Education–Occupation Mismatch and Nativity Inequality Among Highly Educated U.S. Workers

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ABSTRACT Extensive research has documented persistent nativity inequality in the U.S. labor market, even among high-skilled immigrants. Yet, this phenomenon has not been sufficiently explained. This study investigates whether different types of education–occupation mismatch are a source of this inequality. Using longitudinal data from the Survey of Income and Program Participation, we examine nativity differences in the incidence and wage penalty of education–occupation mismatch among highly educated workers. The results demonstrate that high-skilled immigrants, especially those with foreign degrees, are more vulnerable to vertical and horizontal mismatch and suffer higher wage penalties from mismatched employment than similarly educated native-born workers. Auxiliary analyses show that the disadvantage foreign-educated skilled immigrants experience is largely concentrated among immigrants from countries with lower quality tertiary education, immigrants with lower English proficiency, and those with degrees in non-STEM fields and fields with demanding licensing requirements. These results point to skilled immigrants' limited human capital transferability, which stems from the quality and applicability of educational credentials, language proficiency, and institutional barriers.

KEYWORDS Immigration • Nativity inequality • Mismatch • Occupation • Place of education

Introduction

The number of highly educated immigrants in the United States has almost doubled over the past several decades, increasing from 15.7% to 30% of the total immigration population between 1980 and 2016 (Krogstad and Radford 2018). In 2015, approximately 14.7 million U.S. immigrants had at least a college degree (Connor and Ruiz 2019). However, a wage gap between high-skilled immigrants[1] and their native-born counterparts persists. In 1980, immigrants with a college degree earned 35% less than their native-born peers. Although this gap has decreased slightly, it has remained at approximately 25% since 2000 (Richwine 2020).

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[1] We use highly educated immigrants and high-skilled immigrants interchangeably.

Despite a large body of work documenting the extent of the nativity wage gap among highly educated workers, less systematic research has explored the source of such inequality. Much more attention has been devoted to general nativity inequality among workers across different education levels (Bean et al. 2004; Butcher and DiNardo 2002; Goyette and Xie 1999; Hall et al. 2010; Mouw and Chavez 2012; Ruist 2013; Smith and Fernandez 2017; Tomaskovic-Devey et al. 2015; Villarreal and Tamborini 2018). Accordingly, the prevailing explanations for such inequality include deficient human capital and limited language proficiency (Carliner 1996; Hall and Farkas 2008; Miranda and Zhu 2013); segregation in the labor market and residential communities (Andersson et al. 2014; Catanzarite and Aguilera 2002; Gradín 2013, 2020; Mouw and Chavez 2012; Tesfai and Thomas 2020); and undocumented immigration status (Hall et al. 2010; Tienda and Singer 1995). These explanations tend to have limited explanatory power when accounting for nativity inequality among high-skilled workers—those who possess tertiary educational qualifications and are more likely to be documented but less likely to be confined to secondary labor markets or segregated neighborhoods.

The present study investigates nativity inequality in the high-skilled labor market through the lens of education–occupation mismatch. A few studies have focused on the inequality between high-skilled immigrant and native-born workers (Banerjee et al. 2018; Beckhusen et al. 2013; Chiswick and Miller 2010; Lancee and Bol 2017; Lu and Hou 2020). This strand of research points to human capital transferability limitations and the nonrecognition of foreign credentials as the main challenges for skilled immigrants. These barriers can shape the translation of educational credentials into labor market positions. We operationalize this translational process as education–occupation mismatch and distinguish between two dimensions of mismatch: (1) vertical mismatch, the mismatch between an individual's education level and the education level required for a given occupation; and (2) horizontal mismatch, the mismatch between the individual's field of study and the education required for a given occupation. Research has shown that immigrants are more likely to experience vertical mismatch than native-born workers in the United States (Chiswick and Miller 2010; Lu and Hou 2020; Lu and Li 2021) and other societies (Banerjee et al. 2018; Cim et al. 2020; Delaney et al. 2020). Except for a few notable studies outside the United States, very little research has examined vertical and horizontal mismatch together (Banerjee et al. 2018; Nieto et al. 2015).

We extend previous research in three ways. First, we examine the role of both vertical and horizontal mismatch in nativity inequality in the United States. A joint investigation of different dimensions of mismatch enables us to reduce omitted variable bias (Tao and Hung 2014) and identify the respective role of each aspect of mismatch. Second, we study the allocative and reward processes in the labor market—that is, how different occurrences and wage penalties associated with education–occupation match produce nativity inequality among high-skilled workers. High-skilled immigrants' disadvantages may arise because they are more vulnerable to falling into mismatched positions (incidence) than the native-born, which carries wage penalties, or they are subject to the higher wage penalties of mismatched employment. Third, we assess the potential mechanisms underlying the observed nativity difference in the incidence of mismatch, including the quality and applicability of immigrants' educational credentials, their language proficiency, and the institutional barriers to the

recognition of their credentials. To identify such mechanisms, we further differentiate skilled immigrants by place of degree, field of study, language proficiency, and country of origin.

In our empirical analysis, we pool two decades of longitudinal data from the 1996, 2001, 2004, and 2008 Survey of Income and Program Participation to examine the extent to which highly educated immigrants are disproportionately channeled into mismatched occupations and disproportionately penalized when mismatched relative to their native-born counterparts. All the analyses are restricted to individuals with at least a bachelor's degree.

Two Dimensions of Education–Occupation Mismatch: Vertical and Horizontal

There are two conceptually distinct dimensions of education–occupation mismatch: vertical and horizontal. *Vertical mismatch*, the discrepancy between workers' education levels and the education level (or quantity) typically required for their occupations, reflects an underutilization of general human capital. Vertical mismatch is also referred to as *overeducation*,[2] overqualification, or underemployment (McGuinness 2006; Vaisey 2006; Verhaest and Omey 2012). This circumstance arises when college graduates cannot find work commensurate with their education level and end up taking non–college jobs, which typically do not require a college degree (e.g., college graduates working as retail sales associates). The main driver of vertical mismatch is the imbalance between the supply of high-skilled workers and the demand for them (Schofer and Meyer 2005). In the United States, for example, the rise of highly educated workers has outstripped the growth in high-skilled employment opportunities. Vertical mismatch limits workers' ability to convert their human capital into productivity and commensurate economic rewards, resulting in a considerable wage penalty (Leuven and Oosterbeek 2011; McGuinness 2006). A recent study estimated that 27% of highly educated U.S. workers experience some form of vertical mismatch; these workers earn an average of 14% less than matched workers with the same educational credentials (Lu and Li 2021).

