Do Immigrants Experience Education-Job Mismatch? New Evidence from the U.S. PIAAC

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Introduction

We investigate the factors associated with education-job mismatches among U.S. workers by immigrant generation (see the Key Terms box). Mismatch refers to over- and undereducation on the job market when workers hold educational qualifications above or below those required for their current jobs (see the Key Terms box). When there is a close match between workers' educations 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 (Sattinger, 2012). Conversely, job mismatch may decrease workers' job satisfaction (Allen & van der Velden, 2001; Battu, Belfield, & Sloane, 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). 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). Anecdotal and empirical evidence suggest that it is not uncommon to observe the highly skilled newcomers working in the jobs that are below their qualification like for instance, physicians (professional degree) working as radiation therapists (which requires the associate degree only), or urban and regional planners (Master's degree) employed as construction laborers (only requires work experience in related occupation). Education-job mismatch is one of the major sources of labor market disadvantage for immigrants (Piracha & Vadean, 2012) and is often reflected in lower wages compared to non-immigrant workers. Compared to native-born workers, the wage penalty for education-job mismatch is higher for immigrant workers (Banerjee, Verma, & Zhang, 2018; Chiswick and Miller, 2009; Joona, Datta Gupta, & Wadensjo, 2014; Nielsen, 2007; Sanroma, Ramos, & Simon, 2015; Sharaf, 2013; Wald & Fang, 2008). In addition to the immigrant disadvantage in the first generation, prior research has established that patterns of employment and as a result, earning mobility, among second generation workers are different from both first and third-plus generation workers (see, for example, NASEM, 2016).

Conceptual Framework and Literature Review

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 undereducated compared to what is conventionally required for their jobs may have additional on-the-job training and experience that might compensate for their lower educational levels. 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 U.S. than first generation immigrant 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.

The 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, Dietz, & Bhardwaj; 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, Tani, & Vadean; 2012; Piracha & Vadean; 2013). Since the higher probability of immigrant workers to be overeducated 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 some diplomas over others – in this case diplomas from countries that are perceived by employers as having higher value. More recent immigrants are also less likely 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, Castilla, & Moore, 2000). This type of access information 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 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). 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 overeducated. Over time, immigrants may improve their education-job matches as they develop language proficiency and accumulate local human capital. This predicts that the immigrants' education-job match improves with their length of stay in the host country (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 overeducated. 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, and the signaling, and search and match frameworks, we should expect to see higher rates of overeducation among immigrant workers compared to native workers but also a decrease in mismatch with the length of time in the country. We might also observe differences in mismatch across race and 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.

Purpose

The goal of our study is to empirically assess the extent of education-job mismatch and identify factors that exacerbate or mitigate mismatch within the population of U.S. employed workers between the ages of 20 to 65. We restricted the analysis to this age bracket because we expected workers between these ages age to be in the labor force full-time and we wanted to exclude workers that might be employed part-time because of school or retirement. We examine differences in the over and undereducation between workers by immigrant generation, race, gender, and worker characteristics, including the extent to which cognitive skills measured by the PIAAC numeracy score mediate mismatch.

Our two research questions are: a) what is the extent of education-job mismatch for workers by immigrant generation; and b) what factors are associated with overeducation for immigrant workers? We focus on overeducation because our preliminary analyses suggested that while approximately equal numbers of first generation immigrant workers are under- or overeducated, when immigrants are overeducated it suggests that their job market opportunities are restricted in their host countries, while undereducation suggests expanded opportunities in the host country. We additionally explored the likelihood of being under-educated to account for the potential omission from the sample of immigrant workers with low level of English language skills. We found that the chances of being under- or overeducated for first generation immigrant workers were the same conditional on other factors rather than immigrant status. We also found that a higher percentage of second generation workers are overeducated compared to third-plus generation workers, which suggests that there may labor market disadvantages to immigrant status that persist beyond the first generation.

Data and Methods

We use data from the U.S. 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 addition, PIAAC collects sufficiently detailed information about workers' occupations and their educational levels. In the U.S., 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.

Measuring 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 occupational 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 Programme for the International Assessment of Adult Competencies (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 cognitive skills proficiency measured by PIAAC (Fichen & Pellizzari, 2017; McGowan & Andrews, 2017).

Each of these methods have benefits and drawbacks for measuring mismatch (see Chevalier, 2003 for the analysis of issues with the first two measures). The choice of measure often depends on the availability of the necessary data. For instance, 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 skill level. But not all surveys collect information on the workers' self-assessments of the match between their educational backgrounds and the educational requirements of their positions. Even when available, workers' self-assessments are subject to self-assessment bias. The difficulty of applying this measure to PIAAC data is that given the relatively small sample size, there would not a sufficient distribution within occupational categories to create such a measure.

PIAAC studies on education-job mismatch

While our focus is education-job mismatch, most studies that used the PIAAC to address labor market mismatch use the third approach to construct a measure of skill mismatch. As mentioned above, this approach combines workers' self-reported assessments of the match between their jobs and qualifications (i.e., the average literacy and numeracy score reported by respondents who reported that their skills matched those required by their jobs) and respondents' measured skills, literacy and numeracy into a difference between the two measures (Fichen & Pellizzari. 2017; McGowan & Andrews, 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 firm level (McGowan, Andrews, & Millot, 2018), and to propose policy solutions. In addition to using education-job mismatch as opposed to skill mismatch, in our study we compare the incidence of mismatch across immigrant and non-immigrant workers, which previous studies did not explore.

