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July 2009

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Abstract

In this study, we quantify the role of foreign-born founders in high-tech entrepreneurship in a nationally representative sample of rapidly growing "high-impact" companies. This class of companies drives job creation and aggregate growth in the U.S. We find that, while most previous studies have overstated this role, it is nonetheless very important. For instance, about 16% of the companies in our sample had at least one foreign-born person among their founding teams, and these high-tech companies display better performance in some respects than high-tech companies in our sample whose founders were all native-born. We also provide a profile of high-tech immigrant entrepreneurs. The vast majority are strongly rooted in the U.S., highlighting the need to build a coherent pathway to permanent status for highly-skilled immigrants.

JEL-classification: L26, O3, F2

Keywords: Immigrant entrepreneurs, High Tech, High Impact Firms, Entrepreneurship

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1.0 Introduction

A vigorous high-technology sector is vital to sustain U.S. prosperity in the 21st century. The new products, services, and business models that the high-tech sector generates differentiate this nation's output from that of the rest of the world and enable capital accumulation, wage gains, and productivity growth. A high level of entrepreneurship, by which we mean the founding of new businesses, makes the high-tech sector vigorous. High-tech entrepreneurs take risks that existing high-tech businesses are afraid to take and recognize opportunities that they fail to spot.

High-tech entrepreneurship requires a rare combination of inclinations, capabilities, and resources. Most new businesses fail, so founders must be optimistic, but also capable of weathering severe challenges. Because the opportunities in high-tech sectors blend together technological and market factors, individual entrepreneurs and founding teams in these sectors typically combine technical expertise rooted in formal education and market savvy that flows from extensive business experience. They must also be able to tap quickly and effectively into networks of customers, suppliers, expertise, finance, and talent as business opportunities ripen.

Foreign-born individuals play an important role in U.S. high-tech entrepreneurship. By virtue of having left their native land, they may have entrepreneurial inclinations. Their large presence in American higher education and the U.S. labor force, especially science and engineering disciplines and occupations, equips them with valuable knowledge that bears on high-tech innovation. Their outsider status may allow them

to recognize "out-of-the box" opportunities that native-born individuals with similar knowledge and skills do not perceive. These capabilities may be linked to unique entrepreneurial resources, such as access to partners, customers, and suppliers in their countries of origin.

In this study, we quantify the role of immigrants[1] in high-tech entrepreneurship in a nationally representative sample of rapidly growing "high-impact" companies. This class of companies drives job creation and aggregate growth in the U.S. We find that, while most previous studies have overstated the role of immigrants in high-tech entrepreneurship, it is nonetheless very important. For instance, about 16% of the companies in our sample had at least one foreign-born entrepreneur among their founding teams, and these high-tech companies display better performance in some respects than high-tech companies in our sample whose founders were all native-born. We also provide a profile of high-tech immigrant entrepreneurs. The vast majority are strongly rooted in the U.S., highlighting the need to build a coherent pathway to permanent status for highly-educated, highly-skilled immigrants.

Our report begins by situating the subject of high-tech immigrant entrepreneurship in policy and analytical debates about immigration, entrepreneurship, and technology-based economic development. We then describe our methods and findings. We conclude by highlighting the research and policy agendas that our work illuminates.

[1] We use the term "immigrants" in place of "foreign-born" here and in similar spots in this text because, as we show later, the vast majority of foreign-born high-tech entrepreneurs in the U.S. have been in this country for decades and have become citizens. However, we would acknowledge that "foreign-born" is a more precise term.

2.0 Policy Context

Our research brings together two important areas of public policy: technology-based economic development (TBED) and immigration. In both areas, recent research points to new ways to achieve desirable policy outcomes. The linkages between them are just beginning to be explored.

2.1 Technological Innovation, Entrepreneurship, and Economic Growth

The importance of technological innovation in economic growth is by now firmly established. Well-understood by classical economists, such as Adam Smith and Karl Marx, technology's contribution to the economy began to be conceptualized and measured after World War II by modern economists such as Solow (1957), Griliches (1958), Nelson (1959), and Arrow (1962). Applied economists in fields like industrial organization (Scherer 1984) and agricultural economics (Ruttan 2001) sustained this agenda, and they have been joined in recent years by formal theorists such as Romer (1990) and Lucas (1988). As McCraw (2007) has written, the twenty-first century is shaping up to be "Schumpeter's Century," a tribute to Joseph A. Schumpeter (1942), the towering figure whose work in the first half of the twentieth century set the stage for the advances of the post-World War II period.

Early studies of technology and economic growth in the post-World War II period centered on the contributions of formal R&D. Economic dynamism in these decades was

perceived to flow from the investments made by large organizations with big R&D budgets, including public agencies, like the Department of Defense and the National Aeronautics and Space Administration, and multinational companies, such as IBM and General Electric. In his 1952 book *American Capitalism*, John Kenneth Galbraith described the large company as an "an almost perfect instrument" of technological development. Galbraith argued that oligopoly provided a sufficient level of competition to stimulate innovation, while also assuring an adequate resource flow to fund large-scale R&D operations and sufficient confidence that the benefits of these investments would be reaped by firms that built such operations.

This conventional wisdom was not entirely accurate. Beneath the giant redwoods of the Fortune 500, the industrial landscape of the U.S. contained a thriving undergrowth of smaller and newer companies in the 1950s and 1960s, including some seedlings that would grow into giants themselves, toppling their elders as they did so. (Acs and Audretsch 1990) The post-World War II period heralded not only the expansion of large U.S.-based multinational companies but also the invention of whole new institutional forms, such as the venture capital firm and the high-tech start-up, that would eventually blossom into a unique entrepreneurial ecology in places like California's Silicon Valley and Boston's Route 128. (Kenney 2000, Kenney and Hsu 2007) Indeed, the environment in the U.S. for high-growth, high-tech start-up companies grew more hospitable as the twentieth century wore on, culminating in the entrepreneurial frenzy of the dot-com boom that brought the century to a close.

Recent research suggests that high-growth entrepreneurship is linked to a variety of important economic outcomes. Acs and Audretsch and their collaborators have shown in several studies that business start-ups are associated with economic growth at the regional and national levels. For instance, Acs and Mueller (2008) demonstrate that sustained economic benefits from entrepreneurship at the regional level derive only from young, medium-sized enterprises and not from small businesses in general or the establishment of branch plants of large firms. Haltiwanger (2009) provides evidence that companies that are less than five years old account for nearly all net job creation in the U.S. Autio (2005) summarizes a variety of studies (including Wong, Ho, and Autio 2005) showing that 1-10% of new firms generate 40-75% of new jobs. Henrekson and Johansson (2008, 14) summarize the "clear-cut result" in empirical literature covering several countries, including the U.S.: "a few rapidly growing companies generate a disproportionately large share of all new net jobs…" In addition, as Scherer (1992) points out, competition from new entrants, even if they fail, forces their older rivals to adapt or die and thus drives productivity growth across the broader economy.

Although young, high-growth companies are present in a wide variety of industries, the dynamics of those in high-technology sectors are especially important for scholars and policy-makers to understand. These companies are more likely than others to be pursuing opportunities associated with radical innovations that produce positive knowledge externalities and that may have transformative consequences for society. Because such opportunities are so challenging and so risky, existing businesses are particularly unlikely to find out about them or to pursue them. (Utterback 1994, Christensen and Rosenbloom

1995) High-technology start-ups are one of the main organizational vehicles by which new knowledge in the science and engineering disciplines are converted into economic benefits. (Acs, et al. 2009, Acs, Audretsch, and Strom 2009)

It is not surprising, then, that the federal government has made significant efforts to foster technological innovation, at first mainly by investing in R&D and more recently by seeking to stimulate entrepreneurship, especially in high-tech sectors. The federal R&D budget is about $150 billion per year, to which more than $20 billion was added for FY09 and FY10 by the February 2009 economic stimulus package. Since 1982, a designated fraction of this budget across the major R&D agencies has been devoted to the Small Business Innovation and Research (SBIR) program, which supports many innovative small companies. (Wessner 2007) The creation of SBIR was part of a larger package of policy initiatives that dates to the late 1970s, that expanded the impact of the federal government on high-tech start-ups. These initiatives included the relaxation of the "prudent man" rule for venture capital investment in 1978, the 1980 Bayh-Dole Act governing intellectual property generated by federal R&D funding, the National Cooperative Research Act of 1984, and the reorientation and renaming of the National Institute of Standards and Technology in 1988. (Hart 1998, Hughes 2005, Graham 1992)

Many state governments reached the conclusion that TBED deserved their attention in the same period or even earlier. North Carolina's development of Research Triangle Park is a pioneering example that dates back to the 1950s. In addition to seeking to capitalize on federal R&D funding, including SBIR, states have experimented with a wide variety of

programs, including support for academic R&D and technology transfer, venture capital investing, loan programs for small businesses, workforce upgrading, and more. (Clarke and Gaile 1989, Waits 2000, Pages, Friedman, and von Bargen 2003) The central goal of these diverse efforts was to enable organic growth of existing businesses within the state and to nurture new ones, rather than to chase the elusive "smokestacks" (that is, branch plants of large enterprises) that might move to the state from elsewhere. Peter Eisinger (1988) captured the trend for scholars in his book *The Rise of the Entrepreneurial State*, and David Osborne (1988) popularized it the same year in *Laboratories of Democracy*. A recent review of state initiatives in economic development by the National Governors Association (NGA) shows that TBED policy momentum at the state level has been sustained, as states seek to shift the basis of competitive advantage from cost reduction to knowledge creation, innovation, and entrepreneurship. (NGA 2006)

The contribution of immigration to entrepreneurially-oriented TBED has not gone unnoticed. American universities, for example, have long argued that their ability to attract the best students and faculty regardless of nationality was an essential element of the country's global leadership in science and, by extension, high-tech innovation. Recent developments have drawn greater attention on this issue. From Richard Florida's (2002) use of a "melting-pot index" to explain high-tech entrepreneurship at the regional level to the debate over the H1-B visa program, which is described in the next section, U.S. policy-makers are focused as never before on the linkage between foreign-born talent and high-tech entrepreneurship.

