

Immigrant Entrepreneurship: The Effect of Early Career Immigration Constraints on New Venture Formation

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Abstract. We examine how institutional factors may affect microlevel career decisions by individuals to create new firms by impacting their ability to exercise entrepreneurial preferences, their accumulation of human capital, and the opportunity costs associated with new venture formation. We focus on an important institutional factor—immigration-related work constraints—given that technologically intensive firms in the United States not only draw upon immigrants as knowledge workers but also because such firms are disproportionately founded by immigrants. We examine the implications of these constraints using the National Science Foundation’s Scientists and Engineers Statistical Data System, which tracks the careers of science and engineering graduates from U.S. universities. Relative to natives, we theorize and show that immigration-related work constraints in the United States suppress entrepreneurship as an early career choice of immigrants by restricting labor market options to paid employment jobs in organizational contexts tightly matched with the immigrant’s educational training (job-education match). Work experience in paid employment job-education match is associated with the accumulation of specialized human capital and increased opportunity costs associated with new venture formation. Consistent with immigration-related work constraints inhibiting individuals with entrepreneurial preferences from engaging in entrepreneurship, we show that when the immigration-related work constraints are released, immigrants in job-education match are more likely than comparable natives to found incorporated employer firms. Incorporated employer firms can both leverage specialized human capital and provide the expected returns needed to justify the increased opportunity costs associated with entrepreneurial entry. We discuss our study’s contributions to theory and practice.

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Introduction

High technology entrepreneurship is a key driver of economic growth (Audretsch et al. 2006, Braguinsky et al. 2012), and a rich body of organizational research has identified individual and organizational factors that facilitate or impede individual transitions into entrepreneurship. At the individual level, both human capital and preferences are important in decisions to found new firms (Elfenbein et al. 2010, Roach and Sauermann 2015), in part because they shape entrepreneurial mindsets and expectations (Dushnitsky 2010, Garud et al. 2014). At the organizational level, prior knowledge context influences the pursuit of entrepreneurial opportunities (Agarwal and Shah 2014) because work experience provides important human and relational capital (Sorensen and Fassiotto 2011,

Ganco 2013, Shah et al. 2019). Although the confluence of individual and organizational factors are proximate to the decision to form new ventures, institutional factors may also play an important role in shaping career choices regarding new venture formation. Institutions matter not only because they affect aggregate entrepreneurial entry and exit rates across regional and national economies—for example, through regulations that increase bureaucracy (Klapper et al. 2006) or constrain financial access (Kerr and Nanda 2009)—but also through their effects on individuals’ ability to exercise entrepreneurial preferences or their accumulation of human capital. However, such microlevel effects of institutional factors on individuals’ career choices have been greatly under-researched. In addition to earlier work examining policy effects on

academic entrepreneurship (Kenney and Patton 2009), exceptions include recent work on the effect of non-compete enforceability (Starr et al. 2018a) and policies for formerly incarcerated individuals (Hwang and Phillips 2020) on entrepreneurial choices.

We join this budding research stream by examining the effect of immigration-related work constraints, a critical institutional factor for high technology work force and entrepreneurship. Immigrants represent a significant portion of the science and engineering/high-skilled workforce (Kerr 2013), are key contributors to innovative output (Kerr et al. 2015, Bernstein et al. 2018), and launch a disproportionate number of incorporated and high-technology firms in the U.S. economy (Wadhwa et al. 2007; Fairlie and Lofstrom 2015; Kerr and Kerr 2016, 2020). Most immigrants comprising the U.S. science and engineering (S&E) workforce, including those who engage in entrepreneurship (Hunt 2011), are foreign nationals who immigrated to attend U.S. universities (Hanson and Slaughter 2016) and hence were subject to immigration-related work constraints on graduation and entry into the labor force (Roach and Skrentny 2019). Although scholars have begun to examine how immigration-related work constraints suppress graduates' ability to found or join new ventures early in their careers (Roach et al. 2019), it is unclear how such constraints may influence transitions into entrepreneurship in later career stages when the constraints are released. In this study, we address this gap by exploring how early career immigration-related work constraints create path dependences that shape the type of human capital immigrants accumulate and the opportunity costs associated with leaving paid employment, two factors associated with the types of firms immigrants may eventually start on release of work constraints.

Specifically, we build on prior work demonstrating that individuals with preferences for entrepreneurship tend to sort into entrepreneurial organizations, which provide exposure to a broad variety of tasks (Halaby 2003; Lazear 2004, 2005; Elfenbein et al. 2010), thereby systematically sorting *out* of job-education match—that is, jobs that are closely related to their educational training (Stenard and Sauermann 2016). Work experience in job-education match increases the development of specialized human capital and the opportunity costs associated with leaving paid employment, which, when coupled with preference-based sorting, results in a negative relationship between job-education match and entry into entrepreneurship (Åstebro et al. 2011, Stenard and Sauermann 2016). We investigate how immigration-related work constraints—which restricts preference-based sorting and constrains immigrants, including those with entrepreneurial preferences, to job-education match—distorts this established relationship in important ways for both early and late career implications.

Using detailed data on S&E graduates from the National Science Foundation's Scientists and Engineers Statistical Data System (SESTAT), we report significant differences in early career employment choices among individuals with immigration-related work constraints (foreign nationals with temporary work visas on graduation) and those who are unconstrained (U.S. natives and immigrants with permanent residency or U.S. citizenship). Consistent with Roach et al. (2019), we first show that immigrants are less likely than natives to enter entrepreneurship at graduation, a pattern consistent with immigration-related work constraints restricting immigrants to paid employment job-education match. We then confirm that the negative relationship between job-education match and entrepreneurship holds for natives (Stenard and Sauermann 2016). However, we show that this relationship is positively moderated (i.e., significantly less negative) for immigrants who were constrained to job-education match. Importantly, these differences are driven by the founding of *incorporated* new ventures, a characteristic correlated with venture quality and growth intention (Guzman and Stern 2016), and not the founding of unincorporated firms. Together, our results suggest that immigration-related work constraints are associated with lower overall rates of entrepreneurship and a redirection of constrained individuals with preferences for entrepreneurship into a career path in paid employment in job-education match. Upon release of constraints, if these individuals exercise entrepreneurial preferences and enter entrepreneurship, they tend to start incorporated firms, the types of firms which leverage the specialized human capital they have accrued and where the expected returns justify the increased opportunity costs associated with entrepreneurial entry. These results are robust to a battery of empirical tests, subsamples, specifications, and controls for differences between constrained and unconstrained individuals in terms of qualitative characteristics, and preferences for various job characteristics.

Our study makes several contributions to theory and practice. We add to the organizations literature by underscoring the role of institutional work constraints as an understudied contextual factor (Autio et al. 2014). In doing so, we shed light on a mechanism that may contribute to the disproportionate incidence of immigrant founders of incorporated and growth-oriented firms in S&E-related industries (Fairlie and Lofstrom 2015, Kerr and Kerr 2016). We also contribute to the (entrepreneurial) careers literature by emphasizing immigration status as an important and understudied factor impacting the career choice of transitioning from paid employment to entrepreneurship. Although corroborating studies showing natives working in paid employment in high job-education

match are less likely to engage in entrepreneurship (Åstebro et al. 2011, Stenard and Sauermann 2016), we provide a rationale and evidence of how this relationship is distorted for foreign nationals who are subject to immigration-related work constraints. Moreover, by relaxing the implicit assumption that individuals are unconstrained in their choice of initial organizational affiliations (Agarwal and Shah 2014), we inform related literature on frictions in human capital markets (Campbell et al. 2017), showing how initial labor market constraints may yield long-term path-dependent effects on subsequent skill formation, opportunity costs, and career choices.

Study Context: Foreign National S&E Graduates from U.S. Universities and the Immigration Process

Given our focus on immigration-related work constraints on individuals' career decisions—particularly for high technology new venture formation—our study's context draws on the workforce comprising of S&E graduates from U.S. educational institutions. In contrast to natives, foreign nationals who desire to work in the United States typically require temporary work authorization or permanent residency. Founding a new venture serving as the individual's primary employment generally requires permanent residency or U.S. citizenship.¹ Channels to permanent residency include employer sponsorship, family sponsorship (by immediate family member with citizenship or permanent residency), asylum, diversity visa lottery, or investments. Five years of permanent residency is required to be eligible for citizenship. Although some foreign nationals obtain permanent residency status during their studies or immediately on graduation (largely because of family sponsorships), the vast majority originally enter on student (i.e., F-1; J-1) visas (Wadhwa et al. 2007, Hunt 2011,

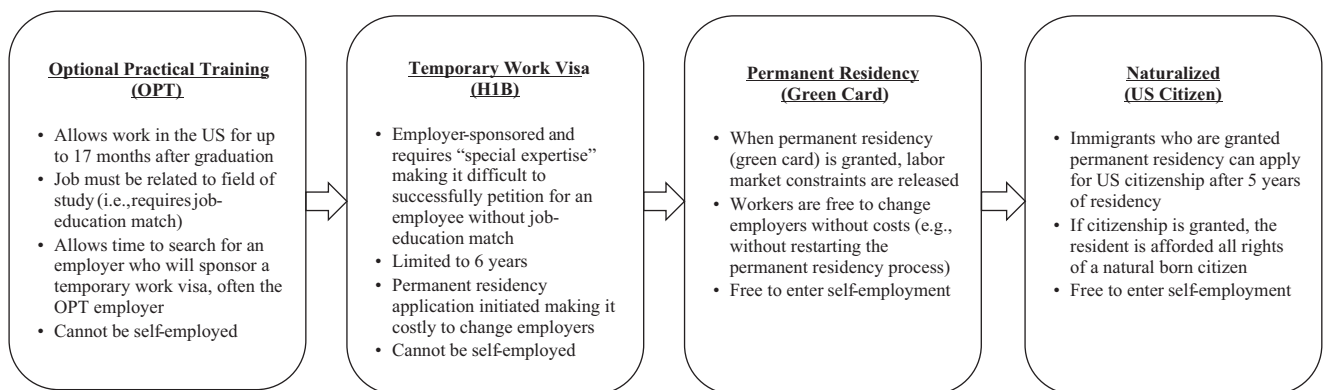
Kerr and Kerr 2016).² For example, Roach et al. (2019) report that 92% of foreign students in their sample were on student visas. Thus, the lion's share of immigrants who found new firms after immigrating to the United States to attend school were likely subject to immigration-related work constraints upon graduation and entry into the U.S. labor force. In the next sections, we briefly describe the stages of the dominant immigration pathway experienced by these immigrants, as summarized in Figure 1. Although Figure 1 depicts the final (terminal) stage in the dominant immigration pathway as naturalization, note that not all immigrants who immigrate into the United States complete the full path and become naturalized citizens.

Immigration Work Constraints on S&E Graduates

Foreign nationals entering the United States for education on student visas are authorized for temporary stays during their course of study. Upon graduation, most immigrants who remain in the United States apply for an optional practical training permit (OPT). These permits do not require employer sponsorship and allow graduates to work in paid employment in the United States for up to one year, for a minimum of 20 hours per week.³ Because OPT is intended to provide training that complements education, the rules explicitly include a requirement that the *job must be related to the individual's field of study* (i.e., job-education match).

