

Education and Tech Entrepreneurship

The popular image of American tech entrepreneurs is that they come from elite universities: some graduate and start companies in their garages; others drop out of college to start their business careers. The dot-com boom reinforced the image of technology CEOs being young and brash. But, even though Bill Gates and Steve Jobs founded two of the world's most successful companies, they are not representative of technology and engineering company founders. Indeed, a larger proportion of founders are middle-aged, well-educated in business or technical disciplines, with degrees from a wide assortment of schools. Twice as many U.S.-born tech entrepreneurs start ventures in their fifties as do those in their early twenties, as this paper will show.

Our earlier research on technology and engineering entrepreneurship revealed that skilled immigrants were a driving force in recent U.S. economic growth. From 1995 through 2005, skilled immigrant founders established 25.6 percent of all the start-ups nationwide, and 52.3 percent of those in Silicon Valley. This group tended to be highly educated in science-, technology-, and engineering-related disci-

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plines. The majority came to the United States to study and decided to stay. These immigrant founders typically established a company thirteen years after coming to the United States and tended to gravitate to technology centers across the country.¹

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What about U.S.-born tech entrepreneurs? Were they young college dropouts or well-educated? Were they graduates of elite schools or a diverse set of schools like the immigrant company founders? Where did they locate their companies?

To answer these questions, we surveyed 652 U.S.-born chief executive officers and heads of product development in 502 engineering and technology companies established from 1995 through 2005.

Our Findings:

- We observed that, like immigrant founders, U.S.-born engineering and technology company founders tend to be well-educated. There are, however, significant differences in the types of degrees these entrepreneurs obtain and the time they take to start a company after they graduate. They also tend to be more mobile and are much older than is commonly believed.
- The average and median age of U.S.-born founders was 39 when they started their companies. Twice as many were older than 50 as were younger than 25.
- The vast majority (92 percent) of U.S.-born founders held bachelor's degrees. Additionally, 31 percent held master's degrees and 10 percent had completed PhDs. Nearly half of these degrees were in science-, technology-, engineering-, and mathematics- (STEM) related disciplines. One-third were in business, accounting, and finance.
- U.S.-born founders holding MBA degrees established companies more quickly (in 13 years) than others. Those with PhDs typically waited 21 years to become tech entrepreneurs, and other master's degree holders took less time to start companies than did those with bachelor's degrees (14.7 years and 16.7 years, respectively).
- U.S.-born founders holding computer science and information technology degrees founded companies sooner after graduating than engineering degree holders did (14.3 years versus 17.6 years). Applied science majors took the longest (20) to create their start-ups.
- These founders graduate from a wide assortment of schools. The 628 U.S.-born founders we interviewed received their terminal (highest) degrees from 287 universities. But degrees from top-ranked universities are over-represented in the ranks of U.S.-born founders. Ivy-League universities awarded 8 percent of the terminal degrees to U.S.-born founders in our sample.
- The top ten universities from which U.S.-born founders received their highest degrees in our sample are Harvard, Stanford, University of Pennsylvania, MIT, University of Texas, University of California-Berkeley, University of Missouri, Pennsylvania State University, University of Southern California, and University of Virginia.
- U.S.-born founders with Ivy League degrees tend to establish start-ups that produce higher revenue and employ more workers than the average. Start-ups

founded by those with only a high school education significantly underperform all others.

- Nearly half (45 percent) of the start-ups were established in the same state where U.S.-born founders received their education. Of the U.S.-born founders in our sample receiving degrees from California, 69 percent later created a start-up in the same state; Michigan, 58 percent; Texas, 53 percent; and Ohio, 52 percent. In contrast, Maryland retained only 15 percent; Indiana, 18 percent; and New York, 21 percent.

