

Imported Entrepreneurs: Foreign-Born Scientists and Engineers in U.S. STEM Fields Entrepreneurship

by

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Contents

Executive Summary	1
Introduction.....	5
Evidence from Prior Literature	6
Visa Options for Foreign Entrepreneurs in the United States	9
F-1 Academic Student Visas	11
H-1B Specialty Occupation	13
E-2 Treaty Investor	16
L-1A, L-1B Intracompany Transferees	16
EB-5 Immigrant Investor.....	18
EB-1, EB-2, O-1: Extraordinary Ability and Achievement	18
Data.....	20
Scientists and Engineers Statistical Data System	20
Defining STEM Entrepreneurship.....	21
Citizenship and Immigration Variables	24
Country-of-Origin Characteristics: GEM & UNESCO.....	27
Descriptive Statistics.....	29
STEM Employment of U.S. versus Foreign-Born College Graduates	29
Higher Education and STEM Entrepreneurship	31
STEM Entrepreneurship by Country-of-Origin.....	33
Econometric Models and Results.....	35
Predictors of Business Ownership	35
Predictors of STEM Fields Entrepreneurship.....	40
Characteristics of Adult Immigrant Entrepreneurs.....	44
Results from Alternative Estimation Strategies and Measures of Entrepreneurship.....	47
Are Foreign-Born STEM Workers Underemployed?.....	48
Conclusions and Policy Implications.....	52
References.....	57

Figures

Figure 1. Trends in F-1 Student Visas and H-1B Temporary Worker Visas.....	14
Figure 2. Entrepreneurship Participation by Citizenship and Immigration Status	23
Figure 3. Bachelor’s Degree Fields and Educational Attainment of U.S. STEM Entrepreneurs	32
Figure 4. Foreign-Born Workers’ Rates of Participation in STEM Entrepreneurship, by Country-of-Origin	34
Figure 5. Effects of Aging on Startup Ventures, by Citizenship and Immigration Status.....	38
Figure 6. Probability of STEM Entrepreneurship by Differences in Country-of-Origin Cultural Support.....	46

Tables

Table 1. Selected U.S. Temporary Resident Visas with Potential for Use by Foreign- Born Entrepreneurs	10
Table 2. Selected U.S. Permanent Resident Visas with Potential for Use by Foreign- Born Entrepreneurs	17
Table 3. Summary of Citizenship and Immigrant Status Variables.....	26
Table 4. Descriptive Statistics.....	30
Table 5. Marginal Effects of Demographics, Education, Immigrant Status, and Country-of-Origin Characteristics on Probability of U.S. Business Ownership	37
Table 6. Effects of Immigrant Status, Demographics, Education, and Country-of- Origin Characteristics on Probability of U.S. STEM Entrepreneurship	41
Table 7. Marginal Effects of Selected Demographic, Educational, and Country-of- Origin Characteristics on Probability of U.S. STEM Entrepreneurship, Adult Immigrants	43

Executive Summary

The STEM fields—science, technology, engineering and mathematics—are the source of tangible innovations in products and processes that help to spur economic growth. Though many of these advances may occur in established organizations, radical innovation has long been associated with entrepreneurial ventures. Several previous studies have shown that high-growth, high-tech STEM-based businesses in the United States are disproportionately founded by foreign-born scientists and engineers. However, recent data also suggest that immigrants’ rate of participation in U.S. entrepreneurship is slowing. Policies that support nascent immigrant STEM entrepreneurs may also help to improve U.S. employment rates, economic productivity, and career satisfaction among new Americans and legal permanent residents.

This report investigates several explanations for differences in STEM entrepreneurship between college-educated native-born and foreign-born workers. It also explores reasons for differences in entrepreneurial participation *among* foreign-born workers. These reasons may include:

- Immigration status and visa eligibility,
- Age of arrival in the U.S. (as a child versus as an adult),
- Graduating from a U.S. or foreign institution of higher learning, and
- Differences in cultural support for entrepreneurship across countries-of-origin.

We also describe differences in aspects of job satisfaction by citizenship and immigration status, providing insight into the preferences and work experiences of high-skilled foreign-born workers in the U.S. labor force.

Although we cannot identify with certainty the causes of recent observed declines in U.S. entrepreneurial participation among the foreign-born, our empirical results do suggest opportunities for policy and further research to help spur greater participation in the future.

Data

Analyses contained in this report primarily draw on recent nationally representative surveys of U.S.-resident workers holding bachelor's degrees and higher, combined in the National Science Foundation's 2010 Scientists and Engineers Statistical Data System (SESTAT) restricted-use data file. These data include information on the following:

- Foreign-born workers' current immigration status (i.e., naturalized U.S. citizen, legal permanent resident, or temporary resident),
- The U.S. state or foreign country where they graduated from high school,
- Where and in what field(s) they earned their first bachelor's and any subsequent higher education degrees, and
- Country of citizenship for foreign nationals.

Additional key variables include:

- Employment sector (e.g., academia, government, industry, non-profit organization, business owner, unincorporated self-employment, etc.),
- Employer size, and
- Demographic variables such as age, marital status, and gender.

However, one important limitation of these SESTAT data is that we cannot observe foreign temporary residents' specific visa type.

Key Findings & Policy Implications

- **U.S.–Foreign STEM Entrepreneurship Gap.** As in previous studies, we find a substantial percentage of the gap in rates of business ownership and STEM entrepreneurship among college-educated native U.S. and foreign-born workers can be attributed to differences in higher education attainment, particularly the undergraduate major they choose. Differences in the distribution of U.S. and foreign-born workers by age, experience, gender, and marital status explain most of the remaining gap, except among immigrants who earned their highest degree in the United States. For this group, the rate of STEM entrepreneurship is almost 4 percentage points higher than for otherwise-similar native U.S. citizens.

- **College-educated immigrants who earned their highest degree from a U.S. institution are more likely than native U.S. citizens and other foreign-born workers to engage in STEM entrepreneurship.** Intriguingly, whether these U.S.-trained adult immigrants earned graduate degrees in STEM versus non-STEM fields had no impact on their probability of STEM business ownership. Retaining more of these students in the United States post-graduation would tend to boost STEM entrepreneurship rates. Based on this report's empirical results, one way of achieving this goal would be to expand pathways for foreign temporary resident students who earn advanced degrees in the U.S. to extend their stay after graduation, contingent on an offer of employment related to their U.S.-earned degree, regardless of employer sector. Successful examples of programs of this kind are described in the Policy and Conclusions section of the report.
- **STEM entrepreneurship rates among those who earned their highest degree abroad were significantly *lower* than one would otherwise expect.** This result is troubling because immigrants in this group who were employed by established organizations were also more likely to express dissatisfaction with their job's level of responsibility and intellectual challenge, indicative of skills-related underemployment. For some immigrants, occupational dissatisfaction and mismatch may spur a transition into entrepreneurship, which we find is associated with significantly greater satisfaction for adult immigrants, partly due to more appropriate use of their knowledge, skills, and abilities. For others, remaining in the U.S. may become increasingly unattractive, even after attaining legal permanent residence here. As long as so many highly skilled immigrants remain underemployed and underutilized, the U.S. will fall short of its potential for economic production and growth. Entrepreneurial venturing, training, and mentoring programs offered by higher education institutions might be particularly useful to help foreign-educated workers advance into STEM employment better suited to their skill level or into STEM entrepreneurship.

- **Foreign-born, foreign-educated workers (who earned STEM graduate degrees outside the U.S.) are more likely to work for startups than established organizations.** About half of firms that apply for H-1B visas on behalf of foreign temporary workers are small businesses with 30 or fewer employees (Doran, Gelber, and Isen 2015). Employment experience within a small firm can help individuals with entrepreneurial propensities to develop their entrepreneurial human capital, which in turn may promote better outcomes for their own future ventures (Elfenbein, Hamilton, and Zenger 2010). Programs that increase availability of highly skilled foreign graduates to new STEM ventures thus may be particularly helpful in spurring growth in U.S. innovative entrepreneurship, even if the foreign-born workers thus engaged are not themselves founders, owners, or investors.
- **Business ownership rates among foreign temporary resident workers from countries that are not eligible for E-2 Treaty Investor visas are lower than one would otherwise expect, based on those individuals' other characteristics.** Relatively few options currently exist for foreign temporary workers to own and manage businesses in the United States. The most accessible, flexible option is the E-2 Treaty investor visa, which links U.S. residency to investment, management, and operation of a U.S. business. However, citizens of many countries—notably including India and China—are not eligible for E-2 visas; the absence of an equally accessible visa alternative for these foreign temporary resident workers appears to be stifling their participation as business owners in the U.S. economy. Nonetheless, despite the positive effect of E-2 Treaty country citizenship on foreign temporary residents' probability of business ownership, among STEM business owners we observe one outlier: over one-third (37%) of foreign temporary resident STEM business owners are from India. Overall, foreign-born founders of high-growth STEM ventures in the U.S. are significantly more likely to be of Indian origin, even after controlling for their other demographic and educational characteristics. More research is needed to understand which of the currently available visa mechanisms are most frequently utilized by foreign STEM entrepreneurs.

Introduction

Foreign-born scientists and engineers have contributed a great deal to U.S. economic growth, innovation, and prosperity. If upward mobility and equal opportunity for socioeconomic advancement are considered American values, then surely opportunity-driven immigrant entrepreneurs must endorse these values all the more strongly.¹

In 2013, immigrants were almost twice as likely as native U.S. citizens to start businesses (Fairlee 2014). The Kauffman Index of Entrepreneurial Activity indicates immigrants' rate of entrepreneurial participation has been consistently higher than among U.S.-born since 1996, and this gap appears to have grown dramatically during the Great Recession. More than 1 in 4 (25.9%) new entrepreneurs in 2013 were immigrants, versus less than 1 in 5 (19.1%) a decade earlier (Fairlee 2014). Nationwide, about 1 in 4 engineering and technology-based companies are immigrant-founded, employing an estimated 560,000 workers and producing \$63 billion in revenues (Wadwha, Saxenian, and Siciliano 2012). Although Fairlie (2008) found no significant differences in immigrants' and non-immigrants' distributions of entrepreneurship across industries—despite immigrants' typically higher levels of startup capital—several previous studies indicate that foreign-born workers are more likely than native U.S. citizens to start high-growth, high-tech companies. One recent nationally representative study estimated that 16% of rapidly growing high-impact, high-tech companies in the U.S. had at least one foreign-born founding member, and furthermore, companies that included immigrant entrepreneurs on their founding team performed better in some respects than similar companies with only U.S.-born founders (Hart and Ács 2011). Two other studies similarly estimated that 1 in 4 high-tech startups with more than \$1 million in sales were founded by immigrants, and 1 in 3 founders of venture-backed companies that went public between 2006 and 2012 were immigrants (Anderson 2013; Wadwha, Saxenian, Freeman, and Gereffi 2007).

Despite these substantial contributions of foreign-born workers to U.S. economic growth, recent evidence suggests their participation in founding high-tech businesses may be slowing. In Silicon Valley, the share of businesses founded by foreign-born workers decreased from 52.4% to 43.9% from 2005 to 2012 (Wadwha, Saxenian, and Siciliano 2012).

These recent findings raise two tightly related questions. First, why do immigrants tend to have a higher rate of entrepreneurial participation than native U.S. citizens? Second, why do some groups of foreign-born workers seem to have higher propensity than others towards high-growth, high-impact, science-based entrepreneurship? Answers to these questions may help to inform immigration policy to better promote innovative entrepreneurship and economic growth.

¹ In this report, the terms “foreign-born” and “immigrant” refer to different groups of U.S. residents. “Foreign-born” includes all U.S. residents who are not native U.S. citizens. “Immigrant” refers to the subset of foreign-born U.S. residents who have attained either naturalized U.S. citizenship or legal permanent residence, and thus it excludes non-immigrant foreign temporary residents on student, work, or dependent visas.

Evidence from Prior Literature

Part of the answer to both of the questions posed above seems to reside in differences across groups in their typical educational preparation. In particular, much of the observed discrepancy between native U.S. citizens and immigrants in wages, innovative activity, and entrepreneurship can be explained by differences in their chosen fields of study (Hunt 2011; Hunt and Gauthier-Loiselle 2010). And yet, even after controlling for field of degree and highest level of education completed, Hunt (2011) found that college-educated immigrants who come to the U.S. for work or study are significantly more likely than native-born U.S. citizens to file for patents and start new companies, and she concluded there exists “a niche for immigrants in founding firms using specialized academic knowledge.”

Another common explanation for higher entrepreneurial participation among the foreign-born asserts higher inherent quality or ability among those who come to the U.S., particularly with regard to science, technology, engineering and mathematics (“STEM”) fields. Early work by Stephan and Levin (2001) documented immigrants’ exceptional contributions as “superstars” in STEM fields, finding that immigrant scientists are disproportionately among the most highly cited authors, and are also more often elected to the National Academy of Sciences. While Kerr (2013) observes that immigrants’ disproportionate presence in the high end of the distribution for scientific productivity does not necessarily imply higher *average* quality or innovativeness, increasing the share of immigrants has been shown to increase U.S. patenting and economic productivity (Hunt and Gauthier-Loiselle 2010; Peri, Shih, and Sparber 2015; Kerr and Lincoln 2010). Foreign-born faculty members also tend to produce more peer-reviewed publications than their native U.S. citizen colleagues, though this may be due to their typically spending a greater share of work time on research than on teaching or service (Webber 2012; No and Walsh 2010). No and Walsh’s (2010) survey also showed slightly higher subsequent citations for patents with foreign-born lead inventors, after controlling for field, organization type, and so on.

The importance of workers’ higher education attainment and STEM training in potentially spurring innovation and entrepreneurship can be further nuanced by asking, does it make a difference whether a foreign-born worker pursued higher education degrees in the U.S. or abroad? The increasing penetration of foreign students in U.S. graduate programs suggests potential for a growing role for U.S.-trained immigrants in the innovative, entrepreneurial workforce. Patents with U.S.-educated foreign-born lead inventors are significantly more likely to be commercialized (No and Walsh 2010). Just over half of Indian, Chinese and Taiwanese founders of U.S. engineering and technology firms initially came to the U.S. to pursue higher education, and earned their highest degree from a U.S. institution (Wadwha, Rissing, Saxenian, and Gereffi 2007). Evidence also suggests the increasing share of foreign students in U.S. graduate programs has itself increased U.S. innovation and productivity. Chellaraj et al. (2008) found that increasing the share of foreign graduate students significantly increased U.S. patent applications and awards, both for academic and non-academic institutions. If foreign students who pursue graduate degrees at U.S. universities are also more likely subsequently to engage in

high-growth and innovative entrepreneurial ventures, that could provide support for immigration policy reforms expanding opportunities for foreign students who graduate from U.S. universities to stay in the U.S. and work after graduation. On the other hand, evidence from prior theoretical and empirical studies suggests that employers' lack of information about the quality of foreign higher education institutions (and labor market discrimination, more broadly) may result in employment mismatch, spurring high-ability immigrants trained abroad into self-employment (Åstebro, Chen, and Thompson 2011; Hegde and Tumlinson 2015).

Despite these previous findings, visa programs for foreign students and foreign temporary workers remain controversial. For example, some studies have found that an increasing share of foreign undergraduates decreases enrollment of native U.S. women STEM majors and crowds out non-Hispanic native white males in graduate programs (Orrenius and Zavodny 2015; Borjas 2007; Hoxby 1998). In theory, highly educated immigrants could also reduce wages and employment among similarly educated native U.S. workers (Stephan and Levin 2007; Freeman 2006; Borjas 2007). However, empirical evidence demonstrates that most of the growing demand for U.S. STEM workers over the past two decades has been met by immigrants and foreign temporary workers, with little to no effect on employment of similarly educated native U.S. workers (Kerr and Lincoln 2010; Peri and Sparber 2011; Peri, Shih, and Sparber 2015). Moreover, at least for lower-skilled immigrants, an increase in their labor supply has no effect on existing firms' total employment or wages, but rather increases the number of new establishments in the region (Olney 2013). If the same effect applies for highly educated foreign-born workers, we would expect to observe two related results: more new startups and higher rates of foreign-born workers joining new startup ventures.

The increasing attractiveness of other countries for foreign-born scientists and engineers combined with immigrants' slowing rate of entrepreneurial participation have raised concerns about the United States' ability to attract and retain innovative and entrepreneurial STEM workers. Recent studies indicate that foreign students from India and China increasingly are finding attractive job opportunities in their home countries, and visa considerations rarely contributed to returnees' decisions to go home (Wadwha, Saxenian, Freeman, and Gereffi 2007). Although many foreign-born STEM entrepreneurs indicate that the scientific infrastructure in their field was an important factor in their decision to come to the U.S., those who train in the U.S. then move to another high-income country with high scientific output can be equally productive in terms of scientific publications as if they had stayed in the U.S. (Kahn and MacGarvie 2014).