Individuals seeking employment in the United States beyond the time allowed by their OPT require employment sponsorships for temporary work visas (typically an H1B visa in S&E fields). Thus, as Roach and Skrentny (2019) note, securing a temporary work visa is often a top priority for foreign S&E graduates entering the U.S. labor force. Accordingly, foreign graduates frequently use their OPT to work for firms who are willing to subsequently sponsor their temporary work visa. The sponsorship process usually takes several

Figure 1. Timeline and Characteristics of Dominant Immigration Pathway for STEM Graduates



Notes. This figure represents the dominant immigration pathway for immigrants who enter the United States on student visas. Although the terminal stage in the immigration pathway is naturalization, some immigrants do not complete the full pathway and become naturalized as U.S. citizens, as permanent residency enables them to work or found new firms in sectors that do not require national security clearance.

months, and, because of various filing and legal fees, the firm's monetary costs can total \$5,000 or more. As a result, foreign graduates tend to sort away from early career startup employment and into established firms who are more willing and able to cover such costs (Roach and Skrentny 2019). Although temporary work visas do not explicitly require educational credentials in the field of study, the requirement of "special expertise" typically makes it very difficult to petition for an employee not in job-education match. Once granted, temporary work visas are typically capped at six years, unless extensions are granted. Because these visas are sponsored by employers, "the immigrant is effectively tied to the firm until obtaining permanent residency or obtaining another visa" (Kerr et al. 2015, p. s159); hence, working on these visas generally creates significant frictions which limit mobility and prevent entry into entrepreneurship.⁴

Process for Release of Immigration-Related Work Constraints

Given time limitations on temporary work visas, foreign nationals usually initiate permanent residency applications while holding temporary work visas.⁵ Employment-based permanent residency applications are tied to a specific employer and include a lengthy certification process wherein the employer must demonstrate there are no available U.S. candidates for the position. During this time, a change in employment invalidates the original permanent residency application and requires the new employer to reinitiate the process.⁶ As such, the "lock-in effect" associated with temporary work visas "is particularly strong if the firm further sponsors the immigrant for permanent residency" (Kerr et al. 2015, p. s159). In addition to time costs, foreign nationals and their employers must invest significant cognitive and financial resources to cover the legal and administrative costs of permanent residency sponsorship, which typically totals \$10,000 or more (Zhang and Associates 2013). Altogether, the process of obtaining release from immigration-related work constraints is cumbersome and creates frictions that greatly limit mobility and entrepreneurship.

Upon approval of permanent residency, immigrants are free of immigration-related constraints on mobility and entrepreneurship. Receipt of citizenship, which requires a minimum of a five-year period as a permanent resident, removes all remaining labor market restrictions, namely the ability to work in federal government and private sector jobs related to national security and therefore require security clearances.

In sum, the dominant pathway for U.S. educated immigrants is characterized by immigration-related work constraints that temporarily suppress the ability to enter entrepreneurship and restrict early career options to paid employment jobs matched with their

education. Such constraints are released once immigrants receive permanent residency status and eliminated completely upon acquiring U.S. citizenship.

Theoretical Framework

The creation of new ventures is an enduring subject of interest to organizational scholars. We begin with a brief review of two literatures that serve as building blocks for our study: the literature on preference sorting into organizational contexts and job-education match and the literature on job-education match and transitions to entrepreneurship. An implicit assumption in both literature streams is that individuals are unconstrained in their career choices, specifically when exercising preferences for entrepreneurship. In relaxing this assumption, we develop the theoretical rationale for how immigration-related constraints shape career paths and transitions to entrepreneurship for foreign nationals graduating from U.S. universities.

Brief Literature Review

When examining new venture creation by individuals, scholars have focused on the role of individual characteristics (e.g., human capital, preferences) and contextual factors (e.g., knowledge context; organizational origins) in shaping entrepreneurial propensities (Ozcan and Reichstein 2009, Sorensen and Fassiotto 2011, Agarwal and Shah 2014). Here, we focus on the literature examining how two components of an individual's human capital—education and work experience acquired through jobs in paid employment—interplay to affect transitions into entrepreneurship. We start with the literature on sorting processes that result in a nonrandom assignment of individuals to entrepreneurship and/or job-education match and then review work examining "treatment" effects of job-education match on entrepreneurial entry.

Preference Sorting into Organizational Contexts and Job-Education Match. Preferences for entrepreneurship are often formed prior to initial job experiences. For example, in a study of U.S. university students, Roach and Sauermann (2015) report more than half of survey respondents viewed entrepreneurship and entrepreneurial careers as an attractive option before graduation (see also Roach et al. 2019). Such preferences tend to predict entry into entrepreneurship (Shane 2003).

Even if individuals with preferences for entrepreneurship do not found new ventures at the onset, these preferences manifest in sorting into specific types of organizations. Individuals with entrepreneurial preferences tend to have an interest in variety (Lazear 2005) and a distaste for bureaucratic job qualities (Halaby 2003), so they are likely to sort into less hierarchical firms that expose them to a broader variety of

tasks and use a wider set of skills (i.e., job-education mismatch) (Åstebro and Thompson 2011, Tåg et al. 2016). Indeed, as Lazear (2004, p. 208) argues, entrepreneurial individuals tend to “make their skills more general by following a particular investment profile.” Accordingly, preference-based sorting suggests that individuals with preferences for entrepreneurship who remain in paid employment will sort out of jobs matched with their education, the result of which is reflected in a negative relationship between job-education match and transitions to entrepreneurship (Stenard and Sauermann 2016).

Job-Education Match and Transition to Entrepreneurship. In addition to the previous preference-based sorting, scholars note two “treatment” effects for why job-education match may negatively relate to entrepreneurial entry. First, job-education match is related to the breadth of human capital an individual develops. Speaking directly to this point, Stenard and Sauermann (2016) show that individuals in jobs not matched with their education tend to engage in a broader set of activities and therefore accumulate more diverse skills. This finding is important because Lazear (2004) argues that operating a business requires a broad portfolio of skills and so entrepreneurs will tend to be generalists—individuals with a broader breadth of human capital (Wagner 2006, Åstebro and Thompson 2011). Thus, by taking individuals down a path of focused skill development, work experience in job-education match may leave individuals unequipped with the requisite array of broad skills needed to “wear multiple hats” as entrepreneurs often do. This, in turn, should reduce the probability of entrepreneurial entry.

The second explanation is centered on opportunity costs, as measured by both pecuniary and nonpecuniary benefits of paid employment. Entry into entrepreneurship means forgoing wages in paid employment—the higher the wages an individual earns, the higher the opportunity costs associated with entrepreneurial

entry. Scholars have documented a robust and positive relationship between job-education match and earnings (Borghans et al. 2000, Groot and Van Den Brink 2000, Bender and Heywood 2009, Bender and Roche 2013, Stenard and Sauermann 2016). Additionally, Stenard and Sauermann (2016) report higher (lower) levels of job satisfaction when there is a job-education match (mismatch), on average. Thus, individuals in job-education match should have higher opportunity costs relative to individuals working in job-education mismatch. In turn, the higher opportunity costs associated with job-education match should result in a higher threshold needed to induce exit from paid employment and hence lower entrepreneurship rates (Amit et al. 1995, Stenard and Sauermann 2016).

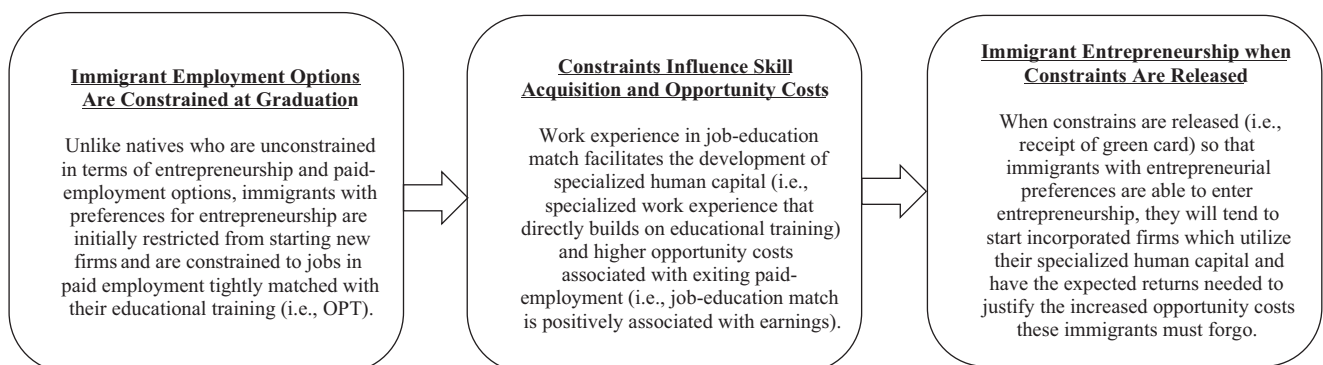
In sum, existing literature suggests a negative relationship between job-education match and transitions to entrepreneurship that arises from three mutually reinforcing mechanisms. That is, individuals with preferences for entrepreneurship are less likely to sort into job-education match, and work experience in job-education match is associated with the accumulation of more specialized human capital and higher opportunity costs, each of which is associated with a lower likelihood of entry into entrepreneurship.

Implication of Immigration-Related Work Constraints for Career Paths and Entrepreneurship

An important boundary condition in the existing literature is the implicit assumption that individuals are unconstrained when exercising their work preferences, aside from normal labor market frictions (Åstebro et al. 2011). We relax this assumption in the context of immigration constraints to provide implications for career trajectories and transitions to entrepreneurship. We summarize these implications in Figure 2.

Individuals graduating from U.S. universities and entering the labor force sort into different types of work based on their preferences and human capital. At this early career juncture, individuals without immigration-related work constraints with preferences

Figure 2. Conceptual Summary of the Role of Immigration Constraints in Immigrant Transitions to Entrepreneurship



for entrepreneurship have the option to found or join an entrepreneurial venture, as noted previously. The first and most direct implication of immigration-related work constraints is that, aside from risky workarounds, immigrants are legally prevented from transitioning into entrepreneurship upon graduation. Thus, we should observe lower entrepreneurship activity from immigrants at the start of their careers, regardless of their entrepreneurial preferences (Roach et al. 2019).

Second, the OPT and H1B labor certification requirements additionally constrain individuals to paid employment job options with job-education match. Moreover, unlike unconstrained individuals, work-constrained immigrants must incorporate immigration process-related issues in their cost-benefit calculus when choosing among alternative job offers, and they place a greater weight on ease and likelihood of successfully securing temporary work visas and sponsorship for green cards (Roach and Skrentny 2019). As a result, work-constrained immigrants tend to opt for larger, established firms with routines and financial and managerial resources to navigate through the H1B and green card applications. Thus, relative to unconstrained individuals who can exercise entrepreneurial preferences and select out of paid employment job-education match (Lazear 2005, Elfenbein et al. 2010), individuals impacted by immigration-related work constraints are disproportionately more likely to sort into early career paid employment in job-education match in more hierarchical firms, even if these individuals have preferences for entrepreneurship.

Given path dependencies, such early career immigration constraints that restrict immigrants to paid employment work in job-education match can have long lasting effects, even in periods when immigrants acquire permanent residency or citizenship and hence are no longer constrained. Recall that job-education match is associated with the development of more specialized human capital and higher opportunity costs and hence is associated with a lower likelihood of transitions into entrepreneurship. Although this relationship may hold for individuals who were always unconstrained and selected into job-education match, it may not be true for immigrants previously constrained to job-education match. This is because among the pool of individuals with similar levels of job-education match, immigrants released from constraints will tend to be different from individuals who were always unconstrained, inasmuch as there will be a higher proportion of individuals with entrepreneurial preferences who were previously unable to sort into entrepreneurial careers. Thus, even though the treatment effect of job-education match on entrepreneurial entry is negative, it should be weaker for immigrants who were constrained to job-education match, because these immigrants were restricted from

exercising preferences for entrepreneurship but can do so now as constraints are released.

Importantly, the specialized human capital and higher opportunity costs generated by work experience in job-education match implies that when entrepreneurial immigrants who are released from work constraints decide to engage in new venture creation, they may be more likely to engage in incorporated rather than unincorporated entrepreneurship. Although the jack-of-all-trades theory of entrepreneurship (Lazear 2005) suggests that diversified human capital is better suited for entrepreneurship, we note that the core logic underlying this argument is more applicable to small-scale entrepreneurship where one individual often performs the majority (if not all) of business tasks. Because specialized human capital tends to be associated with teamwork in production of innovative knowledge (Jones 2009, Agrawal et al. 2016, Haeussler and Sauermann 2020), it is also associated with a higher likelihood of team entrepreneurship (Ganco 2013). Founders with specialized human capital often seek out cofounders with complementary capabilities to create incorporated ventures with larger founding teams (Shah et al. 2019, Lazar et al. 2020). Stated differently, “jack of all trades may be relatively unimportant in startups that begin large and with a high division of labor” (Åstebro and Thompson 2011, p. 640). Moreover, given higher opportunity costs, immigrants with entrepreneurial preferences in job-education match should be more likely to create new ventures only when they identify opportunities which they believe have the potential to offset the higher threshold needed to induce entrepreneurial entry, that is, when they identify entrepreneurial ideas with greater value creation potential (Braguinsky et al. 2012, Ohyama 2015). Taken together, although immigrants released from constraints may lack generalized skills and face higher opportunity costs for engaging in small scale, unincorporated new venture creation, they should be more willing and able to exercise their entrepreneurial preferences by pursuing incorporated entrepreneurship that has higher growth potential.