Horizontal mismatch, the discrepancy between workers' fields of study and the *type* (or substance) of education required for their occupations, captures the extent to which a worker's knowledge and skills are relevant to the demands of their occupations; it reflects an underutilization of field-specific human capital. Horizontal mismatch occurs when college graduates work in occupations that are not closely related to their field of study (e.g., engineering majors working as accountants, business majors working as software engineers). Horizontal mismatch may arise from macro-level imbalances between the supply of workers and the types of skills in demand (Machin and McNally 2007; Verhaest et al. 2017) or the occupational specificity of a field (i.e., vocationally oriented fields have more clearly delineated occupational pathways than generally oriented fields and are thus less likely to lead to horizontal mismatch; Bol et al. 2019; Roksa and Levey 2010; Wolbers 2003). Previous research

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[2] Although vertical mismatch can also mean undereducation, we focus on overeducation because our sample is restricted to high-skilled workers.

suggested that about 45% of highly educated U.S. workers experience horizontal mismatch (Robst 2007). This type of mismatch also results in wage penalties, although these penalties are smaller in magnitude (around 3%) than those for vertical mismatch (Banerjee et al. 2018; Robst 2007).

Because horizontal mismatch may not always impose labor market disadvantages, we further distinguish between two types of horizontal mismatch. The first is *horizontal undermatch*, in which individuals are employed in out-of-field occupations that pay less than matched occupations (e.g., engineering majors working as accountants). Undermatch is the negative form of horizontal mismatch and largely reflects involuntary choices—when horizontally matched positions are unavailable or workers forgo job match for other job amenities (Robst 2007). The second is *horizontal overmatch*, in which workers are employed outside their fields in positions with more remunerative career paths (e.g., accounting majors holding managerial positions). Overmatch is the positive form of horizontal mismatch and reflects voluntary choice; workers typically initiate this mismatch to achieve career advancement (Bender and Heywood 2011; Robst 2007).

Throughout the analysis, we distinguish between vertical mismatch and horizontal mismatch (both undermatch and overmatch). To disentangle their respective roles in nativity inequality, we model each separately while controlling for the other. This strategy also accounts for the potential simultaneity of vertical and horizontal mismatch, thereby yielding more accurate estimates.

Nativity Disparity in the Incidence and Wage Penalties of Mismatch

How does nativity shape the incidence and wage penalties of mismatch among highly educated workers? Several reasons lead us to expect that immigrants fare worse in the matching and reward processes.

High-skilled immigrants may experience imperfect transferability of their human capital, which can lead to the nonrecognition or devaluation of their foreign credentials. This process could result from employers' knowledge or, even more likely, their perceptions about foreign education quality and relevance (Lancee and Bol 2017; Reitz 2001); immigrants' language skills (Chiswick and Miller 2009); or institutional barriers, such as occupational closure via licensure (Lancee and Bol 2017; Weeden 2002). These mechanisms tend to be especially salient among immigrants who obtained a higher education degree outside the United States (foreign-educated immigrants). Indeed, the place of degree is a crucial factor influencing immigrants' income (Zeng and Xie 2004). Its importance likely extends to the process of education–occupation translation to the extent that foreign credentials are perceived as deficient and thus undervalued or unrecognized by employers in their hiring practices (Chiswick and Miller 2008; Damelang and Abraham 2016), especially for high-status and high-paying jobs. To enter the labor market of the destination country, skilled immigrants may be forced to accept positions for which they are overqualified or positions not closely related to their field of study, resulting in a higher incidence of vertical and horizontal mismatch. For horizontal mismatch, skilled immigrants tend to be more vulnerable to the negative type (undermatch) and less likely to achieve an upgrade through overmatch. Thus, we hypothesize that highly educated immigrants

(especially foreign-educated immigrants) are more likely to experience the negative types of mismatch (vertical mismatch and horizontal undermatch) and less likely to be positively mismatched (horizontal overmatch) than their native-born counterparts (Hypothesis 1).

The foregoing processes may also play out in wage-setting practices to the degree that they shape the perceived productivity of a given worker. These processes may even operate in evaluating workers hired for the same mismatched positions. Mismatch may reaffirm employers' negative perceptions of immigrant workers' productivity and could therefore lead to reduced wages for mismatched immigrants (especially those who are foreign-educated) more so than for similarly mismatched native workers. Thus, immigrants bear more severe economic costs from mismatched employment than their native-born counterparts. Hence, we speculate that mismatched high-skilled immigrants (especially those who are foreign-educated) suffer higher wage penalties from mismatch than similarly mismatched native-born workers (Hypothesis 2).

Barriers to Matched Employment for Immigrants

One contribution of this research is its assessment of the impact of several barriers facing foreign-educated immigrants that may combine to inhibit the transferability of their educational credentials. We do so by further differentiating skilled foreign-educated immigrants by four types of barriers they might experience.

First, the *quality of tertiary education* differs markedly across countries (Bratsberg and Terrell 2002). Employers in the United States tend to devalue foreign credentials if they perceive or know that foreign education, especially from countries with lower quality tertiary education, is deficient. The former scenario is more likely among employers who are genuinely stumped when assessing foreign credentials. To reduce their uncertainty, employers may exhibit bias against foreign education and place a premium on domestic qualifications that can be more readily connected with productivity in the domestic labor market. The devaluation of foreign credentials may vary by the country conferring the degree. Degrees earned from countries with a relatively lower average quality of tertiary education are quite possibly deemed less valuable. Immigrants with degrees from these countries are thus subject to greater discrimination than immigrants from countries with relatively higher quality tertiary education (André and Dronkers 2017). This process can unfold for both general human capital and field-specific human capital, resulting in a greater risk of the negative types of mismatch (vertical mismatch and horizontal undermatch) and a lower probability of horizontal overmatch for foreign-educated immigrants from countries with lower quality tertiary education (Hypothesis 3.1).

Second, the *applicability and pertinence of foreign educational credentials* vary by country. Human capital is country-specific with respect to one's knowledge and abilities in language and other market-specific skill sets, including technology (Banerjee et al. 2018; Chiswick and Miller 2010; Lu and Hou 2020). In this respect, the education acquired in the origin country may not be fully or directly applicable to the destination labor market (Beckhusen et al. 2013; Chiswick and Miller 2009; Friedberg 2000; Lancee and Bol 2017; Zeng and Xie 2004). Such limited applicability can

shape employers' evaluation of immigrants' overall and field-specific productivity, leading to a depreciation of foreign educational credentials.

The applicability of foreign human capital is difficult to measure, but one way to operationalize this mechanism is to differentiate by field of study. The degree to which one's credentials are internationally transferable may depend on the extent to which one's knowledge and skills are globalized or localized. Education in STEM fields tends to be more broadly relevant and generalizable across countries than education in non-STEM fields (Hanson and Slaughter 2018). Many STEM-related technical skills reflect and respond to technological demand in the globalized world. The globalization of technology has led even less developed countries to enhance their technological capabilities to improve their international competitiveness. The relatively high international applicability of STEM skills is manifest in the greater representation of immigrants in STEM jobs than in non-STEM jobs (Hanson and Slaughter 2018) and U.S. firms' common practice of recruiting STEM workers from abroad (O'Brien et al. 2020). Overall, because the limited applicability of foreign education is less severe for STEM majors, we expect foreign-educated immigrants in STEM fields to be less vulnerable to vertical mismatch and horizontal undermatch and more likely to achieve horizontal overmatch than their counterparts with non-STEM degrees (Hypothesis 3.2).

