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The Influence of Foreign-Born Population on Immigrants' Academic Achievement: A Multilevel Analysis of Students in High-Income Countries

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Academic Achievement: A Multilevel Analysis of

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ABSTRACT

The Influence of Foreign-Born Population on Immigrants' Academic Achievement: A Multilevel Analysis of Students in High-Income Countries

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Scholars have linked multiple background characteristics to academic achievement; among these are student SES and race/ethnicity. A largely understudied student characteristic in relation to academic achievement is student immigrant status. I contextualize this relationship by considering a macro social setting: country-level foreign-born population. To do this, I examine mathematics achievement from the 2015 PISA assessment in 41 high-income countries. Using mixed-effects modeling, I examine student- and country-level factors and their effects on mathematics achievement. I use within- and cross-level interactions to examine the relationship between 1) immigrant status and student SES and between 2) immigrant status and foreign-born population. To examine the relationship between student immigrant status and student SES and between immigrant status and foreign-born-population, I use within- and cross-level interactions. My findings indicate that immigrant students perform similarly to native-born students when considering other contextual factors at the student-, school-, and country- levels. Furthermore, SES moderates the effect of immigrant status, with second-generation immigrants exhibiting a smaller achievement gain with increased SES. Additionally, everyone – immigrants and non-immigrants alike – benefits from higher foreign-born population rates, suggesting that immigration is advantageous for all students.

Keywords: international education, academic achievement, PISA, immigration, educational equality

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The Influence of Foreign-Born Population on Immigrants' Academic Achievement: A Multilevel Analysis of Students in High-Income Countries

In seeking to expand educational equality in the United States as well as in international contexts, scholars have examined how various student characteristics influence academic achievement. Prominent among these examined characteristics is student socioeconomic status. Scholars have found a positive correlation between SES and academic achievement not just in the United States, but also in other countries (Demir, Kilic, and Unal 2010; Martins 2010; Sun, Bradley, and Akers 2012). Race and ethnicity have also been abundantly studied, and scholars continually find evidence for racial disparities in academic achievement (Gregory, Skiba, and Noguera 2010; Howard 2010).

While these factors are important components of research on educational equality, a key student characteristic is seemingly understudied: immigration status. With international migration at an all-time high (OECD 2014; United Nations 2016), and with a significant proportion of international migrants residing in high-income countries, examining immigrant outcomes in these desirable destinations seems timely. Despite falling under the same economic descriptor, high-income countries vary in macro social contexts and therefore may provide very different environments for immigrants. Very little research has examined outcomes among immigrants comparatively in multiple social contexts. Furthermore, virtually no research has examined specifically the extent to which the proportion of immigrants in a country influences, or moderates, the effect of being an immigrant. Do immigrants exhibit more positive outcomes in countries with large numbers of immigrants, or do they excel in countries with low levels of foreign-born individuals? And how are native-born students affected by higher immigration?

Considering the rising prominence and influence of immigrants worldwide, it is essential to examine immigrant outcomes in an international context. In order to study how contexts shapes student immigrant outcomes, I analyze 2015 PISA mathematics achievement scores in 41 high-income countries. I use hierarchical linear regression models to examine 1) how immigrant status influences achievement, 2) how student socioeconomic status moderates the effect of immigrant status on achievement, and 3) how country-level foreign-born population moderates the effect of immigrant status on achievement, both for immigrants and for native-born students. This analysis will provide insight into existing educational inequalities, which are imperative to understand in order to ensure that all children have equal opportunities in any educational system and context.

REVIEW OF LITERATURE

Student Characteristics and Academic Achievement: What We Know

Scholars in the social sciences, and particularly in sociology, have explored the consequences of various aspects of social stratification on individual-level outcomes in order to inform policy-makers and decrease inequality. A substantial subset of this literature focuses on studying the effects of various background characteristics, or family/student characteristics on educational outcomes. In examining educational outcomes among students, scholars have linked certain individual characteristics to higher academic achievement both in the United States and in a global context. Among these widely discussed student-level characteristics that have been linked to academic achievement as well as to educational attainment are student socioeconomic status, race or ethnicity, and immigration status.

SES and academic achievement

Perhaps one of the most prominent student-level characteristics that is closely correlated with higher academic achievement is student socioeconomic status. According to Sirin's (2005) meta-analysis of literature examining the relationship between family SES and academic achievement, family SES exhibits one of the strongest correlations with academic achievement at various stages of schooling. This relationship has been well-established in literature examining academic achievement in the United States and is the strongest predictor of academic achievement according to numerous scholars (Reardon 2011; Sirin 2005; Stewart 2008; Williams Shanks et al. 2010). Unsurprisingly, higher socioeconomic status is correlated with higher academic achievement. Poor students generally exhibit lower academic achievement than rich students, and these differences between the economically advantaged and the disadvantaged are observed from the time children enter kindergarten (Lee and Burkam 2002) and persist as children progress through the school system. Therefore, there are vast differences in achievement between the rich and the poor in the United States that the income achievement gap is now greater than the black-white achievement gap (Duncan and Murnane 2011). Furthermore, scholars examining the same outcome in other contexts have found a similar positive relationship between higher socioeconomic status and achievement (Martins 2010; Demir et al. 2010; Sun, et al. 2012). The relationship between student SES and educational outcomes is also consistent in an international context, as economic resources tend to translate into academic resources, which in turns translates into higher achievement.

Scholars have observed varying parental practices between social classes, some of which are linked to cognitive ability (Lareau 2002). For example, children in wealthier homes are often exposed to more vocabulary due to parents' language use (Ginsborg 2006), which further advantages them in an academic context. Lam's analysis (2014) further argues that children in poor households are at a disadvantage when entering school due to a lack of cognitive stimulation, which is a result of parenting strategies and preferences. This research is consistent with Spera's (2005) finding that authoritative parenting styles, more common among middle- and upper-class households, is related to higher academic achievement. In schools, students are often then tracked by ability, which further perpetuates disadvantage for poor students (Oakes 2005). Parents in more advantaged homes generally have more economic resources and often social resources to invest in their children, resulting in further disadvantage for children in poor households (Duncan and Murnane 2011). Wealthier parents are also more likely to be involved in their children's education (Jeynes 2007), which is correlated with positive academic outcomes. Furthermore, because of the geographical and political aspects of public education, students from advantaged households generally attend economically advantaged schools due to living in economically advantaged neighborhoods, while children from low-SES households enter the school system in lower-quality schools (Lee and Burkam 2002; Rumberger and Palardy 2005). This also leads to students' peers being socioeconomically advantaged, which is also correlated with higher academic achievement (Van Ewijk and Sleegers 2010). The school context, then, further perpetuates inequality by socioeconomic status, considering that research has found that school SES is positively associated with student-level academic achievement (Perry and McConney 2010).

Race and academic achievement

While some racial minority groups excel academically, scholars have found that most racial and ethnic minorities underperform in terms of academic achievement relative to white students (Gregory et al. 2010; Howard 2010; Stewart 2008) and that the racial achievement gap, although narrower than in the past, continues to be documented among whites and African Americans as well as among whites and Latinos (Howard 2010). Research also finds that race and ethnicity continue to play a significant role *independent* of student socioeconomic status (Carbonaro 2005). Furthermore, similarly to what is observed with socioeconomic status, race is correlated with lower tracking placement in schools (Carbonaro 2005), further disadvantaging minority students. Even when accounting for other background characteristics, African American and Latino students are underrepresented in advanced math classes (Muller et al. 2010).

The findings that race and ethnicity are often tied to lower academic achievement are not surprising when considering how student socioeconomic status is related to racial minorities and how minority students are often stigmatized in academic settings (Walton and Cohen 2007). This leads to minority students being placed in lower academic tracks, net of other student-level characteristics. Despite these findings regarding the relationship between SES and race and ethnicity and how they relate to academic achievement, SES is not able to explain away the effect of race on educational outcomes. In other words, there is something about race and ethnicity that class, income, and education cannot explain when examining school outcomes, as the effect remains when accounting for other background characteristics. For example, because of the stigma that is attached to being a racial or ethnic minority, students from minority groups are disproportionately punished in schools (Skiba et al. 2011), which in turn likely affects their academic performance. This is accounting for other characteristics, including student socioeconomic status. Furthermore, a student's connectedness to their racial/ethnic group and the social context are also predictors of academic achievement (Altschul, Oyserman, and Bybee 2006).

While past research examining race and education in the United States is ample and well developed, research rarely looks at the impact of race in comparison to other contexts. This is because cross-national comparisons are unable to directly compare racial classifications, which is largely due to racial classifications being dependent on context (Desmond and Emirbayer 2009). For example, the Australian census asks if the respondent is of Aboriginal or Islander origin (Australia Bureau of Statistics 2016), while the Canadian census collects information regarding the "ethnic or cultural origins of ancestors" and provides nationalities as options (Statistics Canada 2017). Because of the way race is understood and contextualized in different countries, comparative international research examining outcomes by race or ethnicity are scarce.

Immigrants and Academic Achievement

Considering how strongly student socioeconomic status and race are associated with academic achievement, it is likely that immigrant status would also play a significant role. While student socioeconomic status and race/ethnicity are amply studied, limited research has examined how students' immigrant background influences academic achievement. This emerging body of literature examining academic achievement among immigrants is largely due to the increase in international immigration rates in recent decades (Meyer and Benavot 2013; Population Reference Bureau 2017; United Nations 2016). This has resulted in an increase in immigrant studies in the United States; however, international migrants are dispersed across the world (Connor 2016) and a majority reside in other high-income countries. High-income countries host 71% of all international migrants, or roughly 173 million individuals (United Nations 2016). Considering the increase in international migration worldwide, which leads to a larger proportion of immigrants making up classrooms worldwide, an examination of immigrant student outcomes is important researchers interested in education.

Assuming that being an immigrant is often attached to lower socioeconomic status, language barriers, and decreased parental involvement (Ramirez 2003), we would expect immigrants to underperform relative to native-born students. In addition to these disadvantages, we would assume that there is something about being displaced from one's home context (Koser and Martin 2011) that likely causes stress and therefore influences outcomes. Despite an increase in literature examining immigrant outcomes, very limited research has treated immigrant status as a student characteristic when examining academic achievement. Existing literature does, however, suggest that immigrants are generally at a disadvantage relative to non-immigrants in terms of academic achievement (Borgna 2017; Kalalahti, Varjo, and Jahnukainen 2017; Makarova and Birman 2015).