Though some of the decision to immigrate to the U.S. may be motivated by differences across countries in macroeconomic conditions and financial returns to higher education, we posit that differences across countries in sociocultural, economic, and regulatory support for entrepreneurship may be particularly important among foreign-born workers with entrepreneurial propensities.

For example, all else equal, citizens of foreign countries ineligible for E-2 Treaty Investor visas may be less likely to consider immigrating to the U.S. to pursue entrepreneurial ventures, because the visa mechanisms available to them impose substantially greater restrictions.² If we find that citizens of E-2 Treaty Investor countries are more likely to engage in entrepreneurship, this may suggest potential for an alternative but similarly flexible visa to encourage entrepreneurial foreign citizens from non-E-2 countries to come to the U.S. and start businesses.

In addition, from a sociocultural perspective, citizens of countries that offer as much (or more) moral and tangible support to highly educated entrepreneurs as compared to that found in the U.S. may have relatively little incentive to immigrate to the U.S. for the purpose of pursuing entrepreneurial ventures. Understanding such motivations among current foreign-born entrepreneurs may help us both to predict future trends in U.S. entrepreneurship and to identify characteristics and competitive practices of countries most attractive to innovative entrepreneurs.

This report examines several potential contributors to STEM entrepreneurship among U.S. resident workers with college degrees (bachelor's and higher). It compares probability of owning a business or joining a startup as an employee among foreign- and native-born U.S. workers with otherwise similar educational attainment and demographic characteristics. We employ data from recent nationally representative surveys of U.S. residents with bachelor's and higher degrees to test the importance of various correlates of entrepreneurial participation, including:

- Age of immigrants' arrival in the United States (as children or adults);
- Country granting immigrants' highest degree (U.S. university versus abroad);
- Foreign temporary resident workers' citizenship with an E-2 Treaty country;
- Educational attainment, including bachelor's field of degree, highest degree attained, and whether highest degree was also in a STEM field;
- Postgraduate years of experience;
- Country-of-origin support for entrepreneurship; and
- Demographic characteristics (age, gender, marital status).

The report is structured as follows. First, we review several visa options available for prospective foreign-born workers, the associated ease of engaging in entrepreneurship across these various mechanisms, as well as policy considerations studied in the academic literature. In the second section, we introduce the survey datasets used in our analyses, and compare rates of STEM employment and higher education attainment for native U.S. and foreign-born workers. Next, we present results from multivariate logistic regression models predicting entrepreneurial outcomes

² The E-2 nonimmigrant classification allows a national of a treaty country (a country with which the United States maintains a treaty of commerce and navigation) to be admitted to the United States when investing a substantial amount of capital in a U.S. business. Certain employees of such a person or of a qualifying organization may also be eligible for this classification. U.S. Citizenship and Immigration Service website, www.uscis.gov/working-united-states/temporary-workers/e-2-treaty-investors, accessed January 29, 2016.

as a function of individual and country-of-origin characteristics. Then, we examine measures of job satisfaction among foreign-born STEM workers in the U.S., to identify whether disproportionate dissatisfaction with job opportunities—for example, underemployment vis-à-vis their skills—may be contributing to foreign-born workers’ disenchantment. The final section concludes with a summary of our results and implications for policy alternatives.

Visa Options for Foreign Entrepreneurs in the United States

Many factors may influence an individual’s decision to emigrate, including greater relative or absolute returns to higher education, initial financial wealth, language and cultural ties, geographic distance and cost of migration (Belot and Hatton 2012; Brücker and Defoort 2009; Borjas 1987; Clark, Hatton, and Williamson 2007). These incentives and constraints are further shaped by the immigration policies of prospective destination countries. This section reviews the principal visas available to enable foreign nationals’ participation in entrepreneurship in the United States.³ Table 1 summarizes the temporary resident visa mechanisms, and Table 2 covers those that confer permanent residence. Each visa category has numerous restrictions, advantages, and disadvantages. In addition, the legal and regulatory environment surrounding their use is complex and changing. As of February 2016, the U.S. Department of Homeland Security has released proposed rules and guidance documents that may update some of the visa categories discussed in this report; these proposals are referenced in footnotes.

³ For a comprehensive discussion, see the U.S. Citizenship and Immigration Service’s “Entrepreneur Visa Guide,” available at: www.uscis.gov/eir/visa-guide/entrepreneur-visa-guide, last accessed July 24, 2015.

Table 1. Selected U.S. Temporary Resident Visas with Potential for Use by Foreign-Born Entrepreneurs

Visa	Eligibility Requirements	Options for Entrepreneurs	Maximum Time Limit
F-1* Academic Student	<ul style="list-style-type: none"> • Acceptance by a certified U.S. educational institution • Full-time enrollment in approved course of study • Proof of ability to pay for tuition and living expenses • Declared intent to depart upon completion of program 	Students who qualify for Optional Practical Training (OPT) employment authorization can work full-time in a business directly related to their program of study for up to 12 months following its completion. STEM graduates can apply for an additional 17-month extension.	Following graduation, OPT program participants in STEM fields may remain for 29 months total; 12 months for all others.
H-1B* Specialty Occupation	<ul style="list-style-type: none"> • Bachelor's or higher degree from U.S. or foreign institution • Working in an occupation that normally requires at least a bachelor's degree in business or a STEM field • Job is directly related to their field of degree • Employer petition 	An exception to the employer petition exists; entrepreneurs who provide evidence of an incorporated venture with a separate board of directors that has ability to fire, supervise, or otherwise control their employment may be eligible. Businesses are subject to annual cap on total H-1B visas issued.	Six years; initial visa is issued for three-year period, but is renewable.
E-2* Treaty Investor	<ul style="list-style-type: none"> • Substantial and irrevocable investment in a business majority-owned by citizens of the applicant's country • Home country is on the State Department E-2 Treaty Country list. 	Executive leadership team members and essential employees with highly specialized skills are eligible, provided the applicant can invest sufficient funds. Visa requires beneficiary to operate, manage, or be employed by the organization.	Indefinite; initial visa is issued for two years, but is renewable as long as business continues to operate and creates jobs for U.S. workers or other positive local impacts.
L-1A* Intra- company Transferee	<ul style="list-style-type: none"> • Foreign company executives or managers, entering the U.S. to establish a U.S. office • Foreign company must have existed for at least one year, must continue to exist and do business abroad, and must share common ownership and control with the new U.S. business 	Entrepreneur must have worked abroad for at least one continuous year within the past three years, and in a qualifying position with the foreign entity. Visa requires beneficiary to manage and be employed by the organization.	Seven years total; initial visa is issued for one year, but can be renewed in two-year increments if office is active and operating, with physical premises, hired employees, and sufficient revenues or investment to support the L-1 visa holder(s).

*DHS released a proposed rule revising the F-1 visa program in October 2015, and a proposed rule updating the EB-1, EB-2, EB-3 and H-1B programs in December 2015. As of February 2016, these rules had not been finalized.

Source: "Entrepreneur Visa Guide," U.S. Citizenship and Immigration Service. Available at: www.uscis.gov/eir/visa-guide/entrepreneur-visa-guide, last accessed July 24, 2015.

F-1 Academic Student Visas

The U.S. attracts more foreign students than any other country, though several countries including the United Kingdom, France, Australia, Germany, and Canada have a greater share of foreign students enrolled in their higher education programs (Suter and Jandl 2008). Foreign citizens wishing to pursue higher education degrees in the United States generally will obtain an F-1 Academic Student non-immigrant visa, which allows them to enroll full-time in eligible U.S. degree- and certificate-granting programs. From 2008 to 2012, over 30% of foreign undergraduate and graduate students on F-1 visas were studying business, management, or marketing. By contrast, approximately 60% of foreign PhD students and 37% of foreign students, overall, were pursuing STEM degrees (Ruiz 2014).

F-1 visa holders are permitted to work on campus or in school-approved off-campus positions through the Curricular Practical Training (CPT) program, provided their employment is directly related to their degree program and field of study. After completing their degree, students on F-1 visas are generally eligible to apply for Optional Practical Training (OPT), which permits them to remain in the U.S. for 12 months of full-time work for each postsecondary degree, plus an additional 17 months if their degree was in a STEM field.

Starting a business is generally permitted while on F-1 OPT, provided that the majority of work performed is directly related to their major field of degree.⁴ However, it appears to be rarely used for this purpose. Data from the 2010 National Survey of College Graduates indicate that less than 4% of college-educated foreign temporary resident STEM business owners currently hold a student or trainee visa.⁵

The number of foreign students enrolling in U.S. universities through the F-1 visa program has increased markedly over the past few decades. Prospective foreign students may be attracted to the U.S. by the increased odds of achieving permanent residence following their U.S.-earned degree. Borjas (2002) estimated the probability of ultimately becoming a permanent resident was 26 times higher for those who earned degrees in the U.S., versus through the random “green card” lottery. Relatedly, Kato and Sparber (2013) conversely found that

⁴ U.S. Citizenship and Immigration Services, “Understanding F-1 OPT Requirements,” at <http://www.uscis.gov/eir/visa-guide/f-1-opt-optional-practical-training/understanding-f-1-opt-requirements>, last accessed 6 February 2015. See also U.S. Department of Homeland Security, “Working in the United States,” at <http://studyinthestates.dhs.gov/working-in-the-united-states>, and “International Students and Entrepreneurship,” at <http://studyinthestates.dhs.gov/international-students-and-entrepreneurship>, both last accessed July 24, 2015.

⁵ Well over 90% of foreign temporary resident STEM business owners in our sample report their current visa is “for temporary work,” for which the examples provided to the respondent on the survey instrument include H-1B, L-1A, and L-1B. Among other (non-STEM) college-educated foreign temporary resident business owners, about 1 in 5 indicated “other” visa type, meaning their visa was not “for temporary work” (H-1B, L-1, etc.), nor “for study or training” (F-1, J-1, H-3), nor as a dependent on someone else’s visa. Cognitive interviews with college-educated foreign temporary resident workers may help to clarify how respondents categorize E-2 Treaty Investor visas (“for temporary work” versus “other”), and time spent working with an OPT extension to the F-1 visas (“for study or training” versus “for temporary work” or “other”).

restricting availability of H-1B temporary worker visas reduces the number of high-quality, foreign prospective students applying to U.S. undergraduate programs.

Despite the apparent benefits to U.S. innovation and economic productivity, higher education investments in foreign students remain controversial. Many foreign students who pursue advanced degrees in the U.S. do remain in the U.S. workforce after graduation, and in addition to enhancing universities' research productivity and curricular diversity, those who pay tuition with funding from non-U.S. sources may help to support public goods. But, substantial differences in foreign students' stay rates exist across degree fields and countries of citizenship (Finn 2010). As Winston (1999) discusses, graduate education in particular benefits from public subsidies, and this trend has raised concerns that U.S. taxpayer funds are subsidizing foreign nations' competitiveness (Borjas 2007; Winston 1999; Borjas 2002). Finn (2010) estimates 75% of foreign students who earned PhDs in computer science and electrical engineering in 2002 were still living and working in the U.S. five years later, versus less than half of those who earned PhDs in agricultural sciences.

To some extent, these field-specific differences in foreign students' stay rates reflect differences across sending countries in the U.S. degrees that students from each country tend to pursue. Saxenian (1999) observed that "Chinese and Indian engineers, most of whom arrived in the United States after 1970 to pursue graduate studies, were senior executives at one-quarter of Silicon Valley's new technology businesses," contributing over \$16.8 billion in sales and over 58,000 jobs. Five-year stay rates are highest among Chinese, Indian, and Eastern European students, with over 80% of STEM PhDs from these countries still in the U.S. five years after attaining their doctorates (Finn 2010). Students from these countries are also heavily represented among U.S.-earned PhDs in computer science, electrical engineering, and in the physical sciences, but they comprise a markedly lower share of foreign students earning PhDs in agricultural sciences, economics, and other social sciences.

Hsu et al. (2007) suggest that foreign students who pursue higher education in the U.S. tend to be especially wealthy, relative to most in their home countries. Greater financial wealth enables families to pay upfront migration and transportation costs, but also may have enabled those families to provide superior primary and secondary educational opportunities at home, better preparing candidates for admission to U.S. universities. U.S. immigration policy also requires student visa applicants to demonstrate *a priori* adequate financial resources to support themselves and any dependents for the length of their stay, which may further reinforce this wealth effect. For some foreign students who wish to stay in the U.S. after graduation, non-immigrant E-2 Treaty Investor visas thus might be a feasible solution, particularly for students who were able to afford out-of-pocket the cost of attending elite research universities (Hsu, Roberts, and Eesley 2007). Such selection on wealth would also appear consistent with Fairlee's (2012) finding that immigrant-owned businesses tend to have higher levels of financial capital at startup, compared to businesses founded by U.S. natives, with a greater share of startup funds derived from personal and family sources.

On the other hand, Stuen et al. (2012) find that increases in foreign graduate students who pay their own tuition yield significantly less benefit for academic patenting, as compared to increases in foreign students whose quality earned them fellowships, assistantships, or other types of funding support. Stuen et al. therefore recommend student visa decisions be made on the basis of admission offers from top universities, rather than requiring evidence of substantial financial resources. Others have argued that foreign students completing U.S. degrees in computer science or electrical engineering, and who subsequently obtain H-1B visas to work in IT industry jobs, tend to graduate from lower-ranked programs (Matloff 2013). Further research is needed to understand the extent to which students at these lower-ranked programs are selected on academic quality versus ability to pay, as well as their subsequent contributions to patenting, innovation, and economic growth. Finally, although some complementary descriptive evidence also suggests graduates from top-ranked programs may be less likely to stay in the U.S. after graduation, this may simply reflect differences across sending countries in probability of enrolling in higher-ranked programs, and differences in the probability that graduates from each country will stay (Finn 2010).

Grogger and Hanson (2015) found that, overall, foreign students awarded U.S.-based fellowships, research assistantships, and teaching assistantships are more likely to intend to stay in the U.S. after graduation. Their finding may partly be due to quality effects of the institution attended, as higher-ranked programs more often provide full support for admitted students. Controlling for these differences across institutions, Blume-Kohout and Adhikari (2014) find no significant difference in short-run stay rates or U.S. scientific workforce participation among foreign students whose primary support came from university assistantships versus personal or family funds, controlling for university attended and field of degree. On the other hand, foreign students who rely on other foreign sources of support are overwhelmingly less likely to stay, perhaps due to conditions of the financial assistance they receive (Blume-Kohout and Adhikari 2014; Grogger and Hanson 2015). Together, these results suggest there should be no detrimental effect on foreign students' stay rates if visas are extended to prospective graduate students who are offered admission and funded assistantships from U.S. universities, independent of their other personal or family financial resources.

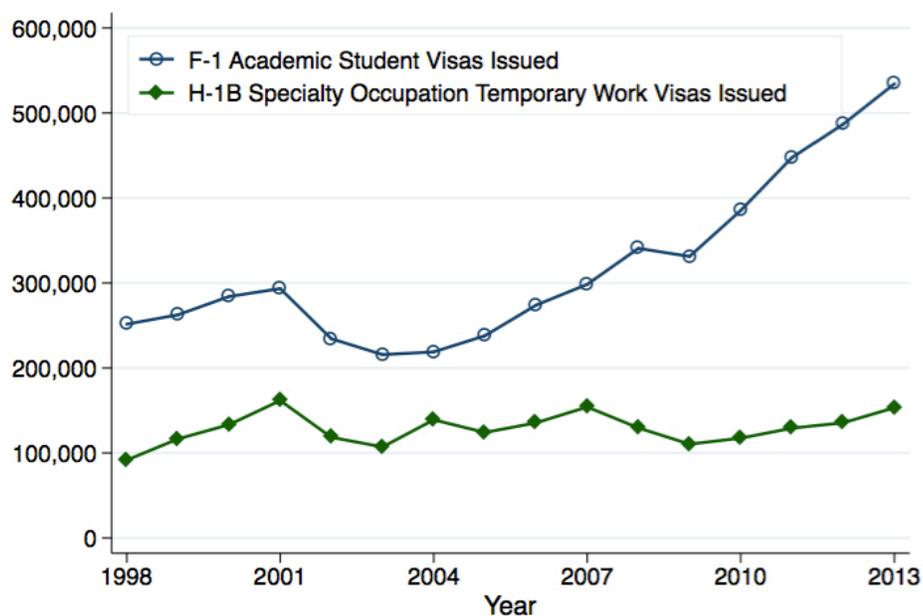
H-1B Specialty Occupation

The H-1B Specialty Occupation visa is available to foreign citizens who hold bachelor's and higher degrees, and who will work in occupations that are both directly related to their field of degree and that would normally require at least a bachelor's degree in business or STEM fields. The H-1B is issued for a three-year period, and is renewable up to six years. As of 2013, over three-quarters (76%) of U.S. adults favored legislation to increase the number of visas available for temporary skilled workers (Dugan 2013).