Third, *limited language proficiency* is a barrier for immigrants. Language skills are essential for high-skilled jobs, which require professional English communication in interactions with coworkers, clients, and those in leadership positions (Damari et al. 2017). Thus, immigrants who are more proficient in English can better transfer their educational credentials to the U.S. labor market. English proficiency may also reflect cultural congruence because language fluency signals cultural affinity and the ability to acclimate to workplace culture (Rivera 2012). Therefore, immigrants lacking English proficiency tend to be perceived as less productive or as a poorer fit for a given workplace and are thus evaluated less favorably than their more English-fluent peers (Chiswick and Miller 2009, 2013; Miranda and Zhu 2013). This tendency increases the risk of vertical mismatch and horizontal undermatch. Because communication skills are especially crucial for leadership positions, immigrants with relatively lower English proficiency are less likely to achieve horizontal overmatch. We speculate that immigrants proficient in English are at a lower risk of the negative types of mismatch (vertical mismatch and horizontal undermatch) and are more likely to be overmatched than their counterparts with lower English proficiency (Hypothesis 3.3).

Finally, *institutional barriers* are exemplified in occupational closure through licensure. Licensure regulates entry into occupations through a set of formal requirements, including legally recognized educational credentials, formal examinations, and citizenship or residency status (Freeman 2003; Redbird 2017; Weeden 2002). In the United States, the most common occupations with licensing requirements are lawyers, nurses, building contractors, teachers, and therapists. Licensing can deter aspiring foreign-educated immigrants from entering regulated professions in destination countries, even if they hold suitable credentials conferred in their countries of origin (Banerjee and Phan 2014). These immigrants are denied access to regulated occupations until they acquire legal credential recognition from government agencies or professional organizations and pass formal examinations (Lancee and Bol 2017). Navigating such restrictive licensing regimes is lengthy, costly, and complex (Rabben 2013), making it extremely challenging and perhaps impossible for

Table 1 Barriers for different immigrant groups and the expected differences in education–occupation mismatch

Barrier	Immigrant Groups Compared	Expected Differences in Mismatch
Among All Immigrants		
Place of degree	U.S.-educated immigrants (1) versus foreign-educated immigrants (2)	(1) < (2)
Among Foreign-Educated Immigrants		
1. Quality of education	Immigrants from countries with higher quality tertiary education (1) versus immigrants from countries with lower quality tertiary education (2)	(1) < (2)
2. Applicability of education	Immigrants with STEM degrees (1) versus immigrants with non-STEM degrees (2)	(1) < (2)
3. Language proficiency	Immigrants proficient in English (1) versus immigrants less proficient in English (2)	(1) < (2)
4. Institutional barrier	Immigrants in licensed fields (1) versus immigrants in nonlicensed fields (2)	(1) > (2)

many skilled immigrants who may have foreign qualifications but lack the time and resources necessary for licensure. As a result, foreign-educated immigrants trained in licensed fields (i.e., fields that disproportionately feed into licensed professions in the United States) tend to be particularly disadvantaged in entering matched occupations than their counterparts trained in nonlicensed fields and are therefore at a greater risk of being pushed into mismatched positions (Hypothesis 3.4).

A summary of the mechanisms and their respective empirical tests is displayed in Table 1.

Data, Variables, and Methods

Data and Sample

We used data from the Survey of Income and Program Participation (SIPP) to examine nativity differences in the incidence and wage penalties of education–occupation mismatch. The SIPP is a nationally representative longitudinal data set with detailed information on immigration status, education level, field of study, occupation, and wages. We pooled four panels of SIPP data (1996, 2001, 2004, and 2008) to increase the sample size. Given our research questions, we focused on individuals with at least a bachelor's degree. To reduce the potential bias resulting from labor market withdrawal at old age, we restricted the sample to individuals aged 23–55 during the observation window, following previous research (Di Stasio et al. 2016). To maintain the same window of observation across panels and to avoid sample size reduction (the 2008 panel reduced the sample size by approximately 50%), we restricted the sample to the first eight waves of each panel. We also limited it to respondents who

were followed up throughout the eight waves in the main analyses. We conducted a sensitivity analysis on respondents who were interviewed for at least two waves, and we obtained similar results. Then, we excluded individuals who were unemployed, self-employed, enrolled in school, disabled, or in the military, as well as those who had missing data on education (level or field) or occupation. The final sample size was 13,315 individuals contributing to 106,520 person-wave observations.

Measuring Education–Occupation Mismatch

We defined vertical mismatch using a modified version of the realized match approach, the most widely used way of measuring mismatch (Kiker et al. 1997; McGuinness 2006; Verdugo and Verdugo 1989). This approach provides an objective measure that is readily available; it can be applied using any data set that contains information on educational credentials (level and field of study) and occupations (Ortiz and Kucel 2008). See section A of the online appendix for more detail on our rationale for choosing this approach. The realized match approach involves identifying the typical education level or field required for each occupation (i.e., matched education for that occupation) by examining the educational distribution of workers in that occupation and using the modal value as the typical educational requirement. The typical education is then compared with each individual's actual education.

We improved on this conventional method in two ways. First, whereas research has commonly used the same data to derive educational requirements and conduct an individual-level analysis, we used data from the American Community Survey (ACS) to determine the educational requirements for each of the 465 three-digit occupations. We then merged the educational requirements with SIPP using the Census 2000 occupation codes to conduct individual-level analyses. The ACS is an annual repeated cross-sectional survey of approximately 1% of the U.S. population. We pooled five years of ACS data (2009–2013) to define the educational requirements for each occupation.[3] To better capture the demand for education in the U.S. labor market, we restricted the ACS sample to U.S.-born workers (Chiswick and Miller 2010) and then defined the education level and type required for each occupation. We excluded individuals with missing data on occupation and restricted the sample to individuals aged 22–55, yielding a sample size of 5,587,494. Using the ACS provides a larger sample size and more detailed educational and occupational categories than other data sets. It also alleviates a potential bias from using the same data for both defining and measuring mismatch.