METHODOLOGY

In this study, we investigate the educational attainment of US-born start-up founders. The primary data source for this work is a subset of an existing dataset of corporate records included in Dun & Bradstreet's (D&B) Million Dollar Database. These listings contain U.S. companies with sales in excess of \$1 million, twenty or more employees and company branches with fifty or more employees. To construct our dataset, we extracted records of all engineering and technology companies founded from 1995 to 2005 (representing the most current decade of data at the time of this initial search). This produced a listing of 28,766 companies. A portion of these (less than 10 percent), which represented shell companies with zero U.S. employees or older companies with recent changes in control / corporate restructurings, were omitted from our dataset. The remaining companies were randomly contacted by our research team via phone or e-mail. During our interview requests we sought to speak directly with a company founder(s) or a direct representative to determine if the founder or founders were U.S.-born. For this work we defined "founders" as individuals holding the position of corporate executive officer (CEO) or corporate technology officer (CTO) at the time of start-up incorporation.

Through these interviews, D&B data, and supplemental information from company websites we gathered the following information for each of the U.S.-born founders in our dataset.

- U.S.-born founder(s)' name
- Terminal (highest) academic degree: level, field, school, state, graduating year
- First academic degree: level, field, school, state, graduating year (if applicable)
- Second academic degree: level, field, school, state, graduating year (if applicable)
- Age of U.S.-born founder when company incorporated
- Company address, city, state, zip code
- Company primary U.S. Government Standard Industrial Classification (SIC) code

We interviewed 652 U.S.-born founders of 502 engineering and technology companies. Our response rate was approximately 40 percent of those we attempted to contact.

DEFINITIONS

Engineering and Technology Start-ups

For the purposes of our study, the phrase “engineering and technology” indicates that the company’s main work focuses on design, manufacturing, or services. Our definition of engineering and technology firms includes the following industry groups, identified by three- and four-digit U.S. Government Standard Industrial Classification (SIC) codes:

- Semiconductors
- Computers
- Communications
- Biosciences
- Defense/Aerospace
- Environmental
- Software
- Innovation/Manufacturing-Related Services

Appendix A contains a full listing of the SIC codes associated with each industry. This list was adopted from an SIC code listing originally employed by a study authored by Dr. AnnaLee Saxenian that explored the roles of immigrant start-up founders in Silicon Valley.³

U.S.-Born Founders

In most engineering or technology companies, the most critical start-up roles are those of the president/chief executive officer and the head of development/chief technology officer. An individual can simultaneously perform both roles. This work focuses on the entrepreneurial contributions of these U.S.-born individuals. Other roles, such as finance and marketing, also can be very important in start-ups, but the focus of our research is these key founders.

EDUCATIONAL ATTAINMENT OF U.S.-BORN FOUNDERS

Terminal (Highest) Degree Completed

Technology and engineering company founders tend to be highly educated. The vast majority (92 percent) of U.S.-born founders hold at least a bachelor’s degree; 47 percent hold more advanced degrees (master’s, PhD, MD, or JD). Figure 1 details the breakdown of the terminal (highest) degrees they completed.

Fields of Education

U.S.-born company founders tend to have diverse educational backgrounds. The largest group (47 percent) of our sample held terminal degrees in science-, technology-, engineering-, and mathematics- (STEM) related fields. Thirty-four percent held degrees in business, finance, and accounting. Figure 2 provides details.

If all degrees held by these U.S.-born founders are considered (first, second, terminal), the percentage holding at least one degree in a STEM field increases to