We used the realized match approach to create our measure of education-job match (Verdugo & Verdugo, 1989). A worker in a given occupation is considered undereducated or overeducated if their educational qualification is outside of the modal educational level or a defined range around the mean educational level for that occupation. For occupation categories, we used the 3-digit occupation codes that provided the optimal trade-off between the granularity of the qualifications required to perform a job and the sample size resulting from breaking down the sample into occupational categories. We used the modal category of education for an occupation (Chiswick

& Miller, 2009; Kiker, Santos, & de Oliveira, 1997). There were 106 3-digit occupational categories with a range of between 5 to 190 workers in each category. Workers were coded as correctly matched if their educational qualifications coincided with the modal value of education for their occupations. Workers whose educational levels were under and over the modal education for their occupational categories were coded as under- and overeducated, respectively. 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 occupation category. In addition, PIAAC allows us to control for different levels of ability among workers with the same level of education in the same occupation. All analyses accounted for the complex sampling design of the survey by using final sampling and replicate weights in the regression analyses to calculate parameter estimates and standard errors. For numeracy scores, we used analytical techniques in the IDB Analyzer that accounted for the ten plausible values used to construct these measures.

Analytic Sample

We restricted our analysis to all employed (full and part-time)[1] individuals between the ages of 20 to 65 years for whom we had data about their education and occupation and complete information on all background variables as described in Appendix 1.[2] There are 4,079 observations in our final unweighted analytic sample (i.e., observations with data available for all variables in the analysis).[3]

Methods

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 a binary logistic regression where our binary dependent variable (described below) indicates individuals who are overeducated (1) or those who are correctly matched or undereducated (0).

Our key independent variables are generational status measured using three mutually exclusive indicator variables (please see Table 1 in the Appendix for construction of the variables for the analysis). First generation immigrants were born outside of the U.S. to parents who were born outside of the U.S. Second generation workers were born in the U.S. to at least one parent who was born outside of the U.S. Third-plus generation workers were born in the U.S. to U.S.-born parents. We also created indicator variables for gender and race[4] (the latter is a set of five

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[1] We did not distinguish between full and part-time workers in the analysis because our preliminary findings indicated that there were no differences in the education-job mismatch by full or part-time employment.

[2] We used AGEG5LFSEXT and EMPSTAT to select individuals who meet our selection criteria, i.e. they were between the ages of 20 and 65 (if AGEG5LFSEXT greater than or equal to 2 and less than 10) and working full or part-time (EMPSTAT equal 2 or 3).

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

[4] The race variable was derived from several items in the questionnaire to combine information about the ethnicity

variables: Hispanic, White, Black, Asian and other). We did not include a measure of education for the workers in our sample because we used this variable to create our education-job mismatch indicator.

Additional variables include: an indicator variable that denotes that the respondent has children, work experience in years, a set of four indicators for U.S. region (Northeast, Midwest, South, and West), and city to denote that the respondent lives in an urban area. Consistent with prior research, we used the total worker's experience, independent of occupation. The location variables account for differences in the labor market conditions for all workers and specifically for immigrant workers who historically settle in urban areas with extensive immigrant social networks. Relatively new immigrants are more likely to live in states that offer the highest wages for the skills they hold (Borjas, 2001) and the mobility of immigrants is much more responsive to regional differences in labor market opportunities than third-plus generation workers (Schundeln, 2007). 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).

We estimated the following models where we sequentially introduce covariates:

Models 1 through 3:
$$Probability(Overmatched = 1|X) = F(\beta_0 + \beta_1 FirstGen_i + \beta_2 SecGen_i + X_i\gamma)$$

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

Model 4:
$$Probability(Overmatched = 1|X) = F(\beta_0 + \beta_1 FirstGen_i + \beta_2 SecGen_i + X_i\gamma + Skills_i * \delta)$$

Model 5:
$$Probability(Overmatched = 1|X)$$

$$= F\left(\beta_0 + \beta_1 FirstGen_i + \beta_2 SecGen_i + X_i\gamma + \delta * Skills_i + \sum \beta_3 * (Imm * Race)\right.$$

$$\left. + \beta_4 * (Imm * Children) + \beta_5 * (Female * Children) + \beta_6 * (Imm * Female)\right)$$

Where 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 individual characteristics; $Skills$ is measured by the respondent's score on the PIAAC numeracy

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(Hispanic or Latino and non-Hispanic or Latino) and race. The derived variable reported non-Hispanic Whites and Blacks as separated categories. The final five variables include Hispanic/Latino (denoted in the text as Hispanic), non-Hispanic White alone (White), non-Hispanic Black alone (Black), Asian and other non-Hispanic Race (represents another single race category or multiracial sample members).

assessment)[5]. For the model with interactions, *Imm* stands for all observations that are associated with either first and second immigrant generation status.

In Models 1 through 3, we estimate the differences in the education-job mismatch by generational status controlling for individual characteristics that include gender, race, marital status, presence of children, ability to speak English, and location (U.S. region and the indicator for city). Correspondingly, Model 1 includes only indicators for first and second generation workers; in Model 2 we included demographic variables – gender and race; and Model 3 includes presence of children, marital status, ability to speak English, and location.