Figure 1 depicts trends over time in F-1 and H-1B visa issuances. In 2010, approximately one-third of new H-1B temporary worker visas were awarded to foreign individuals transferring

from F-1 student visas, of whom approximately three-quarters held graduate degrees (Ruiz 2014). Including both those trained in the U.S. and those who earned their highest degree abroad, nearly half (47%) of workers on H-1B visas in 2010 were in computing-related occupations, totaling over 90,000 (Wasem 2012). The substantially faster growth in F-1 visas versus H-1Bs in recent years implies that a smaller percentage of foreign students may be remaining in the U.S. after graduation. Our analysis of the recently released 2013 National Survey of College Graduates (NSCG) similarly indicates that two in five college-educated, U.S. resident foreign temporary workers are in computer, information technology, and electrical engineering occupations. This share is the same for those who are organizationally employed as well as for business owners, however, these business owners likely hold visas other than the H-1B.

Figure 1. Trends in F-1 Student Visas and H-1B Temporary Worker Visas, 1998-2013



Source: U.S. Department of State, Nonimmigrant Visa Issuances by Visa Class

The H-1B visa requires petition by a bona fide U.S. employer, and one would not expect entrepreneurial venturing among H-1B visa holders, as it effectively “locks” the foreign worker to the employer who petitioned on his or her behalf. Returns to scale in candidate search and the visa application process may also favor larger firms over startups as employers (Kerr, Kerr, and Lincoln 2015a). Foreign citizens wishing to engage in unincorporated self-employment are unlikely to be eligible, as there would be no separation between the petitioning employer and the beneficiary (USCIS 2010). However, under certain circumstances, the sole or majority owner of an incorporated entrepreneurial venture may be eligible for an H-1B visa. Specifically, “if the petitioner provides evidence that there is a separate Board of Directors which has the ability to

hire, fire, pay, supervise or otherwise control the beneficiary's employment, the petitioner may be able to establish an employer-employee relationship with the beneficiary" (UCSIS 2010).

The number of H-1B visas issued annually is limited, though several exceptions exist. While for-profit employers are subject to an annual cap on H-1B visas, the first 20,000 applications filed on behalf of beneficiaries holding advanced degrees from U.S. universities are exempt from this cap. Similar temporary worker programs which are not subject to the H-1B cap exist for college-educated citizens of Chile and Singapore (H-1B1), Canada and Mexico (TN), and Australia (E-3). Importantly, U.S. colleges and universities, university-affiliated research institutes, and other not-for-profit research organizations are also exempt from the H-1B cap. This has given rise to another pathway for foreign citizens with advanced degrees to participate in entrepreneurship. In 2014, Massachusetts established the Global Entrepreneur in Residence (GEIR) program,⁶ with two University of Massachusetts campuses as pilot sites. The GEIR program allows founders and leaders of startup ventures with advanced degrees in business or STEM fields to hold part-time employment with UMass-Boston or UMass-Lowell, while working to grow their Massachusetts-headquartered new businesses.

The H-1B program is also controversial. Foreign temporary workers overwhelmingly are hired into information technology jobs, and some studies suggest these workers displace trained U.S. graduates in these fields, in part by lowering the prevailing wages for computing-related occupations (Salzman, Kuehn, and Lowell 2013; Bound, Braga, Golden, and Khanna 2015). Recent careful work by Kerr and colleagues demonstrates that, within individual firms, increasing employment of immigrants in STEM occupations may also disproportionately displace older workers (Kerr, Kerr, and Lincoln 2015b).

One drawback of the current H-1B program which may affect its attractiveness to highly skilled workers and its use by foreign nationals launching entrepreneurial ventures is that spouses have not been eligible for derivative open work permits. A recent policy change now allows spouses to apply for work permits, but only after the H-1B holder is "in queue" with an approved petition for legal permanent residence.⁷ This contrasts starkly with Canada's equivalent temporary skilled worker program, in which spouses can obtain open work permits, regardless of their own qualifications.

⁶ Massachusetts Technology Cooperative, "The Global Entrepreneur in Residence Pilot Program," at <http://masstech.org/innovation-institute/projects-and-initiatives/global-entrepreneur-residence-pilot-program>, last accessed February 6, 2015.

⁷ On February 25, 2015, DHS released a final rule extending eligibility for employment authorization to H-4 dependents (spouses and unmarried children under 21 years of age) of certain H-1B non-immigrants. For information see www.uscis.gov/working-united-states/temporary-workers/employment-authorization-certain-h-4-dependent-spouses.

E-2 Treaty Investor

The E-2 Treaty Investor visa is available to citizens of specific countries with which the U.S. maintains treaties of commerce and navigation. It allows them to enter the U.S. for the purpose of starting or establishing a new commercial business, or purchasing and managing an existing commercial business such as a franchise, with majority ownership by citizens of the applicant's treaty country.⁸ In fiscal year 2013, about 42% of E-2 Treaty Investor visas were issued to citizens of Asian countries, of which most (75%) were issued to Japanese investors. Another 38% were issued to Europeans, with German investors most common. Investors from the United Kingdom, Mexico, and Canada comprised 7% to 8% each.

The E-2 visa requires that substantial funds be actively and irrevocably invested by the applicant, towards the production of goods and services to be sold for profit. Because only the organization's executive leadership and essential employees with highly specialized skills are eligible for this visa category, simply having an ownership interest in a business is insufficient. The business must also generate employment or other economic impact above and beyond simply income support for the applicant and his or her immediate family members. Although the E-2 Treaty Investor visa is technically a non-immigrant visa, as long as the business continues to exist, satisfies the ownership requirement noted above, and either creates jobs for U.S. workers or generates other positive local economic impacts, the visa can be extended indefinitely beyond the initial two-year period. Despite its restricting eligibility to citizens of specific countries, the E-2 category is more broadly accessible than most other options for prospective immigrant entrepreneurs; it has no specific educational or work experience requirement, no numeric job-creation target, and substantially lower financial investment compared to the EB-5 visa, described later. In addition, spouses of E-2 Treaty investors are eligible to apply for work permits, and both the investor and his or her dependents up to age 21 can enroll in school without need for a separate visa. However, the list of E-2 Treaty countries notably excludes India and China, whose citizens together represent over half of college-educated business owners on foreign temporary worker visas.

*L-1A, L-1B Intracompany Transferees*⁹

Although L-1 visas are primarily used by U.S. companies wishing to bring a foreign national employed by a foreign subsidiary or office of their own organization, these visas can also be used by foreign companies that have been in existence for at least one year to transfer executives,

⁸ U.S. Department of State, Bureau of Consular Affairs. "Treaty Countries," at <http://travel.state.gov/content/visas/english/fees/treaty.html>, last accessed 11 February 2015.

⁹ On August 17, 2015, the United States Citizenship and Immigration Service released a policy memorandum affecting the issuance of the L-1B visa. This guidance can be found at: www.uscis.gov/sites/default/files/USCIS/Laws/Memoranda/2015/L-1B_Memorandum_8_14_15_draft_for_FINAL_4pmAPPROVED.pdf.

managers, and other key personnel with specialized knowledge to the U.S., for the purpose of establishing a U.S. office. Prior literature has identified individuals in this latter group as “transnational entrepreneurs” (Drori, Honig, and Wright 2009). Approximately 28% of L-1 visas in FY2014 were issued to citizens of India.

The foreign company must demonstrate sufficient financial resources to compensate the L-1 employee(s) and to secure physical premises in the U.S., and it must continue to exist and do business abroad. Though initial stay for new U.S. offices is one year, the visa can be renewed in two-year increments, up to seven years for managers and executives. Unlike the E-2 Treaty Investor visa, L-1 visas are not restricted to a subset of countries. The L-1 visa may also be preferable for married workers, as the spouse of an L-1 worker (on an L-2 visa) can apply for an open work permit without limitations on their employment.

Table 2. Selected U.S. Permanent Resident Visas with Potential for Use by Foreign-Born Entrepreneurs

Visa	Eligibility Requirements	Options for Entrepreneurs	Maximum Time Limit
EB-5* Immigrant Investor	Minimum investment of \$500,000 in a lawful commercial enterprise in designated rural or high unemployment areas, \$1 million otherwise.	Visa does not require investor to have any active managerial or employment role with the business. Rarely used for investments in startup companies or projects in STEM-related industries.	None; Permanent resident visa issued following two-year trial period, conditional on creation of at least 10 full-time jobs for U.S. workers during that period.
EB-1, EB-2* Employment- Based Preference, Exceptional Ability	Foreign nationals with extraordinary ability or achievements in their field International recognition, advanced degrees, and 10 or more years of related work experience among the factors considered	EB-1–eligible individuals can apply on his or her own behalf to start a business related to their field of extraordinary ability or achievement. EB-2 eligible individuals must demonstrate U.S. national interest, e.g., holding licensed technologies or significant patents currently in use.	None; Permanent resident visa. (A temporary visa category also exists, the O-1 nonimmigrant visa, for individuals with extraordinary ability or achievement.)

*In December 2015, the Department of Homeland Security released a proposed rule updating the EB-1, EB-2, EB-3 and H-1B programs; this rule had not been finalized as of February 2016.
Source: “Entrepreneur Visa Guide,” U.S. Citizenship and Immigration Service. Available at: <http://www.uscis.gov/eir/visa-guide/entrepreneur-visa-guide>, last accessed July 24, 2015.

EB-5 Immigrant Investor

In contrast with the E-2 Treaty Investor non-immigrant visa, the EB-5 Immigrant Investor visa conveys permanent residence, i.e., a “green card,” to an investor and his or her immediate family members, conditional on successful creation of at least 10 full-time jobs for U.S. workers within the initial two year period (Table 2). EB-5 investors must invest a minimum of \$500,000 for businesses in designated rural or high-unemployment areas, and at least \$1 million otherwise. Fewer than 10,000 EB-5 visas are awarded annually, approximately 65% of which are issued to investors’ spouses and dependent children. Since 2008, Chinese citizens have claimed the largest share of EB-5 visas, and they received over 85% of the EB-5 visas issued in 2014 (U.S. Department of State 2014).

Back-of-the-envelope calculations using U.S. Department of Homeland Security (DHS) statistics on EB-5 visas issued to investors and U.S. Citizenship and Immigration Service (USCIS) statistics for I-829 petition approvals¹⁰ suggest that the success rate for EB-5 immigrant investor enterprises started between 2009 and 2011 was over 90%, substantially higher than the two-year survival rate for all U.S. businesses (approximately 70%) (BLS 2014). However, this comparison is misleading, due to the role of EB-5 Regional Centers in identifying and promoting large-scale economic development projects (e.g., commercial real estate, hotels, retailers, etc.) for prospective immigrants’ direct investment, pooling capital from multiple investors, and providing model-based estimates of the projects’ employment effects. Unlike the E-2 and H-1B visas which require the beneficiary to operate, manage, or be employed by a specific organization, EB-5 investors do not need to have any active role in the business in which they invest. The advocacy group Invest In the USA (IIUSA) estimates 95% of all EB-5 capital investment is raised through these Regional Centers, but very few of these Centers represent startup companies or projects in STEM-related industries. Thus, although in principle the EB-5 visa could be used by wealthy foreign entrepreneurs to establish innovative businesses in the United States, in practice this seems rarely to occur.

EB-1, EB-2, O-1: Extraordinary Ability and Achievement

The EB-1 immigrant visa and its counterpart, the temporary O-1 visa, are reserved for foreign nationals recognized for extraordinary achievements in their field of science, art, business, education, or athletics. Individuals who intend to start a business in the same field as their established extraordinary ability or achievements may qualify for these, and those wishing to immigrate can petition for an EB-1 visa on their own behalf. In addition, a U.S. organization owned by the beneficiary can petition on his or her behalf for an O-1 visa. In 2013, only 12,359 O-1 visas were issued, over half of them to citizens of Europe.

¹⁰ EB-5 visas provide conditional permanent residence for an initial two-year period. Once the required conditions have been met, EB-5 visa holders can file an I-829 petition to have the conditionality on their visa removed.

The level of international recognition and achievement required for these visas makes them generally inaccessible to recent graduates or workers with fewer years of traditional work experience. These limitations also apply to the EB-2 employment-based permanent resident visa. However, UCSIS recently clarified that the EB-2 visa requirement of a job offer from a U.S. employer could be waived if an entrepreneur can show their venture will have national impact and importance. Some examples of evidence that may support this national interest waiver for potential STEM entrepreneurs include documentation of having licensed a technology currently in use by others, or holding significant patents with documented usefulness to one's field.¹¹ Although not necessarily required, one factor considered in determining exceptional ability is having at least ten years full-time work experience in one's field.¹²

¹¹ U.S. Citizenship and Immigration Services, "National Interest Waiver," at www.uscis.gov/eir/visa-guide/eb-2-employment-based-second-preference/national-interest-waiver, last accessed July 24, 2015.

¹² U.S. Citizenship and Immigration Services, "Understanding the EB-2 Requirements for Exceptional Ability," at www.uscis.gov/eir/visa-guide/eb-2-employment-based-second-preference/understanding-eb-2-requirements-exceptional-ability, last accessed July 24, 2015.

Data

Data analyzed for this report include the National Science Foundation's (NSF) 2010 Scientists and Engineers Statistical Data System (SESTAT) restricted-use file, as well as country-level statistics derived from the Global Entrepreneurship Monitor (GEM) Adult Population Survey (APS), and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

We use these data to explore the relative importance of each of the following possible factors affecting rates of business ownership and STEM entrepreneurship among foreign-born workers in the United States:

- Field of bachelor's degree;
- Highest educational attainment (bachelor's, master's, or research doctorate);
- Whether their highest degree was in a STEM field;
- Whether they hold an MBA or similar degree from a U.S. institution;
- Experience, measured as years since highest degree was awarded;
- Immigration status (naturalized U.S. citizen or legal permanent resident, versus on a foreign temporary resident visa);
- For naturalized U.S. citizens and legal permanent residents ("immigrants"), whether they came to the U.S. as children (i.e., before graduating from high school), or as adults;
- For adult immigrants, whether they came to the U.S. to pursue a higher education degree, and earned their highest or most recent degree here;
- For foreign temporary residents, whether they are from countries eligible for E-2 Treaty Investor visas;
- Demographic characteristics including age, gender, and marital status; and
- Country-of-origin characteristics, including cultural support for entrepreneurship, and share of population with postsecondary education.

Scientists and Engineers Statistical Data System (SESTAT)

The SESTAT variables used in this report are drawn from two component surveys: the National Survey of College Graduates (NSCG) and the Survey of Doctorate Recipients (SDR). Access to the restricted-use SESTAT microdata files was provided under NSF license, through NORC's Virtual Data Enclave.

The NSCG is the core SESTAT dataset, covering the entire population of U.S.-resident college graduates under age 76 who hold bachelor's or higher degrees.¹³ Although in previous years the NSCG sampling frame included only those who either (a) were employed in STEM occupations, or (b) had received a bachelor's or higher degree in a STEM or STEM-related field, the 2010 NSCG sample was expanded to provide a representative sample of the U.S. resident college-educated workforce by including bachelor's-educated respondents in non-STEM fields from the 2009 American Community Survey sample.

The SDR is a longitudinal survey of U.S. residents who earned a research doctorate from a U.S. academic institution in natural sciences, engineering, health-related fields, or social/behavioral sciences. Sampled individuals are followed through their careers from the time their degree is awarded until age 76, with newly earned PhDs added in each survey cycle. This unique panel survey provides opportunities to examine responses to topical module questions of current interest for a large, nationally representative cross-sectional sample, and to follow a slightly smaller sample over time (due to individuals lost to follow-up). In the combined SESTAT file, survey weights are provided to accommodate over-sampling of PhDs due to the inclusion of these SDR respondents, as well as over-sampling of STEM workers overall in the NSCG, allowing nationally representative estimates. All empirical results presented in this report were calculated using Stata statistical software, applying these survey weights.

The NSCG and SDR ask a series of questions in each survey year regarding employment and job changes. The surveys also capture whether individuals are underemployed (working part-time when they would prefer full-time employment), and if they are not currently working, the reason(s) they give, for example inability to find a suitable job in their field. The surveys also capture any additional work-related training the respondents pursued, including whether they recently earned another degree, such as a master's in business administration (MBA). Finally, in 2010 the NSCG and SDR instruments both included an additional module focusing on aspects of individuals' job satisfaction. These additional variables permit us to compare, across citizenship and immigration status groups, the extent to which workers are satisfied with their pay, level of responsibility, degree of independence, and opportunities for advancement.