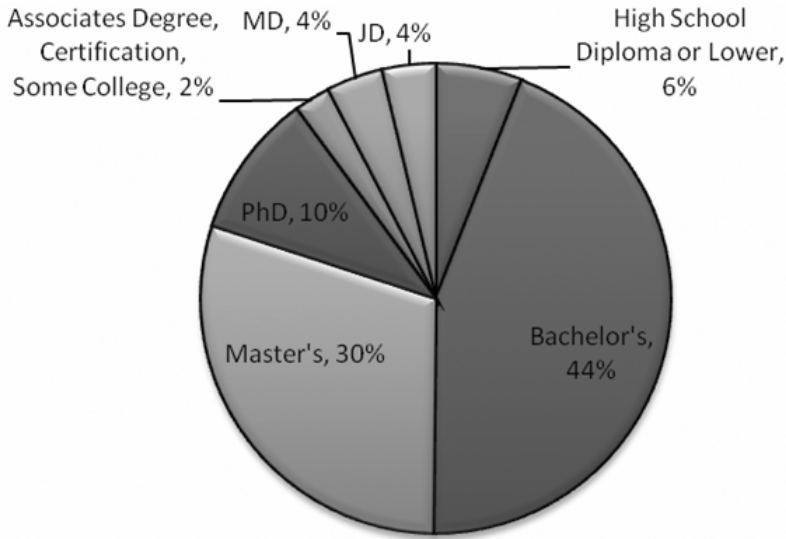


Figure 1. Terminal Degree Completed by U.S.-Born Founders.

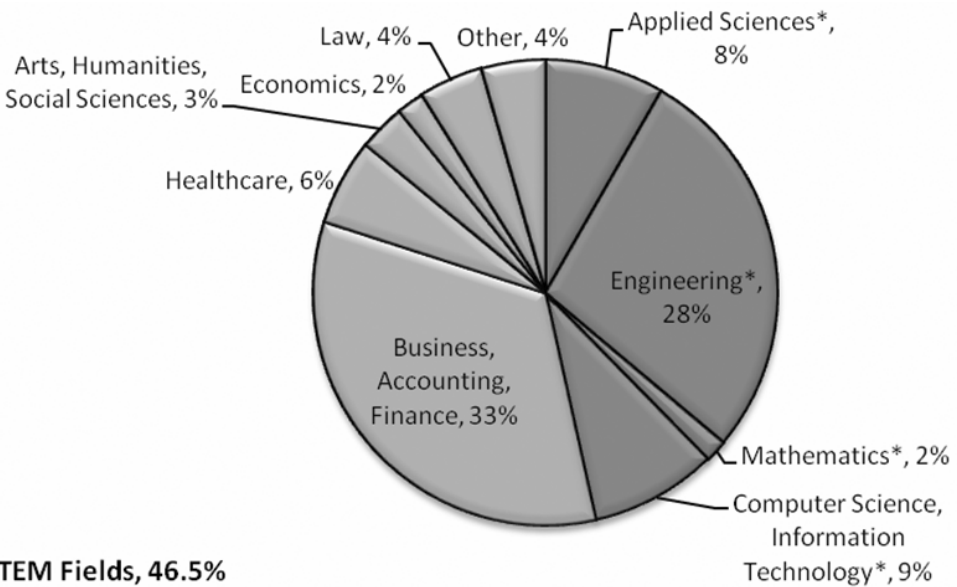


Figure 2. Fields of Terminal Degrees Completed by U.S.-Born Founders.

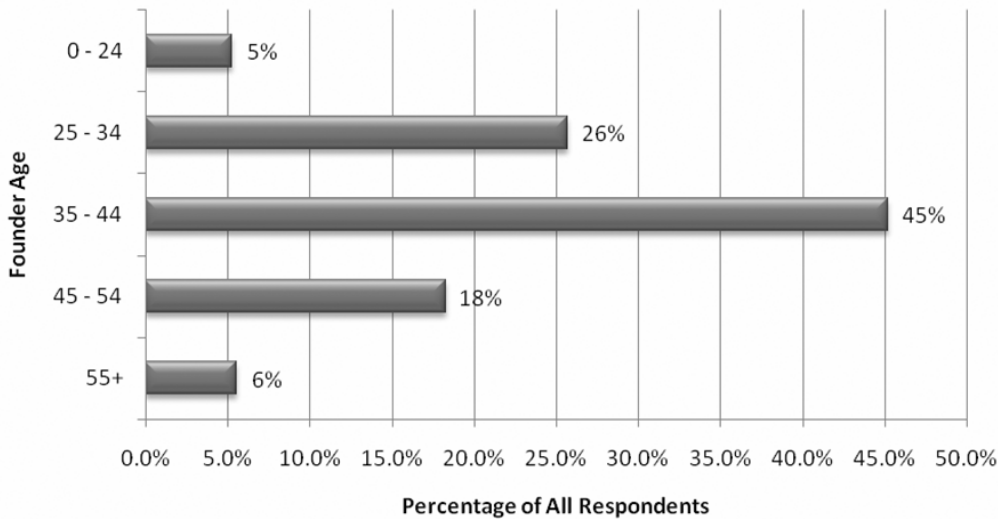


Figure 3. U.S.-Born Founders' Age at Time of Company Founding.

