The Impact of Immigrant Classmates on Educational Outcomes in Egalitarian Norway[*]

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Abstract

Despite a growing empirical literature on the relationship between immigrant concentration in schools and student achievement, few studies address longer-run outcomes. Using Norwegian registry data, this study addresses the causal impact of immigrant classmates on educational attainment in young adulthood, as well as academic track enrollment and educational achievement in school, within six entire student cohorts in their final 10^{th} grade of compulsory education (310,742 students, 751 schools). Controlling for school fixed effects, native peer characteristics and observed characteristics of students and their families, we find that students in cohorts with more immigrant peers within the same school have slightly higher propensities to complete upper secondary education by their early twenties. These effects are substantively stronger among students from immigrant families compared to students with native-born parents and they are also robust to adjustment for average grade achievement. We find similar effects on enrollment in academic upper-secondary tracks, but not for educational achievement at the end of compulsory education. Overall, our results suggest a modest positive influence of exposure to immigrant classmates on minority students' educational attainment several years later. We speculate that these effects operate through behavioral changes related to school motivation and educational decision making.

Key words: peer effects, immigration, education

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Introduction

The implications of large-scale immigrant inflows over the past few decades are of growing public interest in Europe and North America. In this respect, schools are key institutions in promoting social mobility and fostering human capital development among children of immigrants (e.g. Alba, Sloan and Sperling 2011), as well as within the native population. Ethnic segregation in schools is, however, perceived as a potential cause of concern, as immigrants and their families tend to settle in large metropolitan areas, where they often cluster in residential areas marked by relative social deprivation and spatial segregation (Charles 2003; Musterd 2005). Policy makers, school administrators, and parents alike, therefore often worry that high concentrations of low-income immigrant students with language problems may harm the educational opportunities of children attending these schools. Nevertheless, the presence of immigrant students with a strong work ethic and high educational ambitions might also have a positive influence on the learning climate of their fellow students. Understanding whether—and how—immigrant student concentration in schools affects student outcomes is important in order to alleviate educational disparities and implement social policy.

This study addresses the causal relationship between immigrant concentration in schools and educational outcomes of students from native and immigrant families in Norway. We follow six entire cohorts of students from their final 10^{th} grade of compulsory education and the panel structure of our data enables us to observe multiple student cohorts within the same schools (310,742 students, 751 schools). Our study makes several contributions to the existing literature. First, we investigate the impact of immigrant peer environment in schools at the end of compulsory education on students' completed schooling in young adulthood, an outcome with a direct bearing on later life chances. Relative to most previous studies, we

have a longer follow-up of students which enables us to evaluate whether impact of immigrant classmates is sustained over time relative to a narrower focus on short-term effects of immigrant peers on educational achievement in school (e.g. Conger, Schwartz and Stiefel 2011; Jensen and Rasmussen 2011; Ohinata and van Ours 2013; Schwartz and Stiefel 2011; Szulkin and Jonsson 2007). However, we also examine the impact of immigrant peers on educational achievement in school and whether students enroll in academic tracks at the start of upper-secondary education.

Second, to identify the causal effect of immigrant classmates on educational outcomes, we exploit variation in peer composition across adjacent cohorts within the same school. This strategy handles concern for bias from endogenous student sorting under the key assumption that students and their parents sort into schools according to the average school characteristics, but not particularities of the student's cohort (Hoxby 2000). This approach also allows us to control for all time-invariant characteristics at the school level.

Third, we believe that studying effects of ethnic school segregation in Norway is particularly interesting. The mechanisms of immigrant peer dynamics—such as potential problems related to language proficiency and teacher instruction in segregated schools serving many immigrants, but also positive transmission of aspirations and academic motivation between peers—are likely to be of a general character. However, strong welfare state institutions and the egalitarian character of Norwegian society might offset potentially adverse effects of high immigrant concentrations in schools. In particular, a low level of between-school socioeconomic stratification, targeted resource transfers to schools serving disadvantaged student bodies, and a lack of formal ability tracking during compulsory education are features likely to mitigate any negative impact of immigrant peers. Thus, the

Norwegian case is likely to provide a conservative test of the impact of ethnic school segregation on educational outcomes.

Immigrant classmates and educational outcomes

In this section, we present theoretical arguments linking immigrant peer composition in schools to students' educational outcomes. We discuss several causal and non-causal explanations through which a systematic relationship might arise from processes operating both within and between schools.

Within schools, immigrant students might affect their fellow classmates through peer-to-peer interactions and through changes in teacher behavior. Although the Coleman et al. (1966) report convinced many that school-based influences are relatively small, recent studies show that peer characteristics—such as academic performance, socio-economic position, gender and racial minority status—may affect the school performance of students (e.g. Bifulco; Fletcher and Ross 2011; Black, Devereux and Salvanes 2013; Crosnoe 2009; Hanushek et al. 2003; Hanushek, Kain and Rivkin 2009; Hoxby 2000). The educational behavior of students may be directly shaped by the behavior of their peers, such as how much time and effort peers spend on school work, how exited they are about learning, and what educational aspirations they have. Moreover, classmate effects may operate through changes in teacher behavior. A presence of low-achieving and disruptive students with special needs, such as language difficulties or emotional problems, will demand extra attention from teachers, and may lower the quality of classroom instruction (e.g. Fletcher 2010, Lazear 2001). Teachers in schools with many disadvantaged students may also lower their expectations about the academic potential of the whole student body (e.g. Rosenthal and Jacobson 1968). Higher-achieving and academically motivated peers might, alternatively, improve the learning climate by demanding better instruction and asking more advanced

questions to teachers. However, high-achieving peers might also discourage low-performing students, if they face fiercer competition for good grades and experience lowered self-esteem (e.g. Crosnoe 2009).

The direction of any direct influence of immigrant peers is, therefore, likely to depend on both the behavior and achievement of the immigrant students in school. Empirical studies shows that children of immigrant background usually face educational disadvantage, although a large part of these gaps often are attributable to parental characteristics such as formal education and labor market position (e.g. Heath, Rothon and Kilpi 2008; Kao and Thompson 2003; for Norwegian studies see Birkelund and Mastekaasa 2009; Bratsberg, Raaum and Røed 2011). In this perspective, low-income immigrant students with poor educational achievement and limited proficiency in the language of instruction might exhibit a negative influence on the educational outcomes of their classmates. There is, however, a great deal of heterogeneity in the schooling outcomes of immigrant children, even after accounting for parental resources (e.g. Levels, Dronkers and Kraaykamp 2008). Moreover, several studies find that immigrant youth often exhibit a strong motivation for school work, have high educational ambitions and make bolder educational choices when compared to natives (e.g. Jonsson and Rudolphi 2011; Kao and Tienda 1998, for Norway, see Lauglo 1999). In this perspective, immigrant students with a strong belief in schooling as the main avenue for social mobility may transmit social norms producing positive spillover effects on the school motivation and educational choices of their peers.

Overall, different peer effect mechanisms could be at play simultaneously, nulling each other out. For example, positive effects of hard-working and highly ambitious immigrant peers might be counteracted by poor academic achievement related to language problems and socioeconomic disadvantage.

Between schools, resource allocation and teacher recruitment might be affected by the immigrant student composition of schools. For example, schools serving ethnic minority student populations might experience difficulties in recruiting and retaining skilled teachers (e.g. Clotfelter, Ladd and Vigdor 2005; Hanushek, Kain and Rivkin 2004; for Norwegian evidence, see Bonesrønning, Falch and Strøm 2005). Schools in areas dominated by immigrants could also be disadvantaged with respect to other school inputs, such as financial resources and class size (e.g. Ellen et al. 2002). However, school administrators may also attempt to offset negative trends by allocating extra resources to schools with many immigrant students, by, for example, offering special language classes and acculturation programs for immigrant students.