Defining STEM Entrepreneurship

Entrepreneurship is frequently defined in empirical research to cover both self-employment and business ownership. By this definition, the 2010 SESTAT data indicate that 18.2% of adults in the U.S. labor force who hold bachelor's or higher degrees are entrepreneurs, with relatively

¹³ This survey is conducted by the U.S. Census Bureau for the NSF's National Center for Science and Engineering Statistics (NCSES).

little difference between U.S. native and foreign-born workers.¹⁴ About 18.8% of foreign-born and 18.0% of U.S. natives in the college-educated workforce participated in entrepreneurial activities 2010, and about 3.5% in each group were unincorporated self-employed, with no employees.¹⁵

However, the entrepreneurial gap between native U.S. citizens and foreign-born begins to widen when we consider business owners alone, and also if we account for the substantially higher rate of unemployment among the foreign-born. Among *employed* U.S. residents holding bachelor's or higher degrees, 16.8% of foreign-born workers identified as business owners or incorporated self-employed, versus 15.0% of U.S. natives with similar educational attainment.

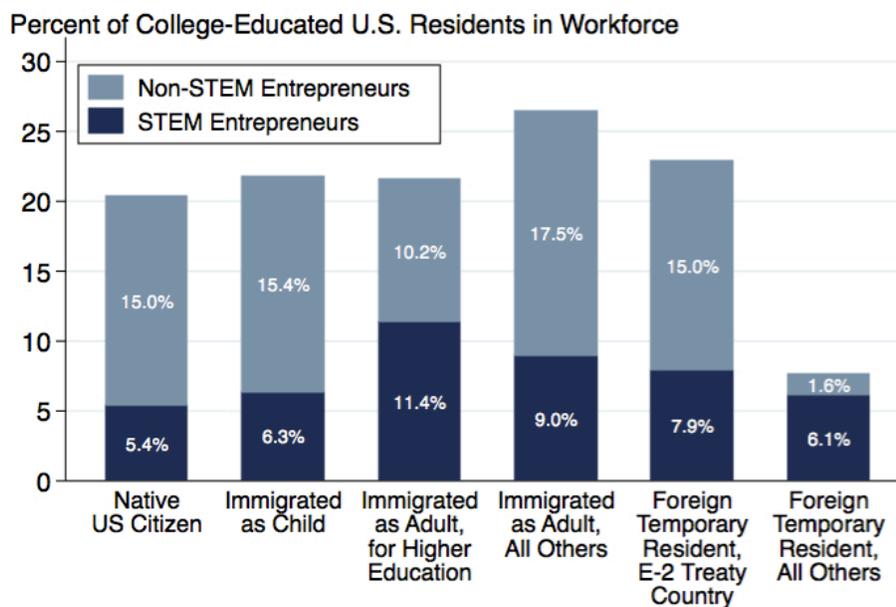
For this study, as in Blume-Kohout (2014), we expand the definition of entrepreneurship further to include employees who join startup ventures (i.e., not just business owners). Conceptually, this follows Lazear's (2005) description of an entrepreneur as "among those who initially established the business." As Roach and Sauermann (2014) point out, nascent entrepreneurial "joiners" tend to share many of the entrepreneurial preferences typically ascribed to founding owners, such as desire for autonomy and tolerance for risk. Operationally, we define these "joiners" to include individuals who began work in 2005 or later with a U.S.-based private sector business or other non-governmental, non-academic organization, which had "come into being as a new business within the past five years," and which as of 2010 had fewer than 100 employees.

Figure 2 depicts percentages of the U.S. college-educated workforce who are self-employed, business owners, or participating as employees of new ventures. As Figure 2 shows, the total rates of entrepreneurial participation are similar for native U.S. citizens and immigrants who came to the U.S. as children and for higher education. Two categories are somewhat more likely than native U.S. citizens to participate in entrepreneurship: adult immigrants whose highest degree was earned outside of the U.S. and foreign-born workers on temporary resident visas from E-2 Treaty countries. By contrast, STEM entrepreneurship is most common among adult immigrants who came to the U.S. for higher education. Not surprisingly, given the restrictions on their work opportunities, foreign-born temporary resident workers from non-E-2 countries are the least likely to engage in entrepreneurship. These citizenship and immigration categories are described in more detail below, and in Table 3.

¹⁴ We define self-employed and business owners based on respondents' reporting their principal job sector as self-employed in a non-incorporated business, professional practice, or farm, or alternatively as self-employed or business owner in an incorporated business, professional practice, or farm.

¹⁵ We define this group as the subset of non-incorporated self-employed individuals who report they have fewer than 10 employees (zero included), but do not directly supervise any workers and have not "recommended or initiated personnel actions such as hiring, firing, evaluating or promoting others."

Figure 2. Entrepreneurship Participation by Citizenship and Immigration Status



Source: Author's calculations, 2010 SESTAT data

STEM entrepreneurs in Figure 2 are those self-employed, U.S. business owners, or new venture joiners who are also identified as working in STEM occupations. We define STEM occupations first by using the U.S. Bureau of Labor Statistics (2012) list, including all life scientists, physical scientists, engineers, and those in mathematics or statistical sciences occupations. To the specified natural sciences and engineering managers which BLS includes, we add other managerial or executive occupations (including, for example, “top-level executive”) if the respondent answered affirmatively to the question: “Did your duties on this job require the technical expertise of a bachelor’s degree or higher in engineering, computer science, math, or the natural sciences?” However, we exclude from STEM occupations any medical clinicians and allied health practitioners, clinical psychologists, and other BLS “health occupations,” unless the respondent indicates that at least 10% of their work activities include basic research, applied research, development or design. For psychologists, we further require an affirmative response on the STEM technical expertise question. A similar approach combining STEM occupations and research-related work activities was recently used by Kahn et al. to identify scientific entrepreneurs in these data (Kahn, La Mattina, and MacGarvie 2015). Excluding traditional providers of clinical health services from our primary outcome variable allows greater focus on individuals most likely to contribute to high-growth innovative entrepreneurship.

Over three-quarters (75.7%) of all STEM entrepreneurs (per our definition) identified themselves as business owners, and about 1 in 8 (12.5%) identified as unincorporated self-

employed, supervising one or more employees. The remaining 11.8% were “joiners”—employees in new startup ventures.

Overall, foreign-born entrepreneurs are significantly more likely than native U.S. citizens to own or join startup businesses requiring STEM fields expertise. About half (51%) of foreign-born entrepreneurs said their work required STEM technical knowledge, versus less than 40% of U.S. native entrepreneurs. However, as Hunt (2011) and others have noted, this distinction between U.S. natives and foreign-born masks dramatic differences in entrepreneurial participation across foreign-born workers, depending on the circumstances of their entry into the United States. Indeed, even U.S. citizens who lived outside the United States in their youth¹⁶ are more likely than those raised in the U.S. to engage in entrepreneurship.

To better focus on entrepreneurs who contribute the most to economic growth and employment (and in contrast with Figure 2, which included all self-employed individuals as entrepreneurs), our econometric analysis in the next section excludes unincorporated self-employed individuals with no employees or direct reports (see footnote 15). Excluding this latter group, we estimate 19.0% of foreign-born and 16.5% of native U.S. citizen workers participated in entrepreneurship, for a total entrepreneurship gap of 2.5 percentage points (STEM and non-STEM).

Citizenship and Immigration Variables

Both the NSCG and the SDR include variables for type of citizenship (native or naturalized U.S. citizen, or foreign citizen), and for foreign citizens, whether they are on permanent or temporary resident visas. However, only the NSCG collects more specific information about foreign temporary residents’ visa type—e.g., worker, student, spouse/dependent, or other—at the time of the survey. Unfortunately, the survey does not ask for the specific type of visa, but rather presents a series of categorical responses with a few provided examples:

(If a Temporary U.S. Resident Visa Holder)

On October 1, 2010, did you hold a visa issued...

1. For temporary work (e.g., H-1B, L-1A, L-1B, etc.)
2. For study or training (e.g., F-1, J-1, H-3, etc.)
3. To you as the dependent of another person (e.g., F-2, H-4, J-2, K-2, L-2, etc.)
4. For any other reason

In addition to asking about current visa type, the NSCG includes a question about the type of visa the respondent had when he or she first came to the U.S. for a period of six months

¹⁶ Here indicated by high school completion outside of the United States, including in Puerto Rico or other U.S. territories.

or longer, that is—whether as a permanent resident or one of the visa types listed previously. It is important to note, however, that this question does not specify the visa type at the individual’s most recent long-term entry. This distinction has practical implications for these responses’ use, as for example, individuals who first entered the U.S. as children of temporary workers but then returned to their home country, completed college and even graduate school abroad, may then return as adults on their own temporary worker visas, and ultimately acquire permanent residence or become naturalized citizens. Qualitatively and practically speaking, the unobserved abilities and preferences of an individual who immigrates to the U.S. as an adult worker but had some childhood experience of living in the U.S. may be significantly different from those of an individual who first entered the U.S. as, for example, the trailing H-2 spouse on their partner’s H-1B visa. With this NSCG variable, however, we cannot distinguish between the two, as both are coded as having entered as dependents rather than for their own work or studies.

Due both to the absence of any similarly detailed question for the SDR respondents in the SESTAT data, and to the difficulties these NSCG responses present for categorizing “types” of immigrants, we combined NSCG responses (when available) with several other variables present in both datasets to better identify the circumstances of individuals’ immigration to the U.S. and categorize immigrants in a policy-relevant way, such as:

- Country of citizenship, if not naturalized U.S. citizens
- Birthplace
- Attended high school in the U.S. or abroad
- Earned bachelor’s degree from a U.S. or foreign institution
- Earned highest or most recent degree in the U.S., in what year and in what field, as recent STEM graduates may apply to extend their postgraduate work authorization in the U.S.
- Current full- or part-time enrollment in a U.S. degree-granting program
- If married, whether their spouse is working full-time
- Principal employer is U.S. versus foreign
- Employer sector (e.g., academia, industry, nonprofit)
- Occupation (e.g., postsecondary teacher, non-clinical medical scientist)

Based on correlations between these responses and NSCG respondents’ first visa type, we identified 10 distinct groups of participants in the U.S workforce. Upon further analysis, however, we found little difference (especially in fully specified models) for U.S. citizens born and raised within the 50 U.S. states, versus those raised abroad. In addition, as previously noted, relatively few foreign temporary resident respondents on student/trainee visas or dependent visas participated in entrepreneurship. For foreign temporary residents the E-2 treaty status of their sending country was substantially more predictive of entrepreneurial activity than their visa category, perhaps in part because both the H-1B and the E-series entrepreneur-investor visas might be categorized by a respondent as “work-related,” though the latter might also be coded as “other.” Given these empirical findings and related survey constraints, we therefore focus most

of the following econometric analysis on six citizenship and immigration categories, as described in Table 3.

Table 3. Summary of Citizenship and Immigrant Status Variables

Category	Description
Native U.S. Citizen	Individual born in the 50 U.S. states or U.S. territories , including Puerto Rico, or born abroad of American parents. Includes some individuals who identified themselves as naturalized citizens despite reporting a U.S. birthplace.
Foreign-Born: Immigrated as Child	Naturalized U.S. citizens and legal permanent residents who were born abroad, not of American parents, and who report they attended high school within the 50 U.S. states, and/or (for NSCG) they first entered the U.S. prior to age 18 on a dependent or student visa, or, most commonly, as permanent residents.
Foreign-Born: Immigrated as Adult, for Higher Education	Naturalized U.S. citizens and legal permanent residents who were born abroad, not of American parents, and who report they attended high school outside the 50 U.S. states, but earned their highest or most recent degree in the U.S. and (for NSCG) either: (a) entered as a temporary resident on a student/training visa, or (b) entered on a permanent resident, dependent, or other non-work visa but indicated “education” was one of the reasons they first came to the U.S. for a period of six months or more. Excludes 52 respondents who recently earned a U.S. degree, but who both originally and at time of survey were on work-related visas, and who answered negatively to the question whether education was one of their reasons for coming.
Foreign-Born: Immigrated as Adult, All Others	Naturalized U.S. citizens and legal permanent residents who were born abroad, not of American parents, and whose highest and most recent degrees were earned outside the U.S., unless (for NSCG) they originally entered the U.S. on a temporary work visa or as a permanent resident age 21 or older, having earned at least their first bachelor’s degree from a foreign institution, and saying that education was not one of their reasons for coming.
Foreign-Born: Temporary Residents, E-2 Treaty Countries	Non-U.S. citizens “with a Temporary U.S. Resident Visa” from certain countries with which the U.S. maintains a free trade or bilateral investment treaty (see State Department website for list of Treaty Countries), in effect prior to 2008. For foreign temporary residents with missing values for the country of citizenship variable, we proxy with country of birth.
Foreign-Born: Temporary Residents, All Others	Non-U.S. citizens “with a Temporary U.S. Resident Visa” from countries with no E-2 designation on the State Department Treaty list, including citizens of some countries that participate only in the E-1 Treaty Trader program.

Country-of-Origin Characteristics: Global Entrepreneurship Monitor & UNESCO

The Global Entrepreneurship Monitor (GEM) Adult Population Survey (APS) collects information on entrepreneurship-related activities and attitudes across more than 100 countries, with typically at least 2,000 adults surveyed per participating country each year. Because not all countries collect data in any given year, for cross-national comparisons researchers often average the responses by country across multiple survey years. For example, in constructing their 2013 Global Entrepreneurship Index (GEI), Ács et al. (2013) averaged GEM APS survey responses for 2010 and 2011 for countries for which both years were available. For this report, we incorporate Ács et al.'s (2013) best estimates of two GEI indicators: cultural support and opportunity perception foreign-born workers' countries-of-origin.

Cultural support is the average of two APS responses, measuring the percentage of adults in each country who agree with the following statements:

- In <country>, most people consider starting a new business a desirable career choice; and
- In <country>, those successful at starting a new business have a high level of status and respect.

We anticipate that immigrants who come to the U.S. as adults to start a business may partly be motivated to do so because their home country offers relatively lower cultural support for entrepreneurship. By contrast, immigrants who choose to come to the U.S. *despite* their home country having relatively high levels of cultural support for entrepreneurship should be relatively *less* likely than other immigrants to engage in entrepreneurship themselves. We therefore construct our explanatory variable *Lack of Cultural Support* as the difference between the U.S. value, and the value for the foreign-born worker's country-of-origin. *Lack of Cultural Support* is therefore set to zero for native U.S. citizens, except for those from Puerto Rico, for whom separate GEM and UNESCO estimates were available.

Opportunity perception is defined as the percentage of adults ages 18 to 64 in the country who said they see good opportunities for starting a business in the area where they live. Because our interest is specifically in entrepreneurship among the college-educated workforce, alone this measure is arguably of limited usefulness. We therefore included an indicator of availability of skilled labor both as an additional control and as an interaction term with opportunity perception. For this purpose we used UNESCO's Institute for Statistics country-level estimates of the percentage of the total population within five years (by age) of secondary school completion who are enrolled in tertiary education.

Prior studies such as that by Clark et al. (2007) have indicated shared language is a significant predictor of immigration. Intuitively, native English speakers may perceive relatively lower costs to immigrate to the U.S. However, the effect of shared language on immigrants' rates of entrepreneurship in their receiving country is theoretically ambiguous. On the one hand, native English speakers' greater facility and fluency may make it easier for them to identify

resources, attract financing, and so on. At the same time, because these immigrants have fewer barriers to overcome in the first place, many may be relatively less motivated or attracted by other aspects of participating in the U.S. economy, including the nation's cultural support for entrepreneurship. Empirically, it is also very difficult to disentangle the effect of shared language from E-2 treaty country status, as the vast majority of countries with English as an official language are also E-2 treaty countries. However, another recent study demonstrates no significant effect of coming from an English-speaking country after controlling for other individual- and country-specific characteristics (Blume-Kohout 2015b).

Descriptive Statistics

The share of native U.S. citizens holding STEM postsecondary degrees is declining, as is the share of U.S. STEM occupations held by native U.S. citizens. From 1990 to 2000, the foreign-born share of U.S. resident workers in STEM occupations grew from 11% to 17% at the bachelor's degree level, from 19% to 29% at the master's degree level, and from 24% to 38% at the PhD level (Freeman 2006). In this sub-section, we compare rates of employment in STEM occupations and STEM degree attainment among college-educated native U.S. and foreign-born workers. Then, we describe differences in entrepreneurial participation by higher education attainment and across countries-of-origin. Finally, we summarize educational and demographic characteristics for the full sample (representing the entire U.S. college-educated workforce) and compare these with characteristics of all self-employed individuals, all business owners, STEM business owners, and STEM new venture joiners.