Second, we adjusted the modal education level for each occupation using the marginal educational distribution to obtain the structurally most common education level for each occupation. This additional step ensured that the derived matched education standard was not driven by the number of workers across educational

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[3] We cannot use ACS data before 2009 because the survey did not collect information on the field of study in those years, preventing an exploration of horizontal mismatch. For vertical mismatch, we used the 2000 ACS to generate the vertical matching standard for the 1996, 2001, and 2004 SIPP panels and the 2009 ACS to generate the standard for the 2008 SIPP. We obtained similar results: the percentage of vertical mismatch is 27.3% for native-born individuals and 37.3% for foreign-educated immigrants. Both are consistent with the main results using the 2009–2013 ACS.

categories. Specifically, matched education was derived as the educational category with the highest value of m_{jg} in the ACS:

$$m_{jg} = \frac{p_{e|o}}{p_e},$$ (1)

where e represents education level or field (g categories), and o represents occupation (j categories), p_e is the unconditional probability of the workforce with education e, and $p_{e|o}$ is the conditional probability of workers in a given occupation o with education e. In effect, the ratio (m_{jg}) represents the extent to which the educational distribution of workers in a given occupation o deviates from the overall educational distribution of all workers. We also conducted a sensitivity analysis using modal education levels without this adjustment and obtained largely similar results. Finally, to construct a measure for vertical mismatch, we classified college graduates as vertically mismatched if the typical education level for their occupation was below a bachelor's degree; otherwise, they were classified as vertically matched.

We measured horizontal mismatch similarly by first deriving the typical field(s) of study for each occupation from the International Standard Classification of Education, which contains 22 fields of study: teaching/education; arts; humanities; social and behavioral sciences; journalism and information; business and administration; law; life sciences; physical sciences; mathematics and statistics; computing; engineering or engineering trades; architecture and building; agriculture, forestry, and fishery; health; social services; personal services; transport services; environmental protection; security services; unknown or unspecified; and no field. We used the two most common fields of study for each occupation as the matched fields, following previous research (Bol et al. 2019). We did so under the assumption that because many occupations have more than one tightly linked field of study, using the mode may not capture that reality. Individuals whose fields were different from the top two matched fields were classified as horizontally mismatched. We conducted a sensitivity analysis defining horizontal mismatch on the basis of the top one, three, or four most common fields; we obtained consistent results. In the main analysis, we present results using the top two matched fields.

We took the following steps to distinguish between horizontal overmatch and undermatch. Specifically, we calculated the median wage of matched occupations for each field of study and then compared the median wage of the respondents' occupations with those of matched occupations for their fields of study. Workers in out-of-field occupations that paid higher, on average, than in-field occupations were classified as horizontally overmatched. Conversely, workers in out-of-field occupations that paid less, on average, than in-field occupations were classified as horizontally undermatched.

The categorical measures of mismatch may be subject to arbitrary cutoff points. We thus conducted a sensitivity analysis using a continuous measure for the level of mismatch. This measure was based on m_{jg} at the education–occupation level. The absolute value of m_{jg} may not be comparable across occupations because some occupations are more strongly linked to educational credentials than others (and thus have higher values of m_{jg}). To make m_{jg} comparable across occupations, we standardized it by subtracting the within-occupation means and then dividing the difference by the within-occupation standard deviation (i.e., z scores; $\mathrm{std}(m_{jg})$). We then inverted the z scores so that higher

values indicate greater mismatch, similar to the categorical measures. This measure is meaningful only for vertical mismatch: it cannot distinguish between horizontal undermatch and overmatch, which are distinct from one another (as shown later). The results are robust whether we used the categorical or continuous measure of vertical mismatch.

Immigration Variables

The main exploratory variable is immigration status. We began by differentiating between highly educated native-born and immigrant workers using information on respondents' place of birth. We classified immigrants as individuals born outside the United States who were not children of U.S. citizens living abroad. Next, we separated immigrants with a U.S. degree from immigrants with a foreign degree. Following previous research (Zeng and Xie 2004), we distinguished between U.S.- and foreign-educated immigrants by comparing the age at U.S. arrival with age at completion of the highest degree earned (obtained using years of education plus 6). The SIPP provides year-of-arrival information on an interval scale (two- to seven-year intervals, with shorter intervals for more recent years). We defined lower and upper bounds for age at U.S. arrival and compared them to the age at the highest degree completion. Individuals whose age at degree completion was less than the lower bound of the age at arrival were classified as immigrants with a foreign degree. Individuals whose age at degree completion was greater than the upper limit of the age at arrival were classified as immigrants with a U.S. degree. Approximately 6% of respondents completed their degrees between the lower and upper bounds of age at arrival. We classified these cases using a logistic regression predicting the place of degree on the basis of age, gender, race/ethnicity, year of arrival, years of education, marital status, and geographic location. We evaluated the quality of this imputation procedure by randomly selecting 50% of the sample as training data with the remaining used as test data and applying a machine learning procedure. The results showed reasonably high classification accuracy, with more than 86% of the cases correctly classified.

We further differentiated foreign-educated immigrants along several dimensions to investigate the potential mechanisms of barriers immigrants faced. First, we distinguished foreign-educated immigrants as those from countries with higher quality versus countries with lower quality tertiary education based on the QS Higher Education System Strength Rankings for 2018.[4] This analysis was restricted to the 1996–2004 panel because the 2008 SIPP did not collect detailed information on countries of origin (only broad region categories). We used the median of the ranking data (70) as the cutoff point to distinguish between foreign-educated immigrants from countries with relatively higher quality (70 or higher) versus lower quality (below 70) tertiary education. Using cutoff points of 60 and 80 led to similar results.

Second, we subdivided foreign-educated immigrants by whether they were trained in STEM versus non-STEM fields. We categorized the following fields as STEM: science, mathematics, computing, engineering, and architecture (Bender and Roche

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[4] The data, available online (https://www.topuniversities.com/system-strength-rankings/2018), provide rankings for the top 50 countries in quality. We classified immigrants from countries outside the top 50 as being from countries with lower quality tertiary education.

2013). The remaining were classified as non-STEM fields. We focused on the STEM versus non-STEM distinction because of sample size considerations and because they are highly identifiable categories.

Third, we differentiated foreign-educated immigrants by whether they had higher or lower English proficiency using respondent-provided information on their ability to speak English. For this analysis, we used only the 2004 and 2008 panels because such data were unavailable before the 2004 panel. Immigrants were considered proficient in English if they reported that they could speak English "very well" (82% of all immigrants). The remaining responses—"well" (13%), "not well" (4%), and "not at all" (0.6%)—were classified as having lower English proficiency.

Finally, we distinguished foreign-educated immigrants who were trained in licensed fields from those trained in nonlicensed fields. Following Redbird (2017), we derived fully licensed occupations from Census 2000 occupational codes, calculated the percentage of fully licensed occupations linked to each field of study using ACS data, and then linked this ACS information to the SIPP data using the respondents' fields of study. If the percentage of licensed occupations in the respondent's field was higher than the median percentage of licensed occupations for all fields of study, we classified the field as a licensed field. We conducted a sensitivity analysis that included partially licensed occupations and obtained similar results.

Covariates

We controlled for years of education and field of study for the highest degree earned. We also included demographic controls: race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and Asian), gender, age, and marital status. We additionally adjusted for job characteristics: work experience (as of the first wave), job tenure (as of the first wave), whether the respondent worked in the public sector, union membership, and the number of occupational changes since the first wave.