In Model 4 we include measures of worker's skills represented by numeracy scores. These scores capture the ability of workers otherwise not observable in the data but potentially observable by employers. The partial correlations between the numeracy score and mismatch will help us understand how workers' assessed skills are associated with mismatch independent of other observable factors.

In Model 5, we include interaction terms between generational status and race, generational status and presence of children, and gender and presence of children, and gender and generational status. Our selection of interaction terms draws on our descriptive analysis (reported below) and more broadly from the extensive literature that highlights how having children is more likely to affect women's employment opportunities than men's (Duvivier & Narcy, 2015; Wilner, 2016). In addition to the main effects, or differences between specific groups such as immigrant generations, the interaction terms will help us understand whether, for instance, the presence of children has different implications for immigrant workers or for female workers on the probability of being overeducated. Similarly, the interactions between immigrant status and race will provide additional information on the role of race for first and second generation workers as compared to third-plus generation workers. The interaction between gender and immigrant status would allow us to assess if female immigrants face any disadvantages in the labor market.

Immigrant generation subgroup analysis

We repeated the analysis described above but limited the sample to first and second generation workers and estimate regression models that compare the differences in mismatch between the two generations 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 U.S. labor are associated with the probability of mismatch.

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[5] We did not include literacy as a measure of skills as it was highly correlated with numeracy scores, and would have led to multicollinearity in the estimation of the models. We use numeracy rather than literacy because numeracy skills are less likely to overlap with oral English skills than literacy.

Findings

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 overeducated for their current jobs. These figures are roughly consistent with existing studies that reported that on average 26% of workers were undereducated and 30% were overeducated (for a review, see Leuven & Oosterbeek, 2011).

Twenty-three percent of the respondents were immigrants; 15% were first generation immigrants and 8% were second generation. Women were slightly underrepresented in the sample at 47%. 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.

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

	% or Mean (SE)
Education-job match	
Undereducated	.20(.007)
Correct match	.49 (.009)
Overeducated	.30(.008)
Generational Status	
First generation	.15 (.006)
Second generation	.08 (.005)
Third-plus generation	.77 (.007)
Female	.47 (.009)
Race	
Hispanic	.14 (.006)
White	.68 (.008)
Black	.11 (.005)
Asian	.05 (.004)
Other	.02 (.002)
Children (yes/no)	.71 (.008)
Work experience (years)	21.62 (0.227)

Part-time work	.17 (.007)
U.S. Region	
Northeast	.19 (.005)
Midwest	.22 (.004)
South	.36 (.005)
West	.23 (.006)
City	.37 (.008)
Numeracy	265 (0.868)
English ability (first and second generation immigrants only)	
Speak English very well	.59 (.020)
Speak English well	.24 (.017)
Speak English not well	.12 (.014)
Speak English not at all	.05 (.010)
Years in country (first generation immigrants only)	
Less than 5 years	.08 (.012)
Six to 10 years	.10 (.013)
Eleven to 15 years	.19 (.020)
More than 15 years	.63 (.020)
Weighted N	129524359
Unweighted N	4079

Note. The first and second generation subsample is comprised of 890 observations (29,483,276 when weighted); of these 548 are first generation immigrants (19,036,284 when weighted)

Table 2 presents the breakdown of the sample by education-job match and selected independent variables. First generation immigrants were almost twice as likely to be undereducated 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 occupational categories in the U.S.[6] On average, a higher share of second generation workers were overeducated compared to the full sample. Females were marginally more likely to be undereducated compared to males (22% and 19%) and were less likely to be correctly matched to jobs compared to males (47% versus 52%), while the percentage of males and females who were overeducated was approximately the same (30%).

Of all racial/ethnic groups Hispanic workers were the most likely and Asian American workers were the least likely to be undereducated for their current jobs (35% and 9% respectively). While we observed a large variability in the share of over or undereducated workers across racial/ethnic groups, the share of correctly matched workers is relatively similar – between 45% (Hispanic workers) and 50% (White and Black workers. Only one out of five Hispanic workers were

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

overeducated compared to one out of two Asian American workers.

The bottom panel presents the average scores on the PIAAC numeracy skills assessment by the type of education-job match. Respondents who were overeducated had higher than average scores, and those who were undereducated had the lowest scores on average.

Table 2: Selected Independent Variables by Job-Education Mismatch, All Workers, PIAAC 2012/2014.

	Undereducated (%, SE)	Correctly Matched (%, SE)	Overeducated (%, SE)
First generation	0.30 (0.024)	0.41 (0.025)	0.27 (0.021)
Second generation	0.17 (0.031)	0.49 (0.032)	0.33 (0.024)
Third-plus	0.18 (0.009)	0.51 (0.010)	0.30 (0.008)
Female	0.22 (0.011)	0.47 (0.013)	30.1 (0.012)
Male	0.19 (.0101)	0.51 (0.013)	29.1 (0.012)
Hispanic	0.35 (0.026)	0.45 (0.027)	0.19 (0.020)
White	0.18 (0.008)	0.50 (0.011)	0.31 (0.010)
Black	0.19 (0.020)	0.50 (0.026)	0.29 (0.023)
Asian American	0.09 (0.023)	0.45 (0.042)	0.45 (0.042)
Other	0.19 (0.045)	0.45 (0.059)	0.35 (0.058)
Less than high school	0.96 (0.012)	0.04 (0.012)	0 (0.00)
High school and some college	0.17 (0.009)	0.59 (0.012)	0.24 (0.011)
Bachelor and higher degrees	0.09 (0.009)	0.45 (0.015)	0.46 (0.015)
Numeracy	245.46 (2.396)	263.08 (1.319)	280.83 (1.419)
N	781	2017	1222

Note. Numbers in the rows do not add up to 100% because of rounding.