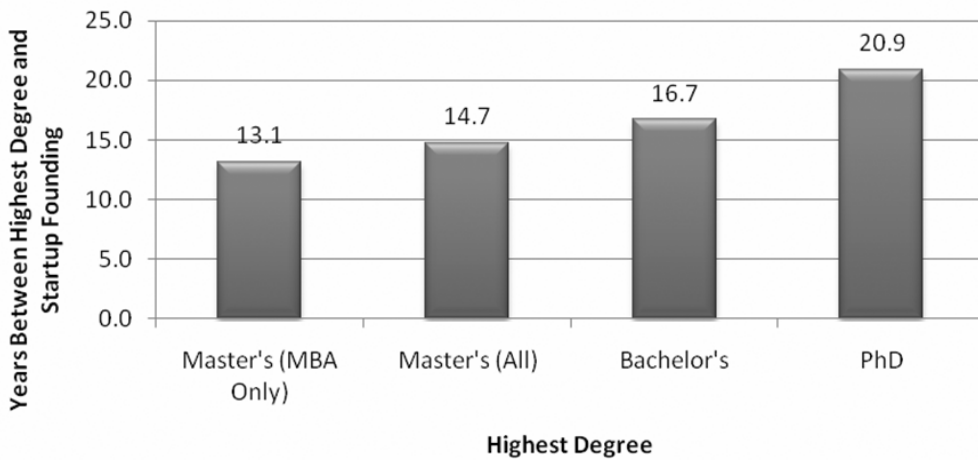


Figure 4. Time Lag Between Completion of Terminal Degree and Company Founding.

55 percent. For instance, a U.S.-born founder may complete a terminal MBA after first obtaining a bachelor's degree in engineering.

AGE AND ENTREPRENEURSHIP

A common belief is that U.S.-born founders of technology companies tend to be young. We found that only 1.2 percent were teenagers when they started their firms. More than twice as many were older than age 50 than were younger than 25. Many, in fact, were in their sixties when they founded their start-ups.

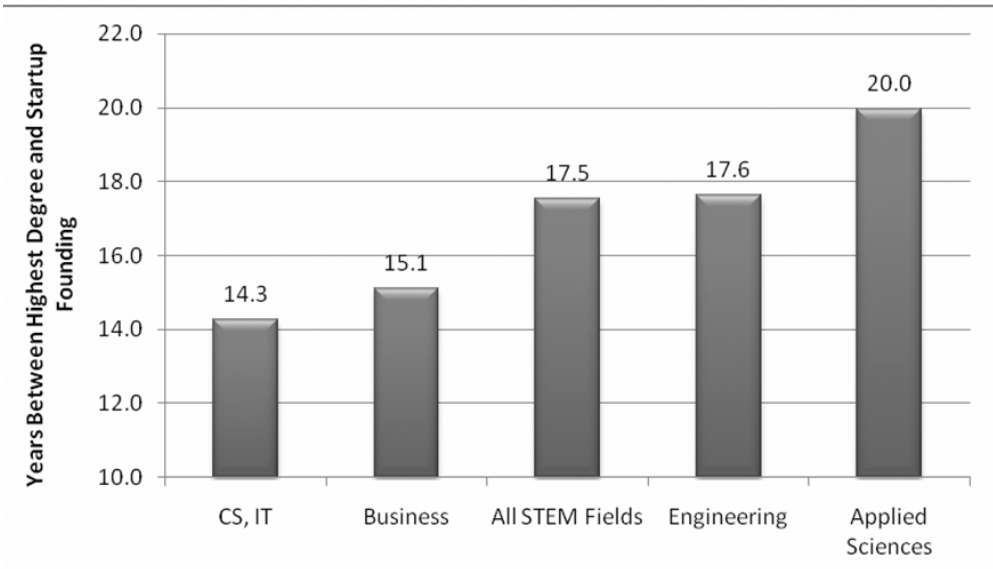


Figure 5. Time Lag Between Completion of Terminal Degree and Company Founding by Field of Study.