The influence of immigrant peers might also vary between students from immigrant and native families. In schools with high immigrant densities, there may be less interaction between immigrant and native students and more pronounced ethnic closure in interpersonal networks (Moody 2001). Lack of contact with native peers might have negative effects on immigrant students' language acquisition, acculturation of social norms and behavior, and, ultimately, their school performance. However, children from underprivileged backgrounds may feel less at disadvantage in the company of similar peers (Steele 1997). By this reasoning, immigrant students could have higher academic gains in school environments where there are larger numbers of similar immigrant classmates (e.g. Portes and Hao 2004).

Teacher instruction and resource allocation might also vary between different student groups within immigrant-dense schools. For example, an increase in the number of immigrant students might improve the tutoring of these students, as well as trigger targeted resource allocation, thus positively affecting their outcomes. Increasing immigrant shares might,

however, harm native students' outcomes by diverting teacher attention and other scarce resources away from them (e.g. Hunt 2012).

Finally, any relationship between student composition in schools and educational outcomes could also reflect (non-causal) sorting of students and their families across schools (e.g. Duncan and Raudenbush 1999; Hauser 1970). Allocation of students to schools is largely governed by decisions made by parents, given their economic constraints. In settings where school attendance is based on residential location, selection of students into local catchment areas is likely to reflect the desirability of these neighborhoods, parental economic resources, and other unobserved family traits, such as parent's demand for high quality schools and educational ambitions on behalf of their children. For example, native families might transfer to private schools or move out of school catchment areas experiencing inflows of disadvantaged immigrant families (e.g. Cascio and Lewis 2012; Rangvid 2010). As a result, schools with high immigrant densities may therefore serve families with a combination of disadvantaged socioeconomic position and other unobserved characteristics. Failure to account for this non-random student sorting is therefore likely to misrepresent the impact immigrant peers have on their fellow students.

To summarize, immigrant peer concentration may have a direct negative impact on educational outcomes if low-performing immigrant student disrupt the classroom learning environment. Alternatively, immigrant students with high educational aspirations and a strong work ethic could have a positive influence on their fellow classmates. Moreover, allocation of resources between schools, as well as recruitment of skilled teachers could vary systematically across schools with different immigrant student compositions. However, estimating the effect of peers is difficult because inequality in educational outcomes across schools could reflect student selection. To tease apart these alternative hypotheses, we

compare changes over time in student outcomes across cohorts within the same school to differences across schools with varying immigrant concentration. If the estimates represent the effects of immigrant classmates operating through peer-to-peer interactions or mechanisms affecting the quality of teacher instruction, one would expect the effects to persist when comparing across adjacent cohorts with different immigrant shares within the same school. However, if within-school immigrant peer variation do not affect student outcomes this indicates that any relationship reflects student sorting and stable characteristics of the schools and their teachers.

Previous studies on immigrant peer effects

Comparative research indicates that the magnitude of immigrant peer effects is sensitive to characteristics of the educational system. A smaller impact of ethnic school segregation has been found in countries with comprehensive school systems and no early ability-tracking (Brunello and Rocco 2013; Entorf and Lauk 2008). However, most studies fail to handle problems related to nonrandom student sorting across schools, and are thus unable to evaluate the causal nature of these relationships.

Evidence from country-specific studies that address nonrandom student sorting is, however, mixed and most studies focus on contemporaneous effects on educational achievement. Cortes (2006) found no effect of attending immigrant-dense schools in two U.S. cities on reading and math test performance of immigrant students after adjusting for sorting using propensity score matching. Cebolla-Boado (2007) found that the concentration of immigrants in Spanish schools had no significant impact on grade retention and track selection in upper secondary, after taking selection into account by instrumenting for immigrant concentration at a more aggregated geographic area. Using a similar approach, Jensen and Rasmussen (2011) conclude that a higher concentration of immigrants in Danish

schools has a negative impact on the reading scores of immigrant and native students, although adjusting for sorting yields a more modest effect on native Danes and no effect on immigrants.

Several studies identify the impact of immigrant peers from within-school peer variation. In the United States, Schwartz and Stiefel (2011) find higher achievement on math and reading tests among students in New York City schools with higher densities of foreign-born students, however, within schools they find that students attending cohorts with more immigrant peers have slightly lower achievement. Conger (2012) uses administrative panel data on public high schools in Florida and finds that students in cohorts with more immigrant peers have equal or slightly better academic achievement relative to fellow students in cohorts with fewer immigrants within the same school. In a comparative study of within-school effects of immigrant peers on native students' performance on standardized tests, Seah (2014) finds a positive influence of immigrant peers in Australia and no impact in the United States, but a negative impact on the achievement of native students in Canada. In Europe, Szulkin and Jonsson (2007) find that immigrant and native students in cohorts exposed to higher shares of immigrant peers have lower average grade achievement at the end of Swedish compulsory education. In the Netherlands, however, Ohinata and van Ours (2013) do not find evidence of a negative spillover effect of the presence of immigrants on the academic performance of native students. Likewise, Geay, McNally and Telhaj (2013) find no indication of a negative causal impact of a higher the presence of non-native speaking peers on student performance in England. In Israel, Gould, Lavy, and Paserman (2009), however, document negative long-term effects of high immigrant concentrations in elementary school cohorts on native students' educational outcomes. For native students, they found that a ten percentage-point increase in the immigrant share lowers the probability of passing their high school matriculation exams by about 1.8 percentage points, but no

significant effect on the drop-out rate. The impact on immigrant students was, however, less clear.

In Norway, prior studies have reached contradictory conclusions regarding the influence of immigrant student composition in upper secondary schools on educational outcomes. Without taking unobserved school characteristics and student sorting into account, Fekjær and Birkelund (2007) found a weak positive relationship between attending schools with many immigrant students and educational achievement. In contrast, Hardoy and Schøne (2013), using a within-school strategy, found that a ten percentage-point increase in the share of immigrant peers lowers native students' probability of completing upper secondary education by about 2 percentage points.

In this study, our main focus is on the impact of immigrant peer exposure in the final grade of compulsory schooling on students' completion of upper secondary education in young adulthood outcomes. Like Gould, Lavy and Paserman (2009), we have a longer follow-up than most studies in the current literature and completed schooling has a direct bearing on students' later life chances. The peer environment during Norwegian compulsory education is observed before early school leaving can occur, in a context without any formal ability tracking and where school attendance is based on residential location. These features are likely to make the peer environment less stratified by student achievement than what is found in upper-secondary schools, where school admission is based on student choice and prior grades.

The Norwegian setting

Norway offers an interesting case due to combination of a strong welfare state and the experience of large-scale inflows of immigrants from less-developed countries over the past few decades. In 2014, immigrants and their native-born children constituted approximately

14.9 percent of the Norwegian population as opposed to 1.5 percent in 1970 (Statistics Norway 2014). The relative size of the Norwegian immigrant population is comparable to countries such as the Netherlands, Germany, France, United Kingdom, and the United States (OECD 2013). The new era of immigration started with the arrival of labor migrants from Pakistan, Turkey, India and Morocco around 1970. After 1975, however, a moratorium on unskilled labor migration outside of the Nordic region was introduced, but allowed for family reunification for individuals already in Norway. Since the late 1970s, the number of refugees and asylum seekers from countries such as Vietnam, Chile, Iran, Iraq, Somalia and Former Yugoslavia grew (Brochmann and Kjeldstadli 2008). Recent immigration has introduced a new dimension of ethnic stratification into Norwegian society, where children of immigrants grow up in families with weaker labor market attachment and higher risks of poverty and social welfare dependency (Birkelund and Mastekaasa 2009; Bratsberg, Raaum and Røed 2010; Bratsberg, Raaum and Røed 2011). The degree of ethnic residential segregation is moderate and comparable to levels found in other Western European countries (Musterd 2005). In this sense, Norway is representative of European countries who have experienced a sharp rise in their immigrant populations.