In the wage regression, we converted hourly wages to 2011 dollars using the Consumer Price Index and then applied a log transformation. We controlled for the same set of covariates as we did in the incidence of mismatch analysis. In addition, we adjusted for broad occupational categories drawn from the Census 2000 occupation codes in the wage regression: (1) management and professional; (2) service; (3) clerical and sales; and (4) production, farming, and construction.

In all the models, we included dummy variables of survey panels and two geographic variables: living in a metropolitan area and region of residence (Northeast, Midwest, South, and West). We excluded the 3.4% of respondents with missing data on any variable in the final analysis. The descriptive statistics of the covariates are displayed in Table B1 (online appendix).

Methods

To examine nativity differences in the incidence of mismatch, we estimated longitudinal random-effects logistic regressions predicting mismatch status on the basis of nativity and the control variables. In this analysis, we used information throughout

the panel while taking into account the correlation of within-person observations. We could not use fixed-effects models because nativity status is a time-invariant variable. (See section C in the online appendix for a more detailed explanation of our modeling strategy choice and sensitivity analysis.) We estimated separate models for vertical and horizontal mismatch, allowing us to adjudicate the relative importance of the different types of mismatch. We controlled for horizontal mismatch in the models that predicted vertical mismatch (and vice versa). To further differentiate between horizontal undermatch and overmatch, we estimated multinomial logistic regressions while adjusting for the clustering of individual observations over time using robust standard errors.

For all logit models, we present the average marginal effects (AMEs), which we obtained by computing marginal effects (predicted probability) for each observation and calculating their average (Mize 2019). We present AMEs rather than log odds because the AMEs were derived from actual values in the data and are easier to interpret (as the average effect of an independent variable on the probability of the outcome variable). The results based on log odds led to the same conclusions.

To examine nativity differences in the wage consequences of mismatch among college graduates, we estimated longitudinal random-effects models that predicted log hourly wages on the basis of mismatch, nativity, the interactions between the two, and other covariates. The interaction terms captured the differences in the wage consequences of mismatch between native and nonnative high-skilled workers. Because the wage regressions further controlled for broad occupation categories, we effectively examined the wage penalty of mismatch among mismatched college graduates of different nativity statuses who were in similar fields of study and held similar occupations.

To assess the robustness of results to potential endogeneity bias, we conducted a sensitivity analysis using a longitudinal system GMM (generalized method of moments) estimation. We did so because nativity differences in the incidence of mismatch may be partially attributed to unobserved heterogeneity (e.g., unmeasured productivity-related personal traits). These unobserved traits may also be correlated with wages (Bauer 2002; Tsai 2010) and thus may affect the wage effects of mismatch. Because nativity status is a time-invariant variable, we could not use fixed-effects models to address this bias. GMM estimation allowed us to adjust for unobserved heterogeneity using panel data (Arellano and Bover 1995; Blundell and Bond 1998). (Section C of the online appendix describes the GMM method in greater detail.) Comparing the results from random-effects models with the GMM models allowed us to assess the extent to which unobserved heterogeneity explained nativity differences in mismatch.

Results

Descriptive Statistics

Table 2 presents the raw nativity differences in the percentage of education–occupation mismatch (see Table D1 in the online appendix for common examples of mismatch). About 26.2% of highly educated workers in the United States experienced vertical

Table 2 Percentage of education–occupation mismatch by nativity

	Overall	By Nativity Status		
		Native-born	U.S.-Educated Immigrants	Foreign-Educated Immigrants
Vertical Mismatch	26.2	25.5	23.3	35.4
Horizontal Mismatch	60.4	60.2	59.0	63.1
Overmatch	29.5	30.0	25.0	24.2
Undermatch	30.9	30.2	34.1	38.9
Number of Observations	106,520	96,448	2,088	7,984
Number of Individuals	13,315	12,056	261	998

mismatch, holding occupational positions that did not require a college degree. More importantly, the incidence of vertical mismatch differed substantially by nativity: immigrants with a foreign degree had a higher percentage of vertical mismatch (35.4%) compared with both their native-born (25.5%) and U.S.-educated immigrant (23.3%) counterparts.

Approximately 60.4% of high-skilled workers were affected by horizontal mismatch: 29.5% entered out-of-field occupations with higher economic returns, and 30.9% held out-of-field occupations that were less lucrative. Notably, substantial nativity differences were evident in horizontal undermatch and overmatch. Immigrants with a foreign degree had the highest percentage of horizontal undermatch (38.9%) compared with native-born workers (30.2%) and their U.S.-educated immigrant counterparts (34.1%). Moreover, foreign-educated immigrants had the lowest percentage of horizontal overmatch (24.2%), followed by their U.S.-educated immigrant peers and native-born workers.

Nativity Differences in the Incidence of Mismatch

Table 3 presents the incidence of education–occupation mismatch by nativity. We found notable differences in mismatch by nativity (see panel A): high-skilled immigrants were 5.2 percentage points more likely to experience vertical mismatch than native-born workers. Further, immigrants were more likely to experience horizontal undermatch and less likely to be horizontally overmatched than their native-born peers.

Place of degree shaped mismatch patterns by nativity (panel B). For vertical mismatch (Model 1), immigrants with a foreign degree were 5.9 percentage points more likely to be vertically mismatched than their native-born counterparts, net of a rich set of covariates. In comparison, immigrants with a U.S. degree did not significantly differ from their native-born counterparts. With respect to horizontal mismatch (Model 2), immigrants with a foreign degree had a higher probability of horizontal undermatch than native-born high-skilled workers but had a significantly lower likelihood of

Table 3 Incidence of vertical and horizontal mismatch by nativity (average marginal effects)

	Model 1: Vertical Mismatch	Model 2: Horizontal Mismatch (base category = horizontal match)	
		Overmatch	Undermatch
A. By Nativity			
Immigrant (ref. = native-born)	0.052***	−0.042*	0.061***
	(0.011)	(0.019)	(0.017)
Control variables	Yes	Yes	
Number of observations	106,520	106,520	
Number of individuals	13,315	13,315	
B. By Nativity and Place of Degree			
Immigration status (ref. = native-born)			
U.S.-educated immigrant	0.027	−0.044	0.054
	(0.018)	(0.031)	(0.032)
Foreign-educated immigrant	0.059***	−0.041*	0.063***
	(0.013)	(0.020)	(0.018)
Control variables	Yes	Yes	
Number of observations	106,520	106,520	
Number of individuals	13,315	13,315	
C. By Nativity and Duration of Immigration			
Immigration status (ref. = native-born)			
Immigrant for 0–5 years[a]	0.081***	−0.076*	0.101***
	(0.023)	(0.031)	(0.030)
Immigrant for 6+ years	0.047***	−0.036	0.053**
	(0.012)	(0.020)	(0.019)
Control variables	Yes	Yes	
Number of observations	105,408	105,408	
Number of individuals	13,176	13,176	

Notes: The results are based on random-effects models. The control variables (for all models) are gender, race/ethnicity, age, age squared, marital status, years of education, working experience, job tenure, total number of occupational changes, public sector employment, union membership, metropolitan area residency, region, and survey panel. Additionally, in Model 1 estimating vertical mismatch, we also controlled for horizontal mismatch; in Model 2 estimating horizontal mismatch, we also controlled for vertical mismatch.