We note that the link between specialized human capital development and opportunity costs associated with job-education match applies to natives and immigrants who were not subject to early career immigration-related constraints. The key difference is that the unconstrained individuals were able to exercise their entrepreneurial preferences early on and hence start firms at graduation or sort into paid employment jobs not matched with their education (Lazear 2005). Thus, work-related immigration constraints result in a higher proportion of immigrants with entrepreneurial preferences in job-education match.

In sum, our framework suggests early career immigration-related work constraints will be associated

with suppressed entrepreneurship and redirection of individuals with entrepreneurial preferences toward job-education match within existing firms. Upon release of these constraints, if immigrants transition into entrepreneurship, the higher levels of specialized human capital and opportunity costs associated with work in paid employment job-education match imply that they should be more likely to transition into incorporated entrepreneurship. Consequently, although job-education match may be negatively related to entrepreneurship for always unconstrained individuals, the relationship will be weaker for individuals that were subject to early career immigration-related work constraints. This general framework guides our empirical analysis.

Methods

Data and Sample Construction

Our study uses restricted-use data from the SESTAT between 1995 and 2013. In the SESTAT surveys (administered every two years), the National Science Foundation collects career information from individuals who have graduated from U.S. universities. The surveys are nationally representative and include The National Survey of College Graduates (NSCG), The National Survey of Recent College Graduates (NSRCG), and The Survey of Doctoral Recipients (SDR). The NSCG surveys college graduates in all S&E fields who reside within the United States, and this forms the core of the SESTAT. The NSRCG supplements the NSCG by surveying recent degree holders, and the SDR focuses on doctoral degree holders. The response rates in the surveys tend to be relatively high, in the range of 70%–80%.⁷ The SESTAT data have been used extensively by management and economics scholars (Elfenbein et al. 2010; Hunt and Gauthier-Loiselle 2010; Sauermann and Cohen 2010; Hunt 2011; Åstebro et al. 2012, 2019; Braguinsky et al. 2012; Agarwal and Ohyama 2013; Stenard and Sauermann 2016; Sauermann 2018; Cohen et al. 2020).

Consistent with prior work using the SESTAT to study entrepreneurship (Stenard and Sauermann 2016), we exclude the unemployed, individuals not participating in the labor force, part-time employees (defined as working less than 30 weeks per year or working less than 30 hours per week), individuals who are younger than 22 or older than 65, and individuals working in academia, government, or non-profit sectors. Given our focus on the S&E workforce, we exclude individuals with a bachelor's degree outside science and engineering (e.g., Arts & Humanities) or highest degrees in a professional field (e.g., J.D.).

Our sample is a pooled cross section where identification comes from comparisons across individuals including both natives and immigrants. To be included in our analysis, an individual must appear in at least

two SESTAT surveys—the first appearance enables us to construct the explanatory variables such as immigration status and job-education match (if in paid employment), and the second appearance enables us to define our sample to estimate the probability of entering entrepreneurship. An individual who appears N times in the SESTAT database is represented by $N - 1$ observations in the estimation sample. Our sample (used in the estimation of entrepreneurship) includes 22,352 unique individuals, of which 6,409 are immigrants. Of the sample of immigrants, we can observe that 2,940 held a temporary work visa at graduation (2,742 are in the job-education match). After an individual transitions into entrepreneurship, additional appearances in SESTAT are not included in the estimation sample. The pooling of individuals across surveys enables us to use all available data and maximize the number of observations used in the estimation. Our estimation sample has one observation (i.e., two survey years) for 28% of individuals, two observations for 27% of individuals, three observations for 20% of individuals, four observations for 7% of individuals, and five or more observations for 18%. We account for the nonindependence of observations for individuals who appear more than once in the estimation sample by clustering errors at the individual level and including time-variant controls.

Variable Definitions

Transition to Entrepreneurship. Our key dependent variables capturing an individual's transition to entrepreneurship by using their response in the focal survey (second appearance and beyond in SESTAT) to the question: "Which of the following best describes your principal employer?"⁸ The variable *Unincorporated entrepreneurship* is coded as one in the first year in which the respondent selected "self-employed or business owner in own not-incorporated business" and zero otherwise. Unincorporated businesses are sole proprietors or simple partnerships. The dependent variable *Incorporated entrepreneurship* is coded analogously as one in the first year in which the respondent selected "self-employed or business owner in own incorporated business" and zero otherwise. Incorporated businesses represent an independent legal entity (e.g., LLC, C-corporation, S-corporation, or limited partnership). Individuals typically incorporate if they create startups with larger founding teams, anticipate hiring employees, or anticipate obtaining outside funding to achieve and/or grow the scale of the organization (Guzman and Stern 2016, Lazar et al. 2020). Consistent with extensive prior work (Fairlie and Chatterji 2013, Levine and Rubinstein 2016, Tåg et al. 2016), we assume the incorporation of a startup is a strong proxy for larger-scale new ventures, in contrast to the lifestyle nature of unincorporated businesses. This assumption is tested

by Guzman and Stern (2016), who use business registration records to show that incorporated ventures are more than three times more likely to achieve an extreme growth outcome such as an initial public offering or acquisition. This assumption is also borne out in our data: the median employee size for unincorporated new ventures is in the lowest bin of 10 or fewer employees compared with incorporated entrepreneurship, which is in the third bin of 25–99 employees. Furthermore, Levine and Rubinstein (2016) report that only 15% of entrepreneurs ever switch from unincorporated to incorporated business and 1% switch from incorporated to unincorporated, and, consequently, conclude that incorporation at entry is a strong proxy for future growth orientation.⁹ In a robustness test, we define a variable, *Startup with employees*, as one if the entrepreneur reported having at least one employee that they directly supervised and zero otherwise. The correlation of *Startup with employees* and *Unincorporated entrepreneurship* is 0.15, whereas it is 0.6 with *Incorporated entrepreneurship*. The results remain robust to the alternative specification of *Startup with employees* instead of *Incorporated entrepreneurship*.¹⁰ In another robustness test, we define a variable *Spinout*, as one if incorporated entrepreneurship variable is also one and the startup is in the same industry defined by the three-digit North American Industry Classification System (NAICS) code as prior employer of the focal individual (and zero for all other startups). Consistent with prior work using survey and administrative records to study entrepreneurial transitions (Elfenbein et al. 2010, Kerr and Kerr 2016, Stenard and Sauermann 2016), the survey responses capture both founders and early equity joiners and we are unable to distinguish between the two categories. To the extent that both categories represent transitions to entrepreneurship, such distinction is less relevant in our context.

Job-Education Match. This variable is constructed based on responses to the survey question “to what extent was your principal job related to your highest degree?” in the individual’s first appearance in the SE-STAT database. The possible responses are “not related,” “somewhat related,” and “closely related.” We code the variable *Job-education match* as one for individuals who responded to this question “closely related” and “somewhat related” and zero if “not related.” We also construct separate dummies for “closely related” (*Job-education closely matched*) and “somewhat related” (*Job-education somewhat matched*), with “not related” being coded as zero for each dummy. About 56% of matched are in the closely related and 33% in the somewhat related category. Thus, about 11% of the sample individuals work in the fields that are “not related.” Given the exclusion of employees in academia, the respondents are unlikely to interpret this question

as whether they changed jobs relative to when they were students.

Stenard and Sauermann (2016) note a potential concern with job-education match is its ex post self-reported nature, because on-the-job performance and experiences may influence individual’s perception of education-job match. Although this issue is generally present in similar nonexperimental settings, we believe our inclusion of a rich set of controls and robustness tests (e.g., using preferences for job characteristics including self-employment preferences) should alleviate concerns about omitted variable bias. Moreover, given the match variable is constructed based on the survey prior to transitioning to entrepreneurship, we do not expect ex-post influences of the decision to transition to entrepreneurship to affect this variable.

Immigration Status. When comparing immigrants and natives, we focus on the *Nonnative status* in an aggregate and examine the effects of various immigration status categories by including dummies for *Temporary work visa* (e.g., H1B), permanent residency (i.e., *Green card*), and *Naturalized citizens* (i.e., individuals who transitioned from green card status to citizenship). These three indicators exhaustively capture the immigration status of foreign nationals in our sample. We also split the *Nonnative individuals* into those who we observe to hold a *Temporary work visa postgraduation* (in the first three years after graduation) and use *Other nonnative individuals* (i.e., holding Green Cards or being Naturalized currently or in the past) as a control.¹¹ We chiefly focus on individuals who held *Temporary work visa postgraduation*, which allows us to examine respondents who we know were directly affected by immigration constraints.

Job and Employee Characteristics. We create several variables capturing job and employee characteristics that are used in analyses examining mechanisms, controls, and/or in robustness tests and extensions of main analysis. Several variables are time variant.

We begin with describing the variables used to explore underlying mechanisms (preference sorting, skill accumulation, and opportunity costs). To assess preferences toward entrepreneurship, we use a survey question that was available in one survey snapshot (1997). The survey asked about the preferred work arrangement. We code the *Preference for Entrepreneurship* as one if the respondent answered self-employment and zero otherwise (the question did not distinguish between incorporated and unincorporated entrepreneurship). This allows a subsample analysis using respondents who participated in the 1997 survey and in subsequent surveys. Our skill accumulation variables include *Employee promoted or changed position*, a binary variable capturing whether the employee was promoted or

changed position internally within the firm since the last survey period. Also, *Business skills used on the job* is a dummy variable indicating if the focal primary job requires management, accounting, finance, marketing, sales, or human resources skills. To measure opportunity costs, *Log salary* is measured as the “basic annual salary” (in 2012 dollars). *Job satisfaction* is measured using a four-point Likert scale based on the question, “rate your overall satisfaction with the principal job” (reverse coded relative to the survey so that four represents the “very high” category). In extensions of the main analysis, we also examine differences between natives and immigrants in the importance that individuals place on job characteristics such as *Importance of advancement opportunities*, *Importance of job benefits*, *Importance of intellectual challenge*, *Importance of independence*, *Importance of responsibility in a job*, *Importance of salary*, and *Importance of job security*. These variables use four-point Likert scales (with four being the highest) and they were available for the survey years 2001, 2003, and 2010.

Other Control Variables. The richness of the SESTAT data enables us to additionally control for factors that may correlate with both the likelihood of transitioning into entrepreneurship and job-education match. *Male* and *Married* are demographic indicators (potentially time variant). In addition to survey year dummies, we include quadratic controls for *Postgraduation work experience* to account for time since graduation in the focal survey to control for aggregate work experience before transitioning to entrepreneurship. Similarly, we include quadratic controls for *Tenure* in the last paid employment before entrepreneurship to proxy for firm-specific knowledge accumulation. These controls are time variant. Indicator variables *PhD degree* and *Master’s degree* (bachelor’s degree is omitted) control for differences in educational levels and thus human capital differences. We also use various controls for education. These include a dummy of whether a *Private school* granted the degree, school region dummies (nine regions of the United States) and field of degree dummies (computer, mathematical, biological, engineering, etc.). In robustness tests, we use the university ranking derived from the National Research Council’s evaluation (Agarwal and Ohyama 2013), which is available for half of the sample, and fixed effects for the Carnegie classification of the university (research I, research II, doctorate-granting institution, etc.), which is available for about two thirds of the sample.¹² Finally, to capture cohort effects, we include graduation year dummies in another robustness test.

Estimation Methods

Pairwise binary outcome regressions are estimated using Logit (the results are robust to using Probit) or the linear probability model (LPM). Models with a

categorical dependent variable (continue in paid employment, transition to incorporated entrepreneurship, transition to unincorporated entrepreneurship) are estimated using multinomial Logit. For the ease of interpretation of the interaction terms, we use LPM to show the robustness of the main models (the results are robust to using Logit and calculating the marginal effects for the interaction term in each model). The LPM models tend to perform well on our sample with less than 2% of predicted probability values falling outside of the unit interval (Chatla and Shmueli 2017). Furthermore, the models with a binary outcome variable (e.g., transition to incorporated entrepreneurship) are akin to a discrete time hazard model.¹³ In models with continuous dependent variables, we use ordinary least squares (OLS). We use error clustering at the individual level to correct the error structure in all estimation models (Wooldridge 2009). Because entrepreneurship is a relatively rare event compared with the number of observations, we also use rare events logit models in robustness tests (Firth 1993, King and Zeng 2001).¹⁴

Results

We report summary statistics and pairwise correlations for the variables in our sample in Table 1 and descriptive statistics for different categories of individuals by match and immigration status in Table 2. For incorporated entrepreneurship, the highest rate is for natives without *Job-education match* (about 2.8%) followed by immigrants with Green Cards and Naturalization (2% with *job-education match* and 2.1% without). This translates into about a 25% difference. Notably, for immigrants who held a *Temporary work visa at graduation*, the incorporated entrepreneurship rate is almost double among the individuals with job-education match (1.5%) relative to those not in a match (0.8%). There are also stark differences in unincorporated versus incorporated entrepreneurship rates. For natives, unincorporated entrepreneurship rate is between 50% and 70% of incorporated rates, whereas for immigrants, it is only between 0% and 35% of the incorporated rates. The patterns observed in the summary statistics are consistent with our argument that immigration constraints both suppresses rates of entrepreneurship and redirects some future immigrant entrepreneurs into job-education match, subsequently affecting the type of new venture creation.