Since our analysis is based on a comparison of overmatch across the three generational groups, we present the description of the data broken down by generation for the same characteristics as above. In Table 3, we observe that the three generations are different in racial composition, education levels, and numeracy skills. The 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.

Table 3: Distribution of Selected Independent Variables by Immigrant Generation, All Workers, PIAAC 2012/2014.

	First generation (%, SE)	Second generation (%, SE)	Third-plus generation (%, SE)
Over-educated	0.27 (0.021)	0.33 (0.030)	0.30 (0.009)
Correctly matched	0.41 (0.025)	0.49 (0.032)	0.51 (0.010)
Under-educated	0.30 (0.023)	0.17 (0.024)	0.18 (0.008)
Female	0.45 (0.025)	0.43 (0.031)	0.48 (0.010)
Children	0.79 (0.018)	0.59 (0.031)	0.71 (0.009)
Hispanic	0.51 (0.025)	0.39 (0.032)	0.04 (0.005)
White	0.15 (0.017)	0.46 (0.032)	0.80 (0.008)
Black	0.11 (0.015)	0.06 (0.013)	0.12 (0.006)
Asian	0.23 (0.019)	0.08 (0.017)	0.01 (0.002)
Other	0.01 (0.005)	0.02 (0.008)	0.02 (0.003)
Work experience, years	18.52 (0.603)	17.05 (0.698)	22.70 (0.257)
Less than high school	0.24 (0.022)	0.07 (0.018)	0.05 (0.004)
High school and some college	0.42 (0.025)	0.55 (0.030)	0.61 (0.010)
Bachelor and higher degrees	0.33 (0.022)	0.37 (0.029)	0.35 (0.009)
Numeracy score	233.20 (2.906)	269.02 (3.051)	270.16 (0.962)
Northeast	0.22 (0.019)	0.24 (0.027)	0.17 (0.005)
Midwest	0.10 (0.015)	0.08 (0.017)	0.26 (0.005)
South	0.32 (0.024)	0.33 (0.028)	0.37 (0.006)
West	0.37 (0.025)	0.36 (0.033)	0.19 (0.006)
City	0.58 (0.022)	0.50 (0.029)	.31 (0.088)
N	548	347	3182

Note. Numbers in the rows do not add up to 100% because of rounding.

The racial composition of first generation workers more closely resembled the second generation than the third-plus generation. Third-plus generation workers are predominantly White (80%) while only 15% of first generation workers are 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 --approximately 12 percent.

First generation workers were more likely to have children than second and third 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 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 reflect the general patterns of immigrant settlements; the smallest share of both groups resided in the Midwest and largest was in the West and South regions.

Given that the demographic characteristics and location of the three generations vary, the differences in education-job mismatch are not surprising. Of the three groups, first generation immigrants are more likely to be undereducated and less likely to be overeducated. One out of two third-plus generation workers were correctly matched while 30% were overeducated for their jobs. Second generation workers had the highest share of overeducated workers; one out of three had an education level higher than the modal education for their current jobs.

Next, we looked at the characteristics of workers by mismatch. The distribution of workers by generation in Table 4 mirrors 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.

Undereducated workers were more likely to be female and more likely to have children, while overeducated workers were less likely to have children. A higher percentage of Hispanic workers were overeducated than undereducated or correctly matched.

Table 4. Distribution of Selected Independent Variables within Each Job-Education Mismatch Category, All Workers, PIAAC 2012/2014.

	Undereducated (%, SE)	Correctly Matched (%, SE)	Overeducated (%, SE)
First generation	0.22 (0.017)	0.12 (0.009)	0.14 (0.011)
Second generation	0.07 (0.010)	0.08 (0.007)	0.09 (0.010)
Third-plus	0.71 (0.018)	0.80 (0.010)	0.77 (0.013)
Female	0.51 (0.021)	0.45 (0.013)	0.48 (0.016)
Children	0.79 (0.016)	0.71 (0.011)	0.66 (0.015)
Hispanic	0.24 (0.018)	0.13 (0.009)	0.09 (0.010)
White	0.61 (0.019)	0.70 (0.011)	0.70 (0.014)
Black	0.11 (0.012)	0.12 (0.008)	0.11 (0.010)
Asian Americans	0.02 (0.005)	0.04 (0.005)	0.07 (0.008)
Other	0.02 (0.005)	0.02 (0.003)	0.02 (0.005)
Numeracy	245.46 (2.396)	263.08 (1.319)	280.83 (1.419)
Work experience	22.27 (0.537)	21.70 (0.318)	21.15 (0.411)
Northeast	0.17 (0.011)	0.19 (0.007)	0.19 (0.008)
Midwest	0.19 (0.009)	0.22 (0.006)	0.24 (0.007)

	South	0.38 (0.012)	0.37 (0.008)	0.33 (0.009)
	West	0.26 (0.013)	0.22 (0.008)	0.23 (0.010)
	N	781	2017	1222

Note. Numbers in the rows do not add up to 100% because of rounding.