2.2 Immigration

Immigration is a volatile and complex policy issue that engages many moral, social, and cultural concerns, but its economic implications are perhaps most politically salient. Public interest has concentrated especially on the economic impact of the unskilled and poorly-educated workers who comprise the bulk of the immigrant flow. Some advocates argue that these immigrants fill necessary jobs that would otherwise go wanting, especially so-called "3D" (dirty, difficult, and dangerous) jobs. Others argue that low-skill immigration displaces native-born workers and drives down wages. Both positions find some support in the scholarly literature. Borjas (1999), for one, argues that low-skill immigration redistributes wealth from low-skill natives to high-skill natives and the owners of capital. Card (2005, p. 2) counters that "evidence that immigrants have harmed the opportunities of less educated natives is scant," while Ottaviano and Peri (2006) find that once the economy equilibrates most native workers actually benefit from immigration.

High-skill immigration cannot be entirely separated from this broad debate about the economic impact of immigration. The annual quota for legal permanent residence ("green cards"), for instance, must be divided among immigrants at all skill levels, which means that policy-makers must weigh the merits of high-skill immigration against those of low-skill immigration. The distribution of approximately one million green cards each year is currently dominated by low-skill applicants. Applicants who have family ties to the U.S. receive about two-thirds of these places, while only about 11% are awarded to principal applicants on the basis of their job skills. Proposals to expand the share of

employment-based green cards and to institute a “point system” that would have benefited the highly-skilled met with fierce resistance from defenders of the current system during the 2007 immigration debate in Congress.

In addition to being linked legislatively and administratively, the debates about high-skill and low-skill immigration are linked ideologically and analytically. Advocates of a more expansive immigration policy claim that highly-skilled immigrants fill positions that natives will not or cannot fill. These are not “3D” jobs, as in low-skill immigration, but rather highly technical ones in the science, technology, engineering, and mathematics (STEM) fields. American students, responding to the national culture and the educational system, they argue, have lost the taste for entering such challenging fields. Yet, educating STEM students and filling STEM jobs, the argument continues, is essential to drive technology-based economic growth. House Speaker Nancy Pelosi, echoing the National Academy of Sciences report *Rising Above the Gathering Storm* (2005), recently called for the country to be more aggressive in recruiting highly-skilled immigrants, for instance, by “stapling a green card to the diploma” of foreign graduate students. (Mervis 2009) These advocates find support in studies like those of Kerr and Lincoln (2008) and Hunt and Gauthier-Loiselle (2008), which use patent data to demonstrate a “crowding-in” effect, in which the presence of foreign-born inventors stimulates more native-born invention.

Advocates of a more restrictive policy argue that highly-skilled immigrants “crowd-out” their native-born counterparts. The Economic Policy Institute (2007), for example,

argues that some measures under debate would lead to more offshore outsourcing, lower wages, and reduced job opportunities for technology industry workers. The share of native-born students interested in STEM fields up through the undergraduate level, this perspective maintains, has not declined. However, many of these students leave these fields in response to labor market signals that reveal that their earnings will be substantially higher in other fields, such as law, medicine, and finance. (Lowell and Salzman 2007) Advocates on this side of the debate can cite in support of their views the work of scholars like Borjas (2005), who estimates that a 10% rise in foreign doctoral students in a field depresses wages by about 3%, and Levin et al. (2004), who find that foreign doctoral recipients displace the native-born from science and engineering positions.

The H1-B visa, a category of temporary visas for highly-skilled workers, illustrates the situation well. This visa was created by the immigration act of 1990, which significantly expanded immigration overall, with a cap of 65,000 per year. The cap was tripled by Congress in the late 1990s, as high-tech companies clamored for qualified help during the Internet boom. It has since returned to its original level, but because H1-B visa holders can stay in the country for up to six years and because of a variety of exemptions to the cap, an estimated 500,000 now reside here. (Lowell 2006) Both sides of the debate find fodder in the H1-B experience. Kierkegaard (2007, 72), for instance, concludes that H1-B visa holders are "complements to U.S. workers, rather than substitutes." Lowell (quoted in Bhattacharjee 2007), on the other hand, views the H1-B as "de facto bondage" to employers, which depresses salaries of native workers.

Since the failure of the 2007 immigration bill in Congress, the U.S. immigration policy debate has receded somewhat,[2] but the global context in which it is being made remains quite dynamic, especially with regard to high-skill migration. (Skills Research Initaitive 2008) Traditional countries of immigration that have long favored the highly-skilled, such as Canada and Australia, continue to adjust their policies to maintain or expand the flow of these immigrants. Canada, for instance, now attracts about ten times as many educated immigrants relative to its population as the U.S. does, although unlike the U.S., it also loses many highly educated workers through emigration (mainly to the U.S.) (National Science Board 2008) The high-skill immigration policies of the smaller English-speaking countries have a Red Queen aspect to them – they have to run harder just to stay in the same place.

Countries that have not historically been receptive to immigration, like Germany and Japan, have also stepped up their efforts to attract scientific and technical talent. (Hart 2006) The European Union as a whole is in the midst of launching a "Blue Card" program that aims to attract highly-skilled migrants to Europe and facilitate their movement within the EU. (EurActiv 2008) Middle- and lower-income countries are now in the global talent game as well. The successful strategies of Taiwan, Ireland, and Israel, which entered high-tech sectors while wooing home expatriates from Silicon Valley, are being emulated by China and India, among others. (Saxenian 2006) Countries of emigration like these are also making more aggressive efforts to retain talented young

[2] The Obama administration has recently suggested that it will seek comprehensive immigration reform legislation in the current Congress.

people who in the past would have seen going abroad as their only viable option for professional success and entrepreneurial opportunity.

It would be inaccurate to conclude that the U.S. has lost its place as the central hub of the global system for high-skill migration. The foreign student population in the U.S. is growing smartly, new restrictions imposed after 9/11 and new competition abroad notwithstanding. (Lowell et al. 2007) The H1-B visa cap was over-subscribed on the first day that applications were permitted in 2008 and will likely be hit again in 2009.[3] The backlog for employment-based green cards totals more than 500,000 applicants. (Wadhwa et al 2007) But the U.S. immigration system is widely viewed as incoherent, lacking logical pathways to adjust from one status to another. Its administration is perceived by nearly all stakeholders as arbitrary and capricious, only loosely connected, if at all, to the goals of the policy. It seems unable to respond to changes in the rest of the world.

[3] USCIS reported on April 9 that it had received approximately 42,000 H1-B visa applications for the fiscal 2010 year, which begins in October.

3.0 Theoretical Context

Our research answers the empirical question "how many high-tech immigrant entrepreneurs are there?" In this section, we describe why this question is interesting from a theoretical perspective. There are, in fact, theoretical reasons to think both that the foreign-born will be *over*-represented in high-tech entrepreneurship and that they will be *under*-represented. Building on the seminal work of Shane and Venkataraman (2000), we define entrepreneurship as the creation, recognition, and exploitation of opportunities to supply future goods and services. (Hart forthcoming) The creation of opportunities is a societal function, but the characteristics of individual entrepreneurs, including their nativity, influences whether they recognize and exploit these opportunities.

3.1 Recognition of Entrepreneurial Opportunity

Our understanding of how and why entrepreneurs recognize opportunities is incomplete. Some part of the process may never be entirely comprehensible from the outside, depending on an ineffable "flash of creative genius," as Justice William O. Douglas famously described the process of invention. (*Cuno Engineering* 1941) But we can say with some confidence that recognition of entrepreneurial opportunity depends in part on psychological attributes and in part on knowledge and experience, with the latter weighing particularly heavily in high-tech entrepreneurship. And we know that foreign-born residents of the U.S. are different in both of these respects from the native-born.

The most commonly accepted distillation of the psychological element of entrepreneurial opportunity recognition is "alertness." (Kirzner 1973) Some people are on the lookout

for opportunities, while others are not. This attribute may be passed down through families, either through nature or nurture; the children of entrepreneurs are more likely than others to become entrepreneurs themselves. Immigrants may also be more "alert" in this sense than native-born. Those who come to the U.S. for education or employment, for instance, have, at a minimum, recognized opportunities for personal achievement outside the borders of their native land. This group is the end product of a self-selection process that separates them from those in their home countries who do not migrate, in part on the basis of the capacity to recognize opportunities.

Educational attainment is easier to measure than "alertness." High-tech entrepreneurs have higher levels of educational attainment than the general public. The Global Entrepreneurship Monitor finds, for instance, that nascent entrepreneurs who expect to create many jobs are better educated than other entrepreneurs. (Bullevag 2005) High-tech entrepreneurs are also more likely to have degrees in science and engineering (S&E) disciplines than other fields. The foreign-born are disproportionately represented in these disciplines in U.S. higher education. Foreign students comprised 25% of all S&E graduate students in 2005, with the highest concentrations in engineering (45%) and computer sciences (43%). (NSB 2008, p. 2-21) The National Science Board points out that "[n]oncitizens, primarily those with temporary visas, account for the bulk of the growth in S&E doctorates awarded by U.S. universities from 1985 through 2005... The temporary resident share of S&E doctorates rose from 21% in 1985 to 36% in 2005." (NSB 2008, p. 2-31)

Many foreign students, perhaps two-thirds of them, stay in the U.S. after graduation and join the labor force. Given their academic training, it is not surprising that the foreign-born are disproportionately present in S&E occupations. The U.S. Census Bureau, for instance, estimates that 26% of college-educated workers in such occupations were foreign born, compared to their 12% share of the overall population. (NSB 2008) This population has been growing steadily in recent years. "In the 2000 census, about 43% of all college-educated, foreign-born individuals in S&E occupations (62% of doctorate holders) reported arriving in the United States after 1990." (NSB 2008, p. 3-50) The formal knowledge reaped from their education and the business experience gained from their work combine to provide the prerequisites for over-representation of the foreign-born in U.S. high-tech entrepreneurship.

