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Do immigrants experience labor market mismatch? New evidence from the US PIAAC

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Abstract

Background: One way of evaluating immigrants' labor market outcomes is to assess the extent to which immigrants are able to enter into jobs that are commensurate with their education and experience. An imperfect alignment between workers' educational qualifications and these required for their current job, or education-job mismatch, has implications for both the broader economy and individual workers. In this study, we investigate the factors associated with education-job mismatches among US workers by immigrant generation.

Methods: We analyzed the data from the US sample of the Program for the International Assessment of Adult Competencies (PIAAC) 2012/2014. Our analytic sample included 4022 employed (full and part-time) individuals between the ages of 20–65 years. We documented the distribution of education-job mismatches across selected independent variables and estimated the relationship between the individual characteristics of workers such as race, gender, presence of children, location, time in the country and knowledge of English for first-generation immigrant workers, and education-job mismatch using multinomial logistic regressions for the full sample and for the sample of first- and second-generation workers.

Results: We found that on average, immigrant workers in the US labor market were more likely to hold jobs which required less education that they had (being overmatched for the job), with first-generation workers being overmatched more frequently than second-generation workers. The probability of being overmatched for immigrant workers declines with the length of stay, and workers who are proficient in English are less likely to be overmatched. Our results also suggest that there may be labor market disadvantages to immigrant status that persist beyond the first-generation.

Conclusions: Previous research demonstrated that over-education depresses wages and lowers workers' standards of living and their abilities to accumulate wealth. Our findings confirm that this dynamic may be particularly acute for first- and second-generation workers who are finding it difficult to become fully integrated into US labor markets, even though the factors behind the mismatch differs between the two immigrant generations.

Keywords: PIAAC, Education-job mismatch, Immigrants, Labor markets, Immigrant integration, Immigration policy

Introduction

After the 2016 presidential elections, political debates about reforming immigration policy into a merit-based system as opposed to the past emphasis on family reunification gained increased salience. A merit-based system of immigration is based on the assumptions that there is a need for skilled labor, and that highly educated immigrants with professional experience will be more likely to adapt to the host society than less skilled or educated immigrants (Hunt & Gauthier-Loiselle, 2010). Given the increasing polarization of immigration politics that has occurred in the context of persistent and growing socioeconomic inequality in the United States, it is important to understand the labor market outcomes of immigrants, and in particular immigrants' labor market outcomes in relation to US-born workers, and the extent to which these align with the assumptions driving some arguments for immigration reform.

Immigrants and their children are one of the fastest growing demographic groups, comprising 26% of the US population in 2015 (Pew Research Center, 2015). Compared to other immigrant destination countries like Canada, the family-based nature of the immigration policy in the United States has resulted in a specific human capital profile of immigrants with a relatively small share of economic-class immigrants and immigrants with university degrees (Kaushal & Lu, 2015; Kaushal et al., 2016).

One way of evaluating immigrants' labor market outcomes is to assess the extent to which immigrants are able to enter into jobs that are commensurate with their education and experience. In this study, we investigate the factors associated with education-job mismatches among US workers by immigrant generation. Mismatch refers to over- and undereducation, or when workers hold educational qualifications above or below those required for their current jobs. This type of mismatch is also known as vertical mismatch, which differs from horizontal mismatch or when worker's education field and job are not perfectly related. In general, when there is a close match between workers' educational attainment and the skills required for and associated with their jobs or occupations, workers can utilize their job-specific skills more effectively, they are more productive, and wages are higher (see Leuven & Oosterbeek, 2011 for a review of the literature on the topic; Sattinger, 2012). Conversely, education-job mismatches may decrease workers' job satisfaction (Allen & van der Velden, 2001; Battu et al., 1999; Green & Zhu, 2010; Maynard & Parfyonova, 2013). In addition to the negative effects on individual workers, education-job mismatches can result in lower aggregate productivity and contribute to deepening income inequality (Green & Zhu, 2010; McGowan & Andrews, 2017; Slonimczyk, 2013).

We use the term first-generation immigrant to refer to workers who were born outside of the United States to parents who were also born outside of the United States. First-generation immigrants may be particularly likely to be overqualified for the jobs they hold in their host countries (Ferrer & Riddell, 2008; Friedberg, 2000; Prokic-Breuer & McManus, 2016) if the skills and credentials they bring from their source countries are not readily transferable to the labor markets in their new settings (Chiswick & Miller, 2009). Education-job mismatch is one of the major sources of labor market disadvantage for immigrants (Piracha & Vadean, 2013) and is often reflected in lower wages. Compared to workers born in the host country, the wage penalty for education-job mismatch is higher for immigrant workers (Banerjee et al., 2019; Chiswick & Miller, 2009; Joona

et al., 2014; Nielsen, 2007; Sanroma et al., 2015; Sharaf, 2013; Wald & Fang, 2008). It may also be important to distinguish workers born in the host country by immigrant generation to assess how second-generation workers, or native-born workers with at least one immigrant parent, fare on the labor market compared to their third-generation peers.

While the incidence of the vertical mismatch among workers by immigrant generation has been previously investigated in the context of other countries, ours is the first study to do so for the United States. Using data from the Programme for the International Assessment of Adults Competencies (PIAAC) administered in 2012, we empirically assess the extent of education-job vertical mismatch and identify factors that exacerbate or mitigate mismatch within the population of US employed workers between the ages of 20–65 by immigrant generation. More specifically, we distinguish between first-, second-, and third-plus generation workers to compare labor market outcomes across the three groups. We refer to workers who were born in the US to US-born parents as third-plus generation workers. Second-generation workers differ from their third-plus generation counterparts (Mosisa, 2006). More specifically, second-generation workers are younger, more racially diverse, and have higher levels of education than third-plus generation workers. While second-generation workers participate in the labor force at similar rates as third-plus generation workers, the former are more likely to be employed in professional and managerial occupations. Our two research questions are: (a) what is the extent of education-job mismatch for US workers by immigrant generation; and (b) what additional factors are associated with education-job mismatch?

Conceptual framework and review of the literature

Education-job mismatch—a signal of market failure due to the inefficient assignment of workers to positions—is one of the main features of the modern labor market (Leuven & Oosterbeek, 2011; Quinitini, 2011; Verhaest & Van der Velden, 2013). Studies that examine education-job mismatch conventionally rely on theories of human capital, signaling theory, search and match theory, although in general, these theories were not originally developed to account for immigrants' labor market experiences.

Human capital theory implies that schooling, on-the-job training, and experience can be substitutes for matching workers to jobs (Duncan & Hoffman, 1981; Sicherman, 1991). Workers who are apparently undermatched may have additional on-the-job training and experience that might compensate for their lower educational levels compared to what is conventionally required for their jobs. Likewise, less experienced workers are more likely to be overeducated for the jobs they hold because their education may serve as a substitute for experience (Alba-Ramírez, 1993; Hartog, 2000; Leuven & Oosterbeek, 2011; Verhaest & Van der Velden, 2013). The substitutability of experience and education is a more plausible explanation for the over- and undereducation of workers born in the US than first-generation workers because many first-generation immigrants find it difficult to transfer their schooling and the skills suggested by their experience to the labor market in their host countries. We also assess the extent to which second-generation workers experience under- and overmatching.

The imperfect transferability of human capital is one of the major barriers for immigrants in the labor market of the host country. Human capital is often country-specific and includes familiarity with labor standards, technological requirements, and

educational curricula, as well as language proficiency (Chiswick & Miller, 2009). These components of human capital may not be readily transferable across labor market contexts. If these skills were acquired in the sending country, they are often less valued and rewarded by the employers in the host country (Aydemir, 2011). In addition to devaluing foreign human capital, employers might discriminate against foreign workers because of racial and cultural biases (Esses et al., 2006; Guo, 2009).