Despite what research has found regarding the relationship between student immigrant characteristics and academic achievement, there is a lack of cross-national comparisons. While the academic achievement gap between immigrants and non-immigrants is a common trend in high-income countries, immigrants in Australian society do not experience the same disadvantage that immigrants face in the United States and Western European countries with historically higher levels of immigration, such as France and the United Kingdom (Collins 2013;

Lokan, Greenwood, and Cresswell 2001). This pattern of outperformance by immigrants relative to non-immigrants is also observed in Greece (Anagonostaki et al. 2016). Being an immigrant, then, does not result in negative outcomes in all contexts.

Even in the United States, scholars have found that not all immigrant groups underperform relative to native-born students. Ample research has shown that immigrant children from certain Asian countries such as Vietnam, Japan and South Korea excel educationally and exceed expectations when considering socioeconomic status (Lee and Zhou 2014). This, coupled with success in the workforce, has led Asian immigrants to be broadly labeled as a 'model minority.' All immigrants, then, are not exhibiting similar and negative outcomes, as certain narratives suggest. There is no single pattern across all high-income countries, illustrating the importance of considering macro social contexts as well as a comparative approach when examining immigrant student outcomes. Furthermore, immigrants are not necessarily low-skilled or uneducated, as immigrants from certain countries are highly desirable by economies around the world and their children are likely socioeconomically advantaged.

Beyond Student Characteristics: The Importance of Context

In addition to a lack of literature considering student immigrant status when examining academic achievement, there is a lack of analyses considering how contextual factors may be influencing (or moderating) the effect of student factors. Even though ample research has examined how various *student* characteristics influence academic achievement, I identified no article examining the key macro social context of foreign-born population and its influence on academic achievement among immigrants and non-immigrants alike. Specifically, do immigrant students exhibit more positive academic outcomes in high-immigration contexts? Or do immigrants excel in countries with a small proportion of immigrants? Conversely, how are native-born students affected by high levels of immigration?

Literature suggests that there are two possible ways in which this particular context could influence achievement among immigrants. On the one hand, it is possible that immigrants would excel in contexts with low levels of immigration. As a result of immigrant policies screening immigrants, there is likely substantial immigrant selectivity in countries with low levels of immigration. This suggests that immigrants are highly educated and skilled in countries with low levels of immigration and are therefore likely to be socioeconomically advantaged. For example, in Finland, a country with relatively low immigration and tight immigration laws, immigrants' legal status is dependent on work type and earnings (Maahanmuuttovirasto 2017). Additionally, due to limited immigrant networks, immigrants in these countries are likely to have stronger networks with non-immigrants, and are therefore more likely to be acculturated, which results in improved outcomes for immigrants (Sam and Berry 2003).

The second perspective posits that immigrants would excel in contexts with high levels of immigration. Countries with high levels of immigration are likely to have immigration policies that are conducive to immigrants' success through effective procedures for integration (Alesina et al. 2003). Furthermore, countries with high levels of immigration provide contexts where the native population is generally accustomed to immigrants. Additionally, contexts with a large proportion of foreign-born individuals offer larger and more interconnected immigrant networks, which have significant positive implications for immigrant outcomes (Patel and Vella 2013).

Finally, it is also likely that macro social context also influences achievement among native-born students. On the one hand, certain political narratives suggest that immigrants are draining government and school resources (Camarota 2007; Ferris and Raley 2016; Wood 2014) and therefore are negatively affecting native-born students' performance. Immigrants needing assistance with English as a second language, for example, are seen by these media outlets and political groups as wasting valuable economic and human resources. This is, according to these outlets, not a problem that is unique to education systems, as immigrants are a 'burden' to the whole population (Barnes 2010). On the flip side, native-born students likely benefit from being in a context with immigrant children whose parents are well-educated and therefore socioeconomically advantaged.

RESEARCH QUESTION

In order to more accurately understand academic achievement, it is necessary to examine students' academic achievement in relation to their immigrant status. This includes examining how contextual factors, such as country-level foreign-born population, moderate the effect of being an immigrant in terms of academic achievement. I also examine the effect of country-level foreign-born population on native-born students. In order to examine immigrant performance relative to native-born students and to examine how the strongest predictor of academic achievement, student socioeconomic status, moderates the effect of immigrant status, I examine mathematics achievement in 41 high-income countries. Furthermore, I examine whether immigrants and native-born students demonstrate more positive educational outcomes in countries with high foreign-born population rates or in countries with low foreign-born population rates using cross-level interactions. My study will consequently examine three hypotheses:

1. Immigrant students (first- and second-generation) exhibit lower academic achievement than native-born students.
2. Student socioeconomic status moderates the effect of immigrant status on academic achievement for all groups.
3. Country-level foreign-born population moderates the effect of immigrant status on academic achievement.

DATA AND METHODS

Data

In order to examine the extent to which immigrant status influences academic achievement and how foreign-born population influences immigrant and native-born students' academic achievement, I use the Programme for International Student Assessment, which is administered by the Organization for Economic Cooperation and Development (OECD) every three years to 15-year-olds in participating nations and economies. Specifically, I use the latest assessment, 2015, which was administered in 72 countries and economies (including 34 OECD countries and 31 partner countries) to about 540,000 students, representing about 29 million 15-year-olds (OECD 2017a). The target population of the assessment includes all 15-year-old students attending educational institutions in grades 7 and higher, meaning that it includes students enrolled in full-time and part-time institutions, as well as students in vocational training programs and students attending foreign schools within the country (OECD 2017b). Additionally, I use the mathematics portion of the assessment for the analysis because it is the most likely of the subjects tested to be taught uniformly and sequentially across international contexts (Akiba, LeTendre, and Scribner 2007). For supplemental country-level measures, such as foreign-born population, per capita GDP, and GINI coefficient, I use World Bank and United Nations sources.

The purpose of the PISA assessment is to examine the extent to which 15-year-old students in participating nations will succeed in modern societies (OECD 2017a). Countries around the world rely on these results to measure educational quality and make educational policy (Walker 2013), as well as to assess future economic competitiveness (OECD 2012). Research shows that PISA results have influenced policy reform in most participating countries/economies (Breakspear 2012), contributing to global expansions for educational reform (Sellar and Lingard 2014) and contributing to worldwide analyses of educational inequality

(OECD 2017a). Since PISA collects information on the students' background, it allows for analysis on how non-school factors, such as immigrant demographics and socioeconomic status, influence achievement in different countries and contexts. Because it includes demographic characteristics as well as academic achievement for students in over 70 countries, it is ideal for an analysis on how country-level context as well as student-level characteristics influence educational outcomes.

Sample

The sampling design used for all countries in my data was a two-stage stratified sample design, where the first stage consisted of systematically selecting schools from nationally representative PISA-eligible schools (OECD 2017b). A minimum of 150 schools were selected from each country with 150+ educational institutions, and all schools were selected in countries with fewer than 150. The second stage sampling units were 15-year-old students within the selected schools. The target cluster size established by PISA was between 35 and 42 students per school (OECD 2017b). Additionally, in order to ensure coverage of the target population, PISA takes into account school and student response rates as well as within-country school strata classifications (OECD 2017b).

Although 72 countries and economies participated in the 2015 assessment, and in order to allow for appropriate comparisons across nations, I limit my analysis to those designated as high-income by the World Bank in the year of PISA's latest administration (2015), resulting in 39 countries and 2 city-states[1] (World Bank 2017a). Because these countries are more economically

[1] The countries in our sample are Australia, Austria, Belgium, Canada, Chile, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Macao, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Kingdom, United States, and

advanced than countries in the other income classifications, and various measures for quality of life rank high-income countries higher, they are often preferred destinations for immigrants. According to the United Nations (2016), high-income countries host 71% of all international migrants.

The sample consequently consisted of 289,912 students, nested within 10,334 educational institutions, nested within 42 high-income economies. As is the case with any dataset, values were missing for a small proportion of observations. Approximately 4.5% of the student observations in our sample have data missing. In order to more precisely handle missing data and to avoid yielding biased results (Li, Stuart, and Allison 2015), I used chained multiple imputation to address missing values. I specifically used Stata's MI command using 20 imputations and imputed for student socioeconomic status, student immigrant status, language spoken in the home, standardized student grade, school administration, and class size. Given that PISA, which uses plausible values for academic achievement, is the best fit dataset for answering my research questions, and considering that a mixed-effects model is required, the necessary statistical model is rather complex. While the multiple imputation process was successful, available statistical software is incapable of running mixed-effect models with plausible values as the outcome in a multiple imputation environment. In order to explore my research questions, however, mixed-

Uruguay. We exclude UAE from our sample, despite their high-income status, due to missing data on key country-level measures. Additionally, I exclude Qatar from my analysis because it is an extreme outlier with values that disproportionately influence my models. The decision to exclude Qatar is a result of post estimation checks showing large values of Cook's D, which indicates a large influence on regression results (Hoffmann and Shafer 2015). Qatar is an unusual country in terms of migration demographics as well as policy; 94% of their workforce is composed of immigrants and they have no visa restrictions for over 80 countries (Chappell 2017).

effect models and plausible values are necessary, and I therefore exclude the multiple imputation mechanism from my analysis.

Because of this limitation with software, I use the listwise deletion procedure to address missing values, and therefore eliminate all observations with any missing values. While this may result in a dataset that is not representative of the population (Williams 2015), I compared the descriptive statistics for the post-multiple imputation dataset to the post-listwise deletion sample. No notable differences were observed either in the explanatory variables or in the outcome variable, suggesting that the remaining observations are a reasonably accurate representation of the original sample. For example, the mean for standardized student grade following the multiple imputation procedure is 9.698, and the mean for the sample variable following listwise deletion is 9.699. Similarly, small differences were observed when comparing other variables. Furthermore, I checked cell sizes for immigrant groups in the countries examined and did not find alarming differences between the original sample and the sample following listwise deletion. Despite these findings, I acknowledge the limitations of my technique for handing missing data and its possible effect on our results (Allison 2002). Following the listwise deletion procedure, the remaining sample consists of 264,867 students nested within 10,113 academic institutions.