STEM Employment of U.S. versus Foreign-Born College Graduates

Over the past decade, an estimated 44% of employment-based legal immigrants in the United States worked in STEM occupations (Wasem 2012). Immigrants tend more often to work in engineering occupations, where they earn higher wages than native-born U.S. citizens due to their stronger and field-specific academic preparation, including quantitative and analytical skills (Peri and Sparber 2011).

In the 2010 SESTAT data, we find nearly one in four (24.6%) U.S. workers in STEM occupations are foreign-born, including 18.5% of STEM workers with only bachelor's degrees, almost one-third (30.9%) of those with master's or professional degrees, and almost half (47.2%) of those holding doctoral degrees. Put another way, about one-third (34.5%) of college-educated native U.S. workers work in STEM occupations, versus half (50.3%) of U.S. resident, foreign-born workers. STEM occupations with the highest shares of foreign-born immigrant and temporary resident workers include: biochemists and biophysicists (47%); postsecondary teachers of engineering (50%); computer hardware engineers (56%); and non-academic mathematicians (62%).

Yet, among foreign-born workers, there is also a stark difference in STEM workforce participation by citizenship or visa status. Those who immigrated to the U.S. as children are only slightly more likely than native U.S. citizens to work in STEM occupations (37.3%), whereas 59.4% of adult immigrants who came to the U.S. to pursue higher education are STEM workers. Among college-educated adult immigrant workers who earned their highest degree abroad, 43.4% hold STEM jobs. Consistent with the dominant H-1B mechanism for foreign temporary residents from non-E-2 treaty countries, over three-quarters of that group (78.2%) are in STEM occupations, compared with only 57.1% of foreign workers from E-2 treaty countries.

Table 4. Descriptive Statistics

	Full Sample, College-Educated Workforce	All Self-Employed & Business Owners	All Business Owners	STEM Business Owners	STEM New Venture Joiners
U.S. Native	81.3%	80.7%	79.8%	72.2%	69.3%
Foreign-Born:					
Immigrated as Child	4.1%	4.2%	4.4%	4.3%	4.7%
Immigrated as Adult/Student, Highest Degree in US	4.9%	5.1%	5.3%	9.9%	7.2%
Immigrated as Adult, Highest Degree outside U.S.	6.9%	8.3%	8.4%	10.0%	10.3%
Temporary Residents	2.8%	1.7%	2.0%	3.1%	6.5%
Highest Educational Attainment:					
Bachelor's	66.0%	75.0%	77.4%	69.4%	64.3%
Master's or Professional	29.0%	21.9%	20.0%	25.3%	25.5%
Doctorate	5.0%	3.1%	2.6%	4.3%	10.2%
STEM Highest Degree	45.9%	42.7%	44.4%	67.7%	67.9%
US-Earned MBA or Similar	5.2%	4.8%	5.2%	6.1%	8.2%
Female	44.7%	37.3%	34.7%	23.0%	26.8%
Married	73.6%	80.0%	80.6%	80.6%	75.8%
Age (average)	44.3 yrs	48.5 yrs	48.0 yrs	46.8 yrs	37.4 yrs
Experience (average)	16.9 yrs	21.8 yrs	21.5 yrs	20.1 yrs	11.1 yrs

Source: 2010 SESTAT data, including 94,173 observations sampled from U.S. residents holding bachelor's and higher postsecondary degrees, who were employed during the survey reference week(s).

Higher Education and STEM Entrepreneurship

Foreign-born workers are significantly more likely than native U.S. workers to hold their highest degree in a STEM field. Among workers with at least a bachelor's degree, only 2 in 5 (41%) U.S. native workers hold their highest degree in a STEM field, whereas about two-thirds (66%) of immigrant workers hold their highest degree in a STEM field, and another 10.6% hold a STEM bachelor's degree along with some higher degree in a non-STEM field.

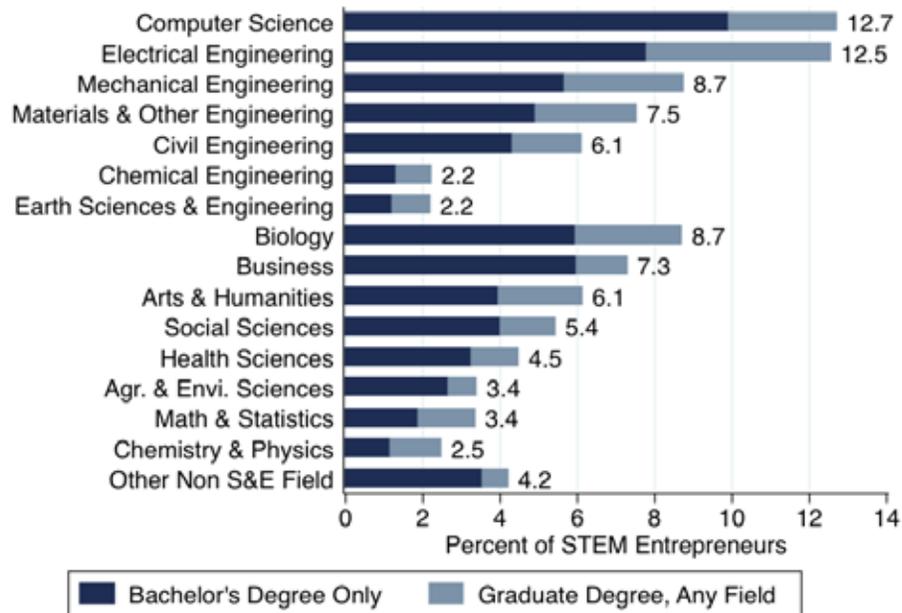
As shown in Table 4, over three-quarters (77%) of college-educated business owners hold only a bachelor's degree, but among STEM entrepreneurs advanced degrees are somewhat more common. About a quarter of college-educated STEM business owners hold masters or professional degrees, and another 5% hold doctorates. STEM entrepreneurship is also relatively rare among those who earned only a bachelor's degree in a non-STEM field. Interestingly, among U.S. resident workers with advanced degrees, a higher proportion of STEM entrepreneurs (versus those otherwise employed) hold a graduate degree in a different field than their bachelor's degree. Consistent with Roach and Sauermann's (2014) finding that individuals with a preference for conducting basic research were significantly more likely to be joiners than founders, here we find individuals with PhDs are more strongly represented among STEM new venture joiners. Some 10% of STEM new venture joiners hold PhDs, versus 4.3% of STEM business owners.

As in Blume-Kohout's (2014) study on gender and STEM entrepreneurship, here we again find individuals with bachelor's degrees in engineering fields generally have higher rates of entrepreneurial participation than those who studied other STEM fields. However, the most common bachelor's degree field among college-educated STEM entrepreneurs overall is computer science. We estimate about 1 in 10 STEM entrepreneurs (9.9%) hold only a bachelor's degree in computer science; another 2.8% of STEM entrepreneurs first earned their bachelor's degree in computer science, but went on to earn a graduate degree in computer science (48%), business (31%), electrical engineering (10%), or some other field. Figure 3 compares the relative frequency of different bachelor's degree fields among STEM entrepreneurs, including both those whose highest educational attainment was that bachelor's degree, as well as those who earned subsequent advanced degrees in any field.

Over half of STEM entrepreneurs who earned their bachelor's degree in chemistry, physics or astronomy also held a graduate degree in some field., and likewise, over 40% of those who majored in chemical engineering, earth sciences and related engineering fields¹⁷, mathematics or statistics. But which advanced degrees did they earn?

¹⁷ Over half (52%) of bachelor's degrees in "earth sciences and related engineering fields" are earned in geology or "geological sciences, other," with another 15% in petroleum engineering, mining and minerals engineering, and geological and geophysical engineering. These subfields together comprise 84% of this group's STEM entrepreneurs. Other subfields in this group include atmospheric sciences and meteorology, earth sciences, and oceanography, but of these only oceanography (6.5%) is proportionally represented among STEM entrepreneurs.

Figure 3. Bachelor's Degree Fields and Educational Attainment of U.S. STEM Entrepreneurs



Source: Author's calculations, 2010 SESTAT Data

Workers who earned their bachelor's degree in physics or astronomy, mathematics or statistics are particularly likely to engage in STEM fields entrepreneurship if they subsequently earned a master's degree in computer science. For workers with bachelor's degrees in these fields, a computer science master's degree may provide additional technical and translational skills that leverage their existing quantitative knowledge and abilities. By contrast, engineering graduate programs tend to require more discipline-specific academic preparation, so may be less accessible as a pathway to entrepreneurship. For those who earned a bachelor's in chemistry, a subsequent degree in electrical engineering is the most common path. On the other hand, individuals who earned their bachelor's degrees in chemical engineering are more likely to engage in entrepreneurship if they also earn an advanced degree in that same field. Those who earned their bachelor's degree in earth sciences or related engineering fields are also more likely to engage in entrepreneurship if they also hold an advanced degree in geology, or in geological and geophysical engineering, however, the range of advanced degrees held by STEM entrepreneurs with a bachelor's degree in this field is broader. Finally, for those who earned their bachelor's degree in biology, an advanced degree in mechanical engineering, mathematics or statistics, or business is positively correlated with entrepreneurship.

STEM Entrepreneurship by Country-of-Origin

Wadwha et al. (2012) estimated that one-third (33.2%) of engineering and technology companies founded by immigrants between 2006 and 2012 had Indian founders, followed by China (8.1%), the United Kingdom (6.3%), Canada (4.2%), Germany (3.9%), Israel (3.5%), Russia (2.4%), Korea (2.2%), Australia (2.0%), and the Netherlands (2.0%).

Although the 2010 SESTAT data indicate only 6.1% of STEM business owners are from India, over 10% of founders (and 28% of foreign-born founders) of high-growth STEM startups started between 2005 and 2010 were from India. Including new venture joiners, we estimate 22.6% of foreign-born STEM entrepreneurs are from India, followed by China (8.1%), Taiwan (5.2%), Canada (4.6%), Korea (4.4%), Vietnam (4.2%), Mexico (4.1%), the Philippines (4.0%), the United Kingdom (2.9%), and Germany (2.0%). Notably, Israel, Australia, and the Netherlands do not appear among the top 10 (or 15) countries-of-origin in our sample.

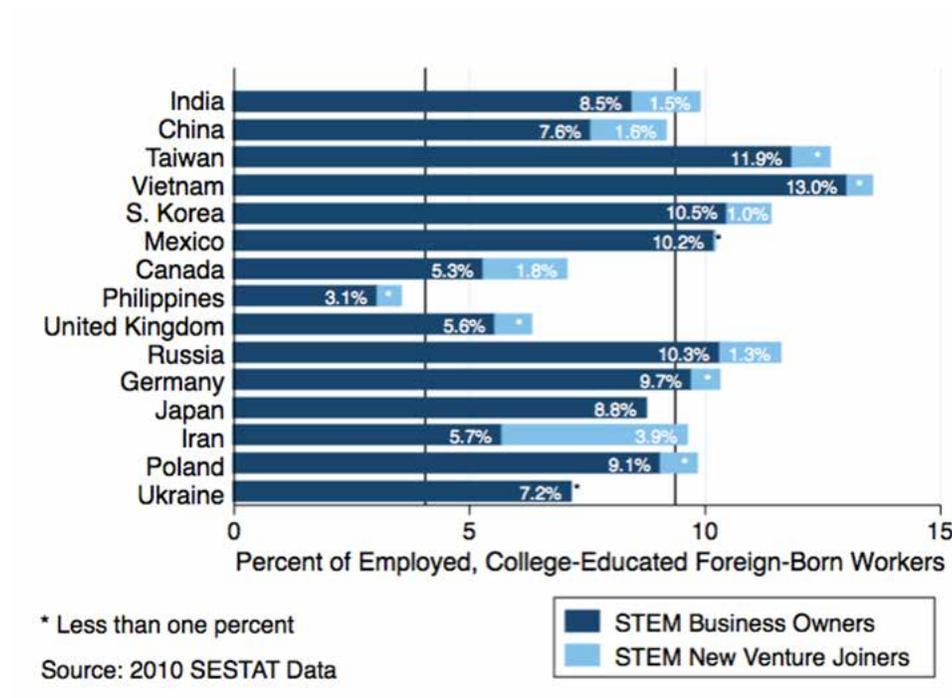
Figure 4 shows rates of STEM entrepreneurship, broken down by business ownership versus startup venture employment, for the 15 countries that contributed most to U.S. STEM entrepreneurship in 2010. Interestingly, we observe that Filipino workers are substantially less likely to participate in STEM entrepreneurship than native U.S. citizens and all other foreign-born workers from the countries listed, even though they comprise 4.0% of foreign-born STEM entrepreneurs overall. This seeming discrepancy is due to the relatively high share of college-educated immigrant workers in the U.S. overall who came from the Philippines.

Likewise, the substantial contribution of Indian entrepreneurs to U.S. STEM entrepreneurship is partly due to the high share of college-educated immigrant and foreign temporary workers from India. Rates of STEM business ownership, in particular, are notably higher among foreign-born workers from Vietnam, Taiwan, Korea, Russia, Mexico, and Germany, as compared to those from India. Compared to foreign-born workers from these other countries, however, U.S. resident workers from India are much less likely to be naturalized U.S. citizens or legal permanent residents, which limits their avenues for STEM business ownership.

Even so, over 60% of Indian founders of high-growth STEM startups have only temporary resident visas. By contrast, other foreign-born founders of high-growth STEM startups are substantially more likely to have permanent resident visas or be naturalized citizens; less than 10% are foreign temporary residents.

Immigrants from India and China who came to the U.S. as adults to pursue higher education are significantly more likely to engage in STEM entrepreneurship than those who earned their highest degree abroad. Over half (51%) of India-born STEM entrepreneurs earned their highest degree in the U.S. overall, and over 70% of India-born recent founders of high-growth STEM startups earned their degrees in the U.S., as well. For China-born U.S. STEM entrepreneurs, the link with U.S. higher education is even more stark: over three-quarters (77%) of those who founded high-growth STEM startups either earned their highest degree in the U.S. or are currently on student visas, and overall, 65% of China-born STEM entrepreneurs earned their highest degree here.

Figure 4. Foreign-Born Workers' Rates of Participation in STEM Entrepreneurship, by Country-of-Origin



Note: The countries-of-origin are ranked from top to bottom based on each country's total share of STEM business owners. The first vertical line, at about 4.1%, represents the rate of STEM business ownership among native U.S. citizens, excluding those raised in Puerto Rico or U.S. territories. The second vertical line, at about 9.4%, represents the total rate of STEM entrepreneurship (including new venture joiners) for this same group.

Hunt (2011) found no difference in probability of having recently founded a startup for foreign-born scientists and engineers with U.S.- versus foreign-earned degrees, and likewise no relationship with age at arrival in the United States. Our results focusing on STEM entrepreneurship strongly differ, and they raise the question: does the U.S. higher education system in some way increase the probability that an individual will become an entrepreneur? Or, is this descriptive result simply driven by the greater proportion of foreign-born workers from China and India who entered on student versus work visas, and the higher propensity towards entrepreneurship among immigrants from those countries?

Econometric Models and Results

In this section, we present results from multivariate logistic regression models predicting entrepreneurial outcomes as a function of demographic characteristics (age, gender, and marital status), educational attainment (highest degree attained, bachelor's degree field, whether highest degree was also in STEM, and so on), postgraduate years of work experience, and country-of-origin characteristics.

Predictors of Business Ownership

In addition to individuals' educational and demographic characteristics, we explore how differences across countries-of-origin may influence college-educated immigrants' rates of entrepreneurial participation. Notionally, we expect adult college-educated immigrants to the United States are more likely to become entrepreneurs when there exists a bigger gap between their home country and the U.S. in terms of cultural support, recognition, and status for entrepreneurs. Because individuals who immigrated as children did not make the same active choice, we might expect such a relationship to be absent or substantially weaker for individuals who immigrated as children. However, we note one indirect pathway remains, due to parental influence. Several prior studies have demonstrated that children of entrepreneurial parents are more likely themselves to become entrepreneurs (Kim, Aldrich, and Keister 2006; Fairlee and Robb 2007). If a parent chose for reasons of greater cultural support to immigrate to the U.S. and pursue entrepreneurial ventures, much as Hout and Rosen (2000) showed for sons of immigrants, we might expect the foreign-born child immigrant also to have greater propensity towards entrepreneurship.