Signaling theory (Spence, 1978) explains mismatch when education is a noisy signal about workers' unobserved skills and abilities and results in suboptimal education-job pairings on the labor market. One of the applications of signaling theory specific to immigrant workers is the difference in education-job mismatch between immigrant and third-plus generation workers with the same levels of education (Piracha & Vadean, 2013; Piracha et al., 2012). Since the higher probability of immigrant workers to be over-educated for their jobs cannot be solely explained by their educational levels, signaling theory suggests the presence of a sheepskin effect (Belman & Heywood, 1997), or the additional return of diplomas from countries that are perceived by employers as having higher value than those of other countries. More recent immigrants are also less likely to be positioned to take advantage of the established social networks that often serve as matchmakers on the labor market (Kalfa & Piracha, 2018). Social networks provide referrals to prospective employers and information about job opportunities (Fernandez et al., 2000). This information about access is especially critical for high-level jobs. Newly arrived immigrants without these social networks may be channeled into jobs for which they are more likely to be overeducated (Kalfa & Piracha, 2018). As immigrants integrate into the host country and expand their social networks and accumulate social capital, we should expect to observe a decrease in mismatches among immigrant workers.

According to search and match theory, mismatches can occur when workers and jobs are extremely heterogenous (Dean, 2018; Sattinger, 2012). Labor market frictions in the form of imperfect information generate mismatches when workers and employers need to spend time and other resources learning how to navigate labor markets. Once employers and workers learn about the complementarity of skills and jobs, matches become closer (Groot & Maassen van den Brink, 2000). More specifically, employers may find it difficult to assess first-generation immigrant workers' credentials or experience. This phenomenon would be reflected in variations in immigrant workers' labor market experiences, and in particular across geographic locations within the host country. Likewise, immigrant workers with less work experience in their host countries may be more likely to be overmatched. Over time, immigrants may improve their education-job matches as they develop language proficiency and accumulate local human capital (Gray, 2019) which suggests that the length of stay in the host country might be an important predictor of education-job match (Chiswick & Miller, 2009). Another possible source of mismatch is immigration policies that favor highly educated immigrants without considering labor market needs (Dean, 2018). Immigrants with education-related skills that are not in high demand are likely to be overmatched.

Labor market shocks such as a rapid downturn in a specific industry, such as technology can also contribute to overmatching among immigrant workers. According to human capital theory, signaling, and search and match frameworks, we should expect to see higher rates of overmatch among immigrant workers compared to third-plus

generation workers but also a decrease in mismatch with the length of time in the country. We might also observe differences in mismatch across race or country of origin that could be due to differences in immigrants' social networks, language and cultural differences, as well as employers' racial and cultural biases. While an imperfect measure, we use race as a proxy for country of origin; including variables for race/ethnicity in the analysis also allows us to control for the racial discrimination on the job market experienced by US- born workers who are not White (Bertrand & Mullainathan, 2004; Quillian et al., 2017). We also control for gender and presence of children to account for the gender stratification in labor markets and because workers with children–and in particular female workers–might experience career penalties such as overmatching (Kahn et al., 2014).

Measures of mismatch

The three most common ways to measure education-job mismatch use qualifications or skills. The first approach, qualification mismatch, compares the educational qualification of the worker to the modal qualification in that worker's occupation category (Mendes de Oliveira et al., 2000). The second approach, skills mismatch, is based on the worker's assessment of the match between their jobs and their qualifications (Battu et al., 2000; Frei & Sousa-Poza, 2012). This measure is derived from the question in the PIAAC survey: "If applying today, what would be the usual qualifications, if any, that someone would need to get that type of job?" A third approach combines workers' self-reported assessments of skill mismatch and quantitative information on skill proficiency (McGowan & Andrews, 2017; Pellizzari & Fichen, 2017).

An advantage of qualification mismatch based on the distribution of qualifications within an occupation is that information about workers' educational qualifications is collected in many surveys and is not subject to self-assessment bias. The other methods have drawbacks (Chevalier, 2003). Many surveys do not collect information on the workers' self-assessments of the match between their educational backgrounds and the educational requirements of their positions. The third measure requires data on workers' assessments of their skills and a sufficient sample to estimate the distribution of skills for each occupational category. It also relies on the assumption that all jobs within a given occupational category require the same level of skills.

Data and methods

Data

We use data from the US sample of the Programme for the International Assessment of Adult Competencies (PIAAC) administered by the National Center for Education Statistics on behalf of the Organisation for Economic Cooperation and Development (OECD). PIAAC assesses adults' abilities in four domains: literacy, numeracy, problem-solving in technology-rich environments, and reading. In the US, the PIAAC was conducted in two rounds. The first round of data collection occurred in 2011 and 2012, and the second was collected in 2013 and 2014. The latter was aimed at enhancing the original sample by oversampling young adults between the ages of 16 and 34.

We restricted our analysis to all individuals employed full or part-time between the ages of 20–65 years for whom we had data about their education and occupation and

complete information on all background variables as described in Appendix. There are 4022 observations in our final unweighted analytic sample (i.e., observations with data available for all variables in the analysis).[1] We use descriptive analysis to document the distribution of education-job mismatches across selected independent variables. To understand the relationship between our independent variables and education-job mismatch we estimate three-category multinomial logistic regressions for the full sample and for the sample of first- and second-generation workers where workers can be matched (the reference category), undermatched, or overmatched.

Methods

Most studies that analyzed PIAAC data to address labor market mismatch assessed skills mismatch as opposed to education-job mismatch, the focus of our study. Skills mismatch is defined as the difference between a respondent's measured skills, literacy and numeracy, and the average literacy and numeracy score reported by respondents who reported that their skills matched those required by their jobs (McGowan & Andrews, 2017; Pellizzari & Fichen, 2017). The OECD employs this measure of skills mismatch (McGowan & Andrews, 2015), described above as the third approach to measuring mismatch. Researchers exploited the international scope of the PIAAC data to compare skills mismatch across occupations within a given country and across countries. The studies aimed to identify factors related to skills mismatch (Levels et al., 2014), to understand the consequences of mismatch at the country (McGowan & Andrews, 2017; Salas-Velasco, 2018) and individual firm levels (McGowan et al., 2018).

We used the realized match procedure developed by Clogg and Shockey (1984) to create our measure of education-job match. A worker in a given occupation is considered undermatched or overmatched if their educational qualification is outside of the modal educational level or a defined range around the mean educational level for that occupation (see Kiker et al., 1997; Madamba & De Jong, 1997; Quinn & Rubb, 2006; Tsai, 2010; Verdugo & Verdugo, 1989;). We used the modal category of education for an occupation (Chiswick & Miller, 2009; Kiker et al., 1997) because in PIAAC education is measured by the years associated with the educational level that corresponds to the International Standard Classification of Education (ISCED) rather than a count of years to facilitate cross-national comparisons.[2] Workers were coded as correctly matched if their educational qualification coincided with the modal value of education for their occupations. Workers whose educational level was under and over the modal education for their occupational categories were coded as under- and overmatched, respectively. All analyses accounted for the complex sampling design of the survey by using replicate weights in the regression analyses to calculate parameter estimates and standard errors.

Our key independent variables are generational status measured using three mutually exclusive indicator variables. First-generation immigrants were born outside of the US to

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[1] The second round of data collection also included an oversampling of unemployed adults and older adults who we excluded from our analytic sample.