Although their educational and occupational backgrounds are similar, foreign-born high-tech entrepreneurs may recognize different opportunities than their native-born counterparts. As Carlsson and Jacobson (1997) put it (in a different context), the blending of cultures experienced by immigrants may enlarge the "search space" in which opportunities are sought. Immigrants may see, for instance, potential markets or supply chain relationships in their native lands that are not visible to those who lack their knowledge and experience. People holding diverse values may also resolve uncertainties about the same opportunity differently. These differences may then drive disagreements about how promising that opportunity is, leading to spin-offs from existing businesses, and start-ups of brand new companies, to exploit that opportunity. The work of Florida (2002, 2005) and Ottaviano and Peri (2006) suggest that there is an association between

social diversity due to foreign and domestic nativity on the one hand and levels of entrepreneurship at the regional and national levels on the other.

We have emphasized in this section the theoretical factors that lead us to hypothesize that the foreign-born will be over-represented in high-tech entrepreneurship, but we also want to point out as well that there are factors that pull in the opposite direction. Language barriers, for instance, may make it difficult for even highly-educated and well-experienced foreign-born technical experts to recognize entrepreneurial opportunities quickly enough to seize them. Language proficiency in general is the most important determinant of immigrant success in the labor market. (Borjas 1999) Foreign-born experts may also be more likely to pursue (or to be shunted into) technical career ladders and get off of the management track. This career path leads to less exposure to market trends and customer feedback that may give rise to the "flash of creative genius" that sparks an entrepreneurial venture.

3.2 Exploitation of Entrepreneurial Opportunity

It is one thing to recognize an entrepreneurial opportunity and another to take advantage of it by creating a new business. Like recognition of opportunity, exploitation of opportunity involves both the attitudes and the attributes of the entrepreneur. The foreign-born and native-born populations differ in important ways with respect to both. These differences, more so than those that bear on opportunity recognition, provide arguments both for and against over-representation of the foreign-born among U.S. high-tech entrepreneurs.

We can conceive of the attitudinal factors that determine entrepreneurial behavior as involving both rational calculation and speculative risk-taking. Rational calculation involves the financial tradeoff of giving up, at least temporarily, what is usually a reasonably secure and remunerative position for a new and uncertain career trajectory. This calculus may also encompass the utility derived from personal satisfaction and social esteem that flow from one's choice. The foreign-born may have less to lose from taking the entrepreneurial plunge than the native-born in these respects, particularly if discrimination blocks their promotion within existing businesses. The opportunity cost of entrepreneurship is lower in such a circumstance. On the other hand, they may also perceive greater difficulties in getting back on their old career track in the likely case of failure, and so be reluctant to become entrepreneurs.

The rational calculation of costs and benefits is inevitably incomplete, and potential entrepreneurs must fill in the gaps with guesses and beliefs. For those who move forward in entrepreneurship, these guesses and beliefs typically reflect optimism and a penchant for risk. The stereotypical immigrant in American folklore possesses just these qualities, suggesting that foreign-born individuals will more likely make the decision to start a company than native-born individuals with similar backgrounds. However, this stereotype does not characterize all highly-skilled immigrants. For some, the reasons for immigration may have less to do with seeking a fortune than in finding security, in which case their decisions will be biased against entrepreneurship.

The exploitation of high-tech opportunities requires that entrepreneurs draw not only their own resources, but also on those of colleagues and of society more broadly. These resources include including money, talent, contacts, and knowledge. Access to these resources quickly and at a reasonable cost depends on the entrepreneurs' social capital – that is, the networks in which they are embedded and the levels of trust that exist in these networks – and the social institutions that surround the high-tech start-up process. Some key networks in the U.S. high-tech sector, most notably those that provide access to venture capital, seem to be comprised by "bonding" social capital, epitomized by "old-boys clubs." Brush (2003), for example, shows that female entrepreneurs tend to be excluded from these networks, and the foreign-born may suffer from a similar process of discrimination in seeking financial support.

The dominance of "old-boys clubs" ought to reduce the probability that foreign-born entrepreneurs can effectively exploit the opportunities that they perceive. Saxenian (2006), though, has shown that, at least in some cases, foreign-born high-tech entrepreneurs take effective advantage of their own "bonding" social capital in the form of networks of co-ethnics and linkages to their countries of origin. Ethnic professional associations and alumni clubs, for instance, provide access to potential new hires and funders. The Indus Entrepreneurs, an organization of U.S. residents from South Asia, for example, aims to enhance the social capital of its membership. Some foreign governments have also enacted "diaspora policies" that support these kinds of networks and even provide venture capital to high-tech entrepreneurs abroad. Scotland, Chile, South Africa, and Armenia are among the countries that have undertaken such policies,

demonstrating the breadth of the appeal of this idea. (Ionescu 2006, Kuznetsov and Sabel 2006)

We can conclude that theory does not provide conclusive guidance about the relative representation of foreign-born and native-born in the population of high-tech entrepreneurs. Although like most others in this field, we would expect the factors that predict over-representation to dominate those that predict under-representation, the issue can only be resolved through empirical observation of the sort that we have undertaken.

4.0 Prior Research

Empirical research on immigrant entrepreneurship in the U.S. is growing. In recent years, several authors have focused on high-tech entrepreneurship. However, no study before this one has studied as carefully the role of immigrant entrepreneurs in the key companies that drive job creation and growth in the U.S. economy.

4.1 Immigrant Entrepreneurship in General

Research on immigrant entrepreneurship is dominated by the study of self-employment, ethnic enclaves, and, most recently, transnationalism. This literature finds that the foreign-born are more likely to start companies than the native-born. (Fairlie 2008, Light and Rosenstein 1995) Most of these businesses, like most of those started by the native-born, remain very small, often employing no one other than the owner. Immigrant-founded companies play key roles in creating and sustaining ethnic communities in major

U.S. cities, such as Los Angeles and Miami. (Light and Gold 2000) Business networks, populated by highly-educated elites who have deep roots in the U.S., link these communities to their countries of origin. (Portes, Guarnizo, and Haller 2002) Immigrant entrepreneurs from particular ethnic groups tend to concentrate in specific niches, including high-skill as well as low-skill sectors. (Fairlie 2008, Federman, Harrington, and Krynski 2006)

4.2 High-Tech Immigrant Entrepreneurship

Saxenian (1999) pioneered research focused specifically on high-tech immigrant entrepreneurship. She observed that Indians and Chinese were an increasingly visible presence within Silicon Valley and that many had founded start-ups there, in part because of the "glass ceiling" that blocked their promotion within existing high-tech companies. She discovered that 24% of Silicon Valley start-ups between 1980 and 1998 had CEOs with Chinese or Indian surnames, although she was unable to distinguish their location of birth. Qualitative research revealed that the Indian and Chinese high-tech communities, like ethnic enclaves in the rest of the economy, were sustained by a rich network of associations and maintained linkages to their countries of origin.

Saxenian's work demonstrates that high-tech immigrant entrepreneurship is very important for Silicon Valley (and for the home countries of the immigrants as well), but because it concentrates on the region of the U.S. in which high-tech immigrant entrepreneurs are most likely to be found, one cannot generalize from it. More recent studies by the National Venture Capital Association (Anderson and Platzer 2006) and the

Massachusetts Biotechnology Association (Monti et al. 2007) have a similar positive selection bias in their approach to the subject and report similar results, a rate of immigrant founding of about 25%. Hsu et al. (2007) and Bhide (2008) also study elite groups, MIT alumni and venture capital-backed companies respectively, and find that non-U.S. citizens and foreign-born in these groups are more likely to be entrepreneurs than U.S. citizens and native-born.

Wadhwa et al. (2007b) seek to generalize Saxenian (1999) to the national level and update it with more recent data. They find that 25% of high-tech companies founded between 1995 and 2005 that had achieved more than $1 million in sales or employed more than 20 people had CEOs or CTOs who were born abroad. This is a valuable study, but it has important weaknesses. The $1 million size threshold excludes a large proportion of high-tech companies that may still be growing rapidly and making important economic contributions. By limiting "founder" to CEO or CTO, the study may exclude up to half of all founders. (Burton 1995, Hannan, Burton, and Baron 1996) Finally, the survey methods used do not appear to have met professional standards to ensure accurate and unbiased results.

Two large national survey projects yield results that are substantially lower than those of Wadhwa et al (2007b). The Kauffman Firm Survey (DesRoches et al. 2007), is a random sample of all companies founded in 2004, and it over-samples high- and medium-tech sectors. About 16% of the companies in the over-sampled sectors reported having at least one foreign-born founder. The weakness of this study for our purposes is that the

sampling frame includes companies with zero or one employees, which comprise the vast majority of U.S. start-ups, but which do not drive aggregate economic performance. The Panel Study of Entrepreneurial Dynamics is a representative national sample of individuals involved in business founding. (Reynolds and Curtin 2007) Of those in this group who expected their companies to create 50 or more jobs after 5 years (about 5% of the sample), 15% were foreign-born. These results, too, are indicative, but not definitive, since they are based on expectations rather than outcomes and the absolute numbers involved are very small.