Immigration Constraints and Entrepreneurship Rates

We first examine consistency of findings reported in prior work on whether graduates holding temporary work visa experience are associated with reduced rates of entrepreneurship (Roach and Skrentny 2019,

Table 1. Descriptive Statistics and Pairwise Correlations

Variable	Mean	Standard deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1) Incorporated entrepreneurship (transition)	0.018	0.116	1.000																		
(2) Unincorporated entrepreneurship (transition)	0.009	0.094	-0.013	1.000																	
(3) Job-education match (prior survey)	0.890	0.312	-0.019	-0.025	1.000																
(4) Nonnative worker (time invariant)	0.298	0.457	-0.009	-0.026	0.055	1.000															
(5) Temporary work visa at grad. (time invariant)	0.141	0.348	-0.016	-0.025	0.074	0.644	1.000														
(6) Temporary work visa (focal survey)	0.057	0.232	-0.007	-0.023	0.053	0.405	0.619	1.000													
(7) Green Card (focal survey)	0.128	0.335	-0.020	-0.012	0.048	0.566	0.480	-0.090	1.000												
(8) Naturalized citizen (focal survey)	0.113	0.316	0.013	-0.007	-0.009	0.560	-0.028	-0.089	-0.124	1.000											
(9) Job tenure (prior survey)	2.281	2.263	-0.002	-0.006	0.062	0.013	0.012	-0.070	0.015	0.057	1.000										
(10) Postgraduation experience (prior survey)	5.700	3.486	0.009	0.002	0.038	0.140	0.080	-0.074	0.141	0.116	0.375	1.000									
(11) PhD degree (focal survey)	0.382	0.486	-0.006	-0.015	0.047	0.210	0.207	-0.001	0.231	0.070	0.185	0.375	1.000								
(12) Master's degree (focal survey)	0.257	0.437	-0.009	0.001	0.073	0.105	0.116	0.191	0.020	-0.015	0.007	-0.025	-0.411	1.000							
(13) White (focal survey)	0.654	0.476	0.007	0.019	-0.009	-0.504	-0.380	-0.267	-0.288	-0.232	0.037	-0.027	-0.095	-0.086	1.000						
(14) Male (focal survey)	0.691	0.462	0.016	0.003	0.038	0.053	0.092	0.054	0.048	-0.012	0.072	0.107	0.075	-0.055	0.008	1.000					
(15) Married (focal survey)	0.645	0.479	0.002	-0.010	0.078	0.124	0.115	0.008	0.146	0.026	0.158	0.292	0.249	0.016	0.000	0.075	1.000				
(16) Highest degree from private school (time invariant)	0.209	0.406	0.007	-0.005	-0.006	0.031	0.026	-0.011	0.017	0.035	0.019	-0.012	0.130	-0.036	-0.030	-0.034	-0.013	1.000			
(17) Salary (log, 2012 dollars) (prior survey)	10.238	0.686	-0.017	-0.030	0.161	0.106	0.095	-0.018	0.105	0.060	0.200	0.311	0.310	0.006	-0.041	0.144	0.203	0.078	1.000		
(18) Job satisfaction (prior survey)	3.274	0.748	-0.004	-0.025	0.152	-0.013	0.005	0.015	-0.012	-0.018	0.014	0.005	0.002	0.021	0.053	0.044	0.068	-0.007	0.116	1.000	
(19) Employee promoted or changed position (prior survey)	0.079	0.270	-0.014	-0.018	-0.018	-0.026	-0.015	-0.042	-0.005	0.000	0.067	0.126	0.080	-0.021	0.030	0.009	0.066	-0.040	0.104	-0.005	1.000
(20) Business skills used on the job (prior survey)	0.674	0.469	0.031	0.023	-0.065	-0.096	-0.083	-0.063	-0.078	-0.013	0.051	0.069	-0.004	-0.024	0.078	-0.049	0.013	0.022	0.009	0.013	0.073

Notes. In the main analysis (Table 6), we regress the transition to entrepreneurship (focal survey) on the job-education match in paid employment. Consequently, job-education match and other characteristics of paid employment are lagged and based on the prior survey snapshot. Demographical characteristics are based on the focal survey. In the analysis where we examine the relationship between match and its correlates (Table 4), we use the immigration status from the focal survey. $N = 31,892$; IDs = 22,352 (sample from Table 6, model 8)

Table 2. Descriptive Statistics by Immigration Status and Job-Education Match

Variable	Native citizen, job-education match = 1	Native citizen, job-education match = 0	Nonnative, job- education match = 1	Nonnative, job- education match = 0	Temporary work visa at graduation, job-education match = 1	Temporary work visa at graduation, job-education match = 0	Green Card, naturalized, and other, job-education match = 1	Green Card, naturalized, and other, job-education match = 0
(1) <i>Incorporated entrepreneurship (transition)</i>	0.017 (0.112)	0.028 (0.149)	0.017 (0.13)	0.016 (0.128)	0.015 (0.093)	0.008 (0.088)	0.020 (0.129)	0.021 (0.131)
(2) <i>Unincorporated entrepreneurship (transition)</i>	0.009 (0.096)	0.019 (0.132)	0.005 (0.073)	0.005 (0.072)	0.004 (0.063)	0.000 (0.)	0.007 (0.082)	0.008 (0.088)
(3) <i>Salary (log, 2012 dollars) (prior survey)</i>	10.234 (0.612)	9.847 (0.927)	10.368 (0.699)	10.231 (0.798)	10.381 (0.727)	10.401 (0.798)	10.355 (0.672)	10.146 (0.786)
(4) <i>Job satisfaction (prior survey)</i>	3.327 (0.735)	2.940 (0.919)	3.286 (0.67)	3.006 (0.826)	3.297 (0.665)	3.081 (0.721)	3.273 (0.676)	2.975 (0.866)
(5) <i>Employee promoted or changed position (prior survey)</i>	0.085 (0.278)	0.083 (0.276)	0.063 (0.243)	0.097 (0.296)	0.063 (0.244)	0.102 (0.303)	0.063 (0.243)	0.095 (0.293)
(6) <i>Business skills used on the job (prior survey)</i>	0.694 (0.461)	0.770 (0.421)	0.596 (0.491)	0.695 (0.461)	0.577 (0.494)	0.625 (0.485)	0.613 (0.487)	0.728 (0.445)
(7) <i>Job tenure (prior survey)</i>	2.365 (2.371)	1.824 (2.098)	2.255 (2.035)	2.063 (2.295)	2.191 (1.916)	1.984 (2.057)	2.311 (2.131)	2.107 (2.407)
(8) <i>Postgraduation experience (prior survey)</i>	5.430 (3.449)	4.952 (3.419)	6.471 (3.439)	6.497 (3.577)	6.172 (3.385)	6.938 (3.388)	6.277 (3.467)	6.277 (3.656)
(9) <i>PhD degree (focal survey)</i>	0.319 (0.466)	0.256 (0.437)	0.555 (0.497)	0.488 (0.5)	0.603 (0.489)	0.656 (0.476)	0.510 (0.5)	0.405 (0.491)
(10) <i>Master's degree (focal survey)</i>	0.246 (0.431)	0.178 (0.383)	0.309 (0.462)	0.215 (0.411)	0.359 (0.48)	0.277 (0.449)	0.261 (0.439)	0.183 (0.387)
(11) <i>White (focal survey)</i>	0.827 (0.378)	0.781 (0.414)	0.259 (0.438)	0.275 (0.447)	0.207 (0.405)	0.184 (0.388)	0.309 (0.462)	0.320 (0.467)
(12) <i>Male (focal survey)</i>	0.683 (0.465)	0.631 (0.483)	0.730 (0.444)	0.683 (0.465)	0.791 (0.407)	0.766 (0.424)	0.672 (0.47)	0.642 (0.48)
(13) <i>Married (focal survey)</i>	0.616 (0.486)	0.501 (0.5)	0.754 (0.431)	0.667 (0.472)	0.780 (0.414)	0.742 (0.438)	0.728 (0.445)	0.630 (0.483)
(14) <i>Highest degree from private school (time invariant)</i>	0.197 (0.397)	0.214 (0.411)	0.231 (0.422)	0.234 (0.424)	0.241 (0.428)	0.262 (0.44)	0.222 (0.416)	0.220 (0.414)
Observations	19,668	2,718	8,729	777	4,250	256	4,481	519
Individuals	13,670	2,273	5,786	623	2,742	198	3,044	425

Notes. All values are mean (standard deviation). Sample is from Table 6, model 8.

Roach et al. 2019). Table 3, models 1–3, provides the analysis of entrepreneurship rates for natives versus immigrants holding *Temporary work visa*, *Green Card*, and *Naturalization*. We observe immigrants have significantly lower likelihood of transitioning to both incorporated and unincorporated entrepreneurship relative to natives (50% lower incorporated entrepreneurship, coefficient = -0.587^{**} in model 2; and 90% lower unincorporated entrepreneurship, coefficient = 2.071^{***} in model 3).¹⁵ The negative effect for incorporated entrepreneurship is reversed only once immigrants hold *Naturalization* (model 2, coefficient = 0.386^{***}). This

indicates that the suppressive effect of immigration constraints may last well after the constraints are released upon receiving a Green Card. In models 3–6, we examine the temporal dimension of this reduction by interacting the *Temporary work visa at graduation* with time dummies capturing 0–6, 7–12, and >12 years after graduation. We observe the negative impact of the *Temporary work visa at graduation* on entrepreneurship is relatively persistent and present in the first two periods (<12 years). These results are consistent with our argument that immigration constraints are associated with lower transition to entrepreneurship.

Table 3. Entrepreneurship Rates After Graduation for Immigrants and Natives

Dependent variable	Model 1 Entrep.	Model 2 Incorp. Entrep.	Model 3 Unincorp. Entrep.	Model 4 Entrep.	Model 5 Incorp. Entrep.	Model 6 Unincorp. Entrep.
<i>Temporary work visa</i>	−0.931*** (0.26)	−0.587** (0.28)	−2.071*** (0.73)			
<i>Green Card</i>	−0.149 (0.13)	−0.127 (0.16)	−0.179 (0.21)			
<i>Naturalized citizen</i>	0.174* (0.10)	0.386*** (0.12)	−0.31 (0.19)			
<i>Temporary work visa at graduation</i> × 0–6 years postgraduation				−0.535*** (0.19)	−0.432* (0.23)	−0.739** (0.35)
<i>Temporary work visa at graduation</i> × 7–12 years postgraduation)				−0.696*** (0.26)	−0.827*** (0.32)	−0.464 (0.45)
<i>Temporary work visa at graduation</i> × >12 years postgraduation				0.089 (0.64)	−0.144 (0.76)	0.585 (1.14)
<i>Job tenure</i>	−0.073** (0.03)	−0.073* (0.04)	−0.066 (0.05)	−0.042 (0.05)	−0.067 (0.06)	0 (0.07)
<i>Job tenure</i> ²	0.002 (0.00)	0.004 (0.00)	−0.002 (0.01)	0.001 (0.01)	0.003 (0.01)	−0.003 (0.01)
<i>Postgraduation experience</i>	0.069** (0.03)	0.084* (0.05)	0.051 (0.05)			
<i>Postgraduation experience</i> ²	−0.002 (0.00)	−0.003 (0.00)	−0.002 (0.00)			
0–6 years postgraduation				−0.13 (0.27)	−0.241 (0.32)	0.144 (0.53)
7–12 years postgraduation				0.098 (0.27)	0.096 (0.31)	0.185 (0.53)
<i>PhD degree</i>	−0.331*** (0.10)	−0.258** (0.12)	−0.481*** (0.15)	−0.313*** (0.11)	−0.144 (0.14)	−0.602*** (0.19)
<i>Master's degree</i>	−0.071 (0.08)	−0.043 (0.10)	−0.127 (0.13)	−0.1 (0.11)	−0.069 (0.14)	−0.139 (0.17)
<i>White</i>	0 (0.08)	−0.028 (0.10)	0.052 (0.14)	−0.013 (0.09)	−0.094 (0.11)	0.12 (0.15)
<i>Male</i>	0.308*** (0.07)	0.338*** (0.09)	0.261** (0.11)	0.344*** (0.09)	0.369*** (0.12)	0.301** (0.13)
<i>Married</i>	−0.130* (0.07)	−0.044 (0.09)	−0.252** (0.11)	−0.109 (0.08)	−0.073 (0.11)	−0.16 (0.13)
<i>Highest degree from private school</i>	0.072 (0.08)	0.096 (0.10)	0.031 (0.14)	0.098 (0.10)	0.165 (0.13)	−0.03 (0.17)
Fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−3.865*** (0.23)	−4.489*** (0.28)	−4.663*** (0.38)	−3.380*** (0.43)	−3.894*** (0.54)	−4.427*** (0.75)
Log likelihood	−5,209	−3,524	−2,391	−3,270	−2,190	−1,521
N	45,247	44,805	44,540	29,516	29,233	29,079