On average, undereducated 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 numeracy – undereducated workers had the lowest scores on both assessments compared to correctly matched and overeducated workers. Overeducated workers had the highest numeracy scores which are most likely correlated with their education levels. We do not observe any geographic patterns in the distribution of workers by education-job match.

Table 5. Distribution of Under- and Overeducated and Correctly Matched Workers by Immigrant Generation and Education Level, PIAAC 2012/2014.

	Immigrant Generation		
	First generation, % (SE)	Second generation. % (SE)	Third-plus generation, % (SE)
Less than high school			
Undereducated	0.33 (0.020)	0.54 (0.024)	0.19 (0.008)
Correctly matched	0.41 (0.023)	0.28 (0.022)	0.51 (0.010)
Overeducated	0.26 (0.002)	0.18 (0.018)	0.30 (0.009)
High school and some college			
Undereducated	0.21 (0.010)	0.17 (0.009)	0.19 (0.011)
Correctly matched	0.52 (0.012)	0.58 (0.012)	0.48 (0.014)
Overeducated	0.27 (0.011)	0.26 (0.011)	0.33 (0.013)
Bachelor and higher degrees			
Undereducated	0.18 (0.011)	0.11 (0.009)	0.21 (0.010)
Correctly matched	0.46 (0.014)	0.46 (0.014)	0.51 (0.012)
Overeducated	0.36 (0.013)	0.42 (0.014)	0.28 (0.011)

Given the focus of this study on the comparison of the job-education mismatch among immigrant generation, we also analyzed the incidence of mismatch by education level within each generation (see Table 5). The analysis revealed that the chances of mismatch differed for workers from the three generations depending on education level. Specifically, among all 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 degree and higher, third-plus generation workers were correctly matched with the jobs more often, in fifty percent of the cases. Second generation workers who graduated from high school and had some college education had a higher chance to be correctly matched compared to first and third-plus generation workers. College-educated second generation workers were more likely to be

overeducated for their jobs and less likely to be undereducated. This could be also because second generation workers were more likely to have college degrees and higher 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.

Regression models

All Workers

Table 6 presents the results of our logistic regression analysis. Because the estimates that are presented in the table are descriptive and not causal, the direction of the estimates is more informative than the magnitude. As such, we interpret the estimates qualitatively by pointing out the direction of the relationship with the probability of being overeducated. Model 1 contains only the variables for generational status. Neither variable was a statistically significant predictor of overmatch. In other words, there were no differences in the probability of being overeducated for either first or second generation workers compared to third-plus generation workers. In Model 2 we added controls for gender and race. First generation status was not associated with the odds of being overeducated even after we controlled for demographic characteristics. However, regardless of race and gender, the likelihood that second generation workers were overeducated relative to third-plus generation workers increased considerably but was now statistically significant. Holding generational status and race constant, women were more likely to be overeducated than men. Compared to White workers, Hispanics were significantly less likely to be overeducated and Asian Americans were more likely to be overeducated even after controlling for gender and generational status.

Table 6. Logistic Regression of Overeducation among All Workers, PIAAC 2012/2014 (3-category occupation).

	(1) Odds Ratio Coefficient (SE)	(2) Odds Ratio Coefficient (SE)	(3) Odds Ratio Coefficient (SE)	(4) Odds Ratio Coefficient (SE)	(5) Odds Ratio Coefficient (SE)
Generational status					
First generation	0.88	1.04	1.06	1.21	2.07***
	-0.12	0.04	0.05	0.19	0.73
	(0.12)	(0.19)	(0.19)	(0.17)	(0.25)
Second generation	1.18	1.42*	1.36*	1.28	1.76*
	0.16	0.35	0.31	0.24	0.57
	(0.13)	(0.15)	(0.15)	(0.15)	(0.26)
Female (=1)		1.04***	1.06	1.20	1.20
		0.04	0.06	0.18	0.18
		(<0.01)	(0.09)	(0.09)	(0.14)
Race					
Hispanic		0.49***	0.47***	0.74	0.96
		-0.72	-0.75	-0.30	-0.04

	(0.19)	(0.20)	(0.18)	(0.26)
Black	0.94	0.94	1.56***	1.53**
	-0.06	-0.06	0.45	0.42
	(0.11)	(0.11)	(0.13)	(0.13)
Asian American	1.73*	1.62	1.68*	1.50
	0.55	0.48	0.52	0.41
	(0.26)	(0.26)	(0.24)	(0.28)
Other	1.19	1.22	1.42	1.39
	0.17	0.20	0.35	0.33
	(0.30)	(0.29)	(0.33)	(0.35)
Children (yes=1)		0.76**	0.83*	0.86
		-0.27	-0.19	-0.15
		(0.07)	(.08)	(0.12)
Work experience, years		1.00	1.00	1.00
		-0.002	-0.001	-0.001
		(0.004)	(0.004)	(0.004)
U.S. region				
Northeast		0.98	1,00	1.00
		-0.02	0.003	-0.003
		(0.12)	(0.12)	(0.123)
Midwest		1.07	1.14	1.14
		0.07	0.14	0.13
		(0.12)	(.11)	(0.11)
South		0.88	0.92	0.93
		-0.13	-0.08	-0.08
		(0.10)	(0.09)	(0.09)
City		1.14	1.07	1.07
		0.13	0.07	0.06
		(0.09)	(0.08)	(0.09)
Numeracy			1.01***	1.01***
			0.01	0.01
			(.001)	(0.001)
Female*children				1.05
				0.05
				(0.19)
Female*first generation				1.03
				0.03
				(0.24)
Female*second generation				0.62
				-0.49
				(0.27)
First generation*children				0.76
				-0.28
				(0.22)
Second generation*children				0.76
				-0.27