The main findings of the earlier studies covered in this section are summarized along with our own key findings in Table 1 below.

5.0 Data and Methods

Our study focuses on foreign-born founders of "high-impact" companies (HICs) in high-tech sectors. As Acs, Parsons, and Tracy (2008) show, high-impact companies account for the bulk of job creation and economic growth in the U.S. High-tech companies within this group are disproportionately important, because of the positive externalities they generate for companies in the rest of the economy. We conducted a professional-quality survey that produced a representative national random sample of these companies.

5.1 The American Corporate Statistical Library (ACSL)

The universe of companies from which our population and survey sample were drawn is the Corporate Research Board's American Corporate Statistical Library (ACSL). The ACSL is among the most comprehensive business databases in the U.S., containing more than 140 variables on all business establishments in the country. The ACSL links each establishment over time from its birth through any physical moves it makes, capturing changes in ownership along the way, and recording the establishment's death if it occurs. The result is a unique longitudinal business file that allows for micro- and macroeconomic analysis of the U.S. economy. Corporate Research Board updates the ACSL every 6 months, drawing on hundreds of public and private sector data sources.

5.2 2007 SBA High-Impact Company Study

We draw upon prior SBA-sponsored work by Acs, Parsons, and Tracy (2008), which identified all HICs in the ACSL for the period 2002-2006. An HIC is an enterprise the sales of which have at least doubled over the most recent 4-year period and which has an employment growth quantifier of 2 or greater over the same period. There were 376,605 HICs (approximately 2.2% of all companies) in the U.S. between 2002 and 2006.

5.3 Definition of Survey Population

From this group of HICs, we selected those classified by the ACSL as having their primary activity in a high-tech industry. An industry is defined as a 3-digit Standard Industrial Classification (SIC). Our list of high-tech SICs appears in Appendix 1. There are 49 such industries, 44 in the manufacturing domain and five in the services domain.

Our definition of "high-tech" draws heavily on the work of the Bureau of Labor Statistics (Hadlock, Hecker, and Gannon 1991), which uses R&D employment as a share of total employment as the key criterion. We also include several other industries that have a high ratio of R&D spending to total revenues, which are identified in Varga (1998). Our list of high-tech sectors is very similar to that used by the Kauffman Firm Survey to define both "high-tech" and "medium-tech" industries. The total population of HICs for 2002-2006 in our 49 high-tech SICs was about 24,000. 17,000 (about 70%) of these companies were in the five service SICs; the remaining 7,000 were in manufacturing sectors. Computer and data processing services (SIC 737) and engineering and architectural services (SIC 871) were the industries containing the largest number of HICs, together accounting for about half the total.[4]

5.4 Survey Method

Our strategy for the design of the survey questionnaire was to keep it short and simple. Although a short, simple instrument yields less information about each company than a long, complicated one, it allows for a wide range of potential respondents within each company and avoids the requirement that a senior decision-maker be reached, boosting the response rate. The short and simple approach also minimizes respondent error.

OMB approval for this instrument was granted on August 6, 2008. It asks about the respondent company's technological and business activities in general terms, such as whether it has an R&D laboratory or holds patents. It then concentrates on the

[4] We dropped SIC 874, management and public relations, which met the BLS definition. Nearly 15,000 HICs were found in this SIC, a very large number, which would have skewed our results.

company's founders, gathering information for each founder about his or her home country, U.S. citizenship status, length of residence in the U.S., educational background, gender, race, and relationship with other members of the founding team.

We estimated in advance that the response rate to our survey would be about 15%. We sought to obtain a sample of 1,000 companies. We therefore purchased contact records from Dun and Bradstreet for about 7,000 high-tech HICs. These records were provided to our survey contractor, the George Mason University Center for Social Science Research.

The survey was administered between October 2008 and January 2009. Telephone interviewers received general training as well as training specific to the questionnaire. For quality assurance purposes, supervisors used wireless headsets to monitor telephone interviews, providing both audio and visual access to interviewer performance. Telephone numbers were called up to eleven times at varying times of day, particularly during weekdays, with times varying to accommodate different time zones. To help maximize response rates, the computer-assisted telephone interviewing (CATI) system was programmed to make callbacks until a final disposition was reached. Interviewers set specific call back appointment times whenever appropriate, and these were automatically processed by the CATI program to be called at the specified time.

We received data for 1,415 completed surveys. The response rate for the survey was higher than our prior estimate. The gross rate (completed surveys/all numbers called)

was 24%. The response rate for eligible respondents who were actually reached (completed surveys/completed surveys + refusals + terminated early) was 53%.

6.0 Findings

The main findings of the survey are presented in this section. Our key finding is that about 16% of the companies in the sample reported that at least one of their founders was foreign-born. (See Table 1.) This rate is very close to the rate found by the Kauffman Firm Survey, despite the fact that the populations sampled were quite different. 81% of the companies in our sample reported that all of their founders were born in the U.S., and 3% of the respondents did not know the answer to this question or refused to answer it. Although the 16% rate is at the low end of the range of published studies reported above, it nonetheless represents a substantial fraction of HICs.

Table 1: High-Tech Immigrant Entrepreneurs – Comparison Across Studies

Author	Year Released	Population	Foreign-Born	Definition
Saxenian	1999	D&B custom database of high-tech firms founded in Silicon Valley, 1980-1998, in selected SICs.	24%	Companies that have CEOs with Chinese or Indian surnames.
Anderson and Platzer (NVCA)	2006	Publicly traded, venture-backed companies that are still independent, 1990-2005, as tracked by Thomson Financial.	25%	Companies with at least one foreign-born founder (self-defined), as stated by respondent or listed in public or Internet documents.
Monti, Smith-Doerr, and MacQuaid (MBA)	2007	Biotech firms founded in New England from Mass. Biotech. Assn. members' list.	26%	Companies with at least one foreign-born founder (self-defined) as stated by respondent or listed on company website.
Wadhwa et al.	2007	Firms founded between 1995 and 2005 listed in *D&B Million Dollar Database* ($1M or more in sales, 20 or more employees) in selected SICs.	25%	Companies with foreign-born CEO or CTO, as stated by respondent.
Reynolds and Curtin	2007	U.S. adults (Panel Study of Entrepreneurial Dynamics I and II).	15%	Nascent entrepreneurs who expect to have substantial impact (50+ jobs) who reported being foreign-born.
DesRoches et al. 2007	2007	Kauffman Firm Survey, high- and mid-tech firms founded in 2004.	16%	Companies with at least one foreign-born founder (self-defined) as stated by survey respondent.
Hart et al. (this study)	2009	High-impact companies as identified in Acs et al. 2007 from ACSL in selected SICs.	16%	Companies with at least one foreign-born founder (self-defined) as stated by survey respondent.

6.1 Profile of Immigrant Founded Firms (IFCs)

The demographics of immigrant-founded companies (IFCs) are very similar to those of native-founded companies (NFCs), with the exception of their location. The distributions of the two groups of companies between manufacturing and services (see Table 2) and across age categories (see Table 3) were not significantly different in a chi-square test. The distributions across SICs showed some statistically significant differences (for instance, IFCs are over-represented in business services and electronics), but the overall pattern is very similar to that of NFCs. (See Figure 1.) The locations of IFCs correspond with the locations of foreign-born populations in generally. They are disproportionately concentrated in states with high and very high shares of foreign-born residents, such as California and Texas. (See Figure 2.)

Table 2: Companies by Founder Nativity and Sector

Sector	Native-Founded	Immigrant-Founded	Total
Manufacturing	343 (32.60%)	56 (27.32%)	399 (31.74%)
Service	709 (67.40%)	149 (72.68%)	858 (68.26%)
Total	1,052 (100.00)	205 (100.00)	1257 (100.00)
	Pearson chi-squared (1) = 2.2138		P = 0.137

Source: authors' calculations

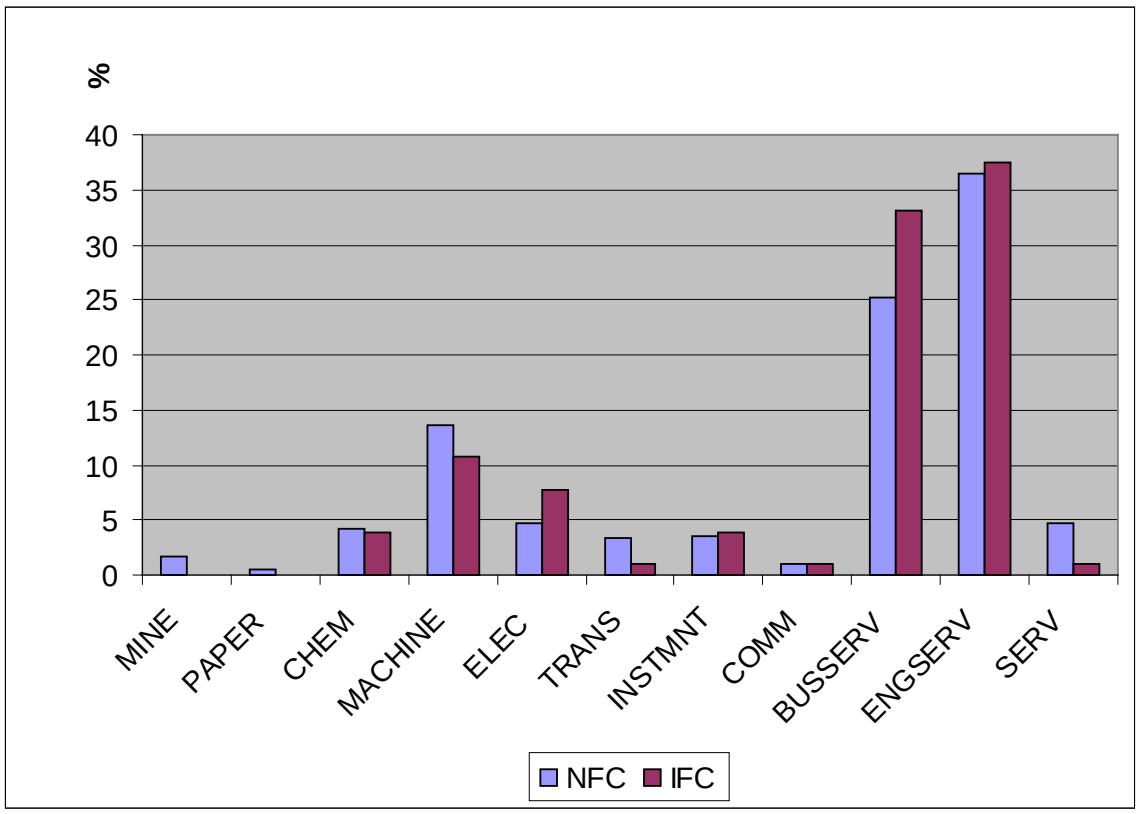
Table 3: Companies by Founder Nativity and Company Age