Measures

Outcome variable

The outcome variable for my analysis is mathematics achievement and follows PISA technical instructions for analysis (OECD 2012). In addition to being used for OECD reporting, the use of plausible values as described in PISA technical manuals is common practice for examining PISA academic achievement in academia (see Ferrera Cordero, Crespo Cebada, and Santin Gonzalez 2010; Jerrim 2015; Kjaernsli and Lie 2011; Liu and Wilson 2009; Stoet and

Geary 2013; Sun et al. 2012). PISA uses specific scales and subscales within each country and across nations, as well as calculating sampling variance, to provide a uniform scale for all participating students (OECD 2012). It is important to note that the outcome variable consists of plausible values and *not* test scores, suggesting that they contain random error variance and should therefore be treated with caution and special attention should be given to standard errors (see Appendix A for standard errors). To calculate mathematics achievement, I use Stata's 'pv' command, which allows for data analysis of international assessments and offers the PISA-specific plausible values procedure. For each student, 10 plausible values are assigned, representing "random numbers drawn from the distribution of scores that could reasonably be assigned to each individual..." (OECD 2012:147). In other words, the 10 plausible values are assigned from the conditional and joint distribution, based on students' background variables, item responses, and model parameters (OECD 2017c). The outcome variable used in my analysis, mathematics achievement, is an estimate derived from the 10 plausible values for each student. The appropriate replicate weights were used to calculate country-level descriptive statistics (see Table 2), but these weights were not used in our regression models due to limitations in software and as is customary in inferential analyses using PISA (Jerrim 2015).

Explanatory variables

At the student level, I use immigrant status and socioeconomic status as key explanatory variables, as well as student background variables as controls. Student immigrant status is a categorical variable consisting of three groupings: native-born students are those born in the country of participation and whose parents were also born in that country; second-generation students are those born in the country of participation with at least one parent who was born in a different country; first-generation students are those who were born in a country other than the country of test participation, regardless of where the parents were born. For student socioeconomic status, I use PISA's index of economic, social, and cultural status (ESCS), a measure of student SES. This index includes "the International Socio-Economic Index of Occupational Status (ISEI); the highest level of education of the student's parents, converted into years of schooling; the PISA index of family wealth; the PISA index of home educational resources; and the PISA index of possessions related to 'classical' culture in the family home" (OECD 2013). Principal component analysis derives that each of the factors included in this measure similarly load on to the measure across nations (OECD 2012). This measure is then standardized to have an OECD average of 0 and standard deviation of 1. Because I draw on a sample of high-income OECD as well as partner OECD nations, the mean for the ESCS measure is 0.044 and the standard deviation is 0.95 (see Table 1). While other measures associated with student achievement such as parental education and income are available, the ESCS index is more commonly used for PISA analyses of achievement than these other variables, and is often referred to as student SES (Jehangir, Glas, and van den Berg 2015; Lafontaine et al. 2015; Ping Lam and Chi Lau 2014). Because our research questions require running interactions and in order to simplify the interpretation of my models, I created decile categories, with each decile containing 10% of students. I use ESCS deciles in all models.

(Table 1 about here)

To accurately examine the relationship between the key explanatory variables and my outcome variable, it is necessary to statistically adjust for other variables that may influence mathematics achievement outcomes. Student-level background controls include gender, language spoken in the home, and grade in school. Because gender is correlated with mathematics achievement in various contexts, with boys generally outperforming girls (Else-Quest, Sibley Hyde, and Linn 2010), I control for gender; gender is coded as 0 = female and 1 = male, and we use females as our reference group. I control for language spoken in the home, since language barriers prevent students from succeeding academically. The variable was coded as 0 = language of the test and 1 = other language, and I use language of the test as the reference group.

Language spoken in the home is likely strongly associated with student immigrant status; because of this, I ran sensitivity checks to ensure that there was no collinearity between these two variables. Considering the results from my variance inflation factor (VIF) checks, which indicated that there is no multicollinearity between these two variables, I choose to include language as a control variable. Although all students who participate on PISA are 15-years old, they are not necessarily in the same grade. It is therefore necessary to account for grade in school because it is largely associated with exposure to mathematical concepts and level of achievement. Grade in school consists of a continuous scale ranging from 7th grade to 12th grade, and I use the 10th grade category as the reference group. Although family structure is associated with academic achievement and previous PISA assessments did provide information regarding student family structure, the 2015 assessment did not, and I therefore do not account for this measure in my analysis.

At the school-level, I control for school characteristics, including public/private administration and class size. School administration is a dichotomous variable, with public coded as 0 and private coded as 1, and public schools are used as the reference category. Class size is an ordinal variable ranging from 13 to 53, with a numerical category falling every five. At the country level, I use foreign-born population as the key explanatory variable, and control for per capita GDP and GINI coefficient. Per capita GDP is a common measure of country wealth, as reported by the World Bank, and ranges from $11,593 to $99,718 for my sample. For modeling and interpretation purposes, GDP is included and discussed in terms of $1,000 differences rather than $1 differences. The GINI coefficient is a measure of income inequality ranging from 0.246 to 0.537 for my sample, with higher values indicating higher levels of income inequality. To run the appropriate models, I multiplied the GINI coefficient by 100 to create a scale ranging from 0 to 100 rather than from 0 to 1, and the variable therefore ranges from 24.6 to 53.7. My key country-level independent variable, country-level foreign population, is the percent of the population that was born in a nation other than the country of residence in 2015, based on United Nations reports. Specifically, foreign-born population figures are retrieved from UN data on International Migrant Stock, which is defined as the number of people born in a country other than that in which they live (World Bank 2017b). In my sample, foreign-born population ranges from 1.6% to 58.3%. Country-level measures for each country can be found on Table 2.

(Table 2 about here)

To test whether the relationship between immigrant status and mathematics achievement is influenced by the student's socioeconomic status, I run a within-level interaction. To test whether the relationship between immigrant status and mathematics achievement is influenced by the country's foreign-born population, I run a cross-level interaction. These interactions will be discussed in subsequent paragraphs.

Analysis

In order to examine the relationship between my key explanatory variables and student mathematics achievement, I use a multi-level (or mixed-effect) regression model where students are nested within schools and schools are nested within countries, in order to account for shared error. Because I am interested in separating the variability of the outcome variable into differences across groups (schools and especially countries) as well as across individuals (students), a mixed-effects model provides information on the random variation at both the group and the individual level. I use a random-effects model instead of a fixed-effects model because I am interested in the student population and not in the larger units (schools and countries). As should be done with all regression models, the assumptions were checked at both the student-level and group-levels.

Model 1

Model 1 in my analysis examines the relationship between student immigration status and mathematics achievement. The level-1 portion of the first model is estimated using the following equation:

(1) $Y_{klm} = \pi_{olm} + \pi_{2lm}IMMIG_{klm} + e_{klm}$,

where Y_{klm} represents the mathematics achievement of student *k* who attended school *l* and lived in country *m*, and π_{olm} is the mean mathematics achievement score of students who attended school *l* in country *m*. $\pi_{2lm}IMMIG_{klm}$ is the student immigration status variable for student *k*. Lastly, e_{klm} is the random student effect. The level-2 portion of the multilevel model is estimated using the following equation:

(2) $\pi_{olm} = \beta_{olm} + r_{olm}$,

where π_{olm} represents the mean mathematics achievement score for students who attended school *l* in country *m*. β_{olm} is the school average score, and r_{olm} is the random school effect. The level-3 portion of the multilevel model is estimated using the following equation:

(3) $\beta_{olm} = \gamma_{oom} + u_{oom}$,

where γ_{oom} represents the mean mathematics achievement score for students in country *m* and u_{oom} represents the random country effect.

Model 2

Model 2 in my analysis examines the relationship between student socioeconomic status as measured by deciles derived from the composite ESCS measure and mathematics achievement. The level-1 portion of the second model is estimated using the following equation:

(1) $Y_{klm} = \pi_{olm} + \pi_{1lm}SES_{klm} + e_{klm}$,

where Y_{klm} represents the mathematics achievement of student *k* who attended school *l* and lived in country *m*, and π_{olm} is the mean mathematics achievement score of students who attended school *l* in country *m*. SES_{klm} is the decile measured derived from the standardized ESCS measure of student socioeconomic status and π_{1lm} represents the mean SES decile of students in the school. Lastly, e_{klm} is the random student effect. The level-2 and level-3 portions of the model are estimated using the same equations as the ones used for model 1.

Model 3

Model 3 in my analysis examines the relationship between country-level foreign-born population and mathematics achievement. The level-1 portion of the third model is estimated using the following equation:

(1) $Y_{klm} = \pi_{olm} + e_{klm}$,

where Y_{klm} represents the mathematics achievement of student *k* who attended school *l* and lived in country *m*, and π_{olm} is the mean mathematics achievement score of students who attended school *l* in country *m*. The level-2 portion of this multilevel model, as was the case in previous models, is estimated using the following equation:

(2) $\pi_{olm} = \beta_{olm} + r_{olm}$,

where π_{olm} represents the mean mathematics achievement score for students who attended school *l* in country *m*. β_{olm} is the school average score, and r_{olm} is the random school effect. The level-3 portion of the multilevel model, which is the country-level, is estimated using the following equation:

(3) $\beta_{olm} = \gamma_{oom} + \gamma_{1om}FOREIGNBORN_{oom} + u_{oom}$,

where γ_{oom} represents the mean mathematics achievement score for students in country *m* and $FOREIGNBORN_{oom}$ represents the percent of country *m*'s population that was born in a country other than the country of participation. Lastly, u_{oom} represents the random country effect.

Model 4

Model 4 in my analysis examines the relationship between all three key explanatory variables, student immigrant status, student socioeconomic status, and country-level foreign-born population, and the outcome variable, student mathematics achievement. The level-1 portion of the fourth multilevel model is estimated using the following equation:

(1) $Y_{klm} = \pi_{olm} + \pi_{1lm}SES_{klm} + \pi_{2lm}IMMIG_{klm} + e_{klm}$.