However, Norwegian society is also marked by modest levels of economic inequality, low prevalence of child poverty, and high levels of social mobility (OECD 2008; UNICEF 2007). High-quality basic services are universally offered to all residents, and immigrants therefore have full coverage in health care services and other social security benefits. Local municipalities provide high quality and highly subsidized child care services to children from age one and until school start. Overall, these institutional features are likely to reduce inequality in the standards of living between children in native and immigrant families.

The Norwegian comprehensive education system is mandatory and publicly funded. Since 1997, Norwegian compulsory education has consisted of 10 years of schooling from age six. However, for the cohorts we consider, students started at age seven and compulsory education was split into primary schools (grades 1—6) and lower secondary schools (grades 7—9). Nevertheless, they officially graduated from the 10th grade, due to these changes in the grade structure. Comprehensive schools are run by local municipalities and there is no formal tracking by ability during these years. School attendance is based on place of residence and the rules specifying that students attend the school in their local catchment area are strictly enforced. Upon finishing compulsory education (usually at age 16), the majority of students continue into upper secondary education, which consists of academic and vocational tracks.

Of particular relevance to us is the fact comprehensive schools receive targeted resource transfers according to need, which implies that schools with high shares of students from disadvantaged family backgrounds have higher student-teacher ratios compared to other schools (Hægeland, Raaum and Salvanes 2005) and schools serving many children from immigrant families have more teaching assistants for special needs students (Hægeland, Kirkebøen and Raaum 2009). Norwegian comprehensive schools are also characterized by modest between-school variation in test scores and socioeconomic stratification (OECD 2006). Moreover, gaps in educational attainment between children of immigrants and natives has narrowed substantially since the early 1990s, which might reflect policy initiatives aimed at improving the educational outcomes of immigrant students (cf. Bratsberg, Raaum and Røed 2011:243-246).

Data and variables

Data

We use matched panel data on students and schools from high-quality Norwegian administrative population registries. A system of personal identifiers enables linkage between various administrative registries, as well as matching children to their parents and students to their school of graduation. The dataset include information six entire student cohorts (2001-2006) in the final grade of Norwegian compulsory education (about 345,000 individuals).

Private and small schools are likely to be of a special kind or serve students with special needs. We therefore exclude students graduating from private schools and small schools, defined as schools where less than 120 graduating students summing over all six cohorts, or single cohorts with less than 20 graduating students. We also exclude a very small number of students who graduate from compulsory education within one year before or after the norm of graduating at age 16. **[Endnote 1]** With these restrictions, our final sample consists of 310,742 students graduating from 751 lower secondary schools. The students are different across cohorts, but the schools are the same.

Variables

Table 1 shows descriptive statistics on educational outcomes and background characteristics of the students, as well as the student composition of the schools they attend.

[Table 1 here]

Educational outcomes. Our main outcome variable is educational attainment in young adulthood, measured as whether the student had completed upper secondary education at age 21. The statutory duration of upper secondary education in Norway is three or four years, depending on academic or vocational tracks, respectively, and students usually graduate from upper secondary at ages 19 or 20 years. Upper secondary education is a prerequisite for continuation into postsecondary education. Furthermore, the upper secondary

diploma has been documented to have high labor market returns among individuals with both immigrant and native background (e.g. Hermansen 2013).

We also examine the effect of immigrant peers on academic track enrollment in upper secondary and educational achievement. A binary indicator of whether the student was enrolled in an academic track in upper secondary school in the academic year following graduation from compulsory education (relative to enrollment in a vocational track or early school leaving). Educational achievement is measured using information on students' grade point average (GPA) and grades on exams in mathematics at the end of compulsory education. GPA measures the weighted sum of the student's teacher-assigned grades in eleven subjects and selected exam grades, and varies between 11 and 66. GPA is the main admission criteria to upper secondary schools and is, thus, consequential for later educational opportunities. From 2002, grade information from standardized exams in mathematics is also available. These exams are issued to a randomized subset of students within each cohort and are externally graded on a range from 1 to 6 by blinded teachers from another school. Both educational achievement outcomes are used in z-standardized form (mean = 0, std. dev. = 1).

Peer characteristics. We measure peers as the school-level student composition of the focal student's graduating cohort. Insofar that there is persistence in the peer environment, we capture the cumulative impact of peer exposure throughout the educational experience in lower secondary schools. We measure immigrant peer exposure as the school-level proportion of immigrant students (i.e. two foreign-born parents), either born in Norway or born abroad. The advantage of such a simple measure of school segregation is that it is both easy to compute and understand, while also informative for social policy. There is much heterogeneity with respect to geographical origin within the immigrant sample, however, the

majority of immigrant students originate from less-developed countries and recent conflict areas (see Table A1).

We also include indicators of the socio-economic composition of native students within each school cohort, using information on the native students' parents' average years of education and their average (log) earnings. We also include a variable measuring the log number of students within each graduating cohort.

Student characteristics. Our dataset includes information on a number of relevant student and parental characteristics. Immigrant background is measured by two binary variables. First-generation immigrants refer to students with two foreign-born parents who were born abroad. Second-generation immigrants refer to students with two foreign-born parents who were born in Norway.

Parental education is measured using information on the parent with the highest educational qualification using the Norwegian version of the International Standard Classification of Education, ISCED-97; see Statistics Norway (2001). We distinguish between five levels of educational qualifications. We also include a separate category for no registered parental education, since immigrant students are overrepresented in this small category.

We measure parents' economic resources using several indicators. We measure parents' annual earnings using information taken from employers' mandatory reports to the Norwegian Social Insurance Scheme. This information includes wage and salary income, self-employment earnings, unemployment benefits, and sickness benefits. We construct a composite measure of parents' earnings by averaging each parent's annual earnings over the years the child was aged 11 to 15 years. We then summarize the mother's and the father's average earnings in this period and finally take the natural logarithm of this sum. **[Endnote 2]**

To measure parents' labor market attachment, we use the basic amount thresholds of the Norwegian Social Insurance Scheme (used to define labor market status, determining eligibility for unemployment benefits as well as disability and old age pension). In 2006, one basic amount (b. a.) was about 10,000 USD. We also include employment indicators of whether the mother and the father had average annual earnings above one b.a. in this period. Furthermore, parents' social welfare indicates whether the parents in sum received means-tested social welfare transfers above the monthly b.a. rate (about 820 USD in 2006) during the student's final year of compulsory education. The indicator of parents' unemployment indicates whether at least one parent received unemployment benefits above the same threshold in the same year.

Family structure is measured by an indicator of whether the student lived in an intact or reconstituted family, that is, in a household with two adults that were either married or had common children, at graduation. We also measure student sex, whether the student was the first born child of his or her mother, sibship size, and the mother's age at the student's birth. We also include an indicator of whether the student had experienced one or more residential relocations during the years of compulsory education using information on residential neighborhood location in this period.