Age	Native-Founded	Immigrant-Founded	Total
Less than 10 years	305 (30.17%)	69 (34.33%)	374 (30.86%)
10 to less than 20 years	415 (41.05%)	83 (41.29%)	498 (41.09%)
20 to less than 30 years	171	27	198

	(16.91%)	(13.43%)	(16.34%)
30 years and above	120 (11.87%)	22 (10.95%)	142 (11.72%)
Total	1,011 (100.00)	201 (100.00)	1,212 (100.00)
	Pearson chi-squared (3) = 2.3088		P = 0.511

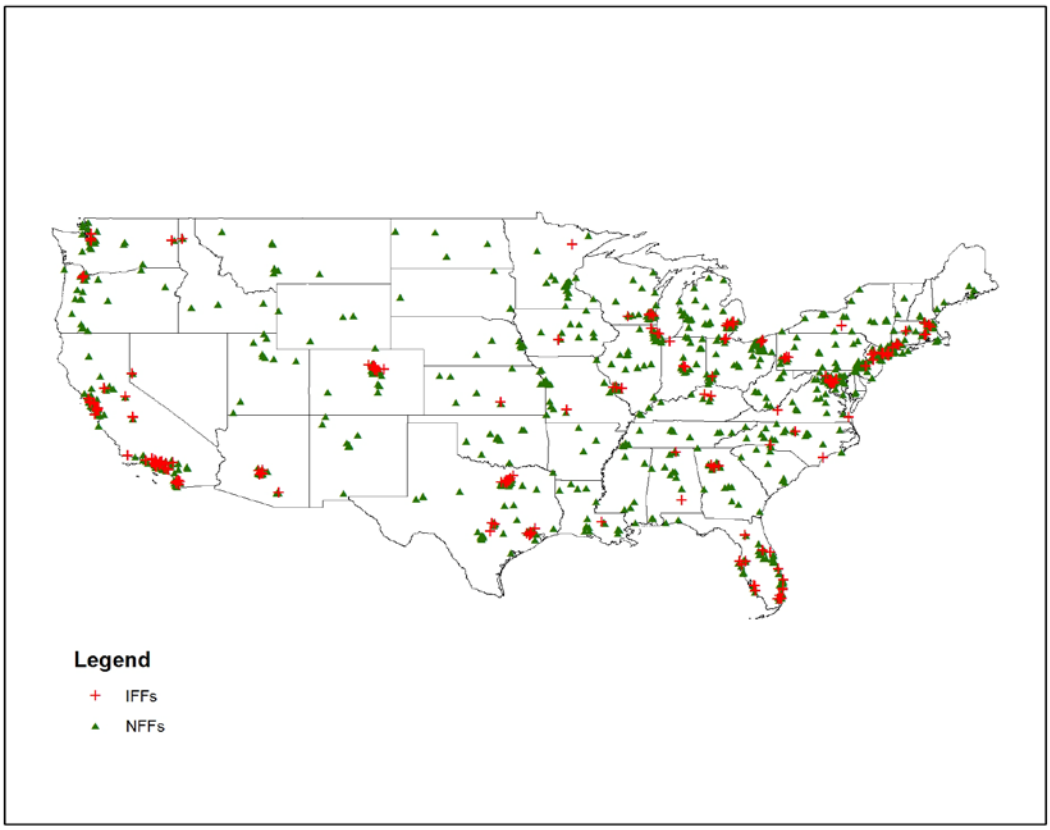
Source: authors' calculations

Figure 1: Companies by Founder Nativity and 2-digit SIC



Source: authors' calculations

Figure 2: Geographical Distribution of Companies by Founder Nativity



Source: authors' calculations

In bivariate tests of economic performance, IFCs outperform NFCs. We use company employment as the dependent variable for economic performance, because it is generally regarded as more reliable in the D&B data than company revenue. Using three categories of company size (less than 20 employees, 21-100 employees, and more than 100 employees), we found that IFCs are more likely to be in the higher categories to a statistically significant degree. In particular, about 33% of the IFCs were in the largest size group, compared with about 24% of the NFCs. (See Table 4.) However, regression results generally suggest that controlling for age and other factors washes out this result. (See Table 5.)

Table 4: Companies by Founder Nativity and Employment (bivariate)

Employment	NFC	IFC	Total
Low Employment (<20 employees)	175 (16.56%)	35 (17.07%)	210 (16.64%)
Medium Employment (21-100 employees)	633 (59.89%)	103 (50.24%)	736 (58.32%)
High Employment (>100 employees)	249 (23.56%)	67 (32.68%)	316 (25.04%)
Total	1,057 (100.00)	205 (100.00)	1,262 (100.00)
	Pearson chi-squared (2) = 8.4754		P = 0.014

Source: authors' calculations

Table 5: Company Employment Regressed on Founder Nativity (multivariate w/controls)

Independent variables	Coefficient	P value
Founder nativity	2.36	.83
Company age	24.95	.07

Linear regression, sample weighted by age, sector, size, and location
N = 1018
Dependent variable: company employment
Control variables (not displayed): 2-digit SIC, education level of most educated founder
Source: authors' calculations

We measured technological performance in our survey by asking whether companies conducted R&D in their own labs, contracted out R&D, and held patents. Positive responses to these questions overall ranged from 17% for contract R&D to 28% for in-house R&D, with patent-holding lying in between at about 22%. IFCs out-performed NFCs to a statistically significant degree in bivariate tests on two of these three measures. About 36% of the IFCs maintained internal R&D labs, compared to 25% of the NFCs. (See Table 6.) For patents, the difference was about the same, 29% for IFCs to 20% for NFCs. (See Table 7.) Contract R&D was out-sourced by the two groups of companies at

roughly the same rate. (See Table 8.) Although the variables for technological performance are more likely to be associated with immigrant founding than those associated with economic performance (company employment, company revenue) in a variety of specifications, the relationship is not significant in the most complete specification, which controls for company age, company employment, and other factors. (See Table 9.)

Table 6: Companies by Founder Nativity and Internal R&D

Internal R&D?	Native-Founded	Immigrant-Founded	Total
Yes	263 (25.07%)	73 (36.14%)	336 (26.86%)
No	786 (74.93%)	129 (63.86%)	915 (73.14%)
Total	1,049 (100.00)	202 (100.00)	1,251 (100.00)
	Pearson chi-squared (1) = 10.5607		P = 0.001

Source: authors' calculations

Table 7: Companies by Founder Nativity and Patent-Holding

Patent?	Native-Founded	Immigrant-Founded	Total
Yes	207 (20.45%)	55 (28.65%)	262 (21.76%)
No	805 (79.55%)	137 (71.35%)	942 (78.24%)
Total	1,012 (100.00)	192 (100.00)	1,204 (100.00)
	Pearson chi-squared (1) = 6.36		P = 0.012

Source: authors' calculations

Table 8: Companies by Founder Nativity and Contract R&D

Contract R&D?	Native-Founded	Immigrant-Founded	Total
Yes	167 (16.58%)	36 (18.95%)	203 (16.96%)
No	840 (83.42%)	154 (81.05%)	994 (83.04%)
Total	1,007 (100.00)	190 (100.00)	1,197 (100.00)
	Pearson chi-squared (1) = 0.6340		P = 0.426

Source: authors' calculations

Table 9: Company Technological Performance Regressed on Founder Nativity (multivariate w/controls)

Independent variables	Coefficient	P-value
Founder nativity	0.46	0.81
Company age (log)	-0.10	0.41
Company employment (log)	0.23	0.001

Logistic regression, weighted by age, sector, size, and location
N = 1088
Dependent variable: technological performance (dummy variable for positive response to any survey question on patenting, in-house R&D, or contract R&D)
Control variables (not displayed): 2-digit SIC, education level of most educated founder
Source: authors' calculations

IFCs are also about twice as likely as NFCs to report that they had strategic relationship with a company outside the U.S., such as a major supplier, key partner or major customer. (See Table 10.) This bivariate relationship suggests that the cross-border social capital of foreign-born founders may be employed in building IFCs and will be explored further in future research.

Table 10: Companies by Founder Nativity and Foreign Partner

Foreign partner?	Native-Founded	Immigrant-Founded	Total
Yes	238 (22.97%)	83 (41.92%)	321 (26.01%)
No	798 (77.03%)	115 (58.08%)	913 (73.99%)
Total	1,036 (100.00)	198 (100.00)	1,234 (100.00)
	Pearson chi-squared (1) = 31.00		P = 0.000

Source: authors' calculations

Of the 205 IFCs in the sample, more than half were founded only by foreign-born entrepreneurs – 85 by a single individual, 30 by a team of two, and five by teams of three or more. (See Table 11.) A single individual founded about 55% of all companies in the sample. We asked the rest of the companies about how the founders came together to create the company. Founding teams of companies with at least one foreign-born founder were slightly more likely to have gotten together through previous school or work relationships and slightly less likely to have done so through family relationships than founding teams made up only of U.S.-born founders. (See Table 12.)