Notes. The category of >12 years postgraduation is omitted from models 4–6. Errors clustered by individuals are in parentheses. Models are based on the sample of natives and immigrants and show a pooled cross-sectional analysis (across individuals and time) of a contemporaneous relationship (in the same survey snapshot). All models include degree field, region, and year fixed effects. All models are Logit.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Immigration Constraints and Job-Education Match

We next examine how immigration status relates to job-education match in paid employment (Figure 2(a)). We first test whether the *Temporary work visa* is associated with *Job-education match*. Table 4 reports analyses of various immigration status as correlates of *Job-education match* (models 1–4), where the dependent

variable *job-education match* is time variant and the explanatory variables are concurrently observed (i.e., all variables are drawn from the survey at time t). In model 1, we include the *Nonnative* dummy, which is positive and statistically significant (coefficient = 0.14***). When immigrants are separated by immigration status in model 2, *Temporary work visa* holders are 4.5% more likely to be in a match than comparable

Table 4. Immigration Status and Job-Education Match

Dependent variable: <i>Job-education match</i>	Model 1	Model 2	Model 3	Model 4 (10 years postgraduation)	Model 5 (1997 only)
<i>Nonnative worker</i>	0.140*** (0.03)				
<i>Temporary work visa</i>		0.639*** (0.07)			0.014 (0.03)
<i>Green Card</i>		0.180*** (0.05)			−0.0038 (0.01)
<i>Naturalized citizen</i>		−0.033 (0.04)			−0.015 (0.01)
<i>Temporary work visa at grad.</i>			0.502*** (0.07)	0.412** (0.18)	
<i>Temporary work visa × Preference for entrepreneurship</i>					0.072** (0.03)
<i>Green Card × Preference for entrepreneurship</i>					−0.01 (0.02)
<i>Naturalized × Preference for entrepreneurship</i>					0.01 (0.02)
<i>Preference for entrepreneurship</i>					−0.027*** (0.01)
<i>Nonnative other</i>			0.119*** (0.04)	0.058 (0.15)	
<i>Job tenure</i>	0.117*** (0.01)	0.119*** (0.01)	0.141*** (0.01)	0.103** (0.04)	0.012*** (0.00)
<i>Job tenure</i> ²	−0.005*** (0.00)	−0.005*** (0.00)	−0.010*** (0.00)	−0.001 (0.00)	−0.0006*** (0.00)
<i>Postgraduation experience</i>	0.051*** (0.01)	0.052*** (0.01)	0.025** (0.01)	−0.026 (0.20)	0.009*** (0.00)
<i>Postgraduation experience</i> ²	−0.004*** (0.00)	−0.004*** (0.00)	−0.003*** (0.00)	0.000 (0.01)	−0.0006*** (0.00)
<i>PhD degree</i>	0.565*** (0.04)	0.534*** (0.04)	0.569*** (0.04)	0.051 (0.17)	0.044*** (0.01)
<i>Master's degree</i>	0.607*** (0.03)	0.565*** (0.03)	0.601*** (0.03)	0.759*** (0.27)	0.044*** (0.01)
<i>White</i>	0.242*** (0.03)	0.253*** (0.03)	0.235*** (0.03)	0.307** (0.13)	0.008 (0.01)
<i>Male</i>	0.087*** (0.02)	0.077*** (0.02)	0.073** (0.03)	−0.072 (0.12)	0.009 (0.01)
<i>Married</i>	0.344*** (0.02)	0.343*** (0.02)	0.347*** (0.03)	0.163 (0.12)	0.023*** (0.01)
<i>Highest degree from private school</i>	−0.066** (0.03)	−0.062* (0.03)	−0.081** (0.04)	−0.169 (0.13)	0.000 (0.97)
Fixed effects included	Yes	Yes	Yes	Yes	Yes
Constant	2.041*** (0.08)	2.039*** (0.08)	1.837*** (0.11)	2.52 (1.60)	0.817*** (0.02)
R^2					0.034
Log likelihood	−46,448	−46,379	−29,607	−1,927	
N	142,851	142,851	87,257	5,386	10,102

Notes. Errors clustered by individuals are in parentheses. Models are based on the sample of natives and immigrants and show a pooled cross-sectional analysis (across individuals and time) of a contemporaneous relationship (in the same survey snapshot). All models include degree field, region, and year fixed effects. Model 4 restricts observations to 10 years postgraduation. Model 5 is based on the 1997 survey only. Models 1–4 are Logit, model 5 is LPM.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

natives (coefficient = 0.639***). This effect is sizeable, because it implies the probability of having a job *not related* to education decreases by 40% (11% for natives versus 6.5% for temporary work visa workers). *Green card* holders are 2% more likely to be in a match than natives (coefficient = 0.18***), whereas *Naturalized* citizen is not significantly different from natives. In model 3, we split the nonnative category into *Temporary work visa at graduation* and *Nonnative other*. As mentioned previously, this allows us to observe immigrants that we know were constrained at graduation (while *Nonnative other* is a “catch all” control). We observe that about 80% of the coefficient magnitude relating *Temporary work visa* with *job-education match* estimated in model 2 is driven by the *Temporary work visa at graduation* variable (coefficient = 0.502***). In model 4, we examine persistence of effects by restricting the sample to respondents observed 10 years or more after graduation. The effect of *Temporary work visa at graduation* on *job-education match* is remarkably persistent as the coefficient magnitude from model 3 decreases only by about 18% (coefficient = 0.412**). Overall, the patterns depicted in models 1–4 are consistent with our premise that immigration constraints (specifically *Temporary work visa at graduation*) results in a *Job-education match*, and the effect persists for 10 or more years even as it attenuates through *Green card* status. It is only when immigrants are granted citizenship that immigrants are no different than natives.

We also examine support for the argument that immigration constraints redirect individuals with entrepreneurial aspirations into job-education match. Model 5 in Table 4 uses the sample of individuals who responded to the 1997 survey that included a question on *Preference for Entrepreneurship*. Consistent with prior work on preference sorting, the main effect of *Preference for Entrepreneurship* on job-education match is negative for natives (coefficient = -0.027^{***}). However, the interaction effect of *Temporary work visa holders* and *Preference for Entrepreneurship* is positive (coefficient = 0.072^{**}), indicating that immigration constraints result in individuals with entrepreneurial preferences being 7% more likely to be in a job-education match. Relative to a comparable native with preference for entrepreneurship, this represents a decrease of about 60% of working in an area not related to education. This evidence is thus consistent with the *sorting* of immigrants with entrepreneurial aspirations into *job-education match* because of the immigration constraints.

Skill Accumulation, Opportunity Costs, and Job-Education Match for Immigrants and Natives

Our theoretical framework highlights that a career trajectory associated with *Job-education match* may change the individual’s skill accumulation and opportunity

costs, and accordingly have a treatment effect on the transition and type of entrepreneurship.

First, we examine whether *job-education match* is associated with an accumulation of specialized skills (Table 5, models 1–4). In Table 5, models 1 and 2, and Figure 3, we find that *job-education match* is associated with a lower likelihood of being *Promoted or changing position internally* within the firm (by about -16% for *Natives* and -44% for immigrants holding *Temporary work visa at graduation* relative to the baseline probability of 7%; this difference is not statistically significant). Furthermore, in models 3 and 4 and Figure 4, we look at the relationship between *job education match* and the acquisition of nonscience and engineering skills on the job, such as business skills related to finance, sales, marketing, and so on. We find that job-education match is associated with a lower likelihood of acquiring such skills (by about -12% for *natives* and -10% for immigrants holding *Temporary work visa at graduation* relative to the baseline probability of 70%; once again, the difference is not statistically significant). These results indicate that individuals (both natives and immigrants) working in job-education match are less likely to acquire diverse skill sets either through position change or new skill accumulation, and there is no significant difference in the magnitude for immigrants and natives.

Second, we examine whether *Job-education match* is associated with the potential for higher opportunity costs and whether these costs vary for immigrants and natives (models 5–8 in Table 5 and Figures 5 and 6). We find that *job-education match* is associated with higher salary—the earnings are higher by about 30% for *Natives* and 9% for immigrants holding *Temporary work visa at graduation* (the difference between the two groups is statistically significant) relative to the baseline salary of \$28,000 (Figures 5 and 6 report marginal effects). *Job-education match* is also associated with greater job satisfaction—about 13% for *Natives* and 7% for immigrants holding *Temporary work visa at graduation* (the difference is once again statistically significant) relative to the baseline satisfaction of 3.3. Consequently, although *Job-education match* is associated with increased pecuniary and nonpecuniary opportunity costs for both natives and immigrants and the effects are statistically significant for both categories, the magnitudes are somewhat higher for natives than immigrants.¹⁶

Release of Immigration Constraints, Job-Education Match, and Transition to Entrepreneurship

In Table 6, we present our results on the relationship between *Job-education match* (in paid employment) and transitions to entrepreneurship once immigration constraints are released. We examine incorporated and

Table 5. Relationship Between Job-Education Match and Opportunity Costs/Skill Accumulation for Immigrants and Natives