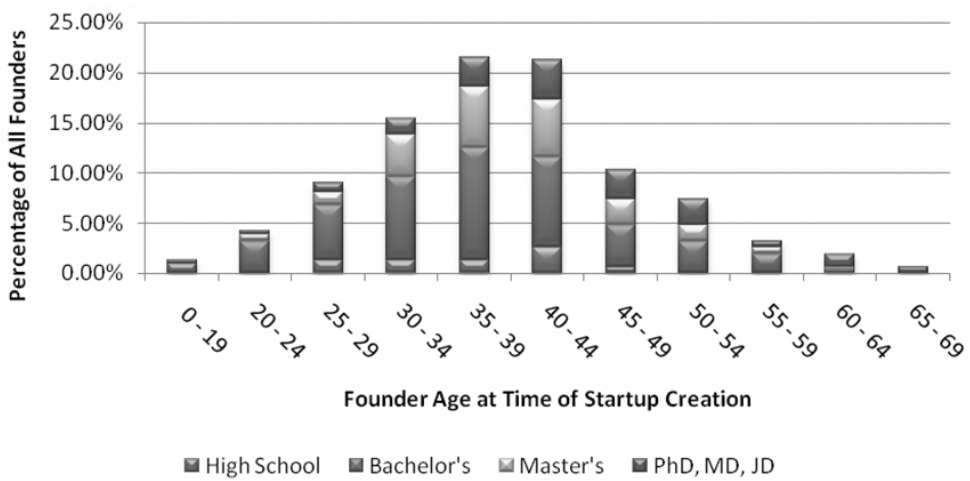


Figure 6. U.S. Founder Age at the Time of Start-up Establishment and Terminal Degree. Degrees listed left-to-right in legend (High School; Bachelor's; Master's; Phd, MD, JD) are represented bottom-to-top in bar chart.

The vast majority of U.S.-born founders were older than 25. The average and median age of key founders was 39. A breakdown of U.S. start-up founders' ages at the time of company founding is shown in Figure 3.

We found a positive correlation between U.S.-born founders' terminal degree level (ie PhD, master's, bachelor's) and the period of time between graduation and start-up formation. By collecting data on the specific year a founder graduated from his or her terminal degree program and the date he or she formed the start-

up, we were able to calculate the length of time between these events. On average, this was 16.4 years.

However, this length of time was noticeably shorter for individuals with specific degree types. MBA holders tended to found companies fastest, with an average lag time of 13.1 years. Together, all master's degree holders (14.7 years) founded companies faster than bachelor's degree holders (16.7 years); both founded companies faster than individuals who hold PhDs (20.9 years). These data are shown in Figure 4.

Additionally, we analyzed the field of the terminal degree completed by U.S.-born founders and the time to establishment of a start-up. This intermediate period between start-up creation and degree completion was shortest for computer science and information technology graduates (14.3-year average) and longest for applied sciences graduates (20-year average). A breakdown is found in Figure 5 (previous page).

When subdivided by a founder's age at the time of start-up formation, our sample approaches a normal distribution. The majority of U.S.-born founders holding bachelor's, master's, PhD, MD, and JD degrees fall within the 30 to 50 year-old age bracket. It is interesting that the left tail of the distribution is dominated by high school degrees, while PhD, MD, and JD degrees constitute the majority of degrees held on the right tail. This information is presented in Figure 6 (previous page).