[a]The difference between 0- to 5-year immigrants and 6+-year immigrants is not statistically significant across all dimensions of mismatch. Specifically, the coefficient difference for vertical mismatch is −0.035, with a standard error of 0.024; the corresponding coefficient differences (and standard errors) for horizontal overmatch and horizontal undermatch are 0.041 (0.033) and −0.049 (0.032), respectively.

*$p < .05$; **$p < .01$; ***$p < .001$

horizontal overmatch than their native-born peers. These results show that highly educated immigrants with foreign degrees were the most disadvantaged: they were disproportionately relegated to non–college jobs and less lucrative out-of-field jobs (Hypothesis 1).

In an additional analysis of immigrants' duration of U.S. residence, we examined whether highly educated immigrants moved up the occupational ladder during their U.S. stay. Whereas previous studies have mainly focused on immigrants' economic

(wage) assimilation (Stolzenberg and Tienda 1997; Villarreal and Tamborini 2018), we provide new insight into immigrants' assimilation in the domain of occupational match. We categorized immigrants as living in the United States for 0–5 years versus 6 years or longer. In a sensitivity analysis distinguishing immigrants with a U.S. stay of 6–10 years versus 10 or more years, we reached similar conclusions.

Panel C of Table 3 shows that both groups of immigrants exhibited a significantly higher probability of vertical mismatch and horizontal undermatch than their native-born peers. Although the coefficient is larger for more recent immigrants, the coefficients for immigrants with stay durations of 0–5 years versus those with durations of 6 or more years do not differ significantly. Thus, although immigrants modestly improved their chances of occupational match during their U.S. residency, they did not reach parity with similarly educated native workers. These results suggest that high-skilled immigrants' vulnerability to education–occupation mismatch largely lingers even as they accumulate more local human capital and employers learn more about their productivity. One possible explanation is that educational mismatch itself is persistent: once mismatch occurs, it is quite difficult for mismatched workers to get back on track (Lu and Li 2021; Pedulla 2018).

Sensitivity Analyses

We conducted sensitivity analyses to assess the robustness of our results. First, we used the GMM method (Anderson and Hsiao 1982; Arellano and Bond 1991; Hansen 1982) to address potential endogeneity bias in estimating the incidence and wage penalty of mismatch. The results (shown in section C, online appendix) were mostly consistent with our main findings, indicating robustness to endogeneity bias. The results highlight the marked disadvantages for high-skilled immigrants with a foreign degree, who were significantly more likely than the native-born to be vertically mismatched and horizontally undermatched (see Table C1, online appendix).

Second, we used the 2010 National Survey of College Graduates to measure foreign-degree status, which is directly available in the data (section E, online appendix). The results were similar, indicating that foreign-educated immigrants were significantly more likely to experience education–occupation mismatch than the native-born.

Third, we conducted an analysis using a continuous measure of mismatch (section F, online appendix), finding that immigrants with a foreign degree experienced greater vertical mismatch (i.e., a lower vertical match quality) than their native-born counterparts. Foreign-educated immigrants also experienced greater overall horizontal mismatch (the continuous measure could not distinguish between horizontal overmatch and undermatch). These results are consistent with our main results based on the categorical measure.

Fourth, we conducted the analyses separate by gender (section G, online appendix) and found largely consistent nativity differences in mismatch patterns for men and women. Specifically, irrespective of gender, immigrants were more likely to experience vertical mismatch and horizontal undermatch than their native-born counterparts. Male immigrants were also less likely than male native-born workers to enter horizontally overmatched positions. Hence, despite potential gender differences

in immigration processes (Cerrutti and Massey 2001; Lu and Li 2020), the higher risk of educational mismatch is prevalent among both male and female immigrants.

Lastly, immigrants' labor market outcomes may be shaped by their race/ethnicity, given research finding that race/ethnicity influences immigrants' labor market outcomes (Hamilton et al. 2018; Tesfai 2017; Thomas 2010). In addition to controlling for race/ethnicity in the main analysis, we explored potential intersectional effects by distinguishing between non-Hispanic White, non-Hispanic Black, Hispanic, and Asian respondents who were native-born and those who were immigrants (see section H, online appendix). The results demonstrate that immigrants across all race/ethnicity categories were more vulnerable to vertical mismatch than their coethnic native peers. The patterns are more complex for horizontal mismatch but generally suggest that White, Hispanic, and Asian immigrants were more vulnerable to horizontal undermatch than native-born White workers as well as their respective native-born coethnics. The only exception was U.S.-born Black Americans and Black immigrants; only U.S.-born Black Americans had a higher risk of undermatch. We found limited nativity and racial differences in horizontal overmatch, apart from Hispanic immigrants' lower likelihood of achieving horizontal overmatch than native-born Whites and their native-born coethnics. This result is consistent with previous findings that Hispanic immigrants are less likely to attain managerial or supervisory positions (Toussaint-Comeau 2006).

Nativity Differences in the Wage Penalties of Mismatch

Table 4 points to marked nativity inequality in wages among highly educated workers. Foreign-educated immigrants' hourly wages were 8.5% lower than those of their native-born peers (calculated as $1 - e^{-0.089}$), whereas U.S.-educated immigrants showed no significant wage disadvantage (Model 1).[5] Moreover, nativity differences in the wage penalty of education–occupation mismatch are evident, as indicated by the interactions between different types of mismatch and immigration status. The wage penalty of vertical mismatch and horizontal undermatch did not significantly differ between U.S.-educated immigrants and native-born workers. However, high-skilled immigrants with foreign degrees significantly suffered higher wage penalties from vertical mismatch (Model 2) and horizontal undermatch (Model 3) compared with native-born workers.[6]

Horizontal overmatch was associated with a general wage premium, and U.S.-educated immigrants received a lower wage premium from horizontal overmatch than their native-born counterparts. The GMM models (Table C2, online appendix), which adjust for potential endogeneity bias, show that U.S.-educated immigrants no longer had lower wage premiums of horizontal overmatch after we accounted for unobserved heterogeneity. On the other hand, the higher wage penalty associated

[5] We also found significant differences in the wage consequences of different types of mismatch. Vertical mismatch and horizontal undermatch imposed wage penalties of 11.8% and 11%, respectively; horizontal overmatch was associated with a 4.4% wage premium.

[6] The differences between vertically matched native-born and immigrants appear in Model 2, which shows no significant wage difference by nativity among vertically matched highly educated workers.