Analytical strategy

The aim of our analyses is to identify the causal effect of immigrant peer concentration on educational outcomes. A key difficulty in estimating peer effects is the problem of endogenous school choice and nonrandom student sorting, implying that unobserved characteristics of students and their families influence both their educational outcomes and which schools they attend. Furthermore, student and peer achievement are simultaneously determined. Since the average educational outcomes in a school is just an aggregation of

individual student outcomes, individual student outcomes will, on average, by necessity be higher in a year when the school average is higher (cf. Manski's 1993 "reflection problem"). Schools serving different student populations may also differ on unobserved characteristics, such as teacher quality and other didactic resources.

Because of these challenges, studies that regress student outcomes on a set of peer characteristics assuming random assignment of students to schools after conditioning on observed covariates are likely to obtain biased estimates of the impact of peers on educational outcomes (Sørensen and Morgan 2006). While our data permit us to control for a wide range of relevant and well-measured peer and student background variables, their primary strength is the panel structure which identify multiple student cohorts within the same schools. This enables us to reduce bias from unobserved variables at both the level of students and their schools. Using school fixed-effects models to analyze the effect of variation in student composition across adjacent cohorts within the same school, we aim to break any remaining correlation between immigrant peer concentration and unobserved characteristics of students and their schools. This quasi-experimental approach relies on the identifying assumption that students and their families do not select which schools to attend based on peculiarities of their child's cohort, but rather on the average student composition of the school (cf. Hoxby 2000). We specify these models as

$$\begin{aligned} Y_{isc} = \alpha_s + \gamma\ immigrant_i + \theta\ immigrant\ composition_{sc} \\ + \delta\ (immigrant\ composition_{sc} \times immigrant_i) \\ + \beta_1 \boldsymbol{Z}_{sc} + \beta_2 \boldsymbol{X}_i + \delta_c + \varepsilon_{isc} \end{aligned} \quad (1)$$

where *i*, *s*, and *c* are indices for students, schools, and cohorts, respectively. Y_{isc} is the relevant educational outcome; α_s is the school fixed effects; $\boldsymbol{Z}_{sc}$ is the control variables for number of students and native peer characteristics within each school-level cohort; $\boldsymbol{X}_i$ is the set of

control variables on student background characteristics; δ_c is the graduation cohort fixed effects; and ε_{isc} is a student-specific error term.

These school fixed-effects models examine whether cohort-to-cohort variation in student outcomes is systematically related to cohort-to-cohort variation in immigrant student composition, controlling for all unobserved school characteristics and non-random selection of students in to schools. Coefficients of interest are θ, which captures the causal effect of immigrant student composition, and δ, which captures the difference in this effect between native students and immigrant students born in Norway or abroad, respectively. Note that these coefficients are obtained solely by relying on variation in immigrant student composition across graduating cohorts within the same schools.

It should, however, be noted that some of the mechanisms through which immigrant student composition might influence educational outcomes are constant across cohorts. For example, the immigrant density within a school might be related to resource allocation and teacher recruitment, but may not vary across cohorts within the school. Similarly, teachers' motivation and evaluation of students could be influenced by the characteristics of preceding cohorts and not only the current cohorts. By relying on within-school variation in cohort composition, any effect of immigrant student composition of the school as a whole will be absorbed by the school fixed effects and missed in the estimates on student outcomes. The within-school estimates therefore tell us whether any relationship between immigrant composition and student outcomes arise from mechanisms related to dynamic changes in immigrant peer exposure across adjacent graduating cohorts within the same school.

Results

Characteristics of native and immigrant students and their peer environments

Table 1 shows that students with immigrant background have lower rates of upper secondary completion and poorer educational achievement relative to native students, but higher enrollment rates in academic tracks in upper secondary education. Moreover, immigrant students are highly overrepresented in families marked by socioeconomic disadvantage compared to natives, with less parental human capital and higher exposure to economic hardship.

Figure 1 shows how native and immigrant students are distributed across schools with varying proportions of immigrants. Not surprisingly, immigrant students on average attend schools with higher immigrant concentrations (see also Table 1). While about 6 percent of all students attend schools with more than 20 percent immigrant students, this amount to 4 percent of the native students while approximately 35 percent of the immigrant students are found in these schools. Index of Dissimilarity (D) estimates indicate that 43 percent of the immigrant background students would have to move in order to balance the distribution of students across schools. The highest proportion of immigrant students within a school is 86 percent, while only 41 of the 751 schools in our sample have no presence of immigrant students.

[Figure 1]

In Figure 2, we plot the relationship between the rate of upper secondary completion and the proportion of immigrant students at the school-cohort level. Panel A clearly shows that fewer students complete upper secondary education in schools with higher proportions of immigrant students ($r = –0.197$, $p < 0.001$). Panel B, however, relates differences in the immigrant share to variation in upper secondary completion rates across adjacent cohorts within the same schools in order to take into account stable characteristics of the schools and their students. The negative relationship still remains, although highly attenuated ($r = –0.052$,

$p < 0.001$). To further explore this relationship, we now turn to multivariate analyses of the individual-level data while controlling for student and peer covariates.

[Figure 2]

The impact of immigrant classmates on upper secondary completion

Table 3 presents results from linear probability models (OLS regression) predicting the likelihood of upper secondary completion. Model 1 shows the linear effect of immigrant student composition while only controlling for graduation cohort fixed effects. **[Endnote 3]** Model 2 adjusts for observed student and additional peer characteristics. In Model 3, we introduce the school fixed effects. Model 4 adds interaction terms between the proportion of immigrant students and individual-level immigrant background (i.e. first and second generation). This is the model of central theoretical interest, since it tests for the presence of variation in long-term immigrant peer effects between native and immigrant students while strongly reducing the risk for bias caused by unobserved heterogeneity of schools and their student composition, as well also controlling for observed socioeconomic characteristics of the students and their families. Finally, in Model 5 we introduce controls for students' grade point average at the end of compulsory education to test whether there is an effect of immigrant peers net of educational achievement.

[Table 2]

In Model 1, the coefficient of the proportion immigrant students indicates that a one percentage-point increase in immigrant share is related to a 0.122 percentage point ($p < 0.001$) reduction in students' likelihood of completing upper secondary education. First-generation and second-generation immigrants have a lower probability of upper secondary completion relative to natives, and this gap is much larger among immigrant students born

abroad. Model 2 adjusts for observed peer and student characteristics, most importantly parental socioeconomic resources. After these controls, the negative relationship between immigrant student composition and upper secondary completion is greatly reduced and only a modest relationship remains. Moreover, the estimated gaps between the native and immigrant students are actually reversed after extensive control for family background characteristics. The estimated coefficients for the peer and student characteristics also operate in ways consistent with theory and previous research.

To address the problem of potential bias from student sorting and unobserved school factors, Model 3 introduces the school fixed effects to identify impact of immigrant classmates from within-school variation in student composition. **[Endnote 4]** Importantly, the inclusion of school fixed effects eliminates the relationship between immigrant student composition and upper secondary education completely. In fact, the coefficient is reversed to a positive and significant impact of immigrant classmates. On average, a one percentage-point increase in the share of immigrant students within schools is related to a 0.090 percentage point higher probability of completing upper secondary education. This suggests that students in cohorts with more immigrant peers have a slightly higher probability of completing upper secondary education relative to students in cohorts with less immigrant peers within the same school, net of observed student characteristics. Furthermore, the estimated coefficients for characteristics of the students and the native peers are generally not affected by the inclusion of school fixed effects. Comparison of Models 2 and 3 illustrates the importance of controlling for unobserved time-invariant differences between schools using fixed-effects models.