UNIVERSITIES AND ENTREPRENEURSHIP

We found that U.S.-born founders of engineering and technology companies tend to graduate from a wide assortment of universities. While elite, highly ranked schools hold no monopoly on tech entrepreneurship, some elite schools are over-represented in the ranks of these founders, and companies formed by these schools' graduates outperform those established by others.

Top Ten Universities Graduating U.S.-Born Key Founders

The 628 U.S.-born founders in our sample received their terminal degrees from 287 colleges and universities. Almost every major U.S. university was represented on this list. The top ten institutions in this group accounted for only 19 percent of the entire sample, as shown in Table 1.

Ivy-League Universities and Entrepreneurship

U.S.-born founders whose terminal degree was awarded from an Ivy League school (Brown, Columbia, Cornell, Dartmouth, Harvard, Princeton, University of Pennsylvania, and Yale) accounted for eight percent of our sample. This group was led by Harvard University, which awarded terminal degrees to just over three percent of our U.S.-born founder sample. Harvard was followed by the University of Pennsylvania with just over a two percent contribution.

Top 10 Schools	Percentage
Harvard University	3.2%
Stanford University	2.2%
University of Pennsylvania	2.2%
Massachusetts Institute of Technology	1.9%
University of Texas	1.9%
University of California-Berkeley	1.6%
University of Missouri	1.6%
Pennsylvania State University	1.6%
University of Southern California	1.4%
University of Virginia	1.3%
High School	5.1%
Other Schools	76.0%
Total	100.0%

Table 1. Schools/Universities Awarding U.S.-Born Founders' Terminal Degrees.

University	Percentage of U.S.-Born Founders Receiving a Degree from This School	Percentage of All 2005 Graduates
Harvard University	3.2%	0.32%
University of Pennsylvania	2.2%	0.29%
Columbia University	0.8%	0.34%
Cornell University	0.8%	0.26%
Brown University	0.3%	0.10%
Yale University	0.3%	0.15%
Dartmouth College	0.2%	0.07%
Princeton University	0.2%	0.09%
Non-Ivy Schools	92.0%	98.38%
Total	100.0%	100.00%

Table 2. Over-Representation by U.S.-born Founders with Terminal Degrees Awarded from Ivy League Universities.^{4, 5}

By contrast, in 2005, these Ivy-league schools graduated approximately thirty-three thousand bachelor's, master's, and PhD degrees, or 1.6 percent of all U.S. degrees awarded at these levels (see Table 2, previous page). As such, our results show a disproportionately high concentration of U.S.-born founders with terminal Ivy League degrees engaging in entrepreneurial start-up activities. While the Ivy-League schools graduated a larger proportion of U.S. students 20 to 30 years ago, they did not come close to the proportions of terminal degrees represented among U.S.-born founders in our sample. We also note that the founders from our sample who graduated from Harvard University and the University of Pennsylvania held a disproportionately high number of MBAs—55 percent and 43 percent, respectively.

U.S.-BORN FOUNDER EDUCATION AND START-UP SUCCESS

We found a correlation between a U.S.-born founder's terminal degree and their company's performance. Figure 7 displays the average 2005 sales and total employment of the start-ups in our sample. In 2005, the average sales revenue of all start-ups in our sample was around \$5.7 million, and these companies employed an average of 42 workers. Start-ups established by founders with terminal Ivy League degrees had higher average sales and employment—\$6.7 million and 55 workers, respectively. The success of these two groups markedly contrasted with start-ups established by founders with high school terminal degrees, which had less than half the average revenues and number of employees—\$2.2 million and 18 workers.

UNIVERSITY/LOCATION OF START-UP

We also observed a correlation between the state in which U.S.-born founders received one or more of their academic degrees (terminal, first or second) and the state in which they eventually established a start-up. Nearly 45 percent of the founders in our sample established start-ups in the same state in which they were awarded one or more of their degrees. Our U.S.-born founder dataset included individuals who received degrees from academic institutions located in 47 of the 50 U.S. states. Figure 8 displays a breakout of retention rates in states where at least 20 founders both received degrees and established start-ups.