The level-2 portion of the multilevel model is estimated using the same equation that used in the previous three models. The level-3 portion of the multilevel model is estimated using the following equation:

(3) $\beta_{olm} = \gamma_{oom} + \gamma_{1om}FOREIGNBORN_{oom} + u_{oom}$.

Model 5

Because it is imperative to adjust for the effects of other variables on the outcome variable, Model 5 in my analysis includes all three key explanatory variables as well as student-level control variables that may be associated with mathematics achievement. This allows me to examine the influence of my key explanatory variables while accounting for other variables that may be influencing our models. The level-1 portion of the second multilevel model, which include the student-level control variables, is estimated using the following equation:

(1) $Y_{klm} = \pi_{olm} + \pi_{1lm}SES_{klm} + \pi_{2lm}IMMIG_{klm} + \pi_{3lm}STUDENT_{klm} + e_{klm}$,

where Y_{klm} represents the mathematics achievement of student *k* who attended school *l* and lived in country *m*, and π_{olm} is the mean mathematics achievement score of students who attended school *l* in country *m*. SES_{klm} is the decile measured derived from the standardized ESCS measure of student socioeconomic status and π_{1lm} represents the mean SES decile of students in the school. $IMMIG_{klm}$ is the student immigration status variable, and $STUDENT_{klm}$ represents the coefficients of the student background control variables, which includes gender, grade in school, and language spoken in the home. Lastly, e_{klm} is the random student effect. The level-2 and level-3 portions of the second multilevel model are estimated using the same equations as were used in Model 4.

Model 6

Model 6 includes all key explanatory variables, student-level control variables, and school-level control variables that are associated with mathematics achievement. The level-1 and level-3 portions of this model are estimated using the same equations that were used in Model 5, and the level-2 (the school level) is estimated using the following equation:

(2) $\pi_{olm} = \beta_{olm} + \beta_{1lm}SCHOOL_{klm} + r_{olm}$,

where π_{olm} represents the mean mathematics achievement score for students who attended school *l* in country *m*. β_{olm} is the school average score, $SCHOOL_{klm}$ are the coefficients for the school-level controls for school *l* in country *m,* which include public/private administration and class size, and r_{olm} is the random school effect.

Model 7

Model 7 includes all key explanatory variables, student-level control variables, school-level control variables, and adds county-level control variables. The level-1 and level-2 equations are the same as the ones used in Model 6, and the level-3 portion of the multilevel model is estimated using the following equation:

(3) $\beta_{olm} = \gamma_{oom} + \gamma_{1om}FOREIGNBORN_{oom} + \gamma_{2lm}COUNTRY_{oom} + u_{oom}$,

where γ_{oom} represents the mean mathematics achievement score for students in country *m* and $FOREIGNBORN_{oom}$ represents the percent of country *m*'s population that was born in a country other than the country of participation. $COUNTRY_{oom}$ represents the country-level controls of per capita gross domestic product and income inequality. Lastly, u_{oom} represents the random country effect. In this model, I expect country-level control variables to further attenuate the effect of the three key explanatory variables on student mathematics achievement.

Model 8

The eighth model in my analysis includes the three key explanatory variables as well as the control variables added in previous models. Additionally, model 8 includes a within-level interaction at the level-1 of analysis, or at the student level: student socioeconomic status and student immigrant status. This interaction allows me to further examine the influence of context on achievement by assuming that these two variables are not completely independent of each other, and therefore examining the possibility that there may be distinct slopes based on the interaction of these two variables. The level-1 portion of the third multilevel model, which includes the within-level interaction effect between student immigrant status and student socioeconomic status, is estimated using the following equation:

$$(1)\ Y_{klm} = \pi_{olm} + \pi_{1lm}SES_{klm} * \pi_{2lm}IMMIG_{klm} + \pi_{3lm}STUDENT_{klm} + e_{klm},$$

where Y_{klm} represents the mathematics achievement of student *k* who attended school *l* and lived in country *m*, π_{olm} is the mean mathematics achievement score of students who attended school *l* in country *m*. $SES_{klm} * IMMIG_{klm}$ represents the within-level interaction between student socioeconomic status and student immigrant status for student *k* attending school *l* in country *m*. As with the previous model, $BACKGROUND_{klm}$ represents the coefficients of the student background control variables, and e_{klm} is the random student effect. The level-2 and level-3 portions of the third multilevel model are estimated using the same equations as the ones used in model 7.

I would expect the interaction between these two variables, student socioeconomic status and student immigrant status, to be statistically significant, suggesting that the effect of one of the variables is moderated by the other. I specifically expect student socioeconomic status to moderate the effect of student immigrant status, and therefore that as student socioeconomic status increases, the effect of immigrant status weakens.

Model 9

The ninth model in my analysis also includes all explanatory variables (key variables as well as controls) at all three levels and adds a cross-level interaction between student immigrant status and country-level foreign-born population. As stated earlier, interactions allow me to examine how one variable moderates the effect of the other on the outcome variable. In this case, to explore the importance of context for immigrant outcomes, I examine how foreign-born population moderates the effect of student immigrant status. This interaction, if significant, will show various slopes between student immigrant status and mathematics achievement based on country-level foreign-born population. The level-3 portion of the fourth multilevel model, which includes the cross-level interaction effect between student immigrant status and country-level foreign-born population, is estimated using the following equation:

(3) $\beta_{olm} = \gamma_{oom} + \gamma_{1om}FOREIGNBORN_{oom} * \pi_{1lm}IMMIG_{klm} + \gamma_{2lm}COUNTRY_{oom} + u_{oom}$,

where $FOREIGNBORN_{oom} * IMMIG_{klm}$ represents the cross-level interaction between student immigrant status and country-level foreign-born population. The level-1 and level-2 portions of the multilevel model are estimated using the same equations as the ones used in model 7.

RESULTS

Isolated Key Explanatory Variables

Table 3 includes the bivariate models for each of the key explanatory variables and mathematics achievement. Model 1 shows the relationship between student immigrant status and achievement. On average, first- and second-generation immigrants perform 18 and 14.5 points below native-born students, respectively, and these relationships are statistically significant. Based on the isolated model examining the influence of immigrant status on academic achievement, immigrants do underperform relative to native-born students. Model 2 shows the relationship between student SES as measured by ESCS deciles and mathematics achievement. As expected, this model illustrates that a one-decile increase in SES is associated with a 9-point increase in mathematics achievement, which equals roughly a fourth of a year of school (OECD 2012a). This suggests that there is a strong positive relationship between student SES and mathematics achievement. The relationship between country-level key explanatory variable, foreign-born population, and mathematics achievement is also statistically significant, as is evident in Model 3. Considering that foreign-born population is measured as a percentage, a one-percent increase in foreign-born population is associated with a 1.2 increase in mathematics achievement for students in that country. For example, based on this model, students in Country A with a 15% foreign-born population are expected to perform 10 points higher than students in Country B with a 5% foreign-born population.

(Table 3 about here)

Combined Key Explanatory Variables

Table 3 also presents the regression output for the effects of the three key explanatory variables when accounting for the other focal variables. When accounting for the other key variables, second-generation immigrants perform 9 points below native-born students, and first-generation students, on average, perform 15 points below native-born students. Accounting for student socioeconomic status and our focal country-level contextual factor does not explain the difference in achievement for first- and second-generation immigrants, although it does weaken the effect, as is shown by the smaller coefficient. Student socioeconomic status remains statistically significant and positively associated with mathematics achievement when accounting for immigrant status and foreign-born population, with a one-decile increase in SES being associated with an 8-point increase in mathematics achievement. Foreign-born population, which is still statistically significant, exhibits a smaller coefficient than the one observed in Model 3, yet remains positive.

Student-Level Controls

Table 4 includes the output for the hierarchical linear model of immigrant status, student SES, foreign-born population, and added explanatory variables. Model 5 includes the following student-level controls: gender, language spoken in the home, and student standardized grade. As is consistent with previously research, females, on average, exhibit lower mathematics achievement than boys, and this relationship is statistically significant. Students who speak a language other than the language of the test at home, on average, perform 16 points below the average score for those who speak the language of the test at home. This equals almost half a year of schooling. As expected, students in higher grades perform, on average, better than those in lower standardized grades.

When accounting for these student-level characteristics, the coefficients for both immigrant groups remain statistically significant yet vary greatly from the ones observed in previous models. Second-generation immigrants, on average, underperform by about 5 points relative to native-born students, while first-generation immigrants, on average, perform 3 points below native-born students. Accounting for other student characteristics results in first-generation immigrants' predicted achievement cuts the difference from native-born students by 12 points. The effect of student socioeconomic status, which remains significant, is also weakened by the added explanatory variables. Foreign-born population remains statistically significant and positively associated with higher academic achievement.

(Table 4 about here)

School-Level Controls

Table 4 also includes the two school-level controls in Model 6: school administration and class size. When accounting for all other variables in the model, students attending private schools, on average, perform 10 points above students who attend public schools. This is not surprising, considering that private schools are generally more socioeconomically advantaged and have more academic and social resources, which is likely to translate into higher academic achievement for students. The coefficient for class size, which is an ordinal variable in which categories increase by 5, is interpreted to mean that a 5-student increase in class size in associated with a 1.098 increase in mathematics achievement.

While second-generation immigrants are expected to perform 4 points below native-born students based on this model, adding school-level controls results in a non-statistically significant coefficient for first-generation immigrants. This suggests that they are no different from native-born students in terms of mathematics achievement when considering the added contextual factors in this model. This is likely due to the private/public variable and suggests that when we control for this contextual advantage, first-generation immigrants are indistinguishable from native-born students in their predicted achievement. School-level factors do not alter the effect of student-level socioeconomic status or country-level foreign-born population.