[2] We used the variables for workers' highest level of education according to the eight-category ISCED classification and current occupation reported in three-digit categories to create our matching variables. In the latter there are 106 three-digit occupational categories with a range of five to 190 workers in each category. The level of detail in the PIAAC data allowed us to create this measure of mismatch because there was sufficient variation in workers' education levels within each occupational category.

parents who were born outside of the US Second-generation workers were born in the US to at least one parent who was born outside of the US Third-plus generation workers were born in the US to US-born parents. We also created indicator variables for gender and race (the latter is a set of five variables: Hispanic, White, Black, Asian American and other). Additional variables include: an indicator variable that denotes that the respondent has children, work experience in years, an indicator of a part time employment, a set of occupational categories, a set of four indicators for US region (Northeast, Midwest, South, and West), and city to denote that the respondent lives in an urban area. We used PIAAC numeracy scores to account for workers' abilities which might not be perfectly correlated with education or otherwise unobserved in the data but potentially observable by employers. We used two additional sets of indicator variables in an analysis of the immigrant subsample: ability to speak English (very well, well, not well, and not at all); and years in country (less than five, six to 10, eleven to fifteen, and more than fifteen) to assess the relative influence of human capital factors that are specific to the immigrant experience.

We estimated the multinomial logistic regression model where we sequentially introduced covariates. The fully saturated model is as follows:

$$Probability(Match_i = m|X_i) = F(\beta_0 + \beta_1 FirstGen_i + \beta_2 SecGen_i + X_i\gamma)$$

where $F(x) = \dfrac{1}{1 + e^{-x}}$

In the model, m denotes the outcome of job-education match (perfect match $= 0$, undermatched $= 1$, overmatched $= 2$), i indicates individual observations, *FirstGen* and *SecGen* are indicators of generational status (third-plus generation is the omitted reference category); X is a vector of demographic characteristics. The full model also includes a set of ten dummy variables that represent occupational categories to control for the difference in job-education match by occupation.[3]

Using four specifications of the model above and controlling for individual characteristics and location (US region and the indicator for city), we estimate the differences in the probability of being under- or overmatched compared to perfect match between first, second, and third-plus generation workers.

Subgroup analysis

We repeated the analysis described above but limited the sample to first- and second-generation workers and estimated regression models that compare the differences in mismatch between the two generations of workers and the factors that are associated with the mismatch. Additionally, we control for language skills and the number of years in the country to understand how first- and second-generation workers' experiences in the US labor market are associated with the probability of mismatch. The subgroup models do not include occupational categories because the sample sizes for some

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[3] The categories are drawn from the one-digit classification of occupations and include: armed forces; legislators, senior officials, and managers; professionals; technicians and associate professionals; clerks; service workers; skilled agricultural workers; craft and related trades; plant and machine operators; and elementary occupations.

of the categories were not large enough for the estimation of the between-occupation differences.

Results

Descriptive statistics

The descriptive statistics for the sample are presented in Table 1. Overall, 49% of employed respondents were correctly matched. One-fifth of the sample held jobs that required higher education levels, and about 30 percent were overmatched for their current jobs. These figures are roughly consistent with existing studies that reported that on average 26% of workers were undermatched and 30% were overmatched (for a review, see Leuven & Oosterbeek, 2011). In the undermatched category, the two modal education levels were less than high school and high school and some college, 37 and 46 percent respectively. In the correctly matched category of workers, two thirds had at least high school diploma and some college. 55 percent of overeducated workers had a bachelor or higher degrees. The average worker in our sample had at least a high school diploma and some college (56%). A small fraction of the sample had not competed high school (8%) and about one-third of the sample had bachelor's degree and higher degrees. Fifteen percent were first-generation immigrants and 8% were second-generation workers. Slightly less than half of the sample (47%) was comprised of female workers. The three largest racial/ethnic groups in the sample were White (68%), Hispanic (14%) and Black (11%) workers. Most of the respondents had children (71%). The average worker in the sample had 22 years of work experience although there was also considerable variation within the sample. One third of the respondents lived in the South. The remainder of the respondents were fairly evenly divided between the other regions. A third of the respondents lived in cities or urban areas.

In Table 2, we report the distribution of the education variable we used to calculate mismatch by generational status. The chances of a worker being mismatched differed by generational status and educational level. Specifically, among the workers with less than a high school degree, third-plus generation workers were more likely to be correctly matched. Within the group of highly-skilled workers with a bachelor's degree and higher, third-plus generation workers were correctly matched in fifty percent of the cases. Compared to first- and third-plus generation workers, second-generation workers who graduated from high school and had some college education had a higher chance of being correctly matched. College-educated second-generation workers were more likely to be overeducated for their jobs and less likely to be undereducated. This could be because second-generation workers were more likely to have college or higher degrees compared to third-plus and first-generation workers. At the same time, second-generation workers with less than a high school degree had the highest probability of being undereducated for their jobs. We will discuss some of the hypotheses underlying this finding below.

Table 3 presents our breakdown of the sample of employed workers by education-job match and selected independent variables with corresponding p-values from the ANOVA test for the comparison between three groups. First-generation immigrant workers were almost twice as likely to be undermatched compared to second-generation workers, which is attributable to the relatively high percentage of first-generation immigrants who did not hold a high school diploma, the modal educational level for most

Table 1 Descriptive Statistics, Full Sample of Workers, PIAAC 2012/2014

	Proportion/ Mean, Weighted (SE)
Education-job match	
Undermatched	0.20 (0.007)
Correct match	0.49 (0.009)
Overmatched	0.30 (0.008)
Generational Status	
First generation	0.15 (0.006)
Second generation	0.08 (0.005)
Third-plus generation	0.77 (0.008)
Education level	
Less than high school	0.08 (0.004)
High school and some college	0.56 (0.010)
College degree and above	0.36 (0.009)
Work experience (years)	21.62 (0.23)
Part-time	
Literacy	277 (0.82)
Numeracy	265 (0.91)
Female	0.47 (0.010)
Race	
Hispanic	0.14 (0.007)
White	0.68 (0.009)
Black	0.11 (0.006)
Asian	0.05 (0.004)
Other	0.02 (0.002)
Children (yes)	0.71 (0.008)
City	0.37 (0.008)
US Region	
Northeast	0.19 (0.007)
Midwest	0.22 (0.007)
South	0.36 (0.009)
West	0.23 (0.009)
English ability (first- and second-generation workers only)	
Speak English very well	0.59 (0.007)
Speak English well	0.24 (0.006)
Speak English not well	0.12 (0.003)
Speak English not at all	0.05 (0.002)
Years in country (first-generation immigrants only)	
Less than 5 years	0.08 (0.002)
Six to 10 years	0.10 (0.002)
Eleven to 15 years	0.19 (0.003)
More than 15 years	0.63 (0.006)
Weighted N	127,728,286
Unweighted N	4020

The first- and second-generation subsample is comprised of 886 observations (29,483,276 when weighted); of these 548 are first-generation immigrants (19,036,284 when weighted)

Table 2 Distribution of workers by immigrant generation, education level, and job-education mismatch, PIAAC 2012/2014

	Immigrant generation		
	First generation, proportion (SE)	Second generation, proportion (SE)	Third-plus generation, proportion (SE)
Less than high school			
Undereducated	0.33 (0.02)	0.54 (0.02)	0.19 (0.01)
Correctly matched	0.41 (0.02)	0.28 (0.02)	0.51 (0.01)
Overeducated	0.26 (0.02)	0.18 (0.02)	0.30 (0.01)
High school and some college			
Undereducated	0.21 (0.01)	0.17 (0.01)	0.19 (0.01)
Correctly matched	0.52 (0.01)	0.58 (0.01)	0.48 (0.01)
Overeducated	0.27 (0.01)	0.26 (0.01)	0.33 (0.01)
Bachelor and higher degrees			
Undereducated	0.18 (0.01)	0.11 (0.01)	0.21 (0.01)
Correctly matched	0.46 (0.01)	0.46 (0.01)	0.51 (0.01)
Overeducated	0.36 (0.01)	0.42 (0.01)	0.28 (0.01)
N	548	338	3134

Table 3 Selected Descriptive Statistics by Job-Education Mismatch, All Workers, PIAAC 2012/2014