Table 4 Wage penalties of vertical and horizontal mismatch by nativity

	Model 1: Hourly Wage (log transformed)	Model 2: Hourly Wage (log transformed)	Model 3: Hourly Wage (log transformed)
Immigration Status (ref. = native-born)			
U.S.-educated immigrant	−0.013	−0.015	0.023
	(0.032)	(0.033)	(0.039)
Foreign-educated immigrant	−0.089***	−0.037	−0.073**
	(0.020)	(0.021)	(0.025)
Vertical Mismatch (VM)		−0.066***	
		(0.008)	
Interaction			
U.S.-educated immigrant × VM		0.025	
		(0.048)	
Foreign-educated immigrant × VM		−0.140***	
		(0.025)	
Horizontal Overmatch (HO)			0.045***
			(0.008)
Horizontal Undermatch (HU)			−0.080***
			(0.008)
Interaction			
U.S.-educated immigrant × HO			−0.106*
			(0.054)
Foreign-educated immigrant × HO			−0.021
			(0.046)
U.S.-educated immigrant × HU			0.049
			(0.031)
Foreign-educated immigrant × HU			−0.067**
			(0.026)
Control Variables	Yes	Yes	Yes
Number of Observations	106,520	106,520	106,520
Number of Individuals	13,315	13,315	13,315

Notes: The outcome variable is hourly wage (log transformed). The control variables (for all models) are gender, race/ethnicity, age, age squared, marital status, years of education, field of study, working experience, job tenure, occupation, total number of occupational changes, public sector employment, union membership, metropolitan area residency, region, and survey panel. Additionally, in Model 2 estimating the wage penalty of vertical mismatch, we also controlled for horizontal mismatch; in Model 3 estimating the wage penalty of horizontal mismatch, we also controlled for vertical mismatch.

*$p < .05$; **$p < .01$; ***$p < .001$

with vertical mismatch and horizontal undermatch remained for foreign-educated immigrants. Overall, these results suggest that foreign-educated immigrants suffer higher wage penalties of vertical mismatch and horizontal undermatch than their native-born counterparts (Hypothesis 2).

The Mechanisms Underlying Nativity Differences

Why are immigrants, especially foreign-educated immigrants, more likely to experience education–occupation mismatch than their native-born counterparts? We tested several potential explanations related to the quality and applicability of foreign credentials, language proficiency, and institutional restrictions (summarized in Table 1). These analyses were restricted to native-born and foreign-educated immigrants. The results are shown in Table 5.

First, the foreign-educated immigrant disadvantages—both vertical mismatch and both types of horizontal mismatch—were largely concentrated among those from countries with lower quality tertiary education (panel A, Table 5). As a sensitivity analysis, we also distinguished among immigrants by their origin country's economic status (panel 1 of Table I1, online appendix) and found consistent results. Immigrants from less developed countries were more likely to be vertically mismatched and horizontally undermatched. These results provide evidence that the quality of tertiary education plays an important role in the cross-country transferability of human capital and thus contributes to education–occupation mismatch for foreign-educated immigrants (Hypothesis 3.1).

Second, foreign-educated immigrants with non-STEM degrees, which have lower cross-country applicability than STEM degrees, were significantly more susceptible to vertical mismatch and horizontal undermatch than native-born college graduates (panel B, Table 5). This finding is consistent with our hypothesis regarding the relevance and applicability of foreign education qualifications (Hypothesis 3.2). Moreover, even immigrants with STEM degrees seemed to face challenges:[7] they had a lower likelihood of achieving horizontal overmatch (i.e., of pursuing out-of-field but lucrative career paths) than native-born college graduates.

Third, language proficiency was an important mechanism contributing to the disadvantages immigrants have in achieving occupational match. Panel C (Table 5) shows that foreign-educated immigrants who were less proficient in English experienced a notably higher risk of vertical mismatch and horizontal undermatch and a lower likelihood of horizontal overmatch (Hypothesis 3.3). Foreign-educated immigrants with proficient English skills were also more likely to experience vertical mismatch, although to a lesser extent than their peers with limited English proficiency. We conducted a sensitivity analysis by distinguishing between foreign-educated immigrants from English-speaking versus non-English-speaking origin countries according to whether English was the official language of the

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[7] Non-STEM immigrants had a similar probability of overmatch as native-born workers. Upon closer investigation, we found that non-STEM immigrants typically achieved overmatch through higher paying professional or technical occupations rather than managerial positions, whereas native-born workers were more likely to achieve overmatch through managerial positions.

Table 5 Mechanisms for nativity differences in the incidence of mismatch (average marginal effects)

	Model 1: Vertical Mismatch	Model 2: Horizontal Mismatch (base category = horizontal match)	
		Overmatch	Undermatch
A. Barrier 1: Quality of Tertiary Education (QTE) in Origin Country, 1996–2006 SIPP			
Immigration status (ref. = native-born)			
Immigrants from high-QTE countries	0.016	0.011	−0.000
	(0.034)	(0.035)	(0.037)
Immigrants from low-QTE countries	0.175***	−0.066*	0.123**
	(0.041)	(0.029)	(0.039)
p value of test between two groups of immigrants	<.001	<.041	<.006
Number of observations	76,112	76,112	
B. Barrier 2: STEM Versus Non-STEM Degree, 1996–2011 SIPP			
Immigration status (ref. = native-born)			
Immigrants with STEM degrees	0.006	−0.064**	0.052
	(0.025)	(0.024)	(0.028)
Immigrants with non-STEM degrees	0.187***	−0.006	0.103***
	(0.026)	(0.021)	(0.025)
p value of test between two groups of immigrants	<.001	<.040	<.111
Number of observations	104,432	104,432	
C. Barrier 3: Immigrant by English Proficiency, 2004–2011 SIPP			
Immigration status (ref. = native-born)			
Immigrants with proficient English	0.105***	0.015	0.066*
	(0.028)	(0.024)	(0.028)
Immigrants with less proficient English	0.388***	−0.138***	0.344***
	(0.052)	(0.027)	(0.045)
p value of test between two groups of immigrants	<.001	<.001	<.001
Number of observations	58,088	58,088	
D. Barrier 4: Licensed Versus Nonlicensed Field, 1996–2011 SIPP			
Immigration status (ref. = native-born)			
Immigrants in licensed fields	0.227***	0.095**	0.085**
	(0.031)	(0.030)	(0.031)
Immigrants in nonlicensed fields	0.058**	−0.084***	0.065**
	(0.022)	(0.017)	(0.024)
p value of test between two groups of immigrants	<.001	<.001	<.576
Number of observations	104,432	104,432	

Notes: The samples are restricted to native-born Americans and immigrants with foreign degrees. The results are based on random-effects models. The control variables (for all models) are gender, race/ethnicity, age, age squared, marital status, years of education, working experience, job tenure, total number of occupational changes, public sector employment, union membership, metropolitan area residency, region, and survey panel. Additionally, in Model 1 estimating vertical mismatch, we also controlled for horizontal mismatch; in Model 2 estimating horizontal mismatch, we also controlled for vertical mismatch. The end year reported in the table is the last year of the SIPP panel used in the analysis.