SUMMARY OF FINDINGS AND CONCLUSIONS

Our survey shows that education provides an advantage in tech entrepreneurship and that most U.S.-born founders of technology and engineering companies are middle-aged with 16 years of work experience before they launch a start-up. The 20-year old wunderkind is the exception, not the rule.

The education that a founder receives is important in tech entrepreneurship. But while elite, Ivy league schools are over-represented in the ranks of U.S.-born tech entrepreneurs and achieve greater business success than others, 92 percent of the U.S.-born founders come from other schools. The biggest difference in busi-

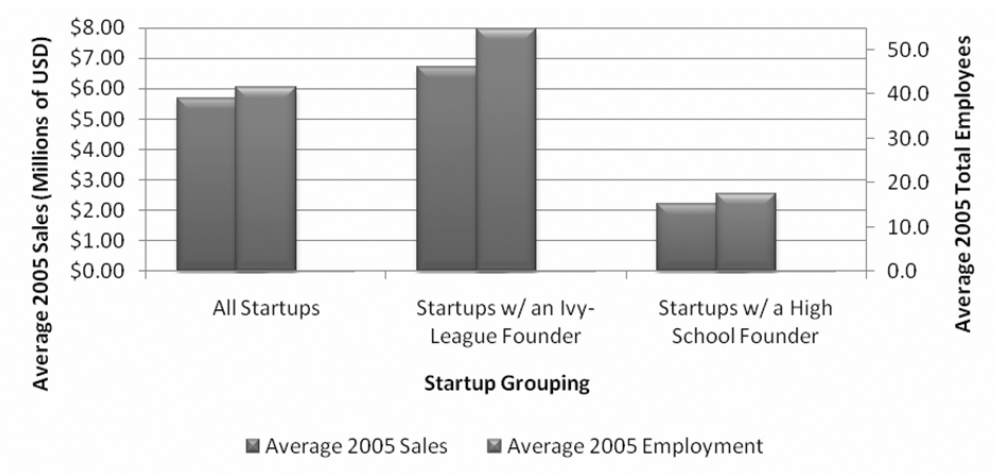


Figure 7. Average 2005 Sales and Employee Count Comparison.

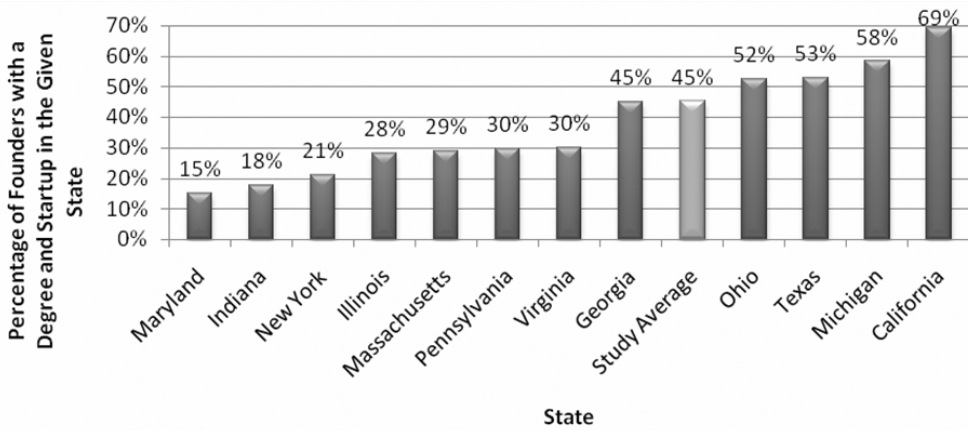


Figure 8. Percentage of U.S. Founders Who Establish a Start-up in the Same State in Which They Received a Degree.

ness success is between founders with terminal bachelor’s degrees and those with terminal high school diplomas.

Some states are more successful than others in retaining their university graduates. California tops this list, but there also are large differences between Michigan, Texas, and Ohio, which rank above average, and Maryland, Indiana, and New York, which are at the bottom.