There is, however, reason to believe that the impact of immigrant peers could vary between native and immigrant students. In Model 4, we introduce interaction terms between

immigrant student composition and students' immigrant background. The estimated coefficients reveal heterogeneity in the impact of immigrant classmates, as these effects are significantly and substantively stronger among the immigrant students relative to their native counterparts. For native students, a one percentage-point increase in the share of immigrant peers is related to a 0.065 percentage point increase in the likelihood of completing upper secondary, while the corresponding effects are estimated to 0.131 and 0.210 percentage points for the first-generation and second-generation immigrants, respectively.

In Model 5, we control for students' grade point average at the end of compulsory education to test whether the positive influence of immigrant classmates operates through educational achievement. The estimated interaction term for first-generation immigrant students is slightly larger but the other coefficients of interest are relatively stable. This indicates that the immigrant peer effect operates through other mechanisms, for example educational decision making in the transition to upper secondary education. Moreover, the coefficients of the individual-level student covariates are attenuated after controls for student grade point average, especially the estimates for parents' education.

Overall, we find a positive influence of immigrant peer exposure on students' educational attainment. These results indicate that lower levels of completed schooling among students in schools with high immigrant densities is not attributable to negative peer effects, but rather sorting of students between schools and, to a lesser degree, variation in school quality. **[Endnote 5]**

The impact of immigrant classmates on academic track enrollment

Table 3 present the estimated impact of immigrant peers on students' probability of enrollment in academic upper-secondary tracks. We use the same model specifications as in Table 2, but the coefficients for the peer and student covariates are omitted from the table.

[Table 3]

Model 1 shows a positive relationship between the immigrant share and students' likelihood of enrolling in academic tracks. Moreover, we see that this propensity is stronger among immigrant students, especially those in the second generation, relative to native students. In Model 2, we see that this pattern persists after adjusting for socioeconomic characteristics of individual students and the native student composition. Moreover, the relatively higher propensity to enroll in academic tracks among the immigrant students increases substantially after these controls. Model 3 introduces the school fixed effects, which slightly reduces the impact of immigrant peers and renders the estimate non-significant. However, Model 4 shows that the effect of immigrant peers on native students' academic track enrollment is weak, while this effect is much stronger among the immigrant students. Finally, as for upper secondary completion, controls for students' grade point average do not substantively alter this pattern.

In sum, Table 3 indicates that there is a positive influence of increasing shares of immigrant peers on immigrant students' likelihood of enrolling in academic upper-secondary tracks, while there is a non-significant, but weak positive effect on the native students. The estimates from Model 4 indicates that a one percentage-point increase in the immigrant share is associated with 0.171 and 0.221 percentage point increases in the likelihood of enrollment in academic tracks among the first-generation and second-generation immigrant students, respectively.

The impact of immigrant classmates on educational achievement

In Table 4, we show the estimated impact of immigrant peers on students' teacher-assigned grade point averages (Panel A) and externally-graded exams in mathematics (Panel B). In Table 4, we also start by showing results from a model without controls for student and peer

covariates, next we add these and then we add the school fixed effects. Finally, we introduce the interaction terms between immigrant background and immigrant student composition. We omit the coefficients for the peer and student covariates.

[Table 4]

Overall, the estimated effect of immigrant peers on the educational achievement outcomes is less consistent. In Panel A, Model 1 shows a weak negative relationship between immigrant share and students' average grade achievement, as well as lower grades among the students with immigrant background. Controls for student and peer covariates in Model 2 eliminate the negative relationship between immigrant share and average grade achievement, as well as the individual-level native-immigrant gaps. In Model 3, inclusion of school fixed effects do not alter these coefficients substantively. Model 4, however, shows a negative and significant interaction term between proportion immigrant students and first-generation immigrant status. However, the estimated coefficient of -0.168 ($p < 0.05$) indicates a modest effect. In Panel B, Model 1 shows a stronger negative relationship between immigrant share and students' performance on exams in mathematics. Model 1 also reveals similar overall achievement gaps between native and immigrant students as those found for average grade points in Panel A. In Model 2, these native-immigrant gaps are closed after controls for student and peer covariates, but a reduced negative relationship between immigrant student share and exam grades remains. The inclusion of school fixed effects in Model 3 eliminates the overall negative relationship between immigrant share and student achievement. In Model 4, the coefficient for the main effect of immigrant peers reveals a weak positive, but non-significant association among the native students. However, the estimated coefficients for the interaction terms between proportion immigrant students and first-generation and second-

generation immigrant status indicates a modest negative relationship between immigrant share and student achievement for these students.

To summarize, we do not find the similar positive influence of immigrant classmates on immigrant students' educational achievement. If anything, there is a weak negative effect on some of the achievement outcomes, but the results are mixed and do not reveal a clear pattern. For native students, we find do not find any evidence of any negative effects of exposure to immigrant peers.

Sensitivity analysis of the impact of immigrant classmates on upper secondary completion

In this section, we return to the impact of immigrant classmates on upper secondary completion to investigate whether our results are sensitive to how we define immigrant student composition, as well as the restrictions we make to the analytic sample. Table 5 reports the results from this sensitivity analysis, and all models include controls for school fixed effects, cohort fixed effects and student and peer covariates. **[Endnote 6]**

[Table 5]

For comparison, Panel A reports the baseline estimates from our main specification (cf. Model 4 in Table 2). In Panel B, we report the estimated the impact of the proportion of foreign-born immigrant students on upper secondary completion, since this group have worse educational outcomes compared to the native-born students of immigrant background. Although the estimated coefficient does change slightly, we do not find any indication of negative effects. Next, we consider whether there is any heterogeneity in the effect of immigrant peers if we focus only on the school-cohort composition of immigrant students with background from less-developed countries or with low levels of parental human capital. In Panel C, we estimate the effect of immigrant peers from non-OECD countries, while Panel

D focus on immigrant peers whose parents has less than full upper secondary education. Results do not indicate that there is any substantial variation in peer effects across these immigrant student subsamples, although there is no positive effect of exposure to immigrant students with low-skilled parents on natives' upper secondary completion. Finally, Panel F presents estimates of immigrant peer effects for all students in all schools. This implies that this sample does not have any restrictions on students' age at graduation or whether they attended small or private schools. However, the inclusion of these students (and schools) does not substantively alter the estimated coefficients.

The results from the sensitivity analyses do not indicate any substantial variation in the effect of immigrant peers depending on how we measure immigrant student composition or which restrictions we make on the analytic sample. Our overall conclusions are supported by these results and indicate that the positive impact of immigrant classmates on immigrant students' outcomes is robust to focus on variation within specific subgroups of immigrant students.

Discussion and conclusions

Despite a growing empirical literature on the relationship between immigrant concentration in schools and student achievement, few studies address longer-run outcomes with a more direct bearing on students' later life outcomes. Using Norwegian registry data, this study have examined the causal impact of exposure to immigrant classmates at the end of compulsory education on students' completed schooling in young adulthood, as well as academic achievement and upper-secondary track enrollment. To identify the causal effect of immigrant classmates on educational outcomes, we exploit variation in immigrant student composition across adjacent cohorts within the same school, thus controlling for unobserved heterogeneity across schools and their student bodies.

The results show that students in cohorts with higher immigrant shares have a slightly higher likelihood of completing upper secondary education relative to students in cohorts with lower immigrant shares within the same school. This positive impact of immigrant classmates is substantially stronger among immigrant students than native students. We found similar immigrant peer effects on students' propensity to enroll in academic tracks in upper-secondary tracks. The impact of immigrant classmates on completed schooling and academic track enrollment is also robust to adjustment for average grade achievement. However, we did not find any clear relationship between immigrant student composition and educational achievement.