Dependent variable	Internal position change		Use business skills on the job		Log salary		Job satisfaction	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
<i>Temporary work visa at grad. × Job-education match</i>		−0.02 (0.01)		0.019 (0.02)		−0.176*** (0.03)		−0.210*** (0.04)
<i>Nonnative other × Job-education match</i>		−0.016* (0.01)		−0.01 (0.02)		−0.111*** (0.02)		−0.117*** (0.04)
<i>Job-education match</i>	−0.015*** (0.00)	−0.011*** (0.00)	−0.086*** (0.01)	−0.086*** (0.01)	0.233*** (0.01)	0.260*** (0.01)	0.406*** (0.01)	0.437*** (0.02)
<i>Temporary work visa at graduation</i>	−0.029*** (0.00)	−0.01 (0.01)	−0.070*** (0.01)	−0.088*** (0.02)	−0.042*** (0.01)	0.122*** (0.03)	−0.009 (0.01)	0.188*** (0.04)
<i>Nonnative other</i>	−0.025*** (0.00)	−0.011 (0.01)	−0.042*** (0.01)	−0.033** (0.01)	−0.015*** (0.01)	0.084*** (0.02)	−0.014 (0.01)	0.090** (0.04)
<i>Job tenure</i>	0.004*** (0.00)	0.004*** (0.00)	0.014*** (0.00)	0.014*** (0.00)	0.019*** (0.00)	0.019*** (0.00)	−0.020*** (0.00)	−0.020*** (0.00)
<i>Job tenure²</i>	−0.000*** (0.00)	−0.000*** (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	0.002*** (0.00)	0.002*** (0.00)
<i>Postgraduation experience</i>	0.020*** (0.00)	0.020*** (0.00)	0.020*** (0.00)	0.020*** (0.00)	0.029*** (0.00)	0.029*** (0.00)	−0.013*** (0.00)	−0.013*** (0.00)
<i>Postgraduation experience²</i>	−0.001*** (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	−0.000*** (0.00)	0.000** (0.00)	0.000** (0.00)
<i>PhD degree</i>	0.028*** (0.00)	0.028*** (0.00)	−0.067*** (0.01)	−0.067*** (0.01)	0.513*** (0.01)	0.503*** (0.01)	0.077*** (0.01)	0.077*** (0.01)
<i>Master's degree</i>	0.002 (0.00)	0.002 (0.00)	−0.040*** (0.01)	−0.040*** (0.01)	0.242*** (0.00)	0.228*** (0.00)	0.057*** (0.01)	0.057*** (0.01)
<i>White</i>	0.009*** (0.00)	0.009*** (0.00)	0.028*** (0.01)	0.028*** (0.01)	0.003 (0.01)	0.004 (0.01)	0.099*** (0.01)	0.098*** (0.01)
<i>Male</i>	−0.019*** (0.00)	−0.019*** (0.00)	−0.014*** (0.00)	−0.014*** (0.00)	0.058*** (0.00)	0.055*** (0.00)	0.042*** (0.01)	0.042*** (0.01)
<i>Married</i>	0.012*** (0.00)	0.012*** (0.00)	0.016*** (0.00)	0.016*** (0.00)	0.047*** (0.00)	0.043*** (0.00)	0.090*** (0.01)	0.089*** (0.01)
<i>Highest degree from private school</i>	−0.009*** (0.00)	−0.009*** (0.00)	0.008 (0.01)	0.008 (0.01)	0.034*** (0.01)	0.034*** (0.01)	0.001 (0.01)	0.001 (0.01)
Fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.049*** (0.01)	−0.052*** (0.01)	0.496*** (0.02)	0.496*** (0.02)	9.937*** (0.01)	9.815*** (0.02)	2.762*** (0.03)	2.789*** (0.03)
R ²	0.041	0.041	0.059	0.059	0.42	0.42	0.051	0.052
N	83,249	83,249	87,257	87,257	86,564	86,564	49,827	49,827

Notes. Errors clustered by individuals are in parentheses. Models are based on the sample of natives and immigrants and show a pooled cross-sectional analysis (across individuals and time) of a contemporaneous relationship (in the same survey snapshot). All models include degree field, region, and year fixed effects. All models are OLS/LPM.

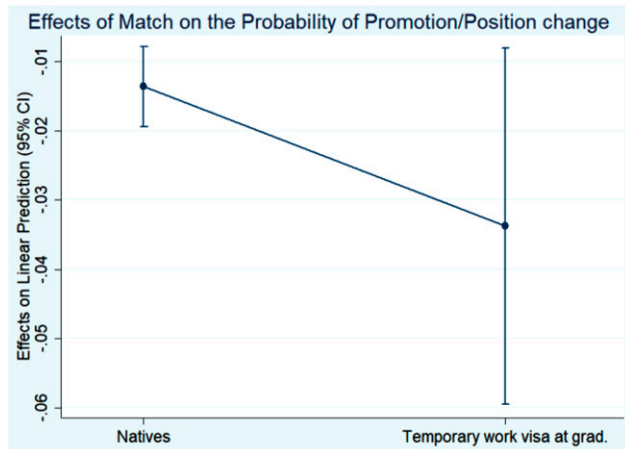
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

unincorporated entrepreneurship separately using Logit and LPM and jointly using multinomial Logit. In models 1 and 2, we report the effect of *Job-education match* and *Nonnative* dummy on *Incorporated* and *Unincorporated entrepreneurship*. For natives, *Job-education match* is negatively related to both *Incorporated entrepreneurship* (1% decrease in probability, coefficient = -0.363^{**}) and *Unincorporated entrepreneurship* (-0.8% decrease in probability, coefficient = -0.485^{***}). These effects are quite large, given the baseline rates of incorporated entrepreneurship is about 2.8% for incorporated entrepreneurship and 1.9% for *unincorporated entrepreneurship* (i.e., this represents 35% and 42% decrease relative to the baseline rate). These findings replicate the results reported in Stenard and Sauer-mann (2016) for natives, who find a positive

relationship between job-education mismatch and transitions to entrepreneurship.

In model 1, we also observe that for incorporated entrepreneurship, the coefficient on the interaction term *Nonnative × Job-education match* is positive and significant (coefficient = 0.64^{***}), whereas the coefficient on *Nonnative* is negative and significant (coefficient = -0.462^{**}). In terms of the marginal effects, this translates to *Nonnatives* with *Job-education match* being 0.9% ($p = 0.08$) more likely to transition into entrepreneurship than *Nonnatives* without *Job-education match*, whereas *Natives* with *Job-education match* are 1% ($p = 0.0001$) less likely to do so relative to *Natives* without *Job-education match*. In model 2, we run an analogous estimation with *Unincorporated entrepreneurship* as the dependent variable. We observe that the coefficient

Figure 3. (Color online) Effect of Job-Education Match on Internal Position Change (Table 5, Model 2)



on the interaction term *Nonnative* \times *Job-education match* is insignificant and the coefficient on *Nonnative* is negative and significant (coefficient = -0.663^*). Calculating the marginal effects, this implies that *Natives* with *job-education match* are 0.8% ($p = 0.001$) less likely to be in unincorporated entrepreneurship than *Natives* without *Job-education match*, whereas the analogous effect is negative but insignificant for *Nonnatives*.¹⁷ In model 3, we estimate the models 1 and 2 jointly using a multinomial Logit. The results are very similar and consistent with the separate model estimation.

A potential issue of examining the relationship between *job-education match* and entrepreneurship by categorizing individuals into *Natives* and *Nonnatives* is that the nonnative category may include individuals who were unconstrained because they were permanent residents or naturalized citizens at time of graduation. Rather than being forced, these individuals may have willingly self-selected into a *job-education match*.

Figure 4. (Color online) Effect of Job-Education Match on Business Skills Used (Table 5, Model 4)

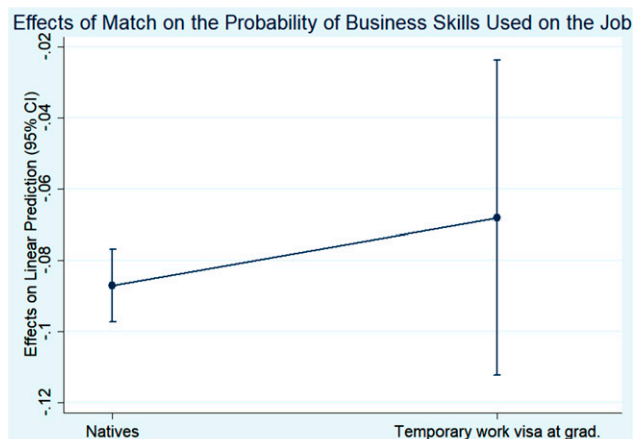
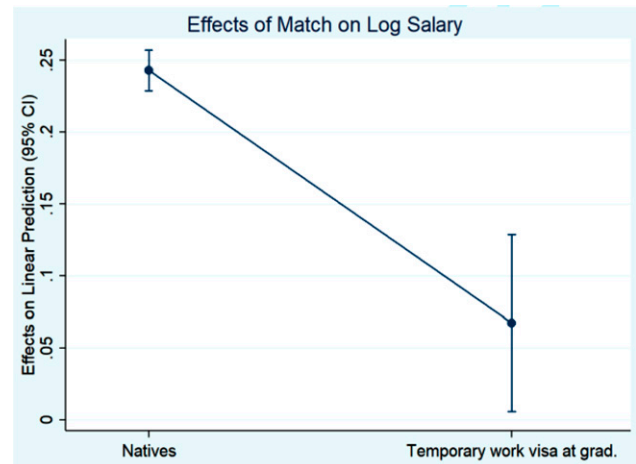


Figure 5. (Color online) Effect of Job-Education Match on Log Salary (Based on Table 5, Model 6)



To examine our relationships using a more precise categorization of constrained immigrants, we split the *Nonnative* category into the immigrants who held *Temporary work visa at graduation* and *Other nonnatives*. We interact these fine-grained categories with *job-education match* using Logit (models 4 and 6) and LPM (models 5 and 7) estimation for incorporated and unincorporated entrepreneurship, respectively. In models 4 and 5, we observe patterns consistent with those reported in model 1. It also appears that the relationship between job-education match and incorporated entrepreneurship is primarily driven by immigrants with *Temporary work visa at graduation*. Furthermore, Figure 7 plots the marginal effects to show that the effect of *job-education match* on incorporated entrepreneurship is strongly negative for *Natives* ($p = 0.002$), but such relationship disappears for immigrants who held *Temporary work visa at graduation* ($p = 0.24$, the difference is statistically significant at the 1% level, as

Figure 6. (Color online) Effect of Job-Education Match on Job Satisfaction (Table 5, Model 8)

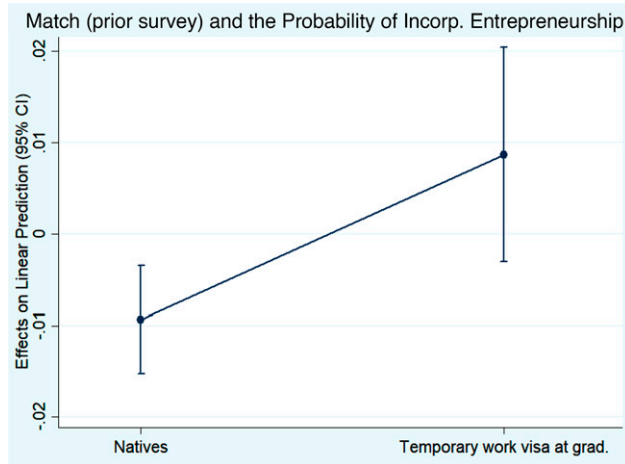


Table 6. Relationship Between Job-Education Match and Entrepreneurship for Immigrants and Natives