This research raises policy questions on how regions of the country and the country itself can foster greater tech entrepreneurship to boost economic growth. While we do not know how some of the founders would have fared had they not obtained higher degrees, the predominance of degree holders suggests that advanced education has become critical, at least in the sectors covered in our sample. The majority of higher education and graduate degrees in our respondent

body fell within founders of 35 to 44 years of age. That a large number of firm U.S.-born founders have many years of experience in business also is important in understanding the supply of tech entrepreneurs.

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Endnotes

1. Wadhwa, V., A. Saxenian, B. Rissing, and G. Gereffi. *America's New Immigrant Entrepreneurs: Part I*. The Ewing Marion Kaufman Foundation. January 2007. Available online at http://www.soc.duke.edu/globalengineering/papers_newimmigrant.html.
2. Wadhwa, V., B. Rissing, A. Saxenian, and G. Gereffi. *Education, Entrepreneurship and Immigration: America's New Immigrant Entrepreneurs, Part II*. The Ewing Marion Kaufman Foundation, June 2007. Available online at http://www.soc.duke.edu/globalengineering/papers_educationentrepreneurship.html.
3. Saxenian, A. *Silicon Valley's New Immigrant Entrepreneurs*. Public Policy Institute of California. 1999. Available online at http://www.ppic.org/content/pubs/report/R_699ASR.pdf.
4. Institute for Education Sciences–National Center for Education Statistics (2006). Table 257. Bachelor's, master's, and doctoral degrees conferred by degree-granting institutions by field of study and year: Selected years, 1970–71 through 2004–05. *2006 Digest of Education Statistics*. Available online at http://nces.ed.gov/programs/digest/d06/tables/dt06_257.asp.
5. National 2005 bachelor's, master's, and PhD degree production data was obtained from the Institute for Education Sciences–National Center for Education Statistics. Individual schools' 2005 graduation statistics were obtained from 2005 commencement announcements.

APPENDIX A: ENGINEERING AND TECHNOLOGY SIC CODES

U.S. Government-Defined Standard Industrial Classification (SIC) Codes

Industry	SIC
Semiconductors	
Special industry machinery	3,559
Semiconductors and related devices	3,674
Instruments for measuring and testing electricity and electrical signals	3,825
Computers/Communications	
Electronic computers	3,571
Computer storage devices	3,572
Computer peripheral equipment, n.e.c.	3,577
Printed circuit boards	3,672
Electronic components, n.e.c.	3,679
Magnetic and optical recording media	3,695
Telephone and telegraph apparatus	3,661
Radio and television broadcasting and communications equipment	3,663
Communications equipment, n.e.c.	3,669
Bioscience	
Drugs	283

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Surgical medical and dental instruments, and supplies	384
Medical laboratories	8,071
Laboratory apparatus and analytical, optical, measuring, and controlling instruments	382 (except 3,822, 3,825 and 3,826)
Defense/Aerospace	
Small arms ammunition	348
Electron tubes	3,671
Aircraft and parts	372
Guided missiles and space vehicles	376
Tanks and tank components	3,795
Search, detection, navigation, guidance, aeronautical, and nautical systems instruments and equipment	381
Environmental	
Industrial and commercial fans and blowers, and air purification equipment	3,564
Service industry machinery, n.e.c.	3,589
Sanitary services	495
Scrap and waste materials	5,093
Software	
Computer programming services	7,371
Prepackaged software	7,372
Computer-integrated systems design	7,373
Computer processing, and data preparation and processing services	7,374
Information retrieval services	7,375
Innovation/Manufacturing-Related Services	
Computers, and computer peripheral equipment and software (wholesale trade)	5,045
Electronics parts and equipment, n.e.c. (wholesale trade)	5,065
Computer facilities management services	7,376
Computer rental and leasing	7,377
Computer maintenance and repair	7,378
Computer-related services, n.e.c.	7,379
Engineering services	8,711
Research and testing services	873