Table 5 presents estimated marginal effects of demographic, educational, immigrant status, and country-of-origin variables on the probability of U.S. business ownership among college-educated U.S. resident workers. These results were obtained from binomial logistic regression on the subsample of employed workers, with the outcome variable equaling 1 if the respondent said their principal employment was with a U.S.-based organization and was best described as either:

- (a) self-employed or a business owner in an incorporated business, professional practice, or farm, or
- (b) same as above, but in an unincorporated business, professional practice, or farm, and either 10 or more employees, or—if fewer than 10 (which could include zero) employees—reporting supervisory responsibility for one or more workers.

For all other workers, this outcome was set to zero.

In addition to the variables shown, models also include 17 dummy variables representing different bachelor's degree fields. All variables except bachelor's field of degree are interacted

with the citizenship and immigration status categorical variable (see Table 3 for descriptions of these categories), to account for differences across groups in distributions of workers by educational attainment, age, experience, and so on. As shown in Table 5 column (1), we do find significantly higher rates of business ownership, overall, among individuals who immigrated to the U.S. as children, as compared to native U.S. citizens. But, taking country-of-origin characteristics including relative support for entrepreneurship and prevalence of tertiary education into account in model (2), we find that immigrants who arrived in the U.S. as children are significantly less likely to become business owners than their nativity would suggest. Interestingly, adult immigrants who earned their highest degrees outside of the U.S. are also less likely to participate than those who came to the U.S. for higher education, after controlling for country-of-origin characteristics.

U.S. resident workers who hold advanced degrees (including in business administration or management), and those who hold their highest degree in a STEM field are significantly less likely to be business owners than individuals who hold only bachelor's degrees with their highest degree in social sciences or most other non-STEM fields. In particular, those holding only bachelor's degrees in physics or astronomy, mathematics or statistics, or health sciences fields are significantly less likely to become business owners.

Experience—measured here as years since highest degree was completed—is a significant positive predictor of business ownership, with each decade of experience conferring about 3.6 percentage points higher probability of business ownership. Interestingly, for the full sample we observe no additional significant age-related effects. The lack of significance on the age quadratic term for the full sample is partly due to differences in the effects of aging on probability of business ownership across citizenship and immigration status. Note that, because biological age is strongly collinear with career age (experience), especially after highest educational attainment is accounted for, and because we anticipate biological aging has a specific dampening effect on the returns to experience, the econometric estimation includes terms for experience (divided by 10 for convenience in reporting) and biological age squared. However, if we replace this career age “experience” variable with biological age, we can retrieve estimates of predicted probability of business ownership by age that implicitly incorporate experience-related effects. Doing so, we find that for native U.S. citizens and immigrants who arrived in the U.S. as children, the probability of business ownership monotonically increases with age, to at least age 60. Immigrants who arrived as adults similarly show no decline or slowing until at least age 55. By contrast, for foreign temporary residents, business ownership rates begin to decline in the mid-40s, most strongly among those from E-2 treaty countries. However, many of these business owners may have started (or purchased) their companies long ago.

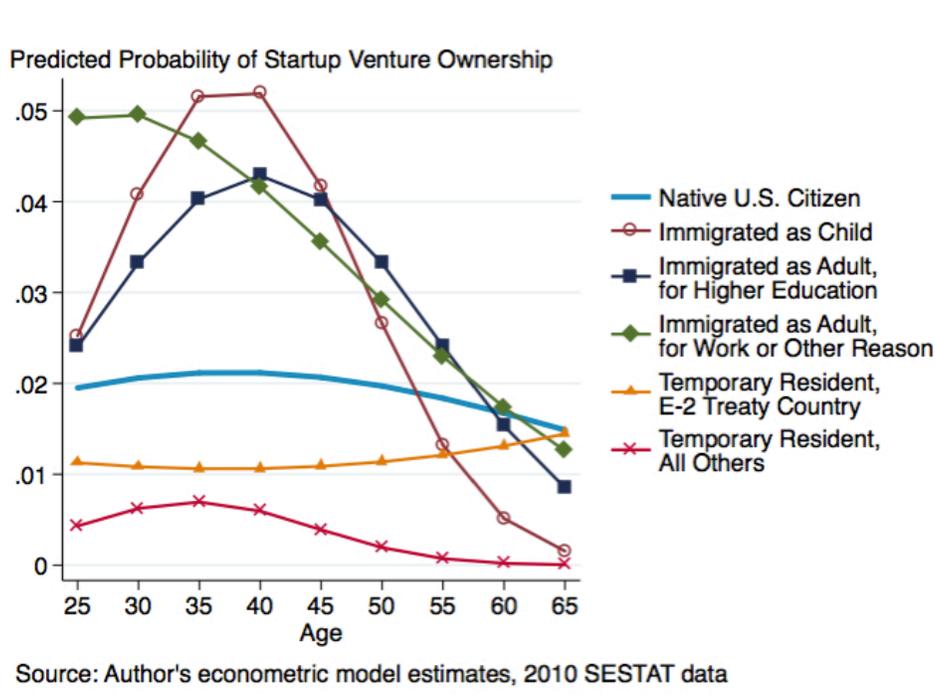
Table 5. Marginal Effects of Demographics, Education, Immigrant Status, and Country-of-Origin Characteristics on Probability of U.S. Business Ownership

	(1)	(2)
<u>Foreign-Born Citizenship/Visa Status:</u>		
Immigrated as Child	0.0402 *** (0.0137)	-0.0783 ** (0.0384)
Immigrated as Adult/Student, Highest Degree in U.S.	0.0571 *** (0.0209)	0.0340 (0.0842)
Immigrated as Adult, Highest Degree outside U.S.	0.0256 * (0.0154)	-0.0936 *** (0.0258)
Temporary Resident, E-2 Treaty Country	0.0195 (0.0386)	0.1275 (0.1661)
Temporary Resident, All Others	-0.0949 *** (0.0155)	-0.1627 *** (0.0373)
<u>Education:</u>		
STEM Highest Degree	-0.0927 *** (0.0087)	-0.0898 *** (0.0085)
MBA or Similar U.S. Degree	-0.0372 *** (0.0126)	-0.0341 *** (0.0132)
Other Master's or Professional Degree	-0.0792 *** (0.0061)	-0.0797 *** (0.0061)
Doctorate	-0.0996 *** (0.0062)	-0.0992 *** (0.0063)
<u>Demographics:</u>		
Experience/10	0.0382 *** (0.0050)	0.0359 *** (0.0050)
Age/10, squared	0.0002 (0.0005)	0.0005 (0.0005)
Female	-0.0403 *** (0.0065)	-0.0407 *** (0.0065)
Married	0.0233 *** (0.0069)	0.0226 *** (0.0069)
<u>Country-of-Origin Characteristics:</u>		
Share with Postsecondary Education		-0.0057 *** (0.0008)
Share Perceiving Entrepreneurial Opportunities		0.0013 (0.0010)
Lack of Cultural Support for Entrepreneurship		0.0289 * (0.0168)
Number of Observations:	88,631	85,564

Source: 2010 SESTAT data, including 88,631 observations sampled from U.S. resident workers holding bachelor's and higher degrees, and who were employed during the survey reference week(s). Model (2) includes all of the explanatory variables from Model (1), but also incorporates merged country-of-origin characteristics from GEM and UNESCO datasets. All models include dummy variable fixed effects for bachelor's field of degree. Statistical significance: * p < .10, ** p < .05, *** p < .01.

If we focus instead only on owners of startup ventures, the more typical age-related trends emerge, as shown in Figure 5. Still, we note the effects of aging for native U.S. citizens' participation in startup ventures appear much less dramatic. Interestingly, among foreign temporary residents from E-2 treaty countries, there appears to be a slight positive trend, with older individuals more likely recently to have started a business. For most groups, the peak age for starting a business appears to be between 35 and 40.

Figure 5. Effects of Aging on Startup Ventures, by Citizenship and Immigration Status



Consistent with prior literature, we find the rate of business ownership is significantly lower for women. Controlling for education, marital status, nativity and immigration status, we find college-educated women in the U.S. workforce have over 4 percentage points lower probability than men of being business owners.

On the other hand, also consistent with prior evidence, we find that marriage is associated with higher probability of business ownership. Though many potential reasons for this have previously been suggested, such as married persons' greater likelihood of having health insurance coverage through their spouse, we note that apparent differences due to marital status may be capturing correlated differences in business ownership by household income and among native U.S. citizens by race/ethnicity. For example, African-Americans in our sample are significantly less likely than non-Hispanic whites to be married, and they are also significantly less likely to be business owners. Separate estimates by citizenship and immigrant status also

reveal no significant effect of marriage on entrepreneurship among foreign-born workers who immigrated to the U.S. as adults, nor among foreign temporary residents from non-E-2 treaty countries. For the latter group, restrictions on spousal employment in prevalent visa mechanisms (e.g., H-1B) may preclude advantages like spousal income support or provision of health insurance.

Finally, holding other country-of-origin characteristics constant, we find that foreign-born workers from countries with higher rates of postsecondary education are significantly less likely to become U.S. business owners. This may reflect that when a highly skilled workforce is more broadly available in their home country, there is less incentive for prospective high-skilled entrepreneurs to emigrate. On the other hand, as we hypothesized, immigrants from countries where there is relatively *lower* cultural support for entrepreneurship than in the U.S. are significantly *more* likely to be business owners than otherwise similar workers from countries with relatively higher cultural support.

Demographic, educational, and country-of-origin distributions differ across citizenship/visa groups, as do the effects of some variables that predict entrepreneurship. We control for these differences empirically by interacting all variables except bachelor's field of degree with binary variables for each citizenship/visa category. Although the pooled average marginal effects reported in Table 5 suggest legal permanent residence and citizenship increase probability of business ownership, we can better estimate the effect of a hypothetical change in foreign temporary residents' status—for example, if a new pathway to permanent residence were to become available—by predicting business ownership among foreign temporary residents using their own values of explanatory variables with coefficients estimated for legal permanent residents. In econometrics, this technique of estimating outcomes for one group “treated as” another has a long history, beginning with Oaxaca-Blinder decomposition.

Employing this technique, we estimate that the probability of business ownership for temporary foreign workers from non-E-2 treaty countries would increase by 10 percentage points, from 0.052 to between 0.153 and 0.155 depending on where they earned their highest degree. This difference is highly significant ($p < .0001$ for comparisons with both adult immigrant groups). Although in principle this 10 percentage point estimate could be confounded by differences in English language ability, Blume-Kohout (2015b) shows no effect on business ownership rate of foreign-born workers' coming from countries where English is an official language. This result suggests that alternative visa mechanisms allowing prospective foreign entrepreneurs from non-E-2 countries greater flexibility to start businesses and awarding legal permanent residence for successes might substantially increase participation by the foreign-born in U.S. business ownership.

Predictors of STEM Fields Entrepreneurship

Next, we examined predictors of STEM entrepreneurship in the college-educated U.S.-resident workforce. In addition to restricting the set of business owners described above to those working in STEM occupations, we also include “joiners” in this outcome measure—individuals working in STEM occupations who are employed by startups founded within the previous five years, with fewer than 100 employees.¹⁸ Less than 12% of the STEM entrepreneurs thus defined in our sample are joiners; the rest are business owners. Because the 3.32 percentage point gap in STEM entrepreneurship between foreign-born and native U.S. citizen workers is both statistically and practically more significant than the gap for business ownership overall, in this section we examine the relative contributions of various factors toward this STEM entrepreneurship gap.

Table 6 presents results from a series of five logistic regression models predicting STEM entrepreneurship versus regular employment, with dependent variable equal 1 if the individual is a STEM business owner or joiner, and equal 0 if the person’s principal job is with an established U.S.-based firm, non-profit, government agency, university or college, or with a new venture but in a non-STEM occupation or field. The analyses intentionally exclude *non-STEM* business owners from the base reference group.

First, even more strongly than for business ownership overall, we find that different categories of foreign-born workers have different probabilities of STEM entrepreneurship. In particular, as the descriptive statistics depicted in Figure 2 suggest, there is no statistically significant difference in rates of STEM entrepreneurship for native U.S. citizens versus foreign-born who immigrated to the U.S. as children. In addition, though the sign for foreign temporary residents from non-E-2 countries is positive, the difference is not statistically significant at the 10% level. However, all other groups of foreign-born workers have higher rates of STEM entrepreneurship, most noticeably those who earned their highest degrees from U.S. institutions.

Controlling for differences across these citizenship and immigrant groups in their bachelor’s degree fields, as in Table 6 column (2), reduces the apparent gap between native and foreign-born workers by about 60%. For foreign temporary residents from E-2 treaty countries, the probability of STEM entrepreneurship versus regular employment is not significantly different from that for native U.S. citizens. But for foreign temporary residents from *non-E-2* countries, the sign reverses: controlling for bachelor’s field of degree, these foreign temporary residents are significantly *less* likely than native U.S. citizens to be STEM entrepreneurs.

¹⁸ As previously noted, we exclude medical practitioners—specifically, all diagnosing and treating health professional occupations—from the STEM entrepreneurship outcome measure, unless the respondent listed R&D among his or her work activities.

Table 6. Effects of Immigrant Status, Demographics, Education, and Country-of-Origin Characteristics on Probability of U.S. STEM Entrepreneurship

	(1)	(2)	(3)	(4)	(5)
<u>Citizenship/Visa Status:</u>					
Immigrated as Child	0.0049 (0.0100)	0.0003 (0.0096)	0.0006 (0.0095)	0.0041 (0.0091)	0.0035 (0.0238)
Immigrated as Adult/Student, Highest Degree in U.S.	0.0574*** (0.0108)	0.0229*** (0.0085)	0.0318** (0.0134)	0.0345** (0.0147)	0.0311 (0.0294)
Immigrated as Adult, Highest Degree outside U.S.	0.0418*** (0.0078)	0.0194*** (0.0062)	0.0155** (0.0069)	0.0102 (0.0076)	-0.0103 (0.0160)
Temporary Resident, E-2 Treaty Country	0.0425* (0.0223)	0.0200 (0.0175)	0.0247 (0.0215)	0.0169 (0.0172)	0.0410 (0.0482)
Temporary Resident, All Others	0.0080 (0.0098)	-0.0197*** (0.0062)	-0.0148 (0.0104)	-0.0115 (0.0211)	0.0095 (0.123)
<u>Controls:</u>					
Bachelor's Field of Degree		X	X	X	X
Graduate Degrees			X	X	X
Age, Experience, Gender, Marital Status				X	X
Country-of-Origin Characteristics					X
AIC	103.85	96.27	95.63	93.99	93.79
Number of observations	78,691	78,691	78,691	78,691	78,691
<p>Marginal effects for probability of STEM business ownership or employment with a new STEM venture versus all other regular employment (excluding non-STEM business owners), estimated using survey-weighted generalized linear models with log link, binomial family. Data are from the 2010 NSF SESTAT database, sampled from U.S. resident workers holding bachelor's and higher postsecondary degrees, and who were employed during the survey reference week(s). Models (1) through (5) incrementally add sets of control variables, as noted in the Table. For Model 5, observations were matched on respondent's country-of-origin to UNESCO and GEM country-level variables. Statistical significance denoted as follows: * p < .10, ** p < .05, *** p < .01.</p>					

In Table 6 column (3), we see differences in graduate degree attainment explain another 9.3% of the gap for immigrants whose highest degrees were earned abroad. But for immigrants who earned their highest degrees in the U.S., the gap actually widens with addition of these covariates, suggesting U.S. higher education itself may contribute in some way to these immigrants' subsequent entrepreneurship participation. Taken together, differences in highest educational attainment and fields of degree explain approximately half (45%) of the gap in rates of STEM entrepreneurship among U.S.-educated immigrants versus native U.S. citizens. Despite the opposing signs for foreign temporary residents from E-2 versus non-E-2 countries, once higher education degrees are accounted for, neither group has significantly different STEM entrepreneurship participation versus native U.S. citizens.

Controlling for age, experience, gender and marital status, in Table 6 column (4) we find the only group of foreign-born workers that remain with a significantly different rate of STEM entrepreneurship as compared to native U.S. citizens comprises those adult immigrants who earned their highest degrees from U.S. institutions. The rate of STEM entrepreneurship among U.S.-educated adult immigrants is significantly higher at the 10% level than that for foreign-born who arrived in the U.S. as children, and compared to foreign temporary residents from non-E-2 countries. Finally, in Table 6 column (5), we find addition of variables for country-of-origin characteristics including share of population with postsecondary education, relative lack of cultural support for entrepreneurs and its square, and shared English language yield little change in the point estimates. However, collinearity between these variables and the citizenship/immigration status indicators also yields substantially larger standard errors, such that we can no longer detect significant differences in STEM entrepreneurship once these variables are included.