Dependent variable Model	Model 1 Incorp. Entrep. Logit	Model 2 Unincorp. Entrep. Logit	Model 3a Incorp. Entrep. Mlogit (a)	Model 3b Unincorp. Entrep. Mlogit (b)	Model 4 Incorp. Entrep. Logit	Model 5 Incorp. Entrep. LPM	Model 6 Unincorp. Entrep. Logit	Model 7 Unincorp. Entrep. LPM	Model 8a Incorp. Entrep. Mlogit (a)	Model 8b Unincorp. Entrep. Mlogit (b)
Nonnative × Job-education match (prior survey)	0.64*** (0.19)	0.463 (0.36)	0.642*** (0.19)	0.472 (0.36)	0.810** (0.41)	0.018*** (0.01)	0.707 (1.04)	0.009 (0.01)	0.811** (0.41)	0.843 (1.04)
Tempor. work visa at grad. × Job-education match (prior survey)					−0.747* (0.40)	−0.020*** (0.01)	−0.771 (1.04)	−0.009 (0.01)	−0.745* (0.40)	−1.267 (1.04)
Temporary work visa at graduation					−0.401*** (0.10)	−0.011*** (0.00)	−0.451*** (0.15)	−0.007*** (0.00)	−0.411*** (0.10)	−0.461*** (0.15)
Job-education match (prior survey)	−0.363*** (0.08)	−0.497*** (0.12)	−0.461** (0.18)	−0.669* (0.35)						
Nonnative	−0.462** (0.18)	−0.663* (0.35)	−0.366*** (0.08)	−0.503*** (0.12)						
Nonnative other × Job-education match (prior survey)					0.724** (0.28)	0.011 (0.01)	0.276 (0.47)	0.006 (0.01)	0.724*** (0.28)	0.292 (0.47)
Nonnative other					−0.527* (0.27)	−0.007 (0.01)	−0.374 (0.44)	−0.006 (0.01)	−0.526** (0.27)	−0.406 (0.44)
Job tenure (prior survey)	−0.047* (0.03)	−0.054 (0.05)	−0.048* (0.03)	−0.056 (0.05)	−0.024 (0.04)	−0.001 (0.00)	−0.012 (0.06)	0 (0.00)	−0.024 (0.04)	−0.005 (0.06)
Job tenure (prior survey) ²	0.002 (0.00)	−0.001 (0.00)	0.002 (0.00)	−0.001 (0.00)	−0.001 (0.01)	0 (0.00)	−0.004 (0.01)	0 (0.00)	−0.001 (0.01)	−0.005 (0.01)
Postgraduation experience (prior survey)	0.082*** (0.03)	0.058 (0.05)	0.083*** (0.03)	0.061 (0.05)	0.113*** (0.04)	0.002** (0.00)	0.049 (0.05)	0 (0.00)	0.114*** (0.04)	0.048 (0.05)
Postgraduation experience (prior survey) ²	−0.003* (0.00)	−0.002 (0.00)	−0.003* (0.00)	−0.002 (0.00)	−0.007*** (0.00)	−0.000* (0.00)	−0.002 (0.00)	0 (0.00)	−0.007*** (0.00)	−0.002 (0.00)
PhD degree	−0.571*** (0.08)	−0.475*** (0.14)	−0.570*** (0.08)	−0.475*** (0.14)	−0.426*** (0.09)	−0.005** (0.00)	−0.591*** (0.17)	−0.006*** (0.00)	−0.426*** (0.09)	−0.587*** (0.17)
Master's degree	−0.189*** (0.06)	−0.165 (0.12)	−0.192*** (0.06)	−0.175 (0.12)	−0.085 (0.08)	−0.002 (0.00)	−0.203 (0.15)	−0.003 (0.00)	−0.088 (0.08)	−0.224 (0.15)
White	−0.156*** (0.06)	0.091 (0.12)	−0.155*** (0.06)	0.084 (0.12)	−0.157** (0.07)	0 (0.00)	0.149 (0.15)	0.002 (0.00)	−0.157** (0.07)	0.135 (0.14)
Male	0.021 (0.05)	0.274*** (0.10)	0.025 (0.05)	0.275*** (0.10)	0.024 (0.07)	0.006*** (0.00)	0.261** (0.12)	0.003** (0.00)	0.027 (0.07)	0.268** (0.12)
Married	0.067 (0.06)	−0.222** (0.10)	0.064 (0.06)	−0.219** (0.10)	0.04 (0.07)	0 (0.00)	−0.167 (0.12)	−0.002 (0.00)	0.038 (0.07)	−0.162 (0.12)
Highest degree from private school	−0.136** (0.06)	−0.042 (0.12)	−0.136** (0.06)	−0.05 (0.12)	−0.08 (0.08)	0.001 (0.00)	−0.111 (0.15)	−0.001 (0.00)	−0.081 (0.08)	−0.113 (0.15)
Fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.602*** (0.18)	−4.158*** (0.35)	−2.604*** (0.18)	−4.154*** (0.35)	−2.671*** (0.28)	0.032*** (0.01)	−3.824*** (0.52)	0.023*** (0.01)	−2.670*** (0.28)	−3.880*** (0.51)
Log likelihood/R ²	−7.460 49,105	−2.893 47,777	−10.379 49,652	−4.812 31,609	−1.831 29,654	0.007 31,609	−1.831 29,654	0.005 29,654	−6.693 31,892	

Notes. Errors clustered by individuals are in parentheses. The models show a pooled cross-sectional analysis (across individuals and time) of a relationship between job-education match (as reported in the prior survey in paid employment) and entrepreneurship transition (focal survey). Except for demographics and temporary work visa at graduation that are time invariant, all control variables are based on the prior survey in paid employment. All models include degree field, region, and year fixed effects. LPM is Linear Probability Model and Mlogit is Multinomial Logit. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Figure 7. (Color online) Effect of Job-Education Match on Incorporated Entrepreneurship (Table 6, Model 4)



captured by the interaction term). For unincorporated entrepreneurship, in models 6 and 7, we observe as before that *job-education match* is negatively related to *unincorporated entrepreneurship* (e.g., coefficient = -0.007^{***} in model 7), whereas the interactions are insignificant. In model 8, we replicate the results while using multinomial Logit.

Overall, we thus find that, although job-education match is negatively associated with incorporated and unincorporated entrepreneurship alike for natives, the interaction term of job-education match for immigrants is significant and positive for incorporated but not for unincorporated entrepreneurship.

Robustness Analysis

To test the robustness of our findings and examine alternative explanations, we implement a range of additional tests and analyses that are presented in the online appendix, Table A1, and conceptually summarized in Table A2. Here, we focus our attention to the relationship between *job-education match* and *incorporated entrepreneurship* for immigrants and natives because the analogous estimates for *unincorporated entrepreneurship* are generally insignificant. For easy interpretation of the interaction terms, we report the LPM models (except the rare events Logit in model 13); the results are similar and generally with the same or higher level of statistical significance when using Logit. Moreover, as a more conservative test, we report the results for the more restrictive categorization of immigrants into those who held *Temporary work visa at graduation* and *Nonnative others*; the results remain robust to use of the more aggregate category of *Nonnatives*.

The first set of robustness tests relate to concerns that the results may be driven by differences among immigrants and natives that are unrelated to immigration constraints and not already controlled for in the

main analysis (Table 6, model 5). To address differences arising from quality of education, Table A1, model 1, includes Carnegie University classification fixed effects for the university where the individual received their highest degree, and models 2–4 include the National Research Council (NRC) university rank variable as even more refined proxy for qualitative differences (model 2 includes rank as control, and model 3 and 4 exclude top 25% and bottom 25% of the individuals, respectively, based on the school rank). Our results remain robust in all four models. In model 5, we show that inclusion of cohort fixed effects leaves the results unchanged.

To address differences arising from preferences for various job characteristics in paid employment, model 6 incorporates a set of controls observed for about one third of the sample that capture differences in aspects such as *Importance of advancement opportunities*, *Importance of intellectual challenge*, *Importance of independence*, *Importance of location*, *Importance of responsibility*, *Importance of salary*, *Importance of job security*, *Importance of societal contribution*, and *Importance of job benefits*. It is conceivable that these importance variables will serve as a proxy for unobserved quality differences such as motivation and drive. In model 6, we show that the effect of *Job-education match* on *Incorporated entrepreneurship* (corresponding to the main results in Table 5) survives the inclusion of these variables. To further probe the role of unobserved differences between immigrants and natives, we conduct the Oster (2019) diagnostic test for potential selection on unobservables, as done in prior organizational research (Starr et al. 2019). We estimate the Oster diagnostic based on the Table 6, model 5. If the Oster diagnostic parameter δ values exceed one, unobservable omitted variables are not likely to overturn the estimated effects of the coefficients of interest to zero. The Oster $\delta = 6.76$ for model 5 indicates this test is met, as selection on unobservables would have to be 6.76 times stronger than the selection on observables to overturn the estimate of *Nonnative* \times *Temporary work visa at graduation* in model 5.

We next examine the sensitivity of our results to measures of key variables in our analysis. As alternatives to incorporated entrepreneurship, we examine *Spinouts* (employee entrepreneurship), which related literature notes is robustly associated with higher performance metrics such as growth and survival (Agarwal and Shah 2014), and the binary variable *Startup with Employees*. Table A1, model 7, shows that conditional on entrepreneurship, *job-education match* is more positively related to starting an *incorporated spinout* for immigrants holding *Temporary work visa at graduation* relative to comparable *Natives*. In model 8, we find consistent results for *Startup with employees*. Importantly, both positive relationships (between *Job-education* and *Spinouts* and between *Job-education*

match and *Startup with employees*) are consistent with *Job-education match* being associated with the accumulation of specialized skills.

We also examine whether our results are sensitive to the aggregated measure of *Job-education match*. In Online Table A1, model 9, we disaggregate this variable into *Job-education match* into *Job-education closely matched* and *Job-education somewhat matched*. Both variables have similar effects, and a test of the coefficients for *Job-education closely matched* and *Job-education somewhat matched* reveals no significant difference, indicating that the aggregation is justifiable.

To address the concern that results are driven by individuals who appear briefly in the surveys, the analysis in Table A1, model 10, constrains the sample to individuals who appear in at least three survey snapshots (70% of the sample) and finds consistent results. In model 11, we focus on five cohorts of graduates and track them over time—these cohorts represent the graduation years for which we had the highest number of individuals (about 55% of the main sample). The results remain unchanged.

In model 12, we include the *preference for entrepreneurship* (based on the 1997 survey) as a control. The control variable not only strongly predicts incorporated entrepreneurship (2.4% increase in the likelihood), but the results reported in Table 6, model 6, remain robust. Although we are unable to causally separate the selection and treatment effects of the job-education match to compare the relative importance of each mechanism, the results in model 12 (in conjunction with Table 4, model 3) indicate presence of both selection and treatment effects associated with *job-education match* as it relates to *incorporated entrepreneurship*.

Finally, in model 13, we implement a rare events Logit estimation (Firth 1993) given that the number of observed entrepreneurship events is low relative to the number of observations. As recommended by Allison (2012), we implemented the penalized rare events Logit (Firth 1993). The results are robust and nearly identical in both the penalized logit and rare events logit proposed by King and Zeng (2001).

Discussion

Stories of immigrants who came to the United States as students and subsequently became successful entrepreneurs are ubiquitous. For example, Alfred Chuang arrived in the United States on a student visa and joined Sun Microsystems after completing his master's degree in computer science from the University of California Davis. As described by Chuang, "The company [Sun Microsystems] helped me apply for my H1-B visa and sponsored my green card. Through this experience, I eventually became a citizen of the United States.... If not for the F1 and

H1-B visas, I would not have gone on to co-found BEA Systems, which employed close to 6,000 people at the time it was acquired by Oracle" (Chuang 2020).¹⁸ Although Chuang graciously credits the immigration system for these opportunities, others note a darker side of immigration constraints in suppressing entrepreneurship until permanent residency is obtained. For example, attorney Greg Siskind of leading immigration law firm Siskind Sussier PC, notes that immigrants with entrepreneurial preferences are constrained to work in paid employment and thus many "are forced to delay their entrepreneurial ambitions for years while they wait in line for green cards working for other employers" (Anderson 2017). This was certainly true of Ash Ashutosh, who wanted to "build a business ... right out of engineering school" in the late eighties but worked for several years on creating computer storage solutions in NCR/AT&T before finally being able to embark with his former boss on his first entrepreneurial foray in 1997 because "I was bored at my job" (Mitra 2013). Ashutosh's illustrious later career comprised several startups and a partnership at a venture capital firm, including the creation of a billion-dollar unicorn Actifio that revolutionized data storage in cloud computing (Anderson 2016).

Consistent with both portrayals, our study provides a theoretical rationale and large-scale quantitative analysis for how immigration constraints temporarily suppress the ability for immigrants to enter entrepreneurship and require work experience in paid employment job-education match. As illustrated by the above anecdotes of immigrants using this experience and networks to conceive business ideas and team with other specialized cofounders to launch new ventures, we show that upon release of constraints, immigrants are more likely to create incorporated ventures, the types of firms that leverage specialized human capital and where expected returns may offset increased opportunity costs.

Although our study focused on immigrants who enter the United States on student visas, the arguments may apply more broadly to foreign nationals educated in other countries who immigrate to the United States directly on temporary work visas. The requirement of "specialty expertise" for labor certification applies to foreign education as well. Thus, immigrants who enter the United States on H1Bs are likely constrained to work in job-education match and face frictions starting a firm until permanent residency is granted. This is exemplified by the story of Jyoti Bansal, who noted: "I waited 7 years for my employment-based green card, and I wanted to leave my job and start a new company but couldn't." Upon green card receipt, Bansal went on to found AppDynamics, a company that now employs more than 900 people and is valued at \$1.9 billion (Anderson 2016).

Limitations and Future Research

Our study is not without limitations, many of which provide avenues for future research. First, we are limited in our ability to make causal inferences for the potential mechanisms at play and fully examine the mediating role of various variables. Although our results are consistent with both sorting and treatment effects, we are unable to causally tease them apart and compare their relative importance. There are several selection effects that may be at play, and we call for future research that examines each of their own right rather than simply conditioning them out. For example, scholars have noted that immigrants may reflect positive selection; that is, relative to both home and host country natives, individuals who choose to immigrate may be higher in both motivations and abilities (Chiswick 1999, Chakravorty et al. 2016). The immigration process too creates its own selection pressures at various stages—Chuang persevered even though the immigration officer who rejected his first visa application “told me there was no need to ever apply again,” (Chuang 2020), and Bansal observed that the green card process resulted in “friends who became frustrated with the uncertainty and after years of waiting they finally left the United States” (Anderson 2016). Additionally, country-level quotas on green cards create different selection pressures because of longer delays and decreases in stay rates for foreign nationals from countries with high excess demand (Kahn and MacGarvie 2020). Greater opportunities in their home countries may also affect the pool of immigrants who stay versus leave (Saxenian 2007). Finally, selection may also be at play based on organizational strategies—Glennon (2020) notes an increase in offshoring by research and development (R&D) intensive multinationals because of increased restrictions on H1-B visas, providing immigrants alternative work arrangements outside the United States.