		(0.27)
First generation*Hispanic		0.44*
		-0.82
		(0.40)
Second generation*Hispanic		0.83
		-0.19
		(0.43)
First generation*Black/ Asian/Other		0.78
		-0.25
		(0.36)
Second generation*Black/ Asian/Other		1.16
		0.15
		(0.40)
N	4079	

Note: Coefficients are reported as odds ratios ($Exp(b)$) relative to the reference category (coefficients from logistic regression and their standard errors are reported below odds ratios). 80 replicate weights are used. The reference categories are: third-plus generation for generational status, White for race, West for U.S. region. Column 1 includes only generational status. Column 2 includes demographic variables: race, gender and generational status. Column 3 includes an indicator for the number of children, work experience, number of years in a country, U.S. region and an indicator for city. Column 4 includes numeracy score. Column 5 includes interaction terms.
*$p < .05$. **$p < .01$. ***$p < 0.001$.

In Model 3 we added work experience, presence of children, and variables for region and city. Perhaps counterintuitively, the presence of children decreased the likelihood of being overeducated. 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. The predominantly female workers who are primary caregivers are also more likely to have less work experience because many women pause their careers for childbirth and child rearing. This may explain why the coefficient for female is no longer significant when we added experience to the model, although the coefficient for experience is not statistically significant.

In Model 4 we added numeracy skills to the model which provides a measure of workers' skills. The numeracy score might serve as a measure of skills that are not captured by educational level but might be assessed in other ways by employers. We no longer observe a statistically significant difference in the likelihood of being overeducated for second generation workers compared to third-plus generation workers. This indicates that conditional on having similar skills measured by the numeracy scores, first and second generation workers had the same chances of being overeducated as the average third-plus generation worker who was employed in a similar job.

Finally, in Model 5 we included interactions between some of the variables of interest to understand the differences across generational status and other characteristics of workers in the probability of being overeducated. We find that second generation workers continued to have higher odds of being overeducated controlling on the variety of interaction effects compared to third-plus generation workers. Surprisingly, when we added moderating effects to the model in the form of interaction variables, we observed a change in the odds of first generation immigrant

workers to be overeducated. This effect is also large in magnitude – the odds of being overeducated for the first generation immigrant workers are twice as large compared to third-plus generation workers. This finding implies that the likelihood of being mismatched for the first generation immigrant workers compared to their third-plus generation counterparts depends on other characteristics of workers such as gender, race, and presence of children. In addition to variables that we included in the model and which, according to our theoretical frameworks, were expected to predict the incidence of overeducation, there are other important factors that were left out because of the data limitations. For instance, we do not have information on the place where the workers received their education. This might be particularly relevant for college educated workers due to the barriers to credential recognition of foreign degrees. Foreign-educated immigrants accounted for about 60 percent of overeducated immigrants in 2009-2013 (Batalova et al., 2016). The legal status of immigrant workers is also associated with both the probability of being employed and the type of job an immigrant worker holds. We are unable to distinguish between the different legal statuses of immigrants in the sample: naturalized citizens, permanent residents, temporary work visa holders, or unauthorized workers. However, empirical evidence suggests that the legal status of immigrants predicts the outcomes of job-education match (Borjas & Cassidy, 2019; Pope, 2016).

While we no longer observed that overall Hispanic workers were less likely to be overeducated, the significant interaction between first generation and the Hispanic indicator implied that first generation Hispanic workers were less likely to be overeducated compared to White third-plus generation workers. In terms of racial differences in the likelihood of education-job mismatch, Black workers regardless of immigrant generation were more likely to be overeducated compared to White workers.

Across both models where we included numeracy score as one of the covariates, numeracy was a statistically significant predictor of overmatch. In other words, those workers with higher numeracy scores were more likely to work in jobs for which they were overeducated relative to an average worker in that occupation. Since skills are highly correlated with education level, i.e., on average workers with higher numeracy scores have higher level of education on average, this finding is not surprising. However, the magnitude of the effect is only marginal – the odds of being overeducated for a worker with higher numeracy skills change only by 0.01.

First and Second Immigrant Generations

In Table 7, we estimated the same models as above but for the subsample of first and second generation workers. In the first part of the analysis we established that first and second generation workers were more likely to be overeducated compared to third plus generation workers, but our results do not address if there is a difference between the first and second generation and the factors might be associated with any difference. In addition to the variables we used in the analysis of the entire sample, our models include variables specific to first and second generation workers – ability to speak English and number of years in the country. The latter is only applicable to first generation immigrants.

Table 7. Logistic Regression of Overeducation among the First and Second Generation Workers, PIAAC 2012/2014 (3-category occupation).