	Undermatched	Correctly Matched	Overmatched	ANOVA (p-value)
First generation	0.30 (0.02)	0.41 (0.02)	0.27 (0.02)	< 0.0001
Second generation	0.17 (0.02)	0.49 (0.03)	0.33 (0.03)	< 0.0001
Third-plus generation	0.18 (0.08)	0.51(0.01)	0.30 (0.01)	< 0.0001
Female	0.22 (0.01)	0.47 (0.01)	0.30 (0.01)	< 0.0001
Male	0.19 (0.01)	0.52 (0.02)	0.30 (0.01)	< 0.0001
Hispanic	0.35 (0.03)	0.45 (0.03)	0.19 (0.02)	< 0.0001
White	0.18 (0.01)	0.50 (0.01)	0.31 (0.01)	< 0.0001
Black	0.19 (0.02)	0.50 (0.03)	0.29 (0.02)	< 0.0001
Asian American	0.09 (0.02)	0.45 (0.04)	0.45 (0.04)	< 0.0001
Other	0.19 (0.05)	0.45 (0.06)	0.35 (0.06)	< 0.0001
Literacy	259.74 (2.49)	276.05 (1.20)	291.07 (1.26)	< 0.0001
Numeracy	245.46 (2.51)	263.08 (1.33)	280.83 (1.42)	< 0.0001
N	781	2017	1224	

Numbers in the rows do not add up to 100% because of rounding. In the last column, we report p-values from ANOVA test with Bonferroni correction for the difference in means between undermatched, correctly matched, and overmatched workers. For all variables, statistically significant differences were found pairwise, i.e., between undermatched and correctly matched, undermatched and overmatched, and correctly matched and overmatched

occupational categories in the US[4] On average, a higher share of second-generation workers were overmatched compared to the full sample. In general, there were few substantive differences in the rates of mismatch for male and female workers.

Turning to race/ethnicity, Hispanic workers were the most likely and Asian American workers were the least likely to be undermatched for their current jobs (35% and 9%

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[4] Twenty-four percent of first-generation immigrants have less than a high school diploma, compared to 5% of second and third-and-plus generation respondents combined.

respectively). While we observed a large variability in the share of over or undermatched workers across racial/ethnic groups, the share of correctly matched workers by race/ethnicity is relatively similar—between 45% (Hispanic workers) and 50% (White and Black workers). Only one out of five Hispanic workers were overmatched compared to one out of two Asian American workers. The bottom panel presents the average scores on the PIAAC literacy and numeracy skills assessments by the type of education-job match. Respondents who were overmatched had higher than average scores on both assessments, and those who were undermatched had the lowest scores on average. This finding is not surprising because literacy and numeracy scores are highly correlated with the education variable we used to construct our measures of mismatch. The differences between the three groups of workers across the job-education match categories were statistically significant for all variables. This suggests that the demographic characteristics assessed here and cognitive abilities might be some of the factors which are associated with mismatch.

Since our analysis is based on a comparison of education-job match across the three generational groups, we also documented the differences in the background and outcome variables by generational status (see Table 6 in the Appendix). There was considerable variation across the three generations in racial composition, education levels, and numeracy and literacy skills. The literacy and numeracy scores of first-generation immigrants were much lower compared to workers from the second and third-plus generations. This may partially reflect the distribution of education within each group; the first-generation has a smaller share of workers with high school and college degrees and a much higher share of workers who did not have high school diplomas. Of the three generations, third-plus generation workers were the most experienced with about 23 years of experience on average, compared to 19 years for the first-generation and 17 for the second.

The racial composition of first-generation workers more closely resembled the second-generation than the third-plus generation. Third-plus generation workers were predominantly White (80%), while only 15% of first-generation immigrant workers were White. Hispanics comprise half of all first-generation workers but 4% of third-plus generation workers. First-generation workers were more likely to be Asian American compared to third-plus generation workers. Two fifths of second-generation workers were Hispanic and almost 50% are White. The first- and third-plus generations had similar shares of Black workers at approximately 12 percent.

First-generation workers were more likely to have children than second and third-plus generation workers—four out of five first-generation workers reported having at least one child compared to 59% percent of second-generation and 71% of third-plus generation workers. Third-plus generation workers were more evenly distributed across geographic regions than the other two groups. The geographic locations for first- and second-generation workers reflected well-documented patterns of immigrant settlement (Massey & Capoferro, 2008); the smallest share of both groups resided in the Midwest and largest were in the West and South regions.

Given the variations in the demographic characteristics and locations across the three generations of workers, the differences in education-job mismatch are not surprising. Of the three groups, first-generation immigrants are more likely to be undermatched

and less likely to be overmatched. One out of two third-plus generation workers were correctly matched while 30% were overmatched for their jobs. Second-generation workers had the highest share of overmatched workers; one out of three had more education than the modal education level for their current jobs.

We also looked at the characteristics of workers by the category of mismatch (see Table 7 in Appendix). The distribution of workers by generation mirrored the overall shares of workers from each generation in the sample: third-plus generation workers comprised the largest share of workers in each education-job category and second-generation workers comprised the smallest. Undermatched workers were more likely to be female and more likely to have children, while overmatched workers were less likely to have children. A higher percentage of Hispanic workers were overmatched than undermatched or correctly matched. On average, undermatched workers had more experience—this is not surprising given that for some occupations, experience and education may be substitutes. Experience may also compensate for skills that are measured by literacy and numeracy—undermatched workers had the lowest scores on both assessments compared to correctly matched and overmatched workers. Overmatched workers had the highest literacy and numeracy scores. We did not observe any geographic patterns in the distribution of workers by education-job match.

Regression models

Table 4 presents the results of our multinomial logistic regression analyses. Model 1 contains only the variables for generational status. In Model 2 we added variables accounting for the differences in work experience and part-time status. Model 3 includes occupational categories. Finally, Model 4 includes the rest of the variables selected for the analysis and conceptually associated with the probability of mismatch: numeracy score, gender, race, presence of children, and geographical location. All coefficients are expressed in odds ratios and can be interpreted as the odds of being under- (odd numbered columns in Table 4) or overmatched (even numbered columns in Table 4) for the first- or second-generation workers relative to the third-plus generation workers, or for workers with different background characteristics represented by other variables in the analysis. For instance, the odds ratio of two on the first-generation indicator in Column 1 implies that the odds of being undermatched for an average first-generation worker is twice that of an average third-plus generation worker. In terms of respective probabilities, this odds ratio corresponds to a 66 percent higher probability of being undermatched for first-generation workers compared to third generation workers with the same background characteristics.

The first major observation from Table 4 is that independent of specification, first-generation workers face significantly higher probability of being undermatched: from 67% higher compared to third-plus generation workers (column 1 of Table 4, odds ratio of 2) to 60% (column 7 of Table 4, odds ratio of 1.44) in our most complete specification where we controlled for the workers' backgrounds and geographic locations. At the same time, first-generation workers are likely to be overmatched compared to third-plus generation workers. Together, it suggests that even after accounting for variety of workers' characteristics, first-generation workers are less likely to be correctly matched compared to their third-plus generation counterparts. We did not

Table 4 Multinomial Logistic Model of the Probability of Mismatch, All Workers, PIAAC 2012/2014