Table 11: Immigrant-Founded Companies by Number of Founders and Founder Nativity

Total number of founders in company							
Number of foreign-born founders	1	2	3	4	5	6	Number of companies
1	85	52	14	5	3	1	160
2	0	30	4	3	0	1	38
3	0	0	4	1	0	0	5
5	0	0	0	0	2	0	2
Number of companies	85	82	22	9	5	2	205

Source: authors' calculations

Table 12: Companies with Two or More Founders by Founder Nativity and How Founding Team Came Together

How founding team came together	NFC	NFC(%)	IFC	IFC(%)
Family	149	31.97%	38	27.34%
Attended school/college together	34	7.3%	14	10.07%
Worked together previously	166	35.62%	57	41.01%
Got together to start his business	65	13.95%	15	10.79%
Something else	40	8.58%	9	6.47%
More than one reason	12	2.58%	6	4.32%
Total	466	100%	139	100%

Source: authors' calculations

6.2 Profile of Immigrant Founders

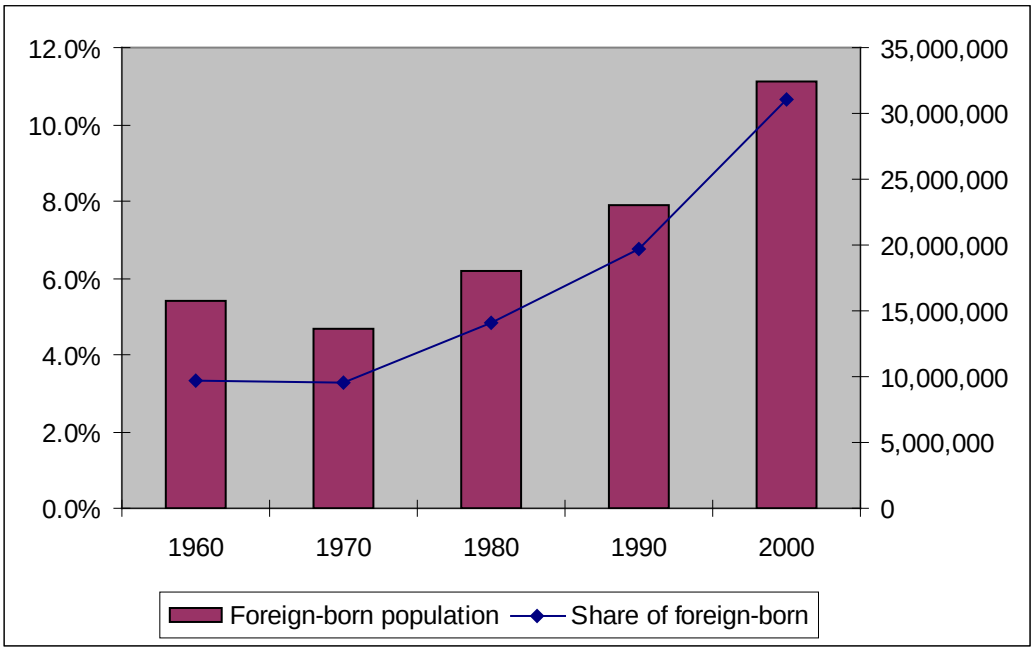
We created a second data base from our sample in which the unit of analysis is the individual founder, rather than the company. We obtained nativity data on more than 2000 founders in total from our set of some 1400 companies. Of these, 261 are foreign-born, or about 12.8%. (See Table 13.) This share is very close to the current share of foreign-born in the U.S. population and much smaller than the share in the STEM workforce and graduate student population. The foreign-born share of these populations has grown rapidly over the past several decades. In 1990, the foreign-born share of the U.S. population was 7.9%, for instance, and it was 6.2% in 1980. (See Figure 3.) (U.S. Census 1993)

Table 13: Founders by Nativity

	Number	Percentage
Native-born	1,773	87.2%
Foreign-born	261	12.8%
Total	2,034	100

Source: authors' calculations

Figure 3: Foreign-Born Population of the United States, 1960-2000



Source: U.S. Census 1993

These earlier population estimates are the most relevant comparisons for this study, rather than the current estimate, because the vast majority of foreign-born founders were reported to have lived in the U.S. for decades. The average duration was more than a quarter-century, 25.9 years. Only about 25% were reported to have been in the U.S. for less than 15 years. (See Table 14.) About 77% of the foreign-born high-tech entrepreneurs in our sample are U.S. citizens. (See Table 15.)

Table 14: Foreign-Born Founders by Duration of Stay in U.S.

Percentile	Length of Stay (years)
25%	15
50%	25
75%	38
90%	50
95%	54
99%	60

N = 233. Mean = 25.9. Std. dev. = 16.3.
Source: authors' calculations

Table 15: Foreign-Born Founders by Citizenship

U.S. Citizen?	Freq.	Percent
Yes	186	77.18%
No	55	22.82%
Total	241	100%

Source: authors' calculations

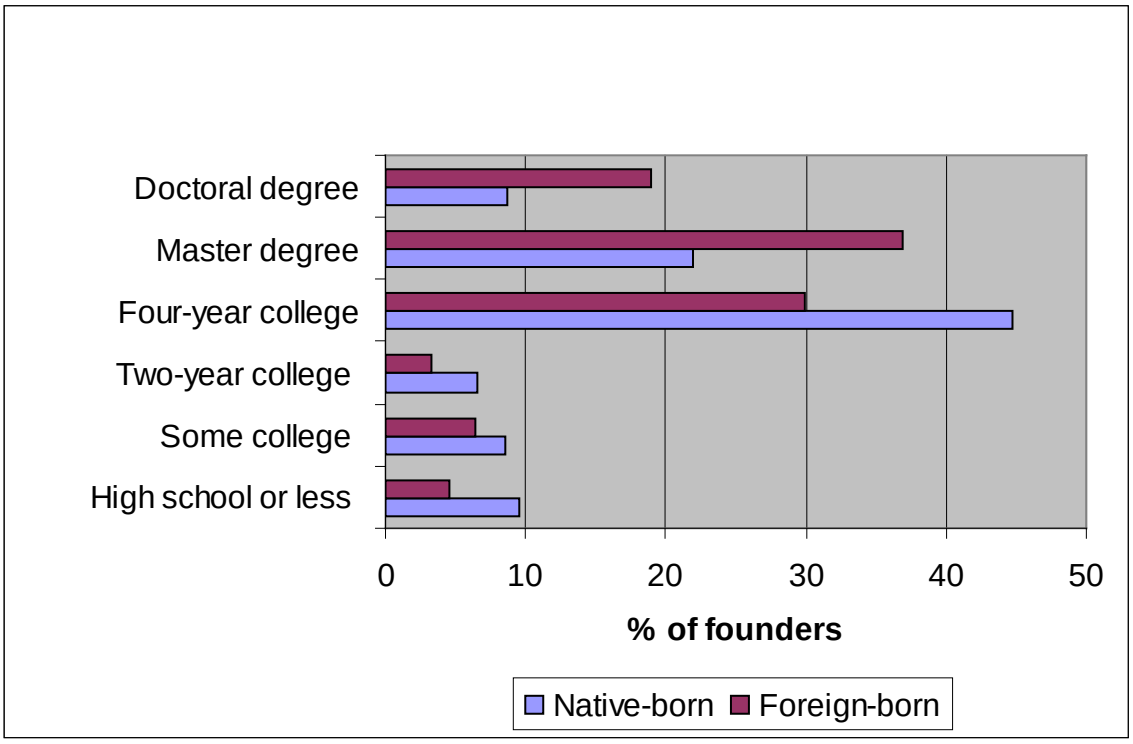
The foreign-born founders are a highly educated group. Roughly 55% of them hold a masters degree or doctorate. In fact, foreign-born founders are more than twice as likely as native-born founders to hold a doctorate and substantially more likely to hold a masters degree as well. On the other end of the spectrum, about twice as many of the U.S.-born founders (9.5%) held a high school degree or less. (See Table 16 and Figure 4.) Exactly two-thirds of the foreign-born founders about whom we have information received their highest level of education in the U.S. (See Table 17.)

Table 16: Founders by Nativity and Level of Education

Level of Education	Native-born	Foreign-born	Total
High school degree or less	154	10	164
%	9.5%	4.61%	8.92%
Some college	139	14	153
%	8.57%	6.45%	8.32%
Two year college or technical degree	107	7	114
%	6.6%	3.23%	6.2%
Four year college degree	724	65	789
%	44.66%	29.95%	42.93%
Master's degree	356	80	436
%	21.96%	36.87%	23.72%
Doctoral/professional degree	141	41	182
%	8.7%	18.89%	9.9%
Total	1,621	217	1,838
	100%	100%	100%

Source: authors' calculations

Figure 4: Founders by Nativity and Level of Education



Source: authors' calculations

Table 17: Foreign-Born Founders by Location of Highest Degree

Highest education in US?	Freq.	Percent
Yes	148	66.67%
No	74	33.33%
Total	222	100

Source: authors' calculations

The countries of origin of the foreign-born founders are diverse. 54 countries are represented in our founder database – about 28% of the United Nations' membership. India is the largest source country, accounting for about 16% of this group. The U.K. provided 10%, followed by Canada and Japan, each of which comprised 6%, and Germany, which accounted for 5%. China and Cuba were the home countries of about 3%. To China's total, one might add Hong Kong and Taiwan, which bring it up to a

third-place tie with Canada and Japan. All of the inhabited continents and major world regions are represented in the group. Table 18 lists the countries of origin, and they are broken down by region in Figure 5.