The magnitude of the peer effects on upper secondary completion are, however, relatively modest, although comparable to previous studies on immigrant peer effects. In our study, a ten percentage-point increase in the share of immigrant students is related to about a 0.6, 1.7 and 2.0 percentage point higher probability of completing upper secondary education for native, first-generation immigrant and second-generation immigrant students, respectively. Gould, Lavy and Paserman (2009), for example, found that a ten percentage-point increase in the immigrant share lowered students' likelihood of passing the high school matriculation exam with about 1.8 percentage points. In our case, a ten percentage-point increase in the share of immigrants is, however, a very large increase, given that the within-school standard deviation in immigrant student proportion is 2.4 percentage points for native students, while the corresponding figure is 4.9 and 4.0 for immigrant students born in Norway and abroad, respectively (cf. Table A2). For the immigrant students, this implies that the effect of a standard deviation increase in the immigrant share is equivalent to slightly less than a one percentage-point increase in the probability of completing upper secondary education. Compared to individuals and family characteristics, these effects are also small.

To summarize, our results indicate that the overall variation in educational outcomes across schools with different immigrant concentrations primarily reflects student sorting according to socioeconomic status, while immigrant student composition seems to be of lesser importance. To raise overall educational success and close gaps between schools, policies that provide support to children with disadvantaged backgrounds and especially improve immigrant parents' human capital and labor market situation may have more potential than policies narrowly aimed at reducing school segregation.

Nevertheless, the modest, but positive impact of exposure to immigrant peers on fellow students' completed schooling and academic track enrollment is interesting. Especially because exposure to school environments with more immigrant peers seems to be particularly beneficial for students from immigrant families. This effect does, however, not seem to operate through improved educational achievement, but could reflect behavioral changes related to educational decision making. The observation of stronger effects on the outcomes of immigrant students might imply that mechanisms related to the social transmission of high educational ambitions among highly-motivated immigrant classmates could explain these patterns. For example, being in a peer environment where fellow immigrant students see schooling as the primary route to upward social mobility could have positive spillover effects on their educational decisions, but these attitudes might have less resonance among their native peers of similar family backgrounds. Such an effect could also be further augmented if immigrant students feel less at disadvantage in the company of immigrant minority peers with similar experiences. Furthermore, the higher propensity to enroll in academic tracks among students in immigrant-dense cohorts might also imply that the sustained immigrant peer effect on upper secondary completion partly reflects the selection of these students into schools of better quality and improved peer environments at upper secondary level. In contrast, it is also possible that the estimated effects could reflect improved instruction of

immigrant students and targeted resource transfers when their numbers increase within schools. However, the absence of improved educational achievement in cohorts with many immigrants, might, however, indicate that improved tutoring of immigrant students is not the most likely explanation of these relationships.

Our study also makes an important contribution by highlighting the importance of taking unobserved student sorting and school factors into account when estimating the effect of immigrant peer concentration on student outcomes. If immigrant-dense schools are located in residential areas with low housing prices, they are likely to serve students from low-performing and disadvantaged families. Failure to account for the complexity of the processes allocating both native and immigrant students to different schools may thus lead researchers to conclude that immigrant students harm the educational outcomes of their fellow students, although the underlying causal mechanisms might be quite different. Given our findings, it is also important that future studies also assess heterogeneity in the effect of immigrant peer concentration across native and minority student populations, as well as variation in immigrant peer effects on different educational outcomes. Future research could also benefit from focusing attention on more fine-grained processes that unfold within schools and classrooms, as well as the timing and temporal aspects of students' exposure to immigrant-dense peer environments.

Our findings should be interpreted within the strengths and limitations of the study. This study is particularly propitious because it uses high-quality registry data with a long follow-up period and information on several educational outcomes as well as an extensive set of student background characteristics. Most importantly, the panel structure of our data enables us to use within-school variation to address the problem of nonrandom student sorting. However, the school fixed-effects framework only captures effects of immigrant

classmates that operate through mechanisms which vary across cohorts within schools. If the school-wide immigrant composition affects the ability to attract and retain skilled teachers over time, this impact will be absorbed by the school fixed effects and, thus, missed. We are also not able to rule out effects of immigrant peers that operate on a school-wide level, such as the long-term effects on learning climate or lowered teacher expectations among the remaining staff. Furthermore, our estimates of immigrant peer effects are primarily informative about counterfactual questions related to the impact of moderate changes in peer composition and not the consequences of moving students between schools with very dissimilar shares of immigrant peers.

To what degree are our results relevant for other countries experiencing large-scale immigration? The rapid growth of the Norwegian immigrant population, as well as moderate levels of school segregation among immigrant minorities, is comparable to the experience of other immigrant-receiving developed countries. Furthermore, the underlying causal mechanisms assumed to be related to immigrant school segregation—such as instruction problems related to language difficulties and low academic achievement among immigrant students, but also the transmission of social norms related to school work and the value of education—suggests that our findings are relevant to other settings. However, strong welfare state institutions and a low degree of socioeconomic stratification may offset any adverse effects of ethnic segregation. The findings from our study might therefore represent a lower bound on the potentially adverse impact that immigrant concentration in schools might have on children's educational opportunities.

Endnotes

1. These students are likely to be of a special kind, for example individuals with disabilities. However, results from the sensitivity analysis reported in Panel E of Table 5 shows that our results are robust to the inclusion of students from private and small schools, as well as removing the age at graduation restriction.

2. For first-generation immigrant students, we followed the same procedure with the exception of students arriving after age 11. For these students, we only average over the years after the student arrived in Norway.

3. We also tested for non-linear effects using polynomial terms but did not find any significant patterns.

4. Table A2 shows that the majority of variation in immigrant student composition is between schools and not within schools. The between-school variation incorporates families' residential choices and, thus, school selection, as well as a variety of other factors that are difficult to consider explicitly. Panel A presents overall (between- and within-school) variation in immigrant peer shares. Panel B presents within-school variation. The distribution shown in Panel B is calculated from the residuals of regressions of the proportion of immigrant students while controlling for school and cohort fixed effects. At the end of compulsory education, immigrant students are both exposed to higher proportions of immigrant peers and more peer variation across schools compared to natives. While the overall standard deviation in proportion immigrant student is 7.5, 18.4 and 21.5 percentage points among native, first-

generation immigrant and second-generation immigrant students, respectively. Within-school immigrant peer variation shrinks to a standard deviation of 2.4 for native students and 4.0 and 4.9 percentage points for first-generation and second-generation immigrant students, respectively. These deviations in within-school peer composition are the basis of our identification of the coefficients for the immigrant peer effects. Although they may seem small, there is enough within-school variation left to identify the effect of immigrant peers with sufficient precision to determine statistical significance at conventional levels.

5. Changes in the R^2 between the different models gives a good indication of which factors are most important for explaining the overall variation in completion of upper secondary education. While Model 1 explains only 0.7 percent of the overall variation in completion of upper secondary education, this increases to 13.2 percent after adjusting for observed student characteristics and SES composition of native peers in Model 2. However, inclusion of school fixed effects in Model 3 only increases the explained variation to 14.1 percent. This indicates that observed student background characteristics, as well as native peer characteristics, explain much more of the overall variation in educational outcomes compared to time-invariant school-level characteristics. Finally, 33.2 percent of the variation is explained in Model 5, after adjusting for GPA at the end of compulsory education.

6. We do not control for GPA in these models. Table A3 shows summary statistics on the alternative measures of immigrant student composition reported in Table 5.