Likewise, our study was unable to make strict causal inferences regarding the treatment effects of job-education match on immigrants and natives. This requires research designs that allow for exogenous variation in both mechanisms (specialization and opportunity costs). Although our results show that job-education match is positively associated with specialization and opportunity costs for both natives and immigrants, we cannot conclude that these mechanisms represent the only channel through which job-education relates to incorporated entrepreneurship. We leave causal investigation of relative importance of various factors for future work using more comprehensive data. Also, making causal inferences will likely require detailed information tracking preferences and human capital attributes affecting individual and institutional choices of enrollment in U.S. institutions, completion of schooling, and staying in the United

States versus returning to home country. We would then need rich characteristics of organizational affiliation and systematic examinations of how job-education matches influences changes in preferences and human capital development to affect subsequent career choices. Such data are simply unavailable, causing us to make design choices where we provide inference by triangulating multiple correlational analyses and relying on a multitude of tests to increase the credibility of support for the theorized mechanisms. Our approach is thus consistent with abductive research design that has been recently advocated as a viable approach in the absence of strict identification (Heckman and Singer 2017, King et al. 2021). We encourage future research to work toward developing appropriate data sets, and design studies that isolate the specific mechanisms we discuss to enable causal inferences, potentially in the context of models with multiple mediating variables.

Moreover, although SESTAT offers an excellent next best alternative, and we made every effort to leverage its rich survey questions in our analysis, not all survey questions have a precise one-to-one correspondence to our theoretical variables of interest. For example, although the survey questions enable a precise mapping to our key construct of job-education match, the supplemental questions in the SESTAT probe reasons for educational *mismatch* rather than match (the inverse of our variable of interest), and our direct measure of entrepreneurial preferences was only available in one survey year. For our key dependent variables, we used the distinction between unincorporated and incorporated entrepreneurship and relied on the correlation between startup size and incorporated entrepreneurship. The use of incorporation is consistent with prior work using it as a proxy for high-growth oriented enterprises (Fairlie and Chatterji 2013, Levine and Rubinstein 2016, Tåg et al. 2016), and Guzman and Stern (2016) show that incorporated ventures are more likely to achieve an extreme growth outcome. Although we also conduct robustness tests for startups who were employer-firms, our study would have been strengthened with more refined measures and richer information about the startups launched by individuals in our sample (e.g., extent of division of labor in startup team, growth versus lifestyle orientation of the startups). Similarly, our ability to examine skill specialization is limited by the information available in the survey and our measures serve as proxies.

Although economically very important, entrepreneurship is a rare event among individuals in the entire labor force regardless of whether they are natives or immigrants. Moreover, as we argue, the low rates of incorporated and, specifically, unincorporated entrepreneurship among immigrants are not random and likely an outcome of immigration constraints.

Although we tried to mitigate the statistical concerns related to the rarity of the entrepreneurship events, this also limits our ability to perform in-depth statistical analyses comparing incorporated and unincorporated entrepreneurship. We encourage the design and collection of large-scale datasets on immigrants and immigrant entrepreneurship that would provide insights into these questions, so future work can more thoroughly examine transitions into different types of entrepreneurship.

Finally, our efforts are also limited by the repeated cross section rather than full panel design, and preservation of anonymity of respondents that preclude matching SESTAT with other data sets (e.g., U.S. Census Longitudinal Employer-Household Dynamics). Although our robustness tests with the subsample of individuals with longer panel observations are consistent with the main sample results, we are limited in our ability to conduct a longitudinal analysis of career transitions while accounting for the effect of job and organizational affiliation (beyond job-education match) on immigrant versus native transitions to entrepreneurship. Development of datasets that address these limitations by government agencies and/or scholarly communities (such as those being created by Roach et al. 2019) would greatly enrich our ability to make causal inferences regarding both selection and treatment factors at play.

Contributions and Conclusion

The limitations notwithstanding, the study makes several contributions. First, it adds to the growing literature on immigrant entrepreneurship (Wadhwa et al. 2007, Kerr 2013, Neville et al. 2014, Kerr and Kerr 2016), where a key finding is that immigrants tend to launch a disproportionately high number of growth-oriented firms in the U.S. economy (Hunt 2011, Fairlie and Lofstrom 2015). Our paper contributes to this conversation by providing a novel theoretical mechanism that helps explain these phenomena—work-related constraints imposed by immigration policies suppress transitions to entrepreneurship in the early career stages and deflect foreign nationals into jobs with high education match, which in turn shapes the type of new ventures they found.

Second, the rich literature examining career transitions into entrepreneurship has identified the role played by preferences and human capital development, particularly through the nexus of education and work experience (Åstebro et al. 2011, Braguinsky et al. 2012, Agarwal and Shah 2014, Ohyama 2015, Stenard and Sauermann 2016). We add to this literature by relaxing an implicit assumption—that initial organizational affiliation choices are largely unconstrained by institutional factors such as immigration policies. Our argument

differs from existing work that examine market frictions *preventing* educational match to create involuntary educational mismatch (Åstebro et al. 2011). Rather, we examine constraints that create *involuntary matches*. As a result, we can reconcile work privileging underlying mechanisms that pull individuals with job-education match in different directions, even as we identify immigration status as an important factor contributing to the observed heterogeneity of individuals. Consistent with Stenard and Sauermann (2016), we provide evidence of job-education match creating higher opportunity costs of paid employment. When combined with the notion that focused skill development is more important for the identification of entrepreneurial ideas and creation of growth-oriented startups (Åstebro and Thompson 2011), this explains why immigrants with job-education match are more likely to engage in *incorporated* entrepreneurship relatively to comparable natives. In doing so, we highlight the complex relationship between preference sorting, (in-)voluntary matches into organizational contexts, and treatment effects of job-education match on entrepreneurial activity.

Third, we contribute to the growing scholarly work examining organizational implications of frictions in human capital markets (Campbell et al. 2017). Here, scholars have noted market frictions as key to constraining voluntary mobility or entrepreneurship by individuals and for firm appropriation of value (Coff and Raffiee 2015, Starr et al. 2018b). We add immigration constraints to the list of institutional frictions identified by other scholars, such as noncompete enforceability (Starr et al. 2019), intellectual property enforcement (Kenney and Patton 2009, Ganco et al. 2015), and policies regarding reporting of former incarceration (Hwang and Phillips 2020). In doing so, we highlight how initial market frictions may yield path-dependent effects on not only the formation of specialization of human capital and opportunity costs associated with exiting paid employment, but also subsequent career choices regarding staying at established firms or engaging in new venture creation, and the types of new ventures that are ultimately created.

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Madison, Soul National University and Washington University St. Louis. All authors contributed equally, and their names are listed in alphabetical order. The usual disclaimer applies.

Endnotes

¹ Please see more information at <https://www.uscis.gov/working-united-states/working-us>. We note growing discussion about ways to enable foreign entrepreneurs to immigrate and start businesses in the United States (e.g., Startup Visa Act of 2013).

² Students who entered on a visa and directly obtained a green card (without going through OPT and H1B) do so most likely through family sponsorship. Because asylum is granted to individuals who are persecuted in their home country, it is unlikely to apply to foreigners already in the United States on a student visa. Also, although it is feasible the student sample contains some lottery winners, the overall low probability of winning a lottery (0.7%; see www.uscis.gov) renders the number of such individuals to be negligible. Similarly, an investment-based green card requires an investment exceeding \$1 million (\$0.5 million in a rural area) and the creation of 10 full-time jobs. It is unlikely that such individuals would enter on a student visa, and less than 1,000 of such green cards are typically issued each year in the United States.

³ On April 2, 2008, U.S. Citizenship and Immigration Services (USCIS) began to allow extensions to OPT by 17 months to students of science, technology, engineering, and mathematics (STEM) fields.

⁴ Workers on H1B can switch employers, but this is less common as the new employer must sponsor the H1B. We note that it is possible for foreign nationals to use a loophole and obtain a workaround to new venture creation while on temporary work visa status. However, the workaround only enables them to be a co-founder with minority control because self-sponsorship for employment status is not permitted and the other sponsoring entity must have majority control in a new venture. Further, while immigrants holding H1B visa (and OPT) cannot self-sponsor, they can start a business or hold shares in a business that is entirely operated by other individuals. Until 2016, holders of OPT could also work in their business if the work was in their field of education. They would have to step back from such an active role when they receive an H1B. The possibility of these workarounds may explain why the rates of incorporated entrepreneurship are not zero among the H1B's, as we estimate below (while the rate of self-employment rate is zero). Even if a workaround is possible, starting a business is much more difficult and riskier for H1B visa holders than for comparable natives and unconstrained immigrants.

⁵ The green card labor certification process and even the need to secure a job offer may be eliminated for individuals with exceptional ability (EB-1 category), such as prominent scholars. Recent graduates, including PhDs, are unlikely to fall under this category since a track record of distinction is required. Zhang and Associates (2013) compiled a sample of approved petitions under the EB-1 category and found that the median number of publications was 14 and citations 159, consistent with the notion of exceptional ability.

⁶ On average, employers initiate this process 18 months after start of employment (Kahn and MacGarvie 2020).

⁷ The SESTAT data does not appear to underreport immigrant respondents relative to the population estimates. Furthermore, the observed rates of immigrant entrepreneurship in SESTAT are comparable to the rates reported for other datasets (Kerr and Kerr 2016). This analysis is available from the authors upon request.

⁸ An individual is included in the risk set of transitioning to entrepreneurship from their second appearance in the SESTAT until they respond with a one to either unincorporated or incorporated entrepreneurship; that is, if an individual engages in entrepreneurship in

the previous survey year, they are not included in the sample for subsequent survey appearances.

⁹ From the entrepreneurship variable, we exclude instances where the respondent answers “yes” to incorporated or unincorporated entrepreneurship and simultaneously reports working for a large employer in another survey question (both questions refer to primary employment). This could indicate data errors or a form of contract work/part-time entrepreneurship. We use 100 employees as the cutoff, but the results are robust to a wide range of cutoffs.

¹⁰ The number of observed unincorporated entrepreneurship events is very low (Table 2). This is likely a consequence of the immigration constraints, and the low rates are consistent with our theory. As such, however, this limits our ability to perform statistical analysis, and we note that the results related to unincorporated entrepreneurship of immigrants need to be interpreted with caution.

¹¹ It is important to note that *Other non-native individuals* may include individuals who currently hold a green card or are naturalized, but we do not observe their status at graduation because they were not surveyed in that period. Consequently, *Other non-native individuals* is a catch all variable that serves as a control.

¹² All results are robust the inclusion of these controls and a dummy to account for missing observations.

¹³ The main variables of interest such as the *Temporary work visa post-graduation* are time invariant, and we have at most one positive outcome per individual. The identification is thus based on differences across individuals.

¹⁴ Some argue that LPM is a superior and more robust choice for rare events estimation when the model includes fixed effects, although Logit and rare events Logit may provide a better fit with the data (Timoneda 2021). Furthermore, rare events Logit models do not allow error clustering.

¹⁵ As noted previously, some incorporated entrepreneurship among H1B holders is possible using workarounds.

¹⁶ Lower pay and satisfaction associated with job-education match for immigrants relative to natives may be driven by immigrants' experiencing a wage penalty because of constrained mobility. At the same time, immigrants may feel stuck and unhappy because of the constrained labor market choices, which may explain comparably lower satisfaction. We leave the examination of these patterns for future work. Furthermore, we note that the transitions to entrepreneurship are associated with an increase in job satisfaction for both natives and immigrants (the difference in the magnitude between natives and immigrants is not statistically significant). These results are available upon request.

¹⁷ As discussed previously, we must be careful when interpreting the insignificant results about unincorporated entrepreneurship. The rate of unincorporated entrepreneurship is very low among immigrants, which translates into a small number of observed events. Although this is likely an outcome of the immigration constraints, it may prevent us from achieving sufficient statistical power when estimating various relationships.

¹⁸ Interestingly, Chuang was almost denied the opportunity to come to the United States—his initial visa application was rejected because he answered yes to the trick question by the immigration officer about staying in the United States to get practice experience after studies (Chuang 2020).

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