	Dependent variable: indicator of mismatch (perfect match is the reference category)							
	Model 1		Model 2		Model 3		Model 4	
	(1) Odds ratio	(2) Odds ratio	(3) Odds ratio	(4) Odds ratio	(5) Odds ratio	(6) Odds ratio	(7) Odds ratio	(8) Odds ratio
Third-plus generation	Reference category							
First-generation	2.01* (0.01)	1.13* (0.01)	2.07* (0.01)	1.11* (0.01)	2.17* (0.01)	1.17* (0.02)	1.44* (0.02)	1.61* (0.02)
Second-generation	0.97 (0.02)	1.15* (0.02)	1.00 (0.02)	1.13* (0.02)	0.99 (0.02)	1.11* (0.02)	0.82* (0.02)	1.28* (0.02)
Work experience			1.01* (0)	0.99* (0)	1.00 (0)	1.00* (0)	1.00 (0)	1.00* (.001)
Part-time (= 1)			1.02 (0.02)	1.00 (0.01)	1.10* (0.02)	0.95* (0.01)	1.04* (0.02)	0.98 (0.01)
Numeracy score							0.99* (0)	1.01* (0)
Female (= 1)							1.09* (0.01)	1.12* (0.01)
White	Reference category							
Hispanic							1.67* (0.02)	0.71* (0.03)
Black							0.73* (0.02)	1.40* (0.01)
Asian American							0.26* (.05)	1.43* (.03)
Other							1.04 (0.06)	1.30* (0.04)
Children							1.48* (0.01)	0.90* (0.01)
City							1.00 (0.01)	1.20* (0.01)
West	Reference category							
Northeast							0.77* (0.02)	1.05* (0.02)
Midwest							0.98 (0.02)	1.07* (0.01)
South							0.96* (0.02)	0.97* (0.01)
Occupations					Y	Y	Y	Y
N					4020			

The estimates for the under matched category are reported in the odd-numbered columns, estimates for the overmatched category are reported in the even-numbered columns. All reported estimates represent odds ratios, Standard errors for the coefficient estimates are listed in parentheses below the corresponding odds ratios

*p-value < 0.05

find significant differences in the probability of being undermatched between second and third-plus generation workers when we controlled for work experience and part-time employment. However, in the fully saturated model (column 7 of Table 4) we found that second-generation workers with the same background characteristics and working in the same locations are less likely to be undermatched compared to third-plus generation workers. This is likely attributable to racial discrimination on the job

market given that on average second-generation workers are similar to third-plus generation workers on most other characteristics (see Appendix Table 7).

The odds of being overmatched on the labor market are almost the same for all generations of workers—the odds ratios in the three models are close to 1—until we control for background characteristics and location (see the even numbered columns in Table 4). Adjusted for covariates, the odds of both first- and second-generation workers of being overmatched are significantly higher compared to similar third-plus generation workers, 1.6 (or 62% higher) and 1.3 (57%) respectively. This observation implies that employers might be sensitive to immigrant status and discount the qualifications of workers who themselves or whose parents were born outside of the country.

Work experience does not change the odds of being mismatched; this finding was consistent across all models and for under- and overmatched categories. While statistically significant, the coefficient on work experience implies the same odds of being under- or overmatched compared to being perfectly matched for workers with different levels of work experience. Even when translated into changes in odds for one standard deviation of work experience, 12.5 years, the magnitude of the difference remained the same. Another labor market characteristic, part-time employment also does not seem to change the odds of mismatch.

The background characteristics of workers such as race and presence of children have differential effects on the odds of being mismatched. Relative to White workers, we find that Hispanic workers face higher odds of being undermatched and lower odds of being overmatched. For Black workers, the findings are opposite—they have lower odds of being undermatched. Both Black and Asian American workers had higher chances of being overmatched compared to White workers. Among the racial/ethnic categories that we included in our analyses, Asian American workers face the lowest odds, one to four, of being undermatched for their current jobs.

The presence of children is associated with the higher chances of being undermatched. Workers with children have almost the same (0.9) odds of being overmatched compared to childless workers. We expected that the need to care for children might force parents and in particular women who are often the primary caregivers to take jobs that they are less qualified for to accommodate their childcare responsibilities, but we did not find support for this hypothesis in the data.

Numeracy scores that might serve as a measure of skills that are not captured by education level but might be assessed in other ways by employers do not seem to be associated with the odds of being mismatched. While the coefficients in columns 7 and 8 are significant, they translate into almost equal odds of being under- or undermatched for a one unit change in the score. However, translated into one standard deviation change in the score (about 50 score points), the higher numeracy implies a 50 percent lower probability of being undermatched, but about a 66 percent chance of being overmatched. The result for overmatching is likely driven by the compression of the numeracy score distribution for workers with higher levels of education while for those who are undermatched, there is more dispersion in both education levels and numeracy scores.

We found very slight variation in the odds of being mismatched by the geographic region. Relative to the workers in the West, workers in the Northeast are less likely to be undermatched. Workers in cities face higher odds of having more education that the

average for their occupations. In the last two models, we also included occupational categories as additional controls (not shown). The likelihood of being over- or undermatched is significantly different between occupational groups: clerks, technicians/associate professionals, and service, shop, and market sales workers have four times the odds of being undermatched than professional workers.

In the analysis presented in Table 4, we were interested in the incidence of mismatch and the factors associated with mismatch by generational status. We established that both first- and second-generation workers were more likely to be overmatched compared to third plus generation workers, but our results did not address if there are differences in education-job match between first- and second-generation workers, and the factors are associated with such differences. In Table 5, we re-estimated the same models as in Table 4 for the subsample of first- and second-generation workers. In addition to the variables we used in the analysis of the full sample, our models include variables specific to first-generation workers—the ability to speak English (which we recoded into a dichotomous variable with ability to speak English very well and well as one category, and not well and not at all as the second category) and number of years in the country.

Our analysis indicates that second-generation workers were significantly more likely to be undermatched for their jobs compared to first-generation immigrant workers. The odds of being undermatched for an average second-generation worker with the same background characteristics are almost three to one compared to a first-generation worker. This stark differences in odds, and especially in comparison with our all-generations model, can be explained by several factors that differ between the two immigrant generations. Our main model with all three generations of workers does not account for characteristics specific to first-generation immigrants such as language and time of stay in the country that may be associated with labor market outcomes. For instance, a good command of English is likely to be a requirement for the most jobs. We found that among immigrant workers, the chances of being correctly matched increase as one's knowledge of English improves. The knowledge of English is valued by employers and may be a substitute for some required qualifications and education in certain occupations, such as sales and services. Immigrants who have lived in a host country longer are more likely to have knowledge of the labor market, additional opportunities to learn on the job, and access to job-seeking social networks than their peers with shorter tenures. Taken together, these factors that were unobservable in our main model might explain why first-generation immigrants who lived in the US for longer periods of time were more likely to be undermatched.

We also observed differences between immigrant workers across racial/ethnic groups. Similar to the entire sample of workers, Asian American and Black immigrants were consistently more likely to be overmatched compared to White immigrants. This provides suggestive evidence of racial discrimination in the work place documented in previous studies (Bertrand & Mullainathan, 2004; Lang & Lehman, 2012; Nunley et al., 2015). We find that the extent of being overmatched for Asian American and Black workers is the same regardless of their immigrant status. Hispanic immigrant workers from both generations had higher odds of being under-educated for the jobs they held. While the difference in odds of being under- or overmatched between male and female workers was small and not meaningful, we did observe that female workers were more

Table 5 Multinomial Logistic Regression of the Probability of Mismatch, Sample of First- and Second-Generation Workers, PIAAC 2012/2014