Table 7. Marginal Effects of Selected Demographic, Educational, and Country-of-Origin Characteristics on Probability of U.S. STEM Entrepreneurship, Adult Immigrants

	Adult Immigrants
Earned Highest Degree in U.S.	0.0262 * (0.0148)
U.S. STEM Bachelor's Only	0.1157 *** (0.0416)
U.S. Non-STEM Graduate Degree	0.1245 *** (0.0469)
U.S. STEM Master's Degree	0.0851 *** (0.0293)
U.S. STEM Doctorate	0.0434 (0.0293)
Foreign STEM Bachelor's Only	0.0910 *** (0.0219)
Foreign Non-STEM Graduate Degree	0.0758 ** (0.0324)
Foreign STEM Master's Degree	0.0887 *** (0.0220)
Foreign STEM Doctorate	0.1671 *** (0.0526)
Experience/10	0.0321 *** (0.0110)
Age/10	-0.0187 * (0.0111)
Female	-0.0428 *** (0.0131)
E-2 Treaty Country	-0.0255 ** (0.0130)
U.S. Degree * Country-of-Origin Postsecondary Education Share	0.0012 ** (0.0005)
Number of Observations	11,689

Marginal effects for predicted probability of STEM business ownership or employment with a new STEM venture versus regular employment in an established organization or with a non-STEM venture, estimated using survey-weighted generalized linear models with log link, binomial family. Data are individual-level observations from the 2010 NSF SESTAT database, sampled from U.S. resident workers holding bachelor's and higher postsecondary degrees, and who were employed during the survey reference week(s). Model includes 17 dummy variables representing bachelor's field-of-degree, and an indicator for marital status, not shown. Delta-method standard errors for the estimated marginal effects are presented in parentheses below the corresponding estimates. Statistical significance denoted as follows: * p < .10, ** p < .05, *** p < .01.

Characteristics of Adult Immigrant Entrepreneurs

In Table 7, we present results from a model similar to that summarized in column (5) of Table 6, but restricting the sample to adult immigrants—that is, naturalized U.S. citizens and legal permanent residents who earned their highest degree in the U.S. or abroad. In this model, we predict probability of STEM entrepreneurship versus regular employment as a function of bachelor's field of degree (17 dummy variables as before, not shown), as well as a more detailed categorical variable for highest degree attained that captures whether the respondent's highest degree was earned in a STEM or non-STEM field. This categorical variable for educational attainment is then interacted with an indicator for having earned that degree in the U.S. versus abroad. As before, demographic variables include age and age-squared, years of experience, female gender, and marital status. Also included are country-of-origin characteristics: share of population in home country with postsecondary education alone and interacted with the indicator for U.S.-earned degree; relative lack of cultural support for entrepreneurship and its square; and an indicator for citizenship with an E-2 treaty country, to test whether the higher rate of entrepreneurship observed among foreign temporary residents from these countries persists once they have immigrated. Because country-of-origin entrepreneurial opportunity perception has been shown insignificant as a predictor of U.S. entrepreneurship, we exclude that variable from this final model.

Overall, earning a degree from a U.S. institution is associated with a 2.6 percentage point increase in the probability of adult immigrants' participating in STEM entrepreneurship. Unsurprisingly, holding a bachelor's degree in some STEM field (and no higher degrees) is also strong positive predictor of STEM entrepreneurship, but this effect is noticeably stronger for U.S.-earned STEM bachelor's degrees, by 2.5 percentage points ($p < .10$). By contrast, immigrants who hold master's or professional degrees in STEM fields participate in STEM entrepreneurship at similar rates, regardless of whether their degree was earned in the U.S. or abroad.

Interestingly, whereas for native U.S. citizens (results not shown) advanced degrees other than the MBA are associated with significantly lower probability of STEM entrepreneurship, for adult immigrants there is no significant negative effect of graduate degrees. In addition, for immigrants who earned their highest degree from a U.S. institution, whether they hold a master's or professional degree in STEM versus non-STEM field appears to be irrelevant. Moreover, among adult immigrants who earned their highest degree abroad, holding a doctorate in a STEM field is associated with a significantly higher rate of STEM entrepreneurship ($p < .10$).

As we observed for business ownership overall, consistent with Blume-Kohout (2014) we find female immigrants are significantly less likely than males to participate in STEM entrepreneurship. Likewise, similar to our overall finding that business ownership increases with experience (Table 5), here we find probability of engaging in STEM entrepreneurship also increases with experience, again defined as years since highest degree awarded. However, aging has a net negative effect, such that rates of STEM entrepreneurship peak around age 50, then

decline. Marital status (not shown) has no significant effect. Finally, the significant negative sign on E-2 treaty country-of-origin for naturalized citizens and legal permanent residents—a group whose ability to work and own businesses in the U.S. is not directly affected by the availability of E-2 temporary resident visas—suggests the substantially higher rate of overall business ownership found for foreign temporary residents from these countries is not simply attributable to other latent characteristics, such as shared English language. Interestingly, estimating this same detailed model presented in Table 7 for the subpopulation of foreign temporary residents yields very little of significance, except for approximately 4 percentage points higher probability of STEM entrepreneurship among foreign temporary residents from E-2 treaty countries ($p < .10$).

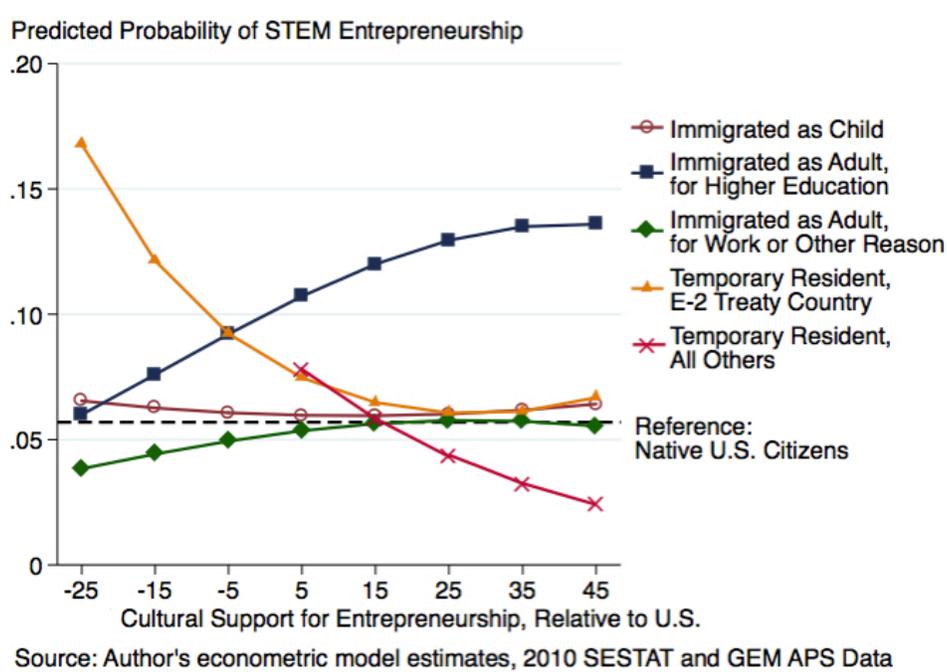
For the full sample regression in Table 6, we found similar significant effects of country-of-origin postsecondary education and relative lack of cultural support for entrepreneurship as for business ownership overall. However, the subpopulation regression presented in Table 7 finds further correlations between STEM entrepreneurship, rates of postsecondary education in one's home country, and immigrants' decision to pursue U.S. higher education. Here we find that immigrants who came to the U.S. for higher education from countries with relatively high rates of postsecondary education are *more* likely to engage in STEM entrepreneurship, all else equal. Put another way, immigrants who choose to come to the U.S. for higher education *despite* the relatively high prevalence of postsecondary education in their home country may in fact be coming to study in the U.S. disproportionately for economic and entrepreneurial rather than purely academic reasons, perhaps to take advantage of the higher probability of attaining legal permanent residence that a U.S. degree affords. Alternatively, if U.S. higher education itself somehow promotes greater entrepreneurial activity than similar degree programs abroad, prospective immigrant entrepreneurs may implicitly be recognizing this in their decision to earn U.S. degrees.

The net marginal effect of a unit increase in relative lack of cultural support was not statistically significant, reflecting underlying nonlinearity (which we accommodated with a quadratic term in the models). However, logistic regression coefficients were statistically significant for both *Lack of Cultural Support* and its square, with the expected signs. As discussed previously, our expectation is that entrepreneurial individuals will be more likely to emigrate from countries with low cultural support for entrepreneurship, and more likely to immigrate to countries with relatively higher cultural support for entrepreneurship than they found at home. Conversely, if an individual chooses to emigrate from a country with very high cultural support for entrepreneurship, and immigrates to a country with relatively lower levels of support, all else equal we would expect that particular individual to be less inclined towards entrepreneurship.

Figure 6 depicts predicted probabilities of U.S. STEM entrepreneurship by relative cultural support, controlling for differences in sending country's share of population with postsecondary education. As Figure 6 shows, foreign-born workers who immigrated to the U.S. as adults from countries with relatively lower cultural support for entrepreneurship are more

likely to engage in STEM entrepreneurship, with more pronounced effects among immigrants who came to the U.S. to pursue higher education versus those who earned their highest degrees abroad. By contrast, among those who immigrated to the U.S. as children, we observe no significant effect of their country-of-origin's characteristics.

Figure 6. Probability of STEM Entrepreneurship by Differences in Country-of-Origin Cultural Support



For foreign temporary residents the results are inconclusive due to the relatively small number of cases observed, and the trends seem in opposition to our initial intuition. Probing more deeply reveals that the downward-sloping curve for foreign temporary residents from E-2 treaty countries is driven by relatively high rates of U.S. STEM entrepreneurship among Canadian temporary workers. Although Canadian-born workers represent less than 5% of foreign-born U.S. STEM entrepreneurs overall, about 1 in 5 (19%) foreign temporary resident STEM business owners are Canadian. Among all foreign temporary residents who earned their degrees abroad, Canadian foreign temporary residents are more likely than any other group to be STEM business owners instead of organizationally employed. Among foreign temporary residents from E-2 treaty countries, Japanese and Mexicans follow, comprising 11% and 10% of foreign temporary resident STEM business owners, respectively. By contrast, over a third of foreign temporary resident STEM business owners (37%) are Indian, only 6.0% of foreign temporary resident STEM business owners are Chinese, and there are too few other STEM entrepreneurs from non-E-2 countries to extend that curve's trace.

Among adult immigrants to the U.S., the distribution across countries-of-origin in entrepreneurial participation is much broader. Fewer than 1 in 4 (24%) adult immigrant STEM entrepreneurs are from India, with 8.9% and 6.0% from mainland China and Taiwan respectively. Korea and the Philippines follow, each contributing about 4.5%, then the United Kingdom and Russia at about 3.5%.

Finally, less than 15% of STEM entrepreneurs from the United Kingdom and the Philippines, and less than a third of those from Mexico (23%) and Canada (30%), earned their highest degree in the U.S., compared to over two-thirds of STEM entrepreneurs from Korea (74%), China (65%) and Taiwan (92%).

Results from Alternative Estimation Strategies and Measures of Entrepreneurship

To test sensitivity of these results to other more traditional measures of entrepreneurship participation, we re-estimated the models presented in Table 6 with an alternative outcome measure that included all self-employed individuals in STEM—that is, including both STEM business owners and unincorporated non-employer self-employed individuals working in STEM occupations, but excluding STEM new venture joiners. The results were remarkably similar. For example, when we re-estimate the model presented in Table 6 column (4) using this alternative STEM self-employment outcome measure, we find 3.95 percentage points ($p < .01$) higher probability of STEM self-employment among immigrants who came to the U.S. for higher education, as compared to native U.S. citizens. This result is very similar to the 3.45 percentage point difference we originally estimated. We also again find no significant differences between foreign-born workers who immigrated as children, those who immigrated as adults but earned their highest degree abroad, and foreign temporary residents from E-2 Treaty countries, as compared to native U.S. citizens sharing similar educational and demographic characteristics.

In an alternative model employing multinomial logistic regression estimation, we investigated whether predictors of either joining a startup as an employee or engaging in non-employer unincorporated self-employment differed versus predictors for business ownership, overall. As the descriptive statistics indicate, joiners do tend to be younger than business owners ($p < .01$), and they are also less likely to be married ($p = .013$). However, no particular bachelor's field of degree was associated with either higher or lower probability of joining a startup venture as an employee, versus owning a business.

The multinomial logistic regression model also showed that significant positive predictors of choosing regular employment in an established organization over business ownership included being a foreign temporary resident from a non-E-2 Treaty country, working in a STEM occupation, having earned one's highest degree in a STEM field, holding a graduate degree, having fewer years of experience, and being unmarried. We also find in the multinomial model that immigrants who earned their highest degree abroad were significantly more likely (1.25 percentage points, $p < .06$) than native U.S. citizens to choose employment with a startup venture over business ownership, especially if their highest degree was in a STEM field.

Immigrants who earned a doctorate in any field from a U.S. institution were also more likely to join startup ventures as an employee than as an owner.

To further investigate the possible role of U.S. higher education in spurring foreign-born workers' entrepreneurship, we re-estimated the logistic regression model predicting STEM entrepreneurship as a function of bachelor's field of degree, highest educational attainment, citizenship and immigration status, age, experience, and gender, but now adding 23 dummy variables for country or region of origin,¹⁹ each interacted with a binary indicator for whether the individual earned his or her highest degree from a U.S. institution.

We find that, across foreign-born U.S. workers from most countries and regions, there is a positive association between coming to the U.S. for higher education, versus earning one's highest degree abroad. Foreign-born workers from Israel and most European E-2 Treaty countries, in particular, had a significantly higher probability of STEM entrepreneurship, overall, if they earned their degree from a U.S. institution. The only country-of-origin groups that produced significantly more STEM entrepreneurs overall among individuals who earned their highest degrees abroad instead of from a U.S. institution were native U.S. citizens, and immigrants from the United Kingdom and Mexico.

Finally, like Hunt (2011), in an alternative regression examining probability of having founded a high-growth enterprise (HGE) within the past five years, we observe that foreign-born college-educated workers are significantly more likely, overall, to be HGE founders, as compared to similarly educated native U.S. citizens. Bachelor's field of degree appears to explain none of this relative advantage, but the dampening effect of graduate degrees on the rate of HGEs among native U.S. citizens also does not hold for foreign-born workers. Put another way, among foreign workers who hold at least a bachelor's degree, highest educational attainment seems to be unimportant as a predictor of founding an HGE.

Are Foreign-Born STEM Workers Underemployed?

Kerr (2013) suggests that, among U.S.- and foreign-born STEM workers with similar education, foreign temporary residents are more likely to be underemployed. Given that visa constraints provide foreign temporary residents with less flexibility to seek more appropriate employment in case of a mismatch, we hypothesize that job mismatch may occur more often for these workers, such that they more often find themselves in technician-type jobs that do not provide as much opportunity for expressing their inventive potential. At the very least, foreign temporary

¹⁹ Country and region dummy variables are mutually exclusive and exhaustive, and include the following: Puerto Rico and other U.S. territories; Canada; Mexico; the United Kingdom; European EU-15, E-2 Treaty countries; Non-EU European E-2 Treaty countries; Russia and non-E-2 Eastern Europe; China; Taiwan; Korea; the Philippines; Vietnam; Japan and other SSE Asia E-2 Treaty countries; India; SSE Asia non-E-2 Treaty countries; Middle East & North Africa (non-E-2); Israel; Africa E-2 Treaty countries; Sub-Saharan Africa, non-E-2; Central America & Caribbean, E-2; Argentina & Chile (E-2); Central & South America, non-E-2; Australia & New Zealand.

residents are likely to be underpaid, relative to similar workers with employer-sponsored permanent residence (i.e., “green cards”) (Mukhopadhyay and Oxborrow 2012). In similar vein, inflexibility in employment may preclude not only employee job changes, but also transitions to self-employment and entrepreneurship. In this section, we examine variables relating to job choice, occupational activities, employment, and job satisfaction among foreign-born scientists and entrepreneurs.

