.13
Asian Citizen	0.22	0.24	0.73
European Citizen	0.31	0.32	0.38
Middle Eastern Citizen	0.08	0.07	-0.59
African Citizen	0.04	0.04	0.17

Note: Bolded numbers indicate statistical significance at the 1% level.

Table 14 Tsinghua

Variable	Before Aug. 2007 (N=2,667)	After Aug. 2007 (N=299)	*t*-stat for Means
Age	49.3	54.1	-4.216**
Age (Founders Only)	38.4	37.4	0.602
Bachelor's Graduation Yr	1980.9	1977.4	3.777**
Bach. Grad yr (Founders Only)	1991.6	1993.2	0.941
Years of Education	17.2	17.0	2.381**
Entrepreneur Parents	0.09	0.12	-0.713
Entrepreneur	0.29	0.40	-2.168**
Privatized	0.10	0.05	1.392
First Start-Up Founded	2000.3	2001.1	-0.661
Tech Only	0.28	0.29	0.757
Business Only	0.10	0.09	0.235
Gender	0.88	0.90	0.901
Family Economic Status	3.75	3.85	-1.871*
High Salary	3.21	2.93	3.351**
Avg. Tenure	6.94	8.01	-2.045*
Overseas Work Exp.	0.26	0.26	-0.126
Number of Positions	2.39	2.26	-2.012*
High Government	0.03	0.03	-0.239
Low Government	0.18	0.17	0.617
Last Job Academia	0.19	0.19	-0.051
Ever Job Academia	0.32	0.27	2.323**
Last Job Business	0.62	0.61	0.348
Student Leader	0.61	0.57	0.874
GPA Rank	2.28	2.58	-2.661**
Bach. Grad Yr. 10th Percentile	1954	1953	--
Bach. Grad Yr. 25th Percentile	1965	1961	--
Bach. Grad Yr. 50th Percentile	1986	1979	--
Bach. Grad Yr. 75th Percentile	1996	1993	--
Bach. Grad Yr. 90th Percentile	2001	2001	--

Note: **, and * indicate significance at the 1% and 5%, respectively.

Table 15 Comparison of key demographic characteristics by survey

Variable	Not Founders Survey (N=334) Mean	Founders Survey (N=378) Mean	*t*-stat for Means
Age	45.8	39.8	6.536***
Entrepreneur Parents	0.130	0.117	0.331
Gender	0.914	0.948	-1.807**
Masters	0.500	0.569	-1.830**
Doctorate Degree	0.139	0.095	1.786**
Tech Only	0.241	0.185	1.784**
Business Only	0.139	0.169	-1.089
Family Economic Status	3.692	3.581	1.370
High Salary	3.495	4.035	-4.647***
Avg. Tenure	5.673	3.976	3.553***
Overseas Work Exp.	0.179	0.183	-0.121
Number of Positions	2.932	3.198	-2.594
High Government	0.056	0.041	0.903
Low Government	0.194	0.158	1.256
Last Job Academia	0.140	0.055	3.553***
Ever Job Academia	0.512	0.569	-1.505
Last Job Business	0.724	0.869	-4.448***
Student Leader	0.494	0.534	-1.055
GPA Rank	2.150	2.500	-3.449***
Left Last Job Involuntarily	0.028	0.040	-0.544
Ever Left Job Involuntarily	0.104	0.103	0.018

Table 16 Comparison of surveys

Categories	Tsinghua	CHNS	NBS HH Survey	NBS HH Survey
Sample	Urban	Rural and Urban	Urban: Self-Employed	Urban: Non- Entrep.
Male	0.89	0.53	0.56	0.50
Age	50.13	41.45	36.2	37.2
Married	0.88	0.98	83.4	84.2
Years of Education	17.1	9.1	9.2	9.4
Household Size	3.40	3.9	--	--
Self-Employed	0.26 (0.8% in 1999)	0.14	(4% in 1999)	--
Experienced a Layoff	0.13	--	0.26	0.19
Father's Educ.	4.11	--	5.4	5.2
Mother's Educ.	4.89	--	6.0	5.9
Parent Self-Empl.	0.08	--	0.06	0.05
Comm. Party	0.62	--	0.05	0.18