	Dependent Variable: indicator of mismatch (perfect match is the reference category)							
	Model 1		Model 2		Model 3		Model 4	
	Under(1) Odds ratio	Over (2) Odds ratio	Under (3) Odds ratio	Over (4) Odds ratio	Under (5) Odds ratio	Over (6) Odds ratio	Under (7) Odds ratio	Over (8) Odds ratio
First-generation	Reference category							
Second-generation	0.48* (0.10)	1.00 (0.19)	0.49* (0.11)	1.00 (0.19)	0.76 (0.19)	0.83* (0.17)		
Work experience			1.02 (0.01)	1.00 (0.01)	1.02* (0.01)	1.00* (0.01)	1.02* (0.01)	1.01* (0.01)
Part-time (=1)			1.02 (0.07)	0.68 (0.08)	1.01 (0.08)	0.85* (0.03)	1.87* (0.06)	0.96* (0.05)
Numeracy score					0.98* (0.002)	1.01* (0.002)	0.99* (0.003)	1.01* (0.002)
Male	Reference category							
Female					0.97 (0.01)	1.10* (0.02)	0.92* (0.03)	1.44* (0.03)
White	Reference category							
Hispanic					1.63* (0.06)	0.91* (0.06)	1.46* (0.07)	0.76* (0.03)
Black					0.67* (0.03)	1.39* (0.05)	0.98 (0.61)	1.10* (0.05)
Asian American					0.54* (0.03)	1.57* (0.05)	0.64* (0.03)	1.46* (0.05)
Other					1.42* (0.04)	1.37* (0.08)	1.71* (0.08)	1.45* (0.05)
Children					1.44* (0.04)	0.75* (0.02)	1.86* (0.03)	0.83* (0.04)
City					1.12* (0.03)	0.86* (0.02)	1.20* (0.03)	1.09* (0.02)
West	Reference category							
Northeast					1.10* (0.04)	1.07* (0.03)	1.67* (0.04)	1.42 (0.08)
Midwest					1.63* (0.07)	1.02 (0.04)	2.84* (0.02)	2.33* (0.03)
South					1.21* (0.03)	0.76* (0.02)	1.00 (0.05)	0.76* (0.06)
Speak English:								
Not well/Not at all	Reference category							
Very well/Well							0.27* (0.10)	0.87* (0.03)
Years in the country:								
5 or fewer	Reference category							
6–10							1.28* (0.08)	0.77* (0.04)
11–15							1.95* (0.02)	0.98 (0.05)
More than 15							2.17* (0.03)	0.84 (0.08)
N	886						548	

The estimates for the under matched category are reported in the odd-numbered columns, estimates for the overmatched category are reported in the even-numbered columns. Model 4 includes only first-generation workers as years in a country and ability to speak English variables available only for the subsample of first-generation survey respondents

* p-value < 0.05

likely to be overmatched. Among the sample of first- and second-generation immigrants we found a similar pattern for the presence of children as in the entire sample: the

presence of children is associated with higher odds of being undermatched and lower odds of being overmatched for the job.

Overall, our findings for the full sample of workers and for the immigrant subsample are consistent. First- and second-generation workers had higher odds of being overmatched compared to third-plus generation workers. Hispanic workers were less likely to be overmatched and Asian American and Black workers were more likely to have higher levels of education than the modal categories for their occupations.

Discussion and conclusion

In this study, we investigated the factors associated with education-job mismatch among immigrant workers compared to third-plus generation workers in the United States and between first- and second-generation workers. We demonstrated that on average, immigrant workers were more likely to be overmatched for the jobs they held in the US labor market, with first-generation workers being overmatched more frequently than second-generation workers. This finding is consistent with human capital theory because skills and education are not readily transferable across the sending and host labor markets. Second-generation workers who have acquired their education in the US have both credentials from the country of residence and more access to the social capital that facilitates occupational advancement and, as such, face better prospects of being matched to their jobs. We also find that, compared to first-generation workers, second-generation immigrants have higher odds of being correctly matched. We speculate based on our empirical results that additional factors such as knowledge of local labor markets, social networks and a good command of English play a role in matching workers to jobs and serve as substitutes for education for second-generation workers. Since knowledge of the host country language and time spent in the host country significantly expands labor market opportunities, second-generation workers have advantages in both characteristics. They were born in US, on average their language skills are superior to the first-generation immigrants, and they are more likely to leverage social networks for employment opportunities than first-generation workers.

One of the most significant predictors of mismatch on the labor market for workers from all generations seems to be worker's reported race. While we cannot directly attribute our findings to racial/ethnic bias in employment, the findings from our analysis is consistent with previous studies. Notably, regardless of their immigrant status, Black and Asian American workers were significantly more likely to be employed at jobs that required less education than these workers had. In our analysis of the subsample of first- and second-generation workers, Black and Asian American workers were more likely overmatched. This finding mirrors evidence from experimental studies documenting persistent patterns of race discrimination in the labor market (Bertrand & Mullainathan, 2004; Quillian et al., 2017; see also Wang et al., 2017).

Consistent with the predictions of human capital and signaling theories, we found that for first-generation immigrant workers who had a longer tenure in the US, the probability of a correct match increases. This implies that the labor market is sensitive to other signals of workers' competency and suitability for the jobs that they acquire in addition to education. For instance, workers who are better able to speak English are more able to signal their abilities and skills beyond what is indicated by their formal credentials. This

hypothesis is supported by our findings that workers who are proficient in English are less likely to be overmatched and hold jobs that require more education that they have. For policies directed at the integration of immigrants, this finding suggests creation and promotion of programs that target immigrants' language skills. We also found that a higher percentage of second-generation workers are overmatched than third-plus gener-ation workers, which suggests that there may labor market disadvantages to immigrant status that persist beyond the first-generation. For example, while second-generation workers' social networks may be more extensive than those of first-generation workers, they may still have less access to the social networks that many third-plus generation workers are able to take advantage of when on the job market.

At the same time, the relationship between the length of stay and mismatch in our sample might mask the importance of the legal status of the immigrants for the prob-ability to be employed in a job with equivalent qualification requirements. Since the length of stay in the host country is associated with the probability of being natural-ized or obtaining a permanent resident status, we cannot distinguish between the two effects in our analysis. Another constraint of the data is that we did not observe whether some of the workers held temporarily work visas–immigrants on temporary visas have a shorter tenure but are also more likely to be employed in jobs matching their education and qualifications (Batalova et al., 2016). Data on immigration status might be especially relevant for clarifying our results related to race/ethnicity.

Our results imply that some adjustments towards a merit-based system of immigration might be beneficial for integrating first-generation immigrants into the labor market. Immigrant workers are more likely to be overmatched for their jobs, and overeducation was more prevalent among first-generation immigrants. However, second-generation workers who were born and educated in the US were as likely to be overmatched for their jobs as first-generation workers. Both immigrant generations had higher chances of being undermatched compared to third-plus generation workers. This indicates that the incoming immigrant labor force is not being absorbed by labor market efficiently. It also indicates that the supply of immigrant skills does not completely respond to the demands of the economy, or at least is not as balanced as the supply and demand of skills for third-plus generation workers. Our finding that second-generation workers are also likely to have more education for the jobs they held compared to third-plus generation workers points to an imbalance in the demand and supply of skills within the economy more broadly that is not specific to immigrant workers. Moreover, the difference in the overmatch between third-plus generation and first- and second-generation workers in the US is significantly smaller compared to that in Canada, another traditionally immi-grant receiving country (Banerjee et al., 2019). In Canada, this gap has been partially attributed to the point-based immigration system that gave preferences to highly skilled workers to enter Canada (Lu & Hou, 2020).

As we mentioned in the introduction, education-job mismatch affects the broader economy as well as individual workers. The underutilization of workers' skills and knowledge creates inefficiencies that could lower economic production. For individ-ual workers regardless of immigrant status, overmatching depresses wages, and low-ers workers' standards of living and their abilities to accumulate wealth. Our findings suggest that this dynamic may be particularly acute for second-generation workers

who are finding it difficult to become fully integrated into US labor markets, even though they have acquired educational credentials that are commensurate with those of third-plus generation workers.