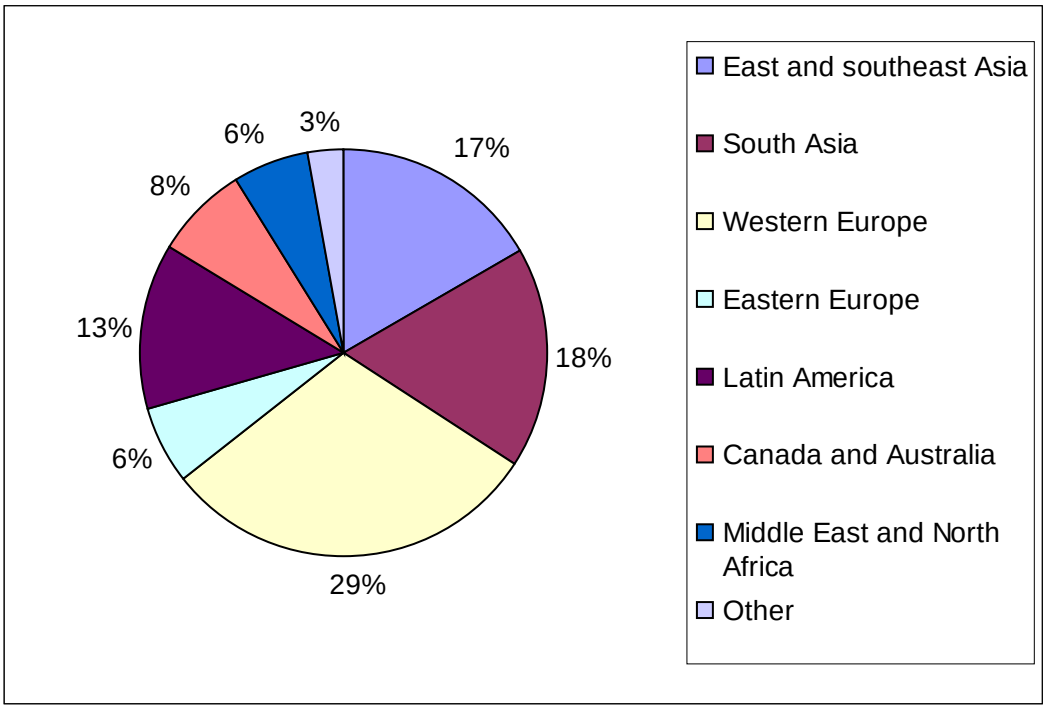
Table 18: Foreign-Born Founders by Country of Origin

Country	Number	Percentage
India	40	15.94%
UK	25	9.96%
Canada	15	5.98%
China	15	5.98%
Japan	15	5.98%
Germany	13	5.18%
Cuba	8	3.19%
Iran	7	2.79%
Russia	7	2.79%
France	6	2.39%
Mexico	5	1.99%
Vietnam	5	1.99%
Australia	4	1.59%
Belgium	4	1.59%
Ireland	4	1.59%
Korea	4	1.59%
Pakistan	4	1.59%
Ukraine	4	1.59%
Austria	3	1.2%
Brazil	3	1.2%
Italy	3	1.2%
Lebanon	3	1.2%
Netherlands	3	1.2%
Romania	3	1.2%
South Africa	3	1.2%
Switzerland	3	1.2%
Greece	2	0.8%
Haiti	2	0.8%
Holland	2	0.8%
Iraq	2	0.8%
Jamaica	2	0.8%
Philippine	2	0.8%

Serbia	2	0.8%
Sweden	2	0.8%
West Indies	2	0.8%
Argentina	1	0.4%
Burma	1	0.4%
Chile	1	0.4%
Colombia	1	0.4%
Croatia	1	0.4%
Denmark	1	0.4%
El Salvador	1	0.4%
Ghana	1	0.4%
Guyana	1	0.4%
Israel	1	0.4%
Nicaragua	1	0.4%
Nigeria	1	0.4%
Panama	1	0.4%
Peru	1	0.4%
Poland	1	0.4%
Spain	1	0.4%
Tanzania	1	0.4%
Turkey	1	0.4%
Uruguay	1	0.4%
Total	251	100%

Source: authors' calculations

Figure 5: Foreign-Born Founders by Region of Origin



Source: authors' calculations

6.3 Gender and Race of Founders

We asked respondents about the gender of all founders and the race of U.S.-born founders (using the standard categories of the U.S. Census). About 22% of all the high-tech HICs in our sample included at least one woman in their founding teams. The founding teams of IFCs were statistically significantly more likely to include at least one woman; about 30% did so, compared to about 20% of NFCs. (See Table 19.)

Table 19: Companies by Founder Nativity and Gender

Gender	Native-Founded	Immigrant-Founded	Total
All male	824 (79.46%)	142 (69.95%)	966 (77.90%)
At least one female	213 (20.54%)	61 (30.05%)	274 (22.10%)
Total	1,037 (100.00)	203 (100.00)	1,240 (100.00)
	Pearson chi-squared (1) = 8.9179		P = 0.003

Source: authors' calculations

About 15% of all the founders of the high-tech HICs in our sample are female. The female founders are distributed similarly by nativity, that is, about the same share of U.S.-born founders are female as are foreign-born. (See Table 20) Male foreign-born founders are more likely to team up with women, regardless of nativity, than male native-born founders. (See Table 21.)

Table 20: Founders by Founder Nativity and Gender

	Native-born founder	Foreign-born founder	Total
Male	1,503	218	1,721
%	85.3%	83.85%	85.11%
Female	259	42	301
%	14.7%	16.15%	14.89%
Total	1,762	260	2,022
	100%	100%	100%

Source: authors' calculations

Table 21: Companies by Founder Nativity and Gender in Companies with More than One Founder

	All founders are male	At least one founder (native-born or foreign-born) is female	Total
Companies in which all male founders are native-born	271	156	426
	63.5%	36.5%	100%
Companies in which at least one male founder is foreign-born	58	41	100
	58.6%	41.4%	100%
Total	329	197	526

Source: authors' calculations
Note:

Just over 7% of NFCs included at least one U.S. minority individual in their founding team.[5] Although the absolute numbers are very small, we find that foreign-born founders are more likely to team up with U.S. minority founders than native-born white founders. (See Table 22.)

[5] We did not ask the race of foreign-born founders, because of the great variation in racial and ethnic definitions and identities across the many countries of origin of these founders.

Table 22: Companies by Founder Nativity and Race of Native-Born Founders in Companies with More than One Founder

	All founders are white or foreign-born	At least one minority founder	Total
Native-founded companies with at least one white founder	363	21	384
	94.5%	5.5%	100%
Immigrant-founded companies with at least one native-born founder	42	10	52
	80.1%	19.9%	100%
Total	405	31	436

Source: authors' calculations

U.S. minorities comprise about 6% of all founders. Hispanic or Latino founders are the most commonly represented group, accounting for 2% of all founders, followed by African-Americans, Asian-Americans, and American Indians in that order. U.S. minorities represent about 15% of the native-born founders of IFCs, compared to about 5% of the founders of NFCs. Here, too, the small absolute number (15 U.S. minority individuals out of 102 native-born individuals who were included in the founding teams of IFCs) makes generalization hazardous.

Table 23: Native-Born Founders by Race and Company Type

	Native-founded company	Immigrant-founded company	Total
American Indian or Alaska Native	14	2	16
%	0.92%	1.96%	0.98%
Asian	15	3	18
%	0.98%	2.94%	1.1%
Black or African American	25	1	26
%	1.64%	0.98%	1.6%
Hispanic or Latino	24	8	32
%	1.57%	7.84%	1.96%
Native Hawaiian or other Pacific Islander	4	1	5
%	0.26%	0.98%	0.31%
White	1,445	87	1,532
%	94.63%	85.29%	94.05%
Total	1,527	102	1,629
	100%	100%	100%

Source: authors' calculations

The higher likelihood of foreign-born founders to team up with female and U.S. minority founders is intriguing, small sample size notwithstanding. The gender variation might be accounted for by marriage if foreign-born male founders are more likely to go into business with their native-born spouses than native-born male founders are. The minority variation might be accounted for by co-ethnicity between foreign- and native-born founders. These findings provide hypotheses for further research with larger sample sizes.

7.0 Research and Policy Agenda

The results of our study are descriptive, not prescriptive. Additional assumptions and assertions are required to reach policy conclusions, and reasonable people may differ as to what these ought to be. In this section, we briefly lay out our views on some of the key policy issues to which our study contributes. We also describe the future agenda for research in this area.

7.1 Key Policy Issues

The broadest questions in immigration policy are how many people the U.S. ought to admit, for what length of stay, and what criteria it ought to use to admit them. Our findings to date do not provide strong insights into the issue of "how many." The admission of more immigrants, however chosen, might produce more opportunities for high-tech entrepreneurship if diversity of country of origin is a societal driver of opportunity creation. To put it another way, if immigrants help to create high-tech entrepreneurial opportunities, then admitting more immigrants is a good idea. If immigrants recognize and exploit opportunities that American society would generate even in the absence of immigration and that the native-born would recognize and exploit, then the case for expansion is harder to make. We are not confident enough about the relationship between immigration and opportunity creation to make policy recommendations that presume that there is such a relationship, although we suspect that one does in fact exist. Future work, described below, will shed additional light on this question.