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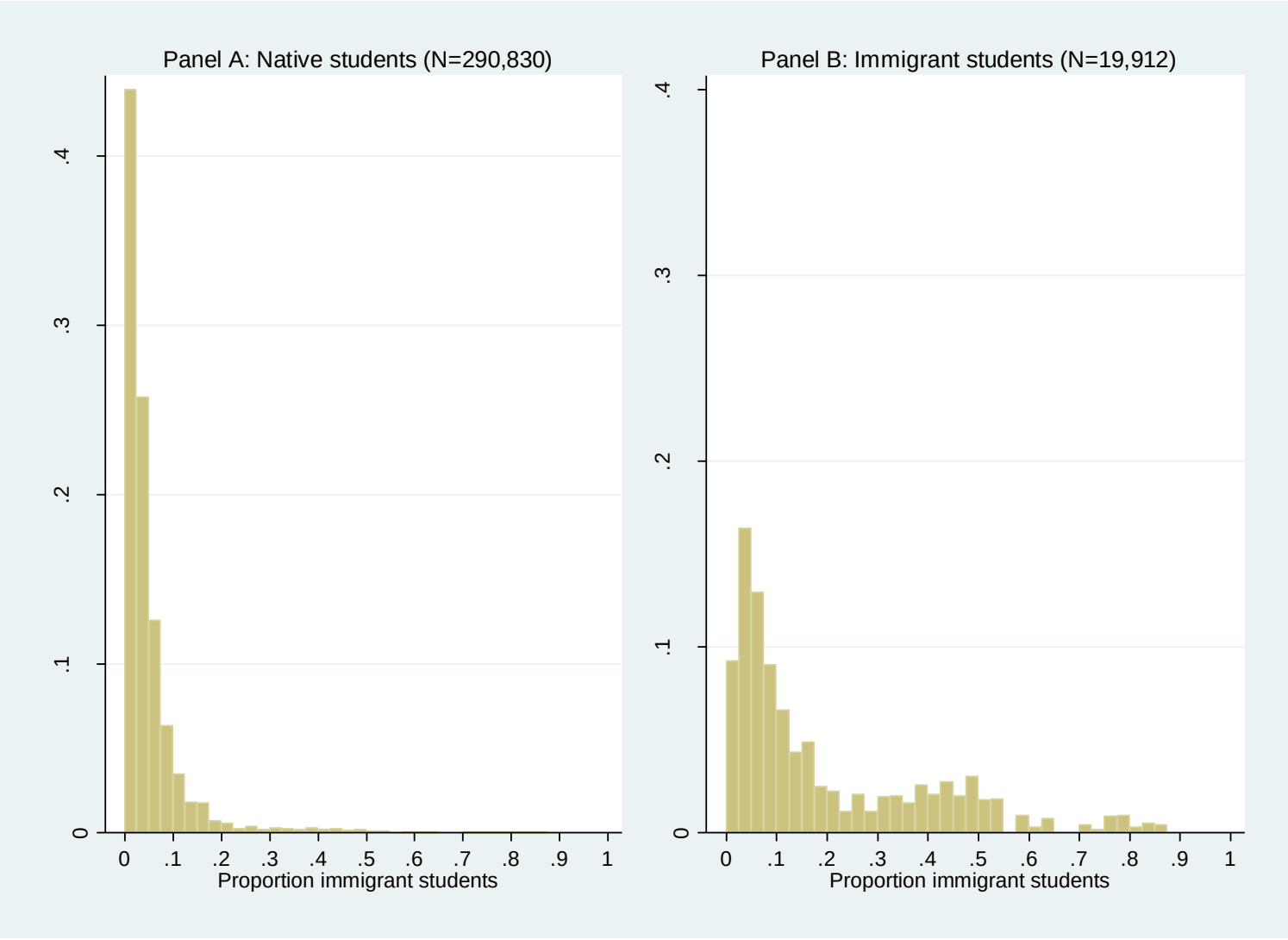

Figure 1. The proportion of native and immigrant students attending schools with varying immigrant shares.

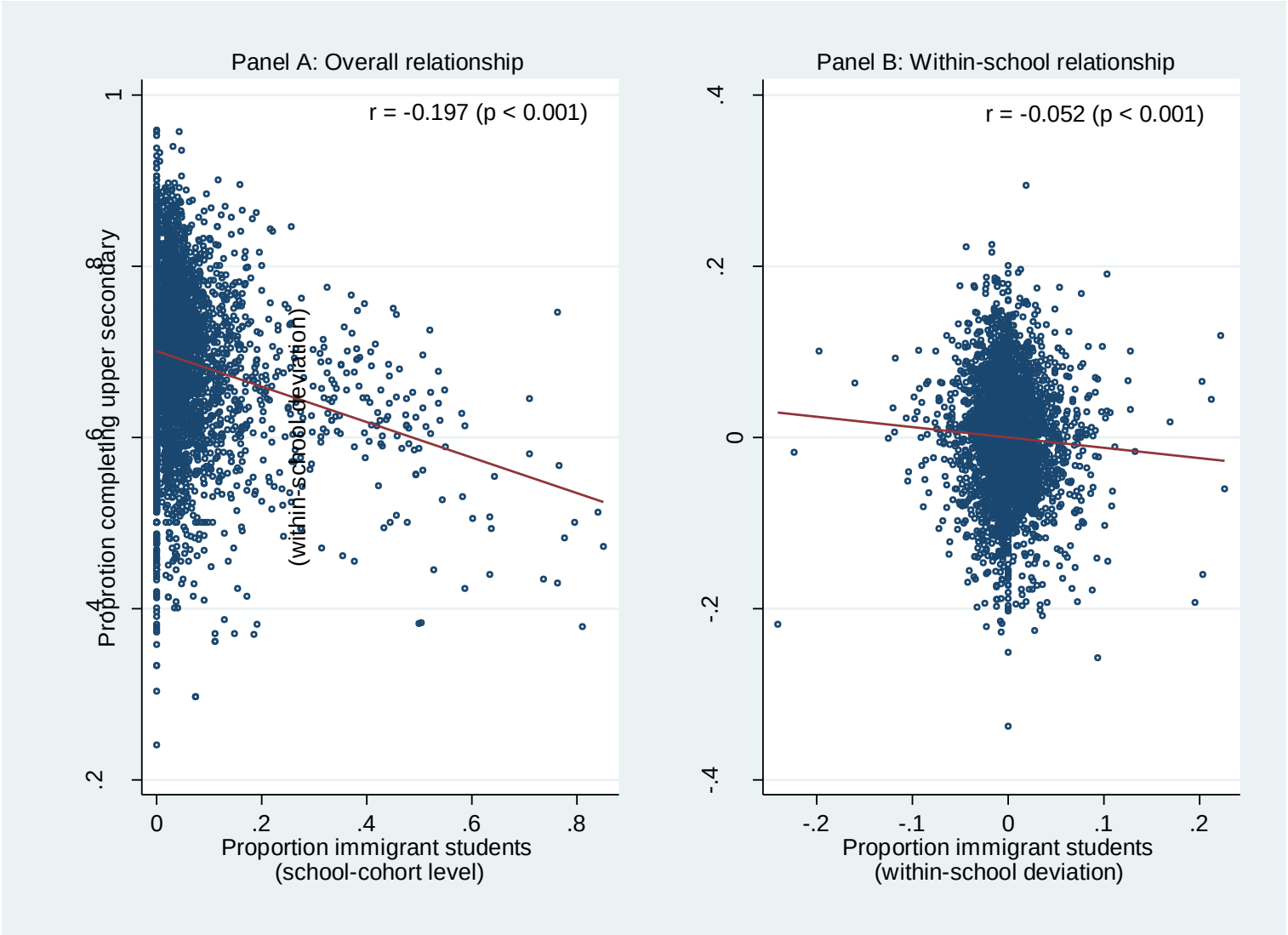

Figure 2. Relationship between immigrant student composition at the end of compulsory education and upper secondary completion in young adulthood at the level of school cohorts.