Appendix

See Tables 6, 7, 8 and 9

Table 6 Dependent variable and independent variables

Variable name in analysis	PIAAC variable	Method of construction
Over-education/under education/correct match	ISCO3C (Occupational classification of the respondent's current job at the 3-digit level); EDCAT8 (Highest level of formal education obtained)	We constructed this variable from two PIAAC variables. We first identified a modal education level for each occupation category, and designated individuals in that occupation category who were below the modal level as under- educated, those who were above—as over-educated, and individuals whose education level was the same as the modal—as correctly matched
Immigrant status	IMPAR and J_Q04a	We constructed this variable from the information derived from two PIAAC variables—parents' place of birth and own place of birth First generation immigrants are the ones who were born outside the U.S. to foreign-born parents. Second generation workers are these respondents who were born in the U.S. to at least one parent who was born outside of the U.S. Third-plus generation respondents are these who were born in the U.S. to U.S.-born parents
Work experience	C_Q09	No transformation required, already derived
Part-time		
Numeracy	A set of plausible values, PVNUM1-PVNUM10	No transformations necessary, apply plausible value procedures in all estimations
Gender	GENDER_R	Indicator variable to denote female and male respondents
Race	RACETHN_5CAT	The race variable in PIAAC is recoded into a series of five indicator variables: Hispanic, White, Black, Asian, and Other
Children	J_Q03b_C	Recoded as 1 if a respondent reported having at least one child
U.S. region	REGION_US	A set of indicator variables representing four regions—Northeast, Midwest, South, and West
City	URBAN_4CAT	Urban area is coded as 1, other categories as 0
Ability to speak English	J_Q05cUSX3b	Recoded into three groups: very well, well, not well (this group includes these respondents who reported not well and not well at all because their individual shares in total were small)
Years in a country	IMYRS_C	Recoded into a series of indicator variables as follows: less than 5 years, 6 to 10 years, 11 to 15 years, more than 15 years Second and third-plus generation are coded as 0

Table 7 Highest Level of Education by ISCED classification, All Workers PIAAC 2012/2014

	Mean (S.E.)
Primary or less (ISCED 1 or less)	0.02 (0.003)
Lower secondary (ISCED 2 or ISCED 3 short)	0.06 (0.004)
Upper secondary (ISCED 3A-B, C long)	0.38 (0.009)
Post-secondary, non-tertiary (ISCED 4 A-B-C)	0.10 (0.006)
Tertiary, professional degree (ISCED 5B)	0.10 (0.005)
Tertiary, bachelor's degree (ISCED 5A)	0.21 (0.007)
Tertiary, master's degree (ISCED 5A)	0.12 (0.006)
Tertiary, research degree (ISCED 6)	0.02 (0.002)

Table 8 Distribution of selected independent variables by immigrant generation, all workers, PIAAC 2012/2014

	First generation, proportion	Second generation, proportion	Third-plus generation, proportion
Female	0.45	0.43	0.48
Children	0.79	0.59	0.71
Hispanic	0.51	0.39	0.04
White	0.15	0.46	0.80
Black	0.11	0.06	0.12
Asian	0.23	0.08	0.01
Other	0.01	0.02	0.02
Work experience, years	18.52	17.05	22.70
Less than high school	0.24	0.07	0.05
High school and some college	0.42	0.55	0.61
Bachelor and higher degrees	0.33	0.37	0.35
Literacy score	238.45	284.77	283.62
Numeracy score	233.20	269.02	270.16
Northeast	0.22	0.24	0.17
Midwest	0.10	0.08	0.26
South	0.32	0.33	0.37
West	0.37	0.36	0.19
City	0.58	0.50	0.31
N	548	338	3134

Numerical valued in columns are proportions of workers in each horizontal category by generational status. Columns for each horizontal category such as race, education, and region add up to total

Table 9 Distribution of Selected Independent Variables within Each Job-Education Mismatch Category, All Workers, PIAAC 2012/2014

	Undermatched	Correctly matched	Overmatched
First generation	0.22	0.12	0.14
Second generation	0.07	0.08	0.09
Third and higher	0.71	0.80	0.77
Female	0.51	0.45	0.48
Children	0.79	0.71	0.66
Hispanic	0.24	0.13	0.09
White	0.61	0.70	0.70
Black	0.11	0.12	0.11
Asian Americans	0.02	0.04	0.07
Other	0.02	0.02	0.02
Literacy	259.74	276.05	291.07
Numeracy	245.46	263.08	280.83
Work experience	22.27	21.70	21.15
Northeast	0.17	0.19	0.19
Midwest	0.19	0.22	0.24
South	0.38	0.37	0.33
West	0.26	0.22	0.23
N	781	2016	1223

For categorical variables, the numbers in the cells represent the proportion of workers with given characteristic within each job-education mismatch category. For instance, the share of first-generation workers among all undermatched workers is 22%, the share of first-generation workers among all correctly matched workers is 12%, and among all overmatched workers 14% are first-generation. Numbers in columns for each independent variable add up to 100%

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

References

Alba-Ramírez, A. (1993). Mismatch in the Spanish labor market: Overeducation? *Journal of Human Resources, 28*, 259–278.

Allen, J., & van der Velden, R. (2001). Educational mismatches versus skill mismatches: Effects on wages, job satisfaction, and on-the-job search. *Oxford Economic Papers-New Series, 53*, 434–452.

Aydemir, A. (2011). Immigrant selection and short-term labor market outcomes by visa category. *Journal of Population Economics, 24*(2), 451–475.

Banerjee, R., Verma, A., & Zhang, T. (2019). Brain gain or brain waste? Horizontal, vertical, and full job-education mismatch and wage progression among skilled immigrant men in Canada. *International Migration Review, 53*(3), 646–670.

Batalova, J., Fix, M., & Bachmeier, J. D. 2016. Untapped Talent: The Costs of Brain Waste among Highly Skilled Immigrants in the United States. *World Education Services*.

Battu, H., Belfield, C. R., & Sloane, P. J. (1999). Overeducation among graduates: A cohort view. *Education Economics, 7*, 21–38.

Battu, H., Belfield, C. R., & Sloane, P. J. (2000). How well can we measure graduate over-education and its effects? *National Institute Economic Review, 171*(1), 82–93.

Belman, D., & Heywood, J. S. (1997). Sheepskin effects by cohort: Implications of job matching in a signaling model. *Oxford Economic Papers, 49*(4), 623–637.

Bertrand, M., & Mullainathan, S. (2004). Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination. *American Economic Review, 94*(4), 991–1013.

Chevalier, A. (2003). Measuring over-education. *Economica, 70*(279), 509–531.

Chiswick, B. R., & Miller, P. W. (2009). The international transferability of immigrants' human capital. *Economics of Education Review, 28*, 162–169.

Clogg, C. C., & Shockey, J. W. (1984). Mismatch between occupation and schooling: A prevalence measure, recent trends and demographic analysis. *Demography, 21*(2), 235–257.

Dean, J. (2018). Does it matter if immigrants work in jobs related to their education? *IZA Journal of Development and Migration, 8*(7), 1–42.

Duncan, G. J., & Hoffman, S. D. (1981). The incidence and wage effects of overeducation. *Economics of Education Review, 1*, 75–86.

Esses, V. M., Dietz, J., & Bhardwaj, A. (2006). The role of prejudice in the discounting of immigrant skills. In R. Mahalingham (Ed.), *The cultural psychology of immigrants* (pp. 113–130). Lawrence Erlbaum Associates.

Fernandez, R. M., Castilla, E. J., & Moore, P. (2000). Social capital at work: Networks and employment at a phone center. *American Journal of Sociology, 105*(5), 1288–1356.

Ferrer, A., & Riddell, W. C. (2008). Education, credentials, and immigrant earnings. *Canadian Journal of Economics, 41*(1), 186–216.

Frei, C., & Sousa-Poza, A. (2012). Overqualification: Permanent or transitory? *Applied Economics, 44*(14), 1837–1847.

Friedberg, R. M. (2000). You can't take it with you? Immigrant assimilation and the portability of human capital. *Journal of Labor Economics, 18*(2), 221–251.

Gray, C. M. (2019). Using profiles of human and social capital to understand adult immigrants' education needs: A latent class approach. *Adult Education Quarterly, 69*(1), 3–23.

Green, F., & Zhu, Y. (2010). Overqualification, job dissatisfaction, and increasing dispersion in the returns to graduate education. *Oxford Economic Papers-New Series, 62*, 740–763.

Groot, W., & Maassen van den Brink, H. (2000). Overeducation in the labor market: A meta-analysis. *Economics of Education Review, 19*(2), 149–158.