We have more to say about the length of stay and criteria for admission. The extensive work experience and strong educational backgrounds of the immigrant founders in our sample provide support for maintaining and possibly strengthening the long-term educational and employment-based immigrant and non-immigrant visa categories. People who come to the U.S. seeking opportunities to learn at the university and graduate school levels and to work in high-skill positions for extended periods of time add significantly to the pool of residents who have a reasonable chance of creating high-impact high-tech companies. This pool is composed of people who not only have the requisite human and social capital to found such companies, but who are also more likely to have entrepreneurial attitudes and outlook. Yet, the U.S. immigration system does not generally favor such people, relying heavily on family relationships to determine who is admitted.

The linkages among non-immigrant visa categories and between non-immigrant status and legal permanent residence are also important policy issues illuminated by this study. These linkages ought to create clear pathways for immigrants, including those who have the potential to become high-tech entrepreneurs, but they do not do so now. A large proportion of the immigrant founders in our sample somehow found their way from higher education to professional work to the green card and, ultimately, citizenship. They gained sufficient certainty about their immigration status during this journey that they were willing to make the investment of a lifetime by starting their own businesses. We worry, though, that some potential high-tech entrepreneurs who are admitted in a non-

immigrant status get trapped in that status without sufficient reason. Or, even if such individuals have some prospect of extending their stay in the U.S., they lack the certainty that they will be here long enough able to reap the benefits of taking the entrepreneurial "leap," because of the way the immigration system treats them. As a result, they never take the leap, and their potential entrepreneurial contribution to the nation is lost.

The pathway from one status to another is by no means easy and has gotten harder in some respects in recent years. Admission as a student is generally not too difficult, as long as the applicant has an offer of a place from a credible school and the means to pay. However, the adjustment from student status to non-immigrant work status is strewn with obstacles. In many cases, recent graduates can stay for an additional year after graduation without changing status if they are employed in "optional practical training" (OPT) directly related to their field of study. OPT was recently extended to 29 months for graduates in STEM fields. However, if the student visa holder is without a firm job offer from a sponsor who holds a non-immigrant visa slot when the OPT period expires, the former student must leave the country immediately (as he or she must upon graduation as well if not eligible for OPT).

The availability of non-immigrant visa slots to graduating students and employers who desire them is spotty at best. As we noted in section 2, the H1-B category, which is the largest one for long-term non-immigrant workers, has faced a glut of applicants for a limited number of visas in recent years. These visas are distributed primarily through a lottery, and no priorities are set with respect to the types of qualifications that the country

might value beyond the general language of the law. Applicants are left in the dark for many months and sometimes years as to whether they will be admitted. Indeed, it was this uncertainty, the so-called H1-B "cap gap," that seems to have stimulated the extension of OPT described above. Yet, this fix simply expands the pool of H1-B applicants who are in limbo. The second largest long-term non-immigrant work visa category, the L-1 for intra-company transferees, is increasingly subject to similar uncertainty as companies have apparently begun to use it to try to work around the constraints of the H1-B process.

The third step along this pathway, from temporary work status to the green card, is perhaps the most difficult of all. Unless the aspiring immigrant marries an American citizen and thus becomes eligible for legal permanent residence as a member of a citizen's family, the wait can be quite long and burdened with onerous conditions and uncertainty. The conditions include remaining with the sponsoring employer until the green card has been approved. The wait for an employment-based green card usually lasts several years, and it is often much longer. The May 2009 *Department of State Visa Bulletin*, for instance, shows that green cards are now being processed for applicants who filed their initial forms as far back as 1986. Because green cards are subject to annual per-country limits, applicants from India, China, Mexico, and the Philippines, which are among the largest source countries, must usually wait longer than applicants from other countries.

There are no easy fixes to the substantial problems that vex the U.S. immigration system. Our study suggests several options for consideration that might allow the country to better utilize high-tech-oriented entrepreneurial talent from outside its borders. One option is to set priorities within temporary employment visa programs, like the H1-B, that favor the most qualified applicants. A second is to restructure or abolish the numerical per-country limits on green cards, which operate without regard for the size of the home country population. A third option is to loosen the linkages between employment and immigration in order to facilitate high-tech immigrant entrepreneurship, for instance, through the introduction of a point system that rewards attributes associated with entrepreneurial potential.

Although immigration policy is a domain of exclusive federal competence in the U.S.,[6] state and local actors may play constructive roles in shaping a federal policy that supports technology-based economic development. The Greater Cleveland Partnership, for instance, has recently called for the federal government to establish high-skill immigration zones in distressed metropolitan areas. (Greater Cleveland Partnership, 2009) Such calls are natural extensions of policies that focus on attraction of entrepreneurial talent at the regional, state, and local levels. They deserve further consideration, although we would caution that any policy that would seek to limit the geographical mobility of immigrant entrepreneurs within the U.S. would be very difficult to carry out. State and local policies to attract high-tech immigrant entrepreneurs would need to rely on incentives, rather than sanctions, if they are to work.

[6] In Canada and Australia, provinces and states play an active role in immigration policy.

7.2 Areas for Further Research

This study and related work on high-tech immigrant entrepreneurship leaves open many questions. Three areas for further research strike us as particular interesting to pursue. The first and most fundamental of these areas is whether native-born and foreign-born high-tech entrepreneurs are substitutes or complements. Do the foreign-born exploit opportunities that, in their absence, native-born entrepreneurs would have recognized and exploited, or are these opportunities generated by their presence? The evidence in other areas of immigration is ambiguous. (Card 2005, Fairlie and Meyer 2003, Light and Rosenstein 1995) Even a high rate of high-tech immigrant entrepreneurship, such as that found by Saxenian (1999) in Silicon Valley, does not necessarily indicate that immigrants and natives are complements, rather than substitutes. And, of course, we cannot re-run history to explore the closed-border counterfactual. However, carefully controlled comparative research designs may help us move closer to the elusive answer to this question.

The second area of interest is closely related to the first: do IFCs and NFCs follow similar strategies and operate similarly? If the two groups of companies tend to pursue different opportunities, as implied by the complementarity hypothesis, we should be able to observe differences in their business models and value chains. IFCs, for example, may export more aggressively than NFCs and tailor their products accordingly. Our finding that IFCs are more likely than NFCs to report that they had strategic relationship with a company outside the U.S. is an intriguing bit of evidence, but it requires much more substantiation before broader claims can be made with respect to this issue. This agenda

would also lead naturally toward an exploration of the causes of such differences, such as differences in the life experiences and social networks of the companies' founders.

The final research agenda that we highlight centers on the regional impacts of high-tech immigrant entrepreneurship. Economic growth and migration both exhibit geographical agglomeration. Industrial clusters rise and fall, and with them, the cities (such as Detroit or Hollywood) with which these clusters are associated. Immigrants, too, tend to cluster as ethnic communities grow in gateway cities like Los Angeles and Miami. The study of high-tech immigrant entrepreneurship should allow us to link these two phenomena together. This study reveals that high-tech immigrant entrepreneurs are distributed much like the immigrant population as a whole, but our sample is not large enough to explore the economic consequences at the regional level. Comparative regional studies would shed light on these fascinating issues. The apparent propensity of immigrant to team up with U.S.-born women and minorities might also be studied in this context.

8.0 Conclusion

The foreign-born play an important role in founding some of the nation's most important businesses. About 16% of the companies in our nationally representative sample of high-impact, high-tech companies count at least one immigrant among their founders. These immigrant high-tech entrepreneurs are deeply rooted in the U.S. A large proportion of them have been in this country for two decades or more, are citizens, and received graduate degrees here. They hail from a very diverse array of countries.

High-impact, high-tech companies founded by immigrant entrepreneurs tend to be located in states that have large immigrant populations. They operate in the same industries as their native-founded counterparts in many ways and are about the same size. They may have a higher level of technological performance (as measured by patenting and R&D activity), although the evidence on this issue is not conclusive, and are more likely to have strategic relationships with foreign partners.

The significance of these companies to the U.S. economy stems from their disproportionate role in employment and revenue growth. Policy-makers are rightly concerned that government sustain a healthy climate for starting and running high-impact companies like those in our sample. Immigration policy, as it affects highly educated and highly-experienced foreign-born individuals who might be drawn into high-tech entrepreneurship, is an important element of that climate that deserves more attention and more creative thinking than it has received in the past.

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Appendix 1: High-Technology SICs (3 Digit)

Manufacturing	
Crude petroleum and natural gas	131
Cigarettes	211
Miscellaneous textile goods	229
Pulp mills	261
Miscellaneous converted paper products	267
Industrial inorganic chemicals	281
Plastic materials and synthetics	282
Medicinals and botanicals	283
Soap	284
Paints	285
Industrial organic chemicals	286
Agricultural chemicals	287
Miscellaneous chemical products	289
Petroleum refining	291
Miscellaneous petroleum and coal products	299
Reclaimed rubber	303
Nonferrous roling and drawing	335
Ordnance and accessories not elsewhere classified	348
Engines and turbines	351
Construction and related machinery	353
Metal working machinery	354
Special industry machinery	355
General industrial machinery	356
Computer and office equipment	357
Industrial machines. N.e.c	359
Electronic distribution equipment	361
Electrical industrial apparatus	362
Household appliances	363
Electric lighting and wiring	364
Audio and video equipment	365
Communications equipment	366
Electronic components and accessories	367
Miscellaneous electrical equipment and supplies	369
Motor vehicles and equipment	371
Aircraft and parts	372
Railroads	374
Guided missiles and space	376
Miscellaneous transportation equipment	379
Search and navigation equipment	381
Measuring and controlling devices	382
Optical instruments and lenses	383
Medical instruments and supplies	384
Ophthalmic goods	385
Photographic equipment and supplies	386
Services	
Communication services not elsewhere classified	489
Computer and data processing services 737	737
Engineering and architectural services	871
Research and development and testing services	873
Services, n.e.c	899