Country-Level Controls

Model 7 includes all key explanatory variables as well as student-, school-, and country-level controls. When accounting for all these variables, a one-unit increase in the GINI coefficient, our measure on income inequality, is associated with a 2.24 decrease in mathematics achievement. This is consistent with previously conducted research, which found that income inequality as measured by the GINI coefficient is associated with lower mathematics achievement for all students (Edmunds 2015). The coefficient for per capita gross domestic product is interpreted to mean that a $1,000 increase in per capita GDP is associated with a 0.02 increase in academic achievement. While this relationship is statistically significant, it suggests that country wealth plays a very small role in academic achievement. To put this in context, it would require a $15,000 increase in per capita GDP to increase students' predicted scores by 3 points. The effects found when considering these two macro contextual factors suggest that while financial resources as measured by per capita GDP are not necessarily associated with higher achievement, income inequality does negatively affect student achievement.

The effect of the key independent variables on academic achievement remains mostly unchanged by country-level controls. First-generation immigrants are statistically indistinguishable from first-generation immigrants, while second-generation immigrants are expected to perform 4 points below native-born students. The effect of student socioeconomic status, unsurprisingly, remains statistically significant. Even when accounting for all controls, a one-decile increase is associated with over a 5-point increase in achievement. Accounting for other country-level contextual factors, however, increases the coefficient for foreign-born population. Based on this model, a 10% increase in foreign-born population is associated with a 13.8 increase in students' average mathematics achievement.

Within-Level Interaction

The output for the within-level interaction (Model 8) between student immigrant status and student socioeconomic status is found on Table 5. Based on this interaction, the predicted scores for various groups are illustrated in Figure 1. As expected, there is a clear positive relationship between student socioeconomic status and mathematics achievement for both immigrant groups and for native-born students. This relationship follows very similar trajectories for first-generation immigrants and native-born students, as is evident by the similar lines in Figure 1 and the coefficient of 0.439 for first-generation immigrants. While these two groups follow a similar trajectory, the coefficient of 0.439 for first-generation immigrants results in a slightly steeper positive slope in predicted achievement relative to native-born students. First-generation immigrants, then, benefit at a higher rate from higher socioeconomic status than native-born students do. This is consistent with previously conducted research, which found that first-generation immigrants outperform other groups in terms of academic achievement when resources are available.

(Table 5 about here)

The relationship between SES and mathematics achievement for second-generation immigrants, while also positive, is flatter than the ones observed for the other two groups, as is illustrated by the slope in Figure 1. This relationship is also illustrated by the statistically significant negative coefficient for second-generation immigrants in Table 5, which is interpreted to mean that for every mathematics achievement increase associated with a one-decile increase for native-born students, second-generation immigrants exhibit the same increase minus 1.622 points. In other words, the gain in terms of academic achievement that comes from a one-decile increase is greater for first-generation immigrants and native-born students than it is for second-generation immigrants. This suggests that second-generation immigrants are not translating resources into higher achievement at the same rate as first-generation immigrants or native-born students, which is also consistent with previous research.

(Figure 1 about here)

As is also evident by Figure 1, all three groups exhibit similar achievement among the first (or poorest) SES decile, with all three groups falling within 6 points of each other. Among the middle-SES groups (5^{th} and 6^{th} deciles), all groups remain within 10 points of each other. It is among the top decile, or among the richest students, that we see the greatest variation in achievement, with the difference between first- and second-generation immigrants exceeding 14 points. While this difference may seem surprising, literature suggests that this is an expected pattern, considering other observed trends among first- and second-generation immigrants in terms of educational outcomes. Furthermore, immigrant selectivity among first-generation immigrants is likely contributing to the observed gap in SES advantage and academic achievement.

Cross-Level Interaction

Table 5 also presents the output for Model 9, which includes the cross-level interaction between student immigrant status and country-level foreign-born population. The coefficients presented in Table 5 indicate that an increase in the percent of foreign-born individuals is associated with higher achievement for both immigrant categories relative to native-born students. Despite the positive coefficient suggesting that immigrants benefit more from higher immigration than native-born students do, this does not mean that native-born students are performing worse in contexts with higher immigration. Native-born students actually exhibit higher achievement as a result of higher immigration. In addition, the coefficient for first-generation immigrants is larger than the one observed for second-generation immigrants, and these coefficients are both statistically significant, suggesting that first-generation immigrants benefit more from a larger foreign-born population in terms of mathematics achievement than second-generation immigrants do.

(Figure 2 about here)

This interaction between student immigrant status and foreign-born population is further illustrated in Figure 2. The predicted values demonstrated in this figure, which range for contexts with foreign-born population rates between 0 and 30%, illustrate 37 of the 41 countries in my analysis. The four countries not illustrated are Luxemburg, Macao, Hong Kong, and Singapore. While not shown, these countries do follow the same pattern as the one illustrated in the figure. As is evident by this figure, *all groups* benefit from higher foreign-born population rates, although the slope is indeed steeper for first- and second-generation immigrants than it is for native-born students, as is expected considering the positive coefficients on Table 5. In countries with a very small proportion of immigrants, immigrants perform about 20 points below native-born students; in countries with 15% or more immigrants, native-born students and immigrants are within 10 points of each other; in countries with 25% foreign-born, all three groups perform within five points of each other. In other words, higher immigration results in a narrowing of the achievement gap between immigrants and native-born students. This narrowing of the gap, however, is *not* a result of decreased native-born achievement, but is the result of an increase in achievement for all groups coupled with a steeper positive slope for both immigrant groups relative to the slope observed for native-born students. First-generation immigrants' achievement is expected to increase by roughly 21 points for every 10% increase in foreign-born population, while second-generation immigrants, on average, exhibit an 18-point increase and native-born students exhibit a 12-point increase. All groups, then, benefit academically from higher foreign-born population rates.

DISCUSSION

Scholars seek to decrease educational inequality through examining student-level characteristics and how these may influence academic achievement. My analysis sought to examine three hypotheses relating to student-level characteristics and academic achievement as well as accounting for contextual factors: 1) immigrant students exhibit lower academic achievement than native-born students, 2) student socioeconomic status moderates the effect of immigrant status on academic achievement, and 3) country-level foreign-born population moderates the effect of immigrant status on academic achievement, both for immigrants and for native-born students. Considering these focuses, I draw three main conclusions. First, when accounting for other student background characteristics as well as school factors, first-generation immigrants are essentially the same as native-born students in terms of mathematics achievement, and second-generation immigrants are not far behind. Second, the moderating effect of SES is very similar for first-generation immigrants and for native-born students, but not for second-generation immigrant, suggesting that second-generation immigrants are not translating resources into higher achievement at the same rate as other groups. Lastly, my key macro social context, foreign-born population, does moderate the effect of immigrant status on academic achievement. While first- and second-generation immigrants benefit more from higher immigration relative to native-born students, *all groups* are expected to perform significantly better with increased immigration.

Immigrants' Disadvantage: A Language Barrier

Contrary to what some current literature suggests, immigrants do not substantially underperform relative to native-born students once other student-level factors are taken into account. While second-generation immigrants do perform slightly below native-born students, first-generation immigrants are statistically indistinguishable from native-born students when considering other student and school factors. What does seem to substantially influence academic achievement among immigrants is language spoken in the home. Based on further analysis, this is the case for both first- and second-generation students as well as for native-born students. Students whose home language is different than the language of the exam, on average, are almost half of a school year behind students who speak the language of the exam at home. Based on this finding, it is likely that previous literature finding discrepancies among first- and second-generation immigrants relative to non-immigrant students were in fact capturing language barriers rather than an immigrant disadvantage. For first-generation immigrants, in addition to having parents who likely struggle with language, students themselves likely face some degree of a language barrier. As would be expected, most students whose language spoken in the home is different from the language of the exam are first-generation immigrants.

This is consistent with findings that suggest that the growing achievement gap between Hispanics and white students in the United States is largely accounted for by considering English language learners (Hemphill, Vanneman, and Rahman 2011), and that immigrant children's struggle with language barriers in general is a strong predictor of school success (Schmid 2001). This is logical, considering that language spoken in the home is a key characteristic in explaining achievement differences (Dustmann et al. 2012). Given my finding regarding the relationship between language spoken in the home and academic achievement, which suggests that the dichotomy seems to be native speaker versus non-native speaker rather than non-immigrant versus immigrant, teachers should continue to bridge this gap in the classroom through focusing on language learning (Beal, Adams, and Cohen 2009; Ernst-Slavit and Slavit 2007; Shin et al. 2012; Winsor 2007). While speaking multiple languages is associated with other critical thinking skills (Adesope et al. 2010), mathematics achievement influences grades and therefore influences access to higher education and educational attainment. If language spoken in the home is what is keeping many immigrants from succeeding academically, educational policy should implement supplemental programs that focus on targeting non-native speakers in order to improve their language skills. Continual emphasis on language learning programs, such as ESL and ELL in the United States, will likely continue narrowing the gap between non-native students and native-speakers in mathematics achievement and therefore contribute to the goal of educational equality.

Second-Generation Immigrants: A Different Story

As discussed in the results section, SES is associated with higher mathematics achievement for all three groups. Regardless of immigrant background, being on the lower end of the socioeconomic spectrum is associated with poor academic achievement, while being socioeconomically privileged is expected to result in higher academic achievement. Based on my findings, the resources that come from being socioeconomically advantaged translate into higher academic achievement for both immigrant groups as well as for native-born students. This is logical, especially considering what research has found regarding resources and academic achievement; students whose parents are socioeconomically advantaged are more likely to be involved in their children's education, regardless of immigrant status. In addition to parental involvement, students in high-SES households are likely attending more privileged schools and having more privileged social networks.

However, second-generation immigrants do not seem to take advantage of socioeconomic resources to the same extent as first-generation immigrants and native-born students do, considering that the gains in academic achievement are smaller for second-generation immigrants than they are for the other two groups. While students in all three groups perform within 5 points of each other in low-SES households, second-generation immigrants in the highest-SES group perform more than 10 points below first-generation immigrants and native-born students. A possible explanation for this finding is that the parents of second-generation immigrants may be facing a language barrier that they did not choose. While first-generation immigrant parents tend to be aware of the language complications that arise from a new context, the parents of second-generation children may not have had a choice, as they may have changed contexts at a young age.