*$p<.05$; **$p<.01$; ***$p<.001$

origin country (panel 2 of Table I1, online appendix). The results are mostly consistent with panel C in Table 5, indicating that relative to native-born workers, foreign-educated immigrants from non-English-speaking countries had a significantly higher probability of vertical mismatch and horizontal undermatch and a significantly lower likelihood of horizontal overmatch. By contrast, we found no significant differences in the risk of mismatch between immigrants from English-speaking countries and the native-born population.

Finally, institutional barriers appear to shape immigrants' occupational match outcomes. as revealed by the higher risk of vertical mismatch and horizontal undermatch among immigrants in licensed fields (panel D in Table 5). The pattern broadly holds for immigrants in nonlicensed fields, but the coefficients are smaller. These results provide some evidence that licensing requirements create substantial hurdles that prevent foreign-educated immigrants from entering matched yet strictly regulated occupations in the destination society, in addition to the challenges that all immigrants face (Hypothesis 3.4). However, the results also point to a bifurcated set of outcomes among immigrants in licensed fields: a group of these immigrants secured out-of-field but higher paying occupations (horizontal overmatch), even more so than their native-born counterparts. This advantage in horizontal overmatch could partly reflect the selectivity of immigrants in licensed fields, who were more likely than those in nonlicensed fields to enter positions that were out-of-field and offered higher wages (e.g., graduates in education working as marketing and sales managers, graduates in health fields working as computer programmers). This finding is in sharp contrast to the experience of foreign-educated immigrants in nonlicensed fields, who were less likely to enter lucrative out-of-field occupations.

Discussion and Conclusion

This study examined nativity inequality among highly educated workers in the United States. We conceptualized and empirically examined a potential source of such inequality: the inability to readily translate educational credentials into occupational positions, which we operationalized as the education–occupation mismatch. We distinguished between vertical and horizontal mismatch and investigated nativity differences in both the incidence and wage penalties of different types of mismatch. In general, we found that high-skilled immigrants, especially those educated abroad, are systematically disadvantaged in the education–occupation match process. Such disadvantages could be due to actual or perceived skill differences, which limit immigrants' ability to fully utilize their collegiate education and field-specific knowledge. The main results were robust to different model specifications and potential endogeneity bias.

The study makes several contributions to the literature on nativity inequality. First, we systematically examined a source of immigrant-nativity inequality in the high-skilled labor market by simultaneously studying different dimensions of education–occupation mismatch. Previous research on the topic has largely focused on vertical mismatch and overlooked the equally important dimension of mismatch between the field of study and the substantive demands of occupations. A small but growing line of research has studied horizontal mismatch but has largely been limited to settings

outside the United States and has relied on subjective reports of mismatch. Further, to our knowledge, no research has examined heterogeneity within horizontal mismatch. We differentiated between vertical and horizontal mismatch, as well as between different qualities of horizontal mismatch (horizontal undermatch and overmatch), in a unified framework. Such differentiation offers a more complete and nuanced understanding of the extent and nature of mismatch that differentially affects highly educated immigrant and native workers. The findings reveal important variability across different types of mismatch and underscore the need to distinguish among them in future research.

Second, the present study examined nativity differences in education–occupation mismatch across two labor market contexts: occupational allocation and wages setting. These processes shape the nativity differences in the incidence and wage penalties of mismatch. Skilled immigrants with foreign degrees have a higher risk of vertical mismatch (hold non–college occupational positions) and horizontal undermatch (hold out-of-field and less lucrative occupational positions) than their native-born counterparts. This result suggests that occupational allocation constitutes an important source of high-skilled immigrants' labor market disadvantage. Further, high-skilled immigrants suffer higher wage penalties than their native-born peers. Together, the allocative and wage-setting processes combine to disadvantage skilled immigrants in the U.S. labor market.

Third, moving beyond studying overall nativity inequality among highly educated workers, we explored the multiple underlying mechanisms at play, leveraging variations in the quality and applicability of foreign educational credentials, language proficiency, and institutional barriers to credential recognition with respect to the country of origin and field of study. We found foreign immigrants to be disproportionately vulnerable to mismatch if they came from countries with lower quality tertiary education, lacked English proficiency, or obtained degrees in non-STEM fields or licensed fields of study. Hence, all these mechanisms contribute to immigrants' increased vulnerability to education–occupation mismatch; they contribute to nonrecognition or devaluation of their foreign credentials. Although language proficiency matters for immigrants' labor market success in general, its importance may vary by field of study. For example, language proficiency may be less important in STEM fields. This possibility is an interesting question for future research.

The study has some limitations. First, other mechanisms may undergird the disadvantages of immigrants in education–occupation mismatch. One such example is social capital, which can be a double-edged sword. Social capital may involve important information that shapes immigrants' job opportunities and can therefore facilitate their transition into the labor market in the destination country, especially when it involves contact with the native-born (Lancee 2012). However, because of segregated social networks, the same process may channel immigrants away from the mainstream economy and into positions in ethnic enclaves (Hagan 1998), increasing their risk of education–occupation mismatch. We lacked appropriate measures for social networks to evaluate this mechanism. In addition, our analyses of underlying mechanisms related to the international transferability of foreign credentials were based on indirect tests because we lacked direct information about such mechanisms. We call on future researchers to collect better data for a more thorough understanding of this issue.

Education–occupation mismatch adversely affects high-skilled immigrants' career and life prospects. The extent to which occupational mismatch occurs is already substantial among U.S. native-born workers, and it is significantly higher for immigrants. A longer duration of stay does not correspond substantially to a reduced risk of occupational mismatch for immigrants, which points to mismatch as a persistent phenomenon. This pattern raises concerns about the strategy that many skilled immigrants adopted to accept mismatched positions initially so that they can accumulate local human capital and work experience for their future career advancement. As we have found, this strategy is likely ineffective because mismatched immigrants tend to be stuck in such positions over the long term.

In general, immigrants' higher risk of education–occupation mismatch underscores the broad need to align immigration policies with domestic labor market demands and facilitate the credential recognition and occupational placement of skilled immigrants. A point-based immigration system based on labor market demand is unlikely to eliminate the immigrant–native wage gap (Smith and Fernandez 2017). Our analysis of underlying mechanisms suggests the need to address highly educated immigrants' various obstacles to transferring their skills along with their subsequent labor market outcomes resulting from such inequality. Given the varying quality of higher education across countries, these steps could include verifying foreign educational credentials and domesticizing foreign degrees to improve their transferability to the U.S. labor market. Other possible directions to reduce the risks of occupational mismatch include facilitating credential recognition by simplifying recertification and offering streamlined retraining programs, as well as establishing special language programs to provide vocational language assistance. ■

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