In the 2010 SESTAT data, we observe that foreign temporary workers in STEM occupations are significantly more likely than native U.S. citizens to express dissatisfaction with their salary when regularly employed by established organizations. Similar to Hunt’s (2015) finding that immigrants with engineering degrees tend to have lower average and 95th percentile wages, we observe substantially lower wages for foreign temporary residents in STEM occupations, especially software developers and programmers. On the other hand, participating in STEM entrepreneurship was associated with significantly higher satisfaction with salaries among foreign temporary residents in STEM occupations. Among all foreign temporary resident workers, only 13.5% of STEM entrepreneurs report dissatisfaction with their salaries, compared with about 18.7% of workers in this group, overall. Given Lan’s (2012) related finding that an exogenous increase in permanent resident visas reduced employment of foreign-born, U.S.-trained scientists and engineers’ in low-paying postdoc positions, it seems plausible that a mechanism conferring permanent residence visas on this group would potentially decrease the number working for regular, established organizations, and increase movement towards entrepreneurship.

Foreign temporary residents are also significantly more likely than native U.S. citizens to be dissatisfied with their job’s level of responsibility.²⁰ But among foreign temporary residents working in STEM occupations, STEM business ownership (and STEM entrepreneurship more broadly) does not appear to convey the expected positive impact on this measure of satisfaction. In fact, foreign temporary resident STEM business owners from non-E-2 treaty countries are significantly *more* likely to be dissatisfied with their job’s level of responsibility, as compared to their regularly employed counterparts. Examining these dissatisfied individuals more closely, we find that over half of them are working as computer systems analysts, systems or network administrators, or software engineers, most of them (66%) holding master’s degrees. Many also report they have no management responsibility for people or projects. Interestingly, foreign temporary resident STEM entrepreneurs whose work activities did include managing people or projects were almost three times more likely to be satisfied with their level of responsibility (27.4% versus 9.8%, $p=.0524$). These findings raise the question, to what extent is the higher rate of self-employment we observe among foreign-born workers driven by necessity or lack of other options, as opposed to entrepreneurial innovation and opportunity recognition?

²⁰ Note that, due to the phrasing of the survey question, we know only that these individuals are “dissatisfied” or “very dissatisfied” with their job’s “level of responsibility,” and not whether they feel they have too much or too little.

As of October 2010, we estimate that 3.8% of the college-educated U.S. workforce was unemployed and actively seeking work. Another 3.7% were involuntarily working part-time. For native U.S. citizens, these unemployment and underemployment rates summed to less than 7%, but for immigrants who earned their highest degree abroad, this combined rate exceeded 12%. In addition, about 6% of college-educated native U.S. citizens, versus over 9% of immigrants who earned their highest degrees abroad, also reported they were working in an occupation unrelated to their field of degree because no related job was available.

Immigrants who came to the U.S. as adults are significantly more likely than all other groups of college-educated U.S. workers to indicate dissatisfaction with their job's intellectual challenge, and this distinction by nativity also holds true when we restrict our comparison just to U.S. resident workers employed in STEM occupations in established organizations. Among these regular-employed STEM workers, immigrants are also significantly more likely than native U.S. citizens to report they are dissatisfied with their job's level of responsibility. Conversely, immigrant STEM entrepreneurs reported higher satisfaction with their job's level of responsibility than their regularly employed counterparts. To the extent that foreign-born workers' observable characteristics—for example, current employment, work experience, and educational pedigree—are a poor signal of ability, immigrant workers may have incentive to choose entrepreneurship once their legal status allows (Hegde and Tumlinson 2015). However, dissatisfaction with the conditions of their U.S. employment could also yield declines in highly skilled foreign-born workers' stay rates, regardless of their final immigration status.

Immigrants who earned their highest degrees from U.S. institutions were significantly less likely than other foreign-born workers to be unemployed (4.0%) or underemployed (4.1%), and among those with STEM degrees, less than one-third (32%) reported working in an occupation that did not require STEM technical expertise. Only 4% reported they were working outside their field of degree because no job was available in their field. Nonetheless, about 20% of those in this group working in STEM occupations for established organizations were dissatisfied with their salary, versus 16% among native U.S. citizens and among immigrants who earned their highest degrees abroad. Foreign-born STEM entrepreneurs who earned their highest degree from a U.S. institution also reported greater satisfaction with their job's intellectual challenge and opportunities for advancement, compared to their counterparts working in STEM occupations with established organizations.

Taken together, these results suggest that U.S. higher education degrees may assist adult immigrants in providing a recognizable signal of quality and/or tacit professional acculturation valued by U.S. employers, while potentially also providing better preparation for immigrants' subsequent pursuit of entrepreneurial ventures. On the other hand, discrimination or lack of information among U.S. employers about quality of foreign higher education programs may also contribute to higher rates of unemployment and underemployment we observe among immigrants who earned their degrees abroad (Ferrer and Riddell 2008). Policies that support nascent immigrant STEM entrepreneurs may also help to improve U.S. employment rates,

economic productivity, and career satisfaction among new Americans and legal permanent residents. To the extent that U.S. higher education institutions help to prepare workers for entrepreneurial venturing, training and mentoring programs for foreign workers transitioning from H-1B programs who earned their degrees abroad may be a particularly useful target. At present, however, foreign temporary residents' mechanisms and opportunities for STEM entrepreneurship seem unsatisfactory, especially from the perspective of career advancement.

Conclusions and Policy Implications

At the beginning of this report, we introduced two policy-relevant questions:

1. Why do foreign-born workers have higher rates of participation than native U.S. citizens in entrepreneurship?
2. Why do some foreign-born workers seem to have higher propensity than others towards high-growth, high-impact, science-based entrepreneurship?

U.S.–Foreign STEM Entrepreneurship Gap. As in previous studies, we find a substantial percentage of the gap in rates of business ownership and STEM entrepreneurship among college-educated foreign-born and native U.S. workers can be attributed to differences in higher education attainment, particularly the undergraduate major they choose. Differences in the distribution of U.S. and foreign-born workers by age, experience, gender, and marital status explain most of the remaining gap, except among immigrants who earned their highest degree in the United States. For this group, the rate of STEM entrepreneurship is almost 4 percentage points higher than for otherwise-similar native U.S. citizens.

Foreign-Born + U.S. Educated = Higher STEM Entrepreneurship Rate. Although descriptive statistics suggest contradictory findings for business owners overall, after controlling for other demographic and educational characteristics we find higher rates of STEM entrepreneurship participation among immigrants who earned their highest degrees from U.S. institutions, as compared to both native U.S. citizens and other U.S. resident foreign-born workers. U.S. higher education institutions may serve a role in advancing foreign students' English language skills, certifying quality for prospective employers, and providing professional and entrepreneurial acculturation (Suter and Jandl 2008). Previous studies have demonstrated the importance of graduate and professional training in influencing subsequent entrepreneurship (Bercovitz and Feldman 2008; Blume-Kohout 2014, 2015a; Stuart and Ding 2006). Thus, it seems plausible that U.S. higher education itself may promote greater subsequent entrepreneurial venturing among foreign-born workers. However, the analyses herein cannot rule out the possibility of selection. That is, immigrants who choose to come to the U.S. to pursue higher education degrees may have other unobserved characteristics which predispose them towards entrepreneurship, as compared to immigrants who arrive for work or other reasons.

STEM Entrepreneurship Link to E-2 Treaty Investor Status. As discussed in the Introduction, one limitation of the data used for this study is that it does not include specific information on the respondent's visa type. As such, we cannot definitively identify which visas foreign temporary resident STEM entrepreneurs are covered by. Overall, however, visa constraints for foreign temporary residents—particularly those from countries not eligible for the E-2 Investor visa—seem to decrease dramatically their participation in self-employment in general, and STEM entrepreneurship more specifically. On the other hand, foreign temporary

workers from E-2 Treaty countries participate in STEM entrepreneurship at similar rates as native U.S. citizens. Descriptively, workers in this group are also significantly more likely than similar native U.S. citizens to choose business ownership over non-employer self-employment. More research is needed to understand the extent to which each of the various non-immigrant visa types currently available are used by nascent STEM entrepreneurs.

Implications for Policy

At present, the United States remains a destination of choice for achievement-oriented foreign nationals seeking greater cultural support for entrepreneurship than their home countries provide. The results presented in this report suggest several opportunities for policymakers interested in spurring new business creation and startup employment in new ventures, focusing in STEM fields. As of February 2016, the U.S. Department of Homeland Security has issued proposed rules and guidance documents that may update some of the visa categories discussed in this section, and additional proposals are planned.

High-Skilled Immigrant Underemployment. The slowing rate of immigrant participation in STEM entrepreneurship observed in recent years may be attributed to several factors, including possibly lower stay rates among innovative foreign-born workers. For example, the higher rates of dissatisfaction we observed among highly skilled immigrant workers trained abroad with the intellectual challenge and level of responsibility their jobs provide, along with their substantially higher rate of unemployment, suggests room for improvement in matching immigrant STEM workers in the U.S. to jobs that make full use of their skills and abilities. More research is also needed to understand how tacit knowledge, skills, innate ability and aspirations may differ across individuals in this group, and whether dissatisfied individuals may be trading off job satisfaction for social or family-related reasons. Specifically, previous studies have shown the importance of ethnic enclaves in attracting immigrants to communities with shared national and cultural origins, and as a result, some immigrants may preferentially locate in cities that provide that sense of community, even if the job market for someone with their knowledge, skills, abilities and interests is relatively weak.

Post-Graduation Pathways to STEM Entrepreneurship. Given the higher rate of STEM entrepreneurship we observe among immigrants who earned their highest degrees here in the United States, policymakers might be tempted to conclude we should aim to increase foreign student enrollment in STEM fields at U.S. universities. But, prior research suggests policies aimed explicitly at increasing foreign student enrollment in U.S. universities may have unintended negative consequences for enrollment of native U.S. students, at both the undergraduate and graduate levels (Betts and Lofstrom 2008; Hoxby 1998; Borjas 2007). Based on the empirical results contained in this report, it seems a better solution would be to expand pathways for foreign temporary resident students who earn advanced degrees in the U.S. to

extend their stay after graduation, contingent on an offer of employment related to their U.S.-earned degree, regardless of employer sector.

The GEIR Program and Support for New Venture Joiners. Initiatives like the Global Entrepreneur-in-Residence (GEIR) program in Massachusetts seem to provide a convenient solution within current legislative and regulatory confines. The GEIR program provides aspiring foreign entrepreneurs access to academic (uncapped) H-1B visas along with mentoring and training. At the same time, we find STEM entrepreneurship strongly increases with years of experience since highest degree. Requiring that graduates with a propensity toward entrepreneurship start their business immediately after graduation or else leave the country may be counterproductive, decreasing the probability of economically productive and satisfying outcomes. Among adult immigrants who earned their highest degree in the U.S., the peak age range for starting a new STEM venture was between 35 and 40. This later peak in participation could partly be due to delays in foreign students' achieving legal permanent residence or U.S. citizenship after graduation, a change in status that would provide them greater flexibility in (self-) employment. Employment in industry and especially with startup ventures may provide important on-the-job training and human capital that encourage foreign-born workers eventually to pursue entrepreneurship themselves.

Expansion of H-1B and F1/OPT Visa Programs.²¹ Our results thus support more generous expansion of H-1B visas and/or F-1 Optional Practical Training (OPT) eligibility to foreign students who earned graduate degrees from U.S. institutions and receive offers of employment in related STEM occupations, regardless of the employer's sector or foreign graduates' immediate startup intent. At present, some 20,000 H-1B visas are reserved annually for foreign temporary resident students who earned graduate degrees from U.S. institutions, but only those students graduating with advanced degrees in STEM fields or business are eligible to extend their F-1 student visas via Optional Practical Training (OPT) beyond the initial 12-month period after graduation. Foreign students on temporary resident visas who complete degrees at U.S. institutions in non-STEM fields are not eligible for this F-1 OPT extension. However, among immigrants who came to the U.S. for higher education and earned their highest degrees here, we find that whether their *highest* degree was earned in a STEM field is irrelevant to their probability of engaging in STEM entrepreneurship. Based on this evidence, we suggest that if a foreign student who graduates from a U.S. master's or doctoral program is able to obtain an offer of employment in a H-1B eligible STEM occupation with any U.S. employer (including new startups), s/he should be eligible for the F-1 STEM OPT extension, even if his or her most recent U.S. degree was in a less closely related or non-STEM discipline. In effect, if their prior knowledge, skills, training and/or innate abilities are sufficient to serve in a position requiring

²¹ In fall 2015, DHS released two proposals updating the F-1/OPT and H-1B visa programs; these had not been finalized as of February 2016.

bachelor's-level technical expertise in some STEM field (thus consistent with the specialized knowledge requirement of the H-1B), the field of their most recent degree may be irrelevant.

Missouri's Exemplary Entrepreneurship Program. Expanding the F-1 OPT program might also permit further entrepreneurial engagement by recent graduates, as self-employment is permitted. Along these lines, Luppino et al. (2012) note the University of Missouri-Kansas City's Entrepreneurship Scholars program does not restrict participation on the basis of field or prior educational attainment. Combining a similar lack of terminal degree restriction with innovative partnerships like Massachusetts' GEIR program utilizing H-1B visas would thus provide greater opportunities for entrepreneurial graduates to engage in mentored startups, and such mentored engagement might also help to reduce the career dissatisfaction many foreign temporary residents expressed regarding their independent efforts as STEM entrepreneurs.

STEM Workforce Visa. Some advocates of immigration reform have suggested awarding permanent residence conditional on remaining engaged in the STEM workforce, in an occupation related to one's field of degree, for several years after graduation from a U.S. graduate program (Gilgannon 2013; Kauffman Foundation 2015). As Gilgannon (2013) suggests, allowing foreign temporary resident workers with verified bachelor's or higher education earned here or abroad and at least five years' U.S. work experience, including but not limited to those in H-1B status, to remain in the U.S. and apply their on-the-job training and knowledge towards a new venture may be particularly productive, and arguably more so than any mechanism requiring a new graduate immediately to embark on a startup venture, else leave the country.

Startup Visa.²² Legislative initiatives in recent years have aimed towards a true "startup visa," which would allow foreign-born entrepreneurs to achieve permanent residence upon satisfying specified conditions during an initial conditional residence period similar to the EB-5. One such approach would be to require applicants to demonstrate they have attracted substantial U.S. investment in their business, such as from a U.S.-based venture capital firm, angel investor, or government agency (Gilgannon 2013). Then, by the end of the two-year initial conditional residence period, the venture must demonstrate that it has created new jobs, and also has achieved either high revenue growth, or alternatively that it has attracted subsequent rounds of investment. In contrast with the EB-5, this path would not select on personal wealth, but rather on market assessment of the potential economic value of the product or service to be provided.

E-2 Investor Visa Expansion. The clear advantage of this pathway for attracting STEM-based, high-tech entrepreneurship to the U.S. is in its use of an intermediate benchmark—in this case, venture funding—while research and development, regulatory clearances, and similar steps are still underway. In this current report, we found evidence that the similarly flexible E-2 Treaty Investor visa is associated with significantly higher rates of STEM entrepreneurship among

²² DHS announced in its Regulatory Agenda that it is planning on releasing a proposed rule that would allow certain inventors, researchers, and entrepreneurs who establish a U.S. startup entity to be considered for admittance to the United States.

foreign temporary residents from eligible countries, with participation rates comparable to that among native U.S. citizens after controlling for workers' demographic characteristics and education. But one drawback of the current E-2 visa is the requirement that the applicant him- or herself be capable of a substantial up front financial investment, which may be infeasible for younger entrepreneurs or high-tech and R&D-based businesses. Expanding opportunities for permanent residence—or, at least, unlimited renewal of temporary resident status—conditional on benchmark successes, and opening eligibility to citizens of India and other countries not eligible for the E-2 visa, seems likely to increase U.S. STEM entrepreneurship overall.

International Competition for STEM Graduates. As mentioned before, the visa-degree gap may put the U.S. at a disadvantage vis-à-vis other advanced countries. Citizens of nations like Canada and Australia that combine a highly educated labor force with strong cultural support for entrepreneurship are already unlikely to immigrate to the U.S. to start entrepreneurial ventures, and increasingly these countries are implementing policies designed to attract and retain highly skilled innovative and entrepreneurial foreign workers. For example, Canada, Australia, and New Zealand all use a points-based scheme for migrant visa eligibility which awards additional points to applicants who have at least two years' study in their countries' higher education institutions (Suter and Jandl 2008). Canada also lowers the threshold for number of points required for a prospective immigrant classified as an entrepreneur, “who intends and has the ability to establish... business or commercial venture in Canada that will make a significant contribution to the economy” (Tabag 2013). Since 2001, Australia also has allowed foreign students to remain and work for any employer during their wait for legal permanent residence. With such a large gap between the number of foreign students graduating from U.S. higher education institutions and the number of employment-based visas available to highly skilled graduates, along with evidence of underemployment and related job dissatisfaction among immigrants who earned their degrees abroad, the U.S. risks driving trained, innovative, and entrepreneurial talent offshore.

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