Furthermore, the second-generation category includes students with one *or* two immigrant parents. With this in mind, it is possible that there are more cultural differences observed among mixed-nationality couples that may be influencing the achievement of second-generation immigrant students. It is also possible that, while first-generation immigrant students have parents who push for academic excellence to a greater degree, second-generation immigrant students do not. A strong motivating factor for parents to migrate to other countries, after all, is to provide a better life for their children through improved educational opportunities (Kao and Tienda 1995). Second-generation immigrant students may simply not have that expectation for academic success from their parents, particularly among families that are already socioeconomically privileged.

The SES differences observed between first- and second-generation immigrants could be explained by immigrant selectivity, or the idea that immigrant groups are composed of select individuals. First-generation immigrants exhibit exceptional skills, resources, and education, which often allow them to migrate in the first place. For example, for many immigrant groups, first-generation immigrants tend to be more socioeconomically advantaged in their country of origin (Crosnoe and Lopez Turley 2011), which facilitates the migration process and advantages them in the destination country. Because first-generation immigrants tend to be socioeconomically advantaged and educated, they exhibit higher expectations for their children's academic achievement (Feliciano 2006), which may explain the differences observed between these two immigrant groups, particularly among high-SES groups.

Macro Social Context: What Matters and What Doesn't

Country-level characteristics also influence academic outcomes for immigrants. Consistent with previous research (Edmunds 2015), country-level income inequality negatively affects academic achievement significantly. This is even when accounting for student-level characteristics, suggesting that income inequality is bad for all students, regardless of SES or immigrant status. For example, Norway has a GINI coefficient of 26, while the United States has a GINI coefficient of 39. Based on our findings, students in the United States are expected to perform 29 points below students in Norway solely because of income inequality. Considering that 39 points equals a year of schooling, income inequality results in students in the US performing three fourths of a school year behind students in Norway. By contrast, a country's wealth is seemingly irrelevant in terms of students' academic achievement. While all the countries in my sample are classified as high-income, there is substantial variation in wealth as measured by per capita gross domestic product. Based on my model, a 6-point increase in mathematics achievement would require a $30,000 increase in per capita GDP. Based on current GDP growth trends in the United States, it would take over 20 years to increase per capita GDP by that amount. Most high-income countries have experienced a change of less than $3,000 dollars in per capita GDP since 2006. Amount of wealth, then, does not seem to have practical consequences for academic achievement, and the changes in wealth required to have a significant impact on achievement are large. The distribution of wealth in a country, however certainly does play a substantial role in students' academic achievement. Based on these findings, there is evidence that macro social factors can be very influential in student performance while simultaneously providing evidence that other macro social factors may not play a substantial role in student-level achievement.

As discussed in the results section, all three groups – first- and second-generation immigrants as well as native-born students – benefit from higher foreign-born population rates. Second-generation immigrants experience a 9-point increase in achievement with a 5% increase in foreign-born population, and first-generation immigrants experience more than a 10-point increase. Just because immigrants benefit from higher immigration, however, does not mean that native-born students' achievement is negatively affected. While the slope is clearly flatter for native-born students than it is for immigrant groups, a 5% increase in foreign-born population is associated with more than a 5-point increase in achievement for native-born students. Based on this, students in Australia, a country with about 28% foreign-born individuals, are expected to perform 20 points higher than students in Portugal merely because of immigration rates. Comparing these two countries again, first-generation immigrants are expected to perform 40 points higher in Australia than in Portugal, solely because of foreign-born population rates.

While examining the mechanisms that could explain the positive effect of immigrants on students' academic achievement is beyond the scope of this paper, previous literature does similarly find that there are benefits from sociocultural diversity that result in higher academic achievement among all students. Consistent with my findings, research has found that third-generation and higher students, or native-born students, perform worse when they are isolated from first- and second-generation immigrants (Pivovarova and Powers 2018), further suggesting that migrant diversity positively affects achievement for native-born students. Considering that diversity has been linked to positive student development (Hurtado 2001) and higher cognitive ability, and that these are associated with higher mathematics achievement (Hart et al. 2009), it is logical that diversity creates a context where students perform better. Furthermore, it is likely that immigrants bring in sociocultural resources that positively affect non-immigrants' educational outcomes.

Despite the benefits associated with diversity, and largely due to increased rates in immigration around the globe, many wealthy high-income countries are considering closing borders to immigrants or restricting the number of incoming immigrants in order to 'protect' their population and their resources. Finnish officials, for example, argue that immigrants struggle with integrating into mainstream society (BBC 2015), and therefore propose to limit migrant visas. Following mass migrations from the east, numerous European countries, including Germany and Austria, have tightened migration policy. The EU itself has formally discussed how to address growing immigration and methods for fortifying borders (Vonberg 2017). American political platforms argue that immigrants are draining resources from the education system and therefore negatively affecting non-immigrant students, in addition to immigrants draining government resources and taking away opportunities from American citizens (Barnes 2010; Ferris and Raley 2016; GOP 2017). Because of these political platforms, current U.S. officials seek to implement reforms to limit legal migration into the United States (Naylor 2017), in addition to addressing illegal immigration, which has actually declined in recent years (Krogstad, Passel, and Cohn 2017).

While it may be true that first-generation immigrants may require language programs, suggesting that some of these 'resource-draining' mechanisms may be true, native-born students actually benefit academically from being in contexts with more immigrants. Perhaps due to immigrant selectivity among first-generation migrants, immigrants may have available resources that extend to native-born students. Research has also shown that diversity leads to increased achievement (Banks and McGee Banks 2010) as well as increasing democratic citizenship among students (Banks 2008; Gurin, Nagda, and Lopez 2004). Why native-born students perform better when immigration rates are higher, however, is beyond the scope of what this analysis sought to explore.

Limitations

As with all academic research, my analysis faces limitations. First, my analysis could not account for immigrants' country of origin, which has been shown to influence academic achievement as well as other outcomes. For example, as mentioned in the review of existing literature, immigrants from certain Asian countries residing in the United States outperform immigrants from other countries as well as native-born students. This analysis could not account for immigrants' country of origin due to very small cell sizes in the data. Furthermore, because of the large-scale nature of the data, and even accounting for country-level nesting, I do not disaggregate groups in each country. Do first-generation Japanese immigrants exhibit similar positive outcomes in Mexico? These types of questions require further descriptive analysis, which future research should pursue. Second, as a result of how PISA coded the variable, my analysis groups together students with one immigrant parent and two immigrant parents as "second generation." Based on previously conducted literature, these two groups may be slightly different and should therefore be examined separately.

Third, due to the nature of the data, I could not compare how race/ethnicity plays a role in an international context. Very few countries in the PISA sample select to add a race/ethnicity question to their assessment, which would result in a substantial portion of the sample missing a key explanatory variable. Future research should consider alternative datasets, such as country-specific data, which is more likely to include racial classifications as a variable. While these racial classifications will likely not be directly comparable, majority-minority classifications can be constructed for multiple contexts. Lastly, because I selected to examine how context influences immigrants' achievement in high-income countries, my findings may not be representative of all contexts, as high-income countries are more desirable destinations for immigrants and are likely more selective in their immigration policies. As such, future research should examine if the patterns observed in high-income countries hold in other contexts. Additionally, future research should examine immigrant and non-immigrant outcomes in extremely unusual contexts, as is the case in countries such as UAE and Qatar, where immigration demographics and policy are drastically different from what is observed in other high-income countries.

Despite these limitations, I believe that my research will provide a springboard from which other scholars can further explore student- and country-level characteristics and their relationship to academic achievement as well as how these two levels of influence interact. Future research should explore how other student-level characteristics may be linked to academic achievement using cross-country comparisons to examine how these background factors may behave differently depending on context. For example, future research could explore how country of origin may be linked to academic achievement, or how length of stay for immigrants may moderate the effect of language spoken in the home. Furthermore, qualitative analyses would supplement this research by examining how the immigrant *experience* may be affecting achievement and therefore explore the mechanisms that are influencing inequality. Similarly, qualitative analyses could explore the mechanisms that may explain why native-born students benefit academically from higher immigration rates. Additionally, future research should further consider how macro social context may be influencing academic achievement at the student level. While I chose to examine foreign-born population, other country-level measures could be influencing academic achievement for students regardless of immigrant background. Educational spending, the democratic index, and unemployment are just a few examples of other contextual factors to explore.

My analysis contributes to the conversation regarding how both student background characteristics as well as macro social context influence academic achievement and how the two levels of context interact. Through considering how context influences achievement in 41 high-income countries, I can better understand the relationship between both student-level characteristics and macro social context on academic achievement. Considering that academic achievement is tied to educational attainment, which in turn influences economic outcomes, examining academic achievement sheds light on mechanisms that may be perpetuating inequality and therefore disadvantaging immigrant and non-immigrant children alike. Consistent with previous research, immigrants underperform relative to native-born students when this variable is isolated. When accounting for other student characteristics, however, immigrant status is practically insignificant, and first-generation immigrants are statistically the same as native-born students in terms of academic achievement. Based on my findings, it is likely that other research has captured a language barrier rather than immigrant underperformance. Furthermore, student socioeconomic status interacts with immigrant status differently for second-generation immigrants than for first-generation immigrants and native-born students, with second-generation immigrants benefiting less from an increase in SES in terms of academic achievement. This is likely explained by immigrant selectivity and parental expectations for children's academic outcomes. Lastly, macro social context does indeed influence academic achievement in two substantial ways. First, income inequality negatively affects academic achievement for all students, while country-level wealth is practically inconsequential when examining mathematics achievement. This suggests that while a country's wealth itself may not play a role, the distribution of wealth certainly does. Secondly, immigrants and native-born students alike benefit from higher rates of immigration.

With these findings in mind, I propose that there are policy implications at the country level as well as micro-level policy repercussions. At the micro level, referring to school districts and municipalities, the continued implementation of and improved administration of language learning programs will continue to narrow the gap between native speakers and non-native speakers. Furthermore, considering the language barriers that immigrant parents often face, bridging this possible gap in parental involvement through multilingual administration or language learning programs for adults may address some of the disadvantages that some groups may face. At the country level, policymakers should consider the positive economic, cultural, and social aspects of a strong immigrant population when drafting or evaluating immigration procedures. Immigrant students are not hurting native-born students' academic performance, and in view of the abovementioned findings, native-born students actually benefit academically from higher immigration. Considering the educational benefits associated with higher immigration and bearing in mind that immigrant students are often escaping detrimental and dangerous contexts, policymakers ought to consider humanitarian immigration and its benefits on their country's economic prosperity, which is tied to academic excellence (OECD 2012).