	(1)	(2)	(3)	(4)	(5)
	Odds Ratio Coefficient (SE)	Odds Ratio Coefficient (SE)	Odds Ratio Coefficient (SE)	Odds Ratio Coefficient (SE)	Odds Ratio Coefficient (SE)
First generation	0.76	0.76	1.65	1.65	1.71
	-0.28	-0.27	0.50	0.50	0.54
	(0.15)	(0.15)	(0.45)	(0.43)	(0.52)
Female		0.90	0.96	1.11	0.82
		-0.11	-0.04	0.10	-0.20
		(0.17)	(0.18)	(0.18)	(0.37)
Race					
Hispanic		0.35***	0.47***	0.84	1.01
		-1.05	-0.76	-0.17	0.01
		(0.23)	(0.23)	(0.24)	(0.40)
Black		0.74	0.68	1.50	1.96
		-0.30	-0.38	0.41	0.67
		(0.34)	(0.35)	(0.34)	(0.44)
Asian American		1.73	1.47	1.73	2.30
		0.55	0.38	0.55	0.83
		(0.29)	(0.28)	(0.30)	(0.47)
Other		0.97	1.03	1.29	1.62
		-0.03	0.03	0.26	0.49
		(0.64)	(0.64)	(0.55)	(0.54)
Children			0.58**	0.68*	0.67
			-0.55	-0.39	-0.40
			(0.17)	(0.17)	(0.33)
Work experience			1.00	1.00	1.00
			-0.01	0.001	0.003
			(0.01)	(0.001)	(0.01)
Northeast			0.92	0.99	1.02
			-0.09	-0.001	0.02
			(0.24)	(0.26)	(0.26)
Midwest			0.93	0.92	0.92
			-0.07	-0.08	-0.08
			(0.40)	(0.39)	(0.39)
South			0.73	0.71	0.71
			-0.32	-0.34	-0.34
			(0.18)	(0.19)	(0.20)
City			0.82	0.85	0.82
			-0.19	-0.16	-0.20
			(0.21)	(0.21)	(0.22)
Ability to speak English					
Well			0.61**	0.78	0.80

	Col 1	Col 2	Col 3	Col 4	Col 5
			-0.49	-0.24	-0.22
			(0.18)-	(0.21)	(0.22)
Not well			0.30**	0.64	0.65
			-1.24	-0.45	-0.43
			(0.41)	(0.46)	(0.50)
Not at all			0.13**	0.30	0.32
			-2.01	-1.22	-1.15
			(0.67)	(0.70)	(0.71)
Time in the country					
Six to 10 years			0.65	0.74	0.74
			-0.43	-0.30	-0.30
			(0.55)	(0.51)	(0.51)
11 to 15 years			0.98	0.93	0.90
			-0.02	-0.07	-0.11
			(0.53)	(0.53)	(0.53)
More than 15 years			0.68	0.70	0.64
			-0.38	-0.36	-0.44
			(0.45)	(0.45)	(0.43)
Numeracy				1.01***	1.01***
				0.01	0.01
				(0.002)	(0.002)
Female*Children					0.95
					-0.05
					(0.47)
Female*First generation					1.8
					0.59
					(0.33)
First generation*Children					1.08
					0.07
					(0.32)
First generation*Hispanic					0.64
					-0.44
					(0.61)
First generation*Black/Asian/Other					0.59
					-0.53
					(0.44)
N	895	895	895	895	895

Note. Coefficients are reported as odds ratios ($Exp(b)$) relative to the reference category (coefficients from logistic regression and their standard errors are reported below odds ratios). 80 replicate weights are used. Reference categories are: second generation for generational status, White for race, West for U.S. region, Speak English very well for English ability, less than five years for year in country. Column 1 includes only generational status. Column 2 includes demographic variables: race, gender and generational status. Column 3 includes an indicator for the number of children, work experience, number of years in a country, U.S. region and an indicator for city. Column 4 includes numeracy score. Column 5 includes interactions terms.
*$p < .05$. **$p < .01$. ***$p < 0.001$.

After we controlled for all other factors that might be associated with education-job match we found no significant differences in the probability of being overeducated between first and second generation workers. Asian immigrants were consistently more likely to be overeducated compared to White immigrants while Hispanic workers from both generations had lower odds of being overeducated for the jobs they held. While there was no difference in being overeducated by gender overall, first generation female workers were almost twice as likely to be overeducated compared to first generation male workers and second generation female workers but again, the statistical significance of this effect was marginal.

In general, we found that the presence of children reduces the probability of being overeducated regardless of gender. However, when we accounted for the interaction effects between gender and presence of children and presence of children for first generation immigrants, workers with children had the same odds of being overeducated as workers without children.

We did not find any differences in the probability of being overeducated for the first generation workers depending on the length of stay in the country. On the one hand, this finding goes against the prediction of human capital model which stipulates that accumulating more host country-specific human capital would increase chances of being perfectly matched. At the same time, this finding is consistent with prior literature that established that immigrant employment rates rise sharply during the first few years after arrival in the United States and did not change much with further time in the country (Chiswick et al.,1997; Funkhouser &Trejo,1998).

In our models without the numeracy score, we observed that compared to those who spoke English very well, workers with fewer language skills had lower chances of being overeducated. Since numeracy might be a measure of workers' skills, once numeracy was accounted for (Model 4), we did not find any differences in the probability of being overeducated between immigrant workers with different levels of ability to speak English.