Guo, S. (2009). Difference, deficiency, and devaluation: Tracing the roots of non-recognition of foreign credentials for immigrant professionals in Canada. *Canadian Journal for the Study of Adult Education, 22*(1), 37–52.

Hartog, J. (2000). Over-education and earnings: Where are we, where should we go? *Economics of Education Review, 19*, 131–147.

Hunt, J., & Gauthier-Loiselle, M. (2010). How much does immigration boost innovation? *American Economic Journal: Macroeconomics, 2*(2), 31–56.

Joona, P. A., Gupta, N. D., & Wadensjö, E. (2014). Overeducation among immigrants in Sweden: Incidence, wage effects and state dependence. *IZA Journal of Migration, 3*(1), 9.

Kahn, J. R., García-Manglano, J., & Bianchi, S. M. (2014). The motherhood penalty at midlife: Long-term effects of children on women's careers. *Journal of Marriage and the Family, 76*(1), 56–72. https://doi.org/10.1111/jomf.12086

Kalfa, E., & Piracha, M. (2018). Social networks and the labor market mismatch. *Journal of Population Economics, 31*(3), 877–914.

Kaushal, N., & Lu, Y. (2015). Recent immigration to Canada and the United States: A mixed tale of relative selection. *International Migration Review, 49*(2), 479–522.

Kaushal, N., Lu, Y., Denier, N., Wang, J. S. H., & Trejo, S. J. (2016). Immigrant employment and earnings growth in Canada and the USA: Evidence from longitudinal data. *Journal of Population Economics, 29*(4), 1249–1277.

Kiker, B., Santos, M., & de Oliveira, M. (1997). Overeducation and undereducation: Evidence for Portugal. *Economics of Education Review, 16*(2), 111–125.

Lang, K., & Lehmann, J. Y. K. (2012). Racial discrimination in the labor market: Theory and empirics. *Journal of Economic Literature, 50*(4), 959–1006.

Leuven, E., & Oosterbeek, H. (2011). Overeducation and mismatch in the labor market. In E. Hanushek, S. Machin, & L. Woessman (Eds.), *Handbook of the economics of education* (pp. 283–326). North Holland Elsevier.

Levels, M., van der Velden, R., & Allen, J. (2014). Educational mismatches and skills: New empirical tests of old hypotheses. *Oxford Economic Papers, 66*(4), 959–982.

Lu, Y., & Hou, F. (2020). Immigration system, labor market structures, and overeducation of high-skilled immigrants in the United States and Canada. *International Migration Review, 54*(4), 1072–1103.

Madamba, A. B., & De Jong, G. F. (1997). Job mismatch among Asians in the United States: Ethnic group comparisons. *Social Science Quarterly, 78*(2), 524–542.

Massey, D., & Capoferro, C. (2008). The geographic diversification of American immigration. In D. Massey (Ed.), *New Faces in New Places: The Changing Geography of American Immigration* (pp. 25–50). Russell Sage Foundation.

Maynard, D. C., & Parfyonova, N. M. (2013). Perceived overqualification and withdrawal behaviours: Examining the roles of job attitudes and work values. *Journal of Occupational and Organizational Psychology, 86*, 435–455.

McGowan, M. A., & Andrews, D. (2015). Skill mismatch and public policy in OECD countries. OECD Economics Department Working Papers No. 1210.

McGowan, M. A., & Andrews, D. (2017). Labor Market Mismatch and Labor Productivity: Evidence from PIAAC Data. In S. Polachek, K. Pouliakas, G. Russo, & K. Tatsiramos (Eds.), *Skills mismatch in labor markets* (pp. 199–241). Bingley: Emerald Publishing Limited.

McGowan, M., Andrews, D., & Millot, V. (2018). The walking dead? Zombie firms and productivity performance in OECD countries. *Economic Policy, 33*(96), 685–736.

Mosisa, A. (2006). *Monthly Labor Review*. https://www.bls.gov/opub/mlr/2006/09/art2full.pdf

de Oliveira, M. M., Santos, M. C., & Kiker, B. F. (2000). The role of human capital and technological change in overeducation. *Economics of Education Review, 19*(2), 199–206.

Nielsen, C. P. (2007). *Immigrant overeducation: Evidence from Denmark*. The World Bank.

Nunley, J. M., Pugh, A., Romero, N., & Seals, R. A. (2015). Racial discrimination in the labor market for recent college graduates: Evidence from a field experiment. *The BE Journal of Economic Analysis & Policy, 15*(3), 1093–1125.

Pellizzari, M., & Fichen, A. (2017). A new measure of skill mismatch: Theory and evidence from PIAAC. *IZA Journal of Labor Economics, 6*(1), 1.

Pew Research Center (2015). Modern immigration wave brings 59 million to U.S., driving population growth and change through 2065: Views of immigration's impact on U.S. society mixed. Washington, D.C.: Author.

Piracha, M., Tani, M., & Vadean, F. (2012). Immigrant over-and under-education: The role of home country labour market experience. *IZA Journal of Migration, 1*(1), 3.

Piracha, M., & Vadean, F. (2013). Migrant Educational Mismatch and the Labour Market. International Handbook on the Economics of Migration, 9, 176–192. https://doi.org/10.4337/9781782546078.00017

Prokic-Breuer, T., & McManus, P. A. (2016). Immigrant educational mismatch in Western Europe, apparent or real? *European Sociological Review, 32*(3), 411–438.

Quillian, L., Pager, D., Hexel, O., & Midtbøen, A. H. (2017). Meta-analysis of field experiments shows no change in racial discrimination in hiring over time. *Proceedings of the National Academy of Sciences, 114*(41), 10870–10875.

Quinitini, G. (2011). Over-qualified or under-skilled: A review of existing literature. OECD Social, Employment and Migration Working Papers, No. 121. Retrieved from https://doi.org/10.1787/5kg58j9d7b6d-en

Quinn, M. A., & Rubb, S. (2006). Mexico's labor market: The importance of education-occupation matching on wages and productivity in developing countries. *Economics of Education Review, 25*(2), 147–156.

Salas-Velasco, M. (2018). Resource misallocation and production inefficiency: Estimating cross-country differences in macroeconomic performance. *Journal of Economic Studies, 45*(6), 1272–1287.

Sanromá, E., Ramos, R., & Simón, H. (2015). How relevant is the origin of human capital for immigrant wages? Evidence from Spain. *Journal of Applied Economics, 18*(1), 149–172.

Sattinger, M. (2012). Qualitative mismatches. *Foundations and Trend in Microeconomics, 8*, 1–168.

Sharaf, M. F. (2013). Job-education mismatch and its impact on the earnings of immigrants: Evidence from recent arrivals to Canada. *ISRN Economics*, *2013*.

Sicherman, N. (1991). Overeducation in the labor market. *Journal of Labor Economics, 9*, 101–122.

Slonimczyk, F. (2013). Earnings inequality and skill mismatch in the US: 1973–2002. *Journal of Economic Inequality, 11*, 163–194.

Spence, M. (1978). Job market signaling. *Uncertainty in economics* (pp. 281–306). Academic Press.

Tsai, Y. (2010). Returns to overeducation: A longitudinal analysis of the US labor market. *Economics of Education Review, 29*(4), 606–617.

Verdugo, R. R., & Verdugo, N. T. (1989). The impact of surplus schooling on earnings: Some additional findings. *The Journal of Human Resources, 24*, 629–643.

Verhaest, D., & Van der Velden, R. (2013). Cross-country differences in graduate overeducation. *European Sociological Review, 29*, 642–653.

Wald, S., & Fang, T. (2008). Overeducated immigrants in the Canadian labour market: Evidence from the workplace and employee survey. *Canadian Public Policy, 34*(4), 457–479.

Wang, S. X., Takei, I., & Sakamoto, A. (2017). Do Asian Americans face labor market discrimination? Accounting for the cost of living among native-born men and women. *Socius*. https://doi.org/10.1177/2378023117741724

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