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TABLES

Table 1. Description of Variables

	Mean	SD	Min	Max
Outcome Variable				
Student Mathematics Achievement	494.31	96.65	0	912.20
Mathematics achievement is computed by calculating the predicted mathematics score using PISA's plausible values.				
Country-Level Key Explanatory Variable				
Foreign Born Population	15.35	11.73	1.6	58.32
Percent of the country population born in a country other than the country of participation.				
Student-Level Key Explanatory Variables				
Student Immigrant Status				
Determined by birth country of the student and their parents.				
Native-born student (reference group)	0.861	--	0	1
Second-generation immigrant	0.079	--	0	1
First-generation immigrant	0.060	--	0	1
Student SES (ESCS deciles)				
Deciles derived from a composite variable created from equally weighted information about parental income, parental education status, and home possessions.	5.51	2.87	1	10
Student-Level Background Controls				
Student Gender				
Male = 0	0.499	--	0	1
Female = 1	0.501	--	0	1
Language Spoken in the Home				
Language of Test = 0	0.864	--	0	1
Different language = 1	0.136	--	0	1
Student International Grade				
Grade 7	0.005	--	0	1
Grade 8	0.038	--	0	1
Grade 9	0.312	--	0	1
Grade 10 (reference group)	0.544	--	0	1
Grade 11	0.094	--	0	1
Grade 12	0.019	--	0	1
School-Level Controls				
Administration				
Public = 0	0.784	--	0	1
Private = 1	0.216	--	0	1
Class Size	25.74	6.98	13	53
Country-Level Controls				
GDP Per Capita (in US $)	37,203	21,466	11,593	99,718
GINI Coefficient	31.61	8.07	24.6	53.7

Table 2. Country-Level Contextual Variables and Mathematics Achievement

	2015 Per Capita GDP	2015 Percent Foreign-Born	2015 GINI	Overall Country Score	Native-born Students	Second Gen. Students	First Gen. Students
Australia	56,261	28.22	33.7	497.19	494.45	512.36	498.28
Austria	43,637	17.47	27.4	498.13	511.81	451.15	430.85
Belgium	40,454	12.28	26.6	511.91	523.12	466.16	451.25
Canada	43,316	21.8	31.3	517.94	514.86	522.91	527.49
Chile	13,416	2.62	45.4	424.55	424.99	434.92	373.72
Croatia	11,593	13.6	32	465.28	467.21	450.75	442.67
Czech Republic	17,557	3.84	25.7	494.08	494.73	487.42	464.01
Denmark	53,015	10.1	25.6	512.67	518.97	459.54	458.36
Estonia	17,085	15.42	34.6	520.76	523.37	497.58	491.95
Finland	42,403	5.74	26	512.08	514.5	467.74	439.82
France	36,352	12.09	29.7	496.16	503.12	461.4	425.48
Germany	41,178	14.88	28.9	511.69	520.41	472.79	449.18
Greece	18,007	11.34	33.9	455.03	459.7	424.97	400.49
Hong Kong	42,328	38.95	53.7	549.08	553.93	541.11	430.85
Hungary	12,366	4.56	28.8	478.38	477.86	509.13	480.92
Iceland	50,722	11.39	24.6	489.36	491.87	449.65	422.04
Ireland	61,094	15.92	29.8	505.26	506.38	502.32	497.46
Israel	35,729	24.95	0.36	473.3	474.87	479.4	426
Italy	29,993	9.68	32.6	491.77	494.61	472.28	450.5
Japan	34,524	1.61	33	533.78	534.16	474.55	429.26
Korea	27,222	2.64	29.5	524.31	524.36	N/A	459.08
Latvia	13,655	13.35	35	483.27	484.32	467.43	447.93
Lithuania	14,252	4.73	38.1	480.41	480.27	494.31	466.5
Luxembourg	99,718	43.96	28.4	488.02	506.54	470.74	471.05
Macao	78,586	58.32	35	544.63	536.38	550.67	547.24
Malta	22,568	9.9	28	484.51	493.37	489.93	513.46
Netherlands	44,291	11.7	30.3	514.4	519.64	474.43	453.54
New Zealand	37,808	22.96	34.9	499.76	497.66	497.99	510.55
Norway	74,482	14.24	25.7	504.04	509.17	473.20	459.5
Poland	12,559	1.6	29.8	506.14	506.04	486.77	477.3
Portugal	19,223	8.09	33.8	501.43	503.31	494.94	463.84
Singapore	52,889	45.39	45.6	565.28	559.1	596.64	584.99
Slovak Republic	16,089	3.27	24.7	478.88	479.62	412.81	418.51
Slovenia	20,729	11.41	25.1	511.36	515.69	470.33	446.06
Spain	25,685	12.69	34.4	487.35	492.09	465.79	445.33
Sweden	50,585	16.77	27.4	497.08	507.07	461.28	430.67
Switzerland	80,999	29.39	29.7	524.6	540.44	487.04	491.78
Trinidad and Tobago	17,322	3.67	40.3	424.37	425.43	388.66	401.53
United Kingdom	43,930	13.2	36	496.58	498.59	494.83	478.61
United States	56,116	14.49	39	472.23	478.23	459.21	436.85
Uruguay	15,574	2.09	41.6	419.49	419.45	422.52	426.32
Average	**37,202**	**15.13**	**31.61**	**469.26**	**499.55**	**477.44**	**459.05**

Table 3. Hierarchical Linear Model Regression of Immigration Status (Model 1), ESCS (Model 2), Foreign-Born Population (Model 3), and combined key explanatory variables (Model 4) on Mathematics Achievement

	Model 1	Model 2	Model 3	Model 4
Key Explanatory Variables				
Immigrant Status				
Second-generation	-14.511***			-9.433***
	(0.552)			(0.542)
First-generation	-17.740***			-15.422***
	(0.610)			(0.597)
ESCS		9.015***		8.165***
		(0.051)		(0.051)
Foreign-born Population			1.216***	0.127***
			(0.058)	(0.052)
Constant	491.94***	457.64	472.39***	441.54***
	(0.594)	(0.600)	(1.014)	(0.949)
N	264,867	264,867	264,867	264,867

**p<.05 **p<.01 *** p<.001*

Note: 264,867 students, nested within 10,113 educational institutions, nested within 41 countries/economies.

Table 4. Hierarchical Linear Model Regression of Immigration Status, ESCS, Foreign-Born Population and Student-Level Controls (Model 5), School-Level Controls (Model 6), and Country-Level Controls (Model 7) on Mathematics Achievement

	Model 5	Model 6	Model 7
Key Independent Variables			
Immigrant Status			
Second-generation	-4.926***	-3.977***	-4.084***
	(0.541)	(0.594)	(0.594)
First-generation	-2.972***	-0.716	-0.789
	(0.617)	(0.675)	(0.675)
ESCS	5.266***	5.294***	5.299***
	(0.049)	(0.054)	(0.054)
Foreign-born Population	0.878***	0.888***	1.385***
	(0.052)	(0.053)	(0.079)
Student-Level Controls			
Gender			
Female	-13.956***	-13.998***	-13.863***
	(0.269)	(0.293)	(0.293)
Language Spoken in the Home			
Other Language	-15.841***	-15.524***	-15.596***
	(0.493)	(0.544)	(0.544)
Standardized Grade			
Grade 7	-105.760***	-105.614***	-104.542***
	(1.901)	(2.028)	(2.028)
Grade 8	-78.708***	-77.994***	-77.710***
	(0.777)	(0.828)	(0.827)
Grade 9	-36.087***	-35.235***	-35.136***
	(0.424)	(0.461)	(0.461)
Grade 11	12.566***	12.572***	13.501***
	(0.826)	(0.891)	(0.891)
Grade 12	40.987***	39.284***	40.393***
	(3.133)	(3.560)	(3.559)
School-Level Controls			
Administration			
Private		9.908***	14.848***
		(1.405)	(1.396)
Class Size		1.098***	1.527***
		(0.079)	(0.081)
Country-Level Controls			
GINI			-2.237***
			(0.111)
Per Capita GDP (in $1,000)			0.020***
			(0.000)
Constant	473.428***	444.174***	503.469***
	(0.988)	(2.188)	(3.943)
N	264,867	264,867	264,867

**p<.05   **p<.01   *** p<.001*

Note: 264,867 students, nested within 10,113 educational institutions, nested within 41 countries/economies.

Table 5. Condensed Hierarchical Linear Model Regression of Immigration Status, ESCS, and Foreign-Born Population and Controls with Within-Level Interaction (Model 8) and Cross-Level Interaction (Model 9) on Mathematics Achievement

	Model 8	Model 9
Key Independent Variables		
Immigrant Status		
Second-generation	3.933***	-15.236***
	(1.080)	(1.110)
First-generation	-2.899**	-20.672***
	(1.253)	(1.281)
ESCS	5.401***	5.295***
	(0.058)	(0.054)
Foreign-born Population	1.389***	1.269***
	(0.079)	(0.079)
Within-Level Interaction		
Second-generation	-1.622***	
	(0.175)	
First-generation	0.439*	
	(0.201)	
Cross-Level Interaction		
Second-generation		0.489***
		(0.038)
First-generation		0.838***
		(0.045)
Constant	502.892***	505.551***
	(3.942)	(3.937)
N	264,867	264,867

**p<.05 **p<.01 *** p<.001*

Note: 264,867 students, nested within 10,113 educational institutions, nested within 41 countries/economies.

Note: Model 8 and Model 9 also account for student gender, language spoken in the home, school administration, class size, per capita GDP, and GINI coefficient.