Overall Findings

Our findings for the full sample of workers and for the first and second generation sample are consistent. To summarize the main results across both models, we found that second generation immigrant workers were more likely to be overeducated for their jobs relative to third-plus generation workers, but there was no difference between the first and second immigrant generations in the likelihood of being overeducated. Surprisingly, we found that relative to third-plus generation workers, first generation immigrants had significantly higher odds of being overeducated after we controlled for a large number of factors and their interactions. In terms of the background characteristics of workers, independent of generational status, Hispanic workers were less likely to be overeducated. Accounting for factors associated with job mismatch, such as works experience, presence of children, numeracy skills, and location, we found that Black workers had higher odds of being overeducated compared to White workers, again, regardless of generational status. Numeracy seems to be a consistent and significant predictor of overeducation for all workers, but the magnitude of the effect is small and not policy relevant.

Implications for Policy and Practice

In this study, we investigated the factors associated with education-job overmatch workers in the United States by immigrant generation. Our results have potential implications for both immigration and immigrant integration policies. Specifically, some adjustments towards a merit-based system might be warranted and could benefit the integration of newcomer immigrants into the labor market. A merit-based system of immigration assumes 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). In the U.S., the 1965 Immigration and Nationality Act instituted a family-based immigration policy that resulted in a specific human capital profile of immigrants with a relatively small share of economic-class immigrants and immigrants with university degrees compared to other immigrant destination countries like Canada (Kaushal & Lu, 2015; Kaushal et al., 2016).

We found that on average, immigrant workers were more likely to be overeducated for the jobs they held in the U.S. labor market, with both first and second generation workers being overeducated more frequently than third-plus generation workers. This finding is surprising to the extent that human capital theory would predict that first generation workers' skills and education are not readily transferable across the sending and host labor markets as opposed to second generation workers who have acquired their education in the U.S. While having country of residence credentials, second generation workers, however, may have less access to the social capital that facilitates occupational advancement than their third-plus generation peers, which may explain their higher levels of overeducation. That finding was also not consistent with the predictions of the signaling model when we expected that the country of residence credentials obtained by the second generation workers would be considered by the employers as a more credible signal of a worker's qualifications.

We found some evidence of racial and cultural bias in employment which is consistent with previous studies (Esses, Dietz, & Bhardwaj; 2006; Guo; 2009). Notably, Asian American workers were more likely to be employed in jobs that required less education than these workers had. For all workers regardless of generational status, Black workers were more likely to be overeducated. This supports patterns of race discrimination in the labor market found in experimental studies (Bertrand & Mullainathan, 2004).

Contrary to our expectations in accordance with the search and match theory, we anticipated but did not find any decrease in the probability of being overeducated for immigrant workers who had a longer tenure in the U.S. This indicates that the labor market for immigrant workers is more rigid than predicted by signaling and human capital theories. At the same time, this finding might mask the importance of the legal status of the immigrants for the probability to be employed in a job with equivalent qualification requirements. Since the length of stay in the country is directly associated with the probability of being naturalized or obtaining a permanent resident status, we cannot distinguish between the two effects in our analysis. We also did not observe whether some of the workers held temporarily work visas – immigrants on temporary visas have a shorter tenure but also more likely to be employed in jobs matching their education and qualifications (Batalova et al., 2016).

Language proficiency, on the other hand, reduces the probability of overeducation among immigrants which 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.

Immigrant workers were more likely to be overeducated for the jobs they held, and overeducation was more prevalent (though not significant) among first generation immigrants. This indicates that there is untapped potential of the incoming immigrant labor force which is not being absorbed by labor market efficiently. At the same time, second generation workers who were born and educated in the U.S. were almost as likely to be overeducated for their jobs as first generation workers compared to third-generation workers, which suggests that there may be labor market disadvantages to immigrant status that persist beyond the first generation.

As we mentioned in the introduction, education-job mismatch affects the broader economy as well as individual workers. Not capitalizing on the entire potential of workers' skills and knowledge creates inefficiencies that could lower economic production. For individual workers regardless of immigrant status, overmatching depresses wages, and lowers workers' standards of living and their abilities to accumulate wealth. Our findings suggest that second generation workers are finding it particularly difficult to become fully integrated into U.S. labor markets, even though they have acquired educational credentials that are commensurate with those of third-plus generation workers.

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Appendix 1: Dependent Variable and Independent Variables

	Variable name in analysis	Original PIAAC variable	Method of construction
	Over-education/under-education/correct match	ISCO3C (Occupational classification of the respondent's job at the 3-digit level); EDCAT8 (Highest level of formal education obtained)	We constructed this variable from two original 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 original 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 immigrants 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.
	Gender	GENDER_R	Indicator variable to denote female and male respondents
	Race	RACETHN_5CAT	Race variable is recoded into a series of five indicator variables: Hispanic, White, Black, Asian, and Other.
	Married	J_Q02a	Recoded into an indicator variable with 1 representing married individuals
	Children	J_Q03b_C	Recoded as 1 if a respondent reported to have at least one child

	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)
	Work experience	C_Q09	No transformation required, already derived
	Years in a country	IMYRS_C	Recoded into a series of indicator variables to represent years in a country as follows: less than 5 years, from 6 to 10 years, from 11 to 15 years, more than 15 years. Second and third and higher generation are coded as 0
	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 three categories as 0
	Numeracy	A set of plausible values, PVNUM1-PVNUM10	No transformations necessary, apply plausible value procedures in all estimation