FIGURES

Figure 1. Predicted Mathematics Achievement based on Immigrant Status and SES Deciles Interaction

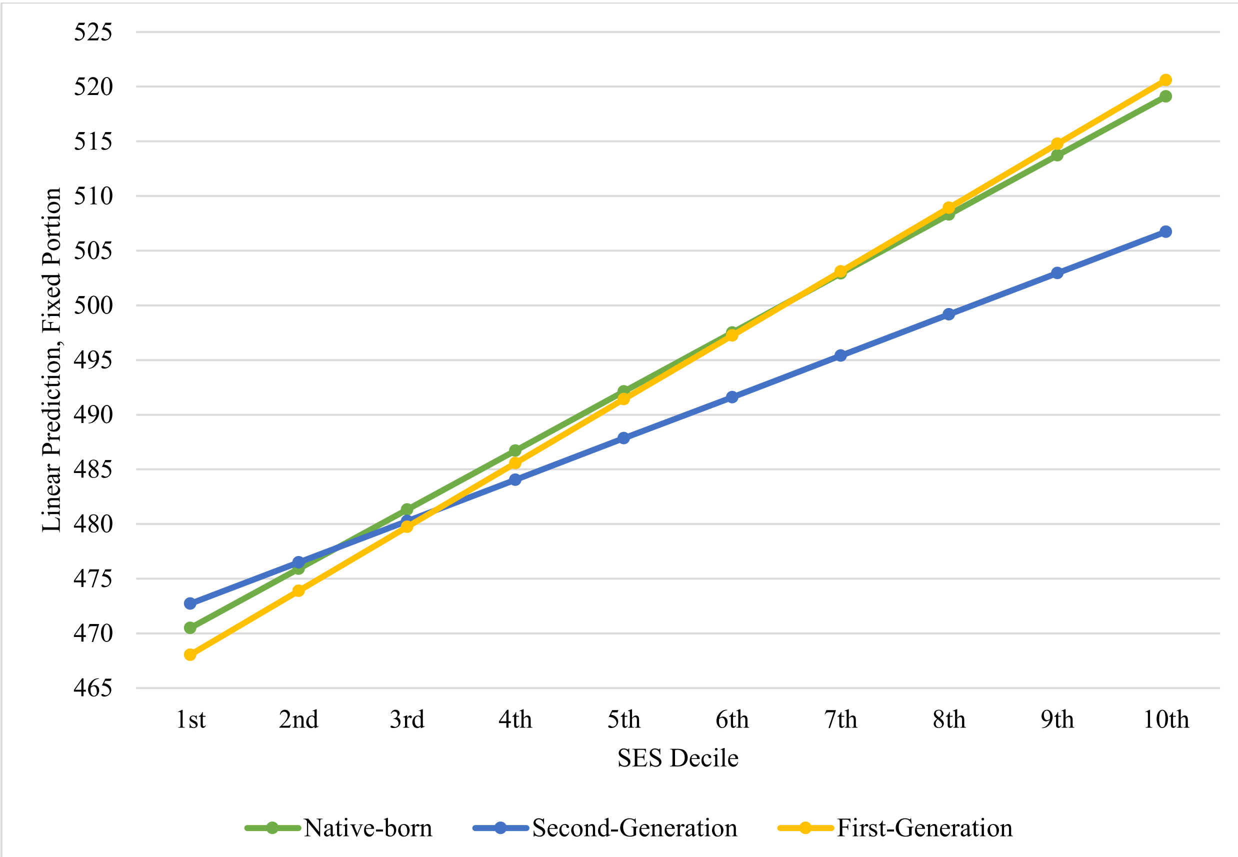
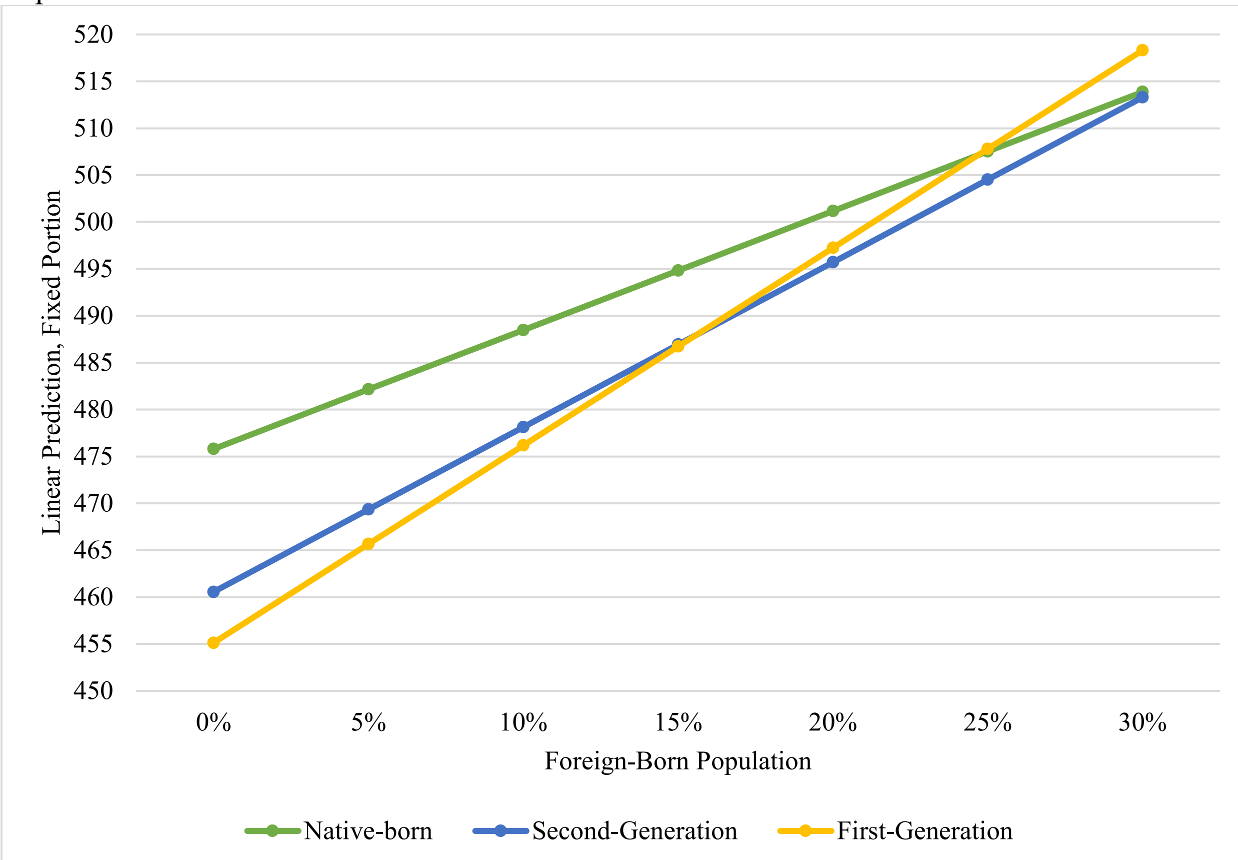


Figure 2. Predicted Mathematics Achievement based on Immigrant Status and Foreign-Born Population Interaction



APPENDIX

Appendix A. Standard Errors and Ns

	Overall N	Overall SE	Native-born N	Native-born SE	Second Gen. N	Second Gen. SE	First Gen. N	First Gen. SE
Australia	13594	1.598	10861	1.491	1333	4.218	1400	4.253
Austria	6882	2.817	5580	2.758	836	4.729	466	7.098
Belgium	9146	2.303	7655	2.04	748	5.543	743	6.3
Canada	18889	2.350	14750	2.737	2007	3.854	2132	3.722
Chile	6839	2.549	6704	2.571	35	24.628	100	10.734
Croatia	5614	2.780	5009	2.766	505	5.191	100	10.783
Czech Republic	6737	2.273	6515	2.233	114	14.953	108	15.667
Denmark	6889	2.196	5249	2.357	1279	4.367	361	7.376
Estonia	5444	2.063	4886	2.199	521	4.157	37	17.593
Finland	5774	2.276	5549	2.22	103	11.169	122	12.335
France	5882	1.969	5143	2.141	495	8.257	244	8.865
Germany	5580	2.941	4655	2.922	722	5.673	203	10.109
Greece	5405	3.648	4878	3.851	357	7.534	170	8.768
Hong Kong	5134	2.880	3344	3.309	1090	5.39	700	7.098
Hungary	5538	2.582	5391	2.551	90	11.862	57	21.169
Iceland	3242	2.061	3108	2.086	39	15.816	95	10.078
Ireland	5469	1.988	4717	2.158	176	7.534	576	4.309
Israel	6307	3.634	5248	3.627	800	6.446	259	14.433
Italy	11189	2.891	10296	2.94	371	8.023	522	7.309
Japan	6513	2.928	6481	2.89	20	28.037	12	50.444
Korea	5529	3.723	5525	3.726	N/A	N/A	4	54.493
Latvia	4758	1.831	4516	1.833	200	7.152	42	16.99
Lithuania	6207	2.291	5986	2.322	185	9.329	36	18.461
Luxembourg	5079	1.331	2458	1.856	1551	2.765	1070	3.093
Macao	4412	1.078	1663	2.569	1916	2.221	833	3.373
Malta	3420	1.838	3249	1.837	51	16.741	120	11.196
Netherlands	5181	2.197	4630	2.316	441	8.05	110	10.092
New Zealand	4174	2.312	3078	2.554	436	5.764	660	4.531
Norway	5229	2.200	4586	2.325	329	5.892	314	6.677
Poland	4401	2.381	4390	2.379	4	67.45	7	30.359
Portugal	6209	2.606	5834	2.707	170	9.474	205	7.078
Singapore	5996	1.423	4820	1.552	375	5.349	801	5.963
Slovak Republic	6142	2.497	6074	2.509	35	21.923	33	23.404
Slovenia	6265	1.320	5754	1.319	289	6.967	222	8.897
Spain	6544	2.144	5866	2.126	125	8.699	553	4.479
Sweden	5221	3.038	4355	2.769	493	8.22	373	8.817
Switzerland	5671	2.833	3932	2.836	1141	4.615	598	6.526
Trinidad & Tobago	4111	1.512	3980	1.622	71	13.334	60	17.623
United Kingdom	13068	2.459	11430	2.453	598	6.914	1040	8.801
United States	5445	3.113	4185	3.211	882	5.946	378	6.589
Uruguay	5738	2.580	5703	2.578	16	33.574	19	33.049