Notes: Scatter points refer to school-level graduating cohorts (N=4,245).

Table 1. Variables Used in Main Analysis at Individual and School-Cohort Level.

Variables	Mean	SD	Min–Max	Mean (Natives)	Mean (Immigrants)	Diff. in Means
Educational outcomes						
Upper secondary completion	0.70		0–1	0.71	0.57	0.14
Academic track enrollment	0.48		0–1	0.48	0.55	0.07
Grade point average	0.00	1.00	-4.19– 2.25	0.03	-0.43	0.46
Mathematics exam	0.00	1.00	-2.84–2.50	0.03	-0.43	0.46
Student characteristics (individual level)						
Immigrant background						
First generation	0.04		0–1	0.00	0.63	-0.63
Second generation	0.02		0–1	0.00	0.37	-0.37
Parents' education						
Basic compulsory	0.12		0–1	0.10	0.35	-0.25
Some upper secondary	0.12		0–1	0.12	0.05	0.07
Full upper secondary	0.35		0–1	0.36	0.21	0.15
Postsecondary, ≤ Bachelor's level	0.29		0–1	0.30	0.17	0.13
Postsecondary, ≥ Master's level	0.11		0–1	0.11	0.07	0.04
No education registered	0.01		0–1	0.00	0.16	-0.16
Log parents' earnings	13.05	0.87	8.57–17.22	13.14	11.74	1.40
Father employed	0.90		0–1	0.93	0.58	0.35
Mother employed	0.84		0–1	0.86	0.53	0.33
Parents' unemployment	0.08		0–1	0.08	0.14	0.06
Parents' social welfare	0.06		0–1	0.05	0.24	-0.19
Female	0.49		0–1	0.49	0.49	0.00
Mother's age at birth	27.68	5.08	15–45	27.70	27.43	0.27
First born child	0.44		0–1	0.44	0.38	0.06
Sibship size	1.88	1.20	0–16	1.83	2.53	-0.70
Intact or reconstituted family	0.74		0–1	0.74	0.75	-0.01
Residential relocation	0.38		0–1	0.36	0.66	-0.30
Peer characteristics (school-cohort level)						
Proportion immigrant students	0.07	0.10	0.00–0.86	0.06	0.21	-0.15
Native students' parents' mean years of education	13.50	0.92	10.86–16.83	13.50	13.53	-0.03
Native students' parents' mean log earnings	13.14	0.20	11.63–13.76	13.14	13.13	0.01
Number of students in cohort	93.1	40.9	20–235	92.72	99.38	-6.66
Number of schools	751			751	710	
Number of students	310,742			290,830	19,912	

Source: Norwegian administrative registry data.

Notes: Standard deviations are not shown for discrete variables, as the full distribution of responses is shown. Sample includes students graduating from compulsory education at ages of 15-17 in 2001-2006. Students from private schools and small schools are excluded. Mathematics exam are availbale for a subset of students for the 2002-2006 only; there are 98,604 observations, of which 92,448 and 6,156 students have native and immigrant background, respectively.

Table 2. Estimated Effect of Immigrant Student Composition on Completion of Upper Secondary Education. OLS Regressions.

	Model 1	Model 2	Model 3	Model 4	Model 5
Proportion immigrant students	-0.122***	-0.033*	0.090*	0.065†	0.061†
	(0.024)	(0.015)	(0.035)	(0.034)	(0.036)
x First generation				0.066*	0.106***
				(0.029)	(0.027)
x Second generation				0.145***	0.141***
				(0.034)	(0.026)
Immigrant background (ref. = native)					
First generation	-0.173***	0.052***	0.053***	0.046***	0.032***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)
Second generation	-0.030***	0.082***	0.083***	0.053***	0.024**
	(0.008)	(0.007)	(0.007)	(0.009)	(0.008)
Native students' parents' mean years of education		0.003	0.004	0.005	0.004
		(0.002)	(0.003)	(0.003)	(0.003)
Native students' parents' mean log earnings		0.037**	0.029**	0.029**	0.028*
		(0.011)	(0.011)	(0.011)	(0.011)
Log number of students		-0.006	0.003	0.004	0.024*
		(0.004)	(0.006)	(0.006)	(0.011)
Female		0.090***	0.090***	0.090***	-0.014***
		(0.002)	(0.002)	(0.002)	(0.002)
Parents' education (ref. = compulsory)					
Some upper secondary		0.088***	0.084***	0.084***	0.038***
		(0.004)	(0.004)	(0.004)	(0.003)
Full upper secondary		0.138***	0.133***	0.134***	0.054***
		(0.003)	(0.003)	(0.003)	(0.003)
Postsecondary, ≤ Bachelor's level		0.227***	0.225***	0.225***	0.062***
		(0.004)	(0.004)	(0.004)	(0.003)
Postsecondary, ≥ Master's level		0.265***	0.262***	0.262***	0.049***
		(0.004)	(0.004)	(0.004)	(0.004)
No education registered		0.032**	0.032**	0.031**	0.030***
		(0.010)	(0.010)	(0.010)	(0.009)
Log parents' earnings		0.043***	0.044***	0.045***	0.008***
		(0.002)	(0.002)	(0.002)	(0.002)
Father employed		0.007†	0.003	0.003	0.020***
		(0.004)	(0.004)	(0.004)	(0.004)
Mother employed		0.031***	0.032***	0.032***	0.020***
		(0.003)	(0.003)	(0.003)	(0.002)
Parents' unemployment		-0.059***	-0.058***	-0.057***	-0.030***
		(0.003)	(0.003)	(0.003)	(0.003)
Parents' social welfare		-0.113***	-0.111***	-0.111***	-0.054***
		(0.004)	(0.004)	(0.004)	(0.004)
Mother's age at birth		0.007***	0.007***	0.007***	0.003***
		(0.000)	(0.000)	(0.000)	(0.000)
First born		0.041***	0.042***	0.043***	-0.001
		(0.002)	(0.002)	(0.002)	(0.002)
Sibship size		-0.012***	-0.012***	-0.012***	-0.008***
		(0.001)	(0.001)	(0.001)	(0.001)
Intact or reconstituted family		0.099***	0.095***	0.094***	0.043***
		(0.002)	(0.002)	(0.002)	(0.002)
Residential relocation		-0.072***	-0.072***	-0.072***	-0.040***
		(0.002)	(0.002)	(0.002)	(0.002)
Grade point average (std.)					0.236***
					(0.002)
Intercept	0.720***	-0.799***	-0.779***	0.711***	-1.175***
	(0.004)	(0.124)	(0.136)	(0.003)	(0.144)
School fixed effects	No	No	Yes	Yes	Yes
R^2	0.007	0.132	0.141	0.141	0.332
Number of students	310,742	310,742	310,742	310,742	310,742

Notes: Linear probability coefficients. Huber-White standard errors in parentheses are robust to within school clustering and heteroskedasticity. All models control for graduation cohort fixed effects.

† p <0.10; * p <0.05; ** p <0.01; *** p <0.001 (two-tailed tests).

Table 3. Estimated Effect of Immigrant Student Composition on Academic Track Enrollment. OLS Regressions.

	Model 1	Model 2	Model 3	Model 4	Model 5
Proportion immigrant students	0.113**	0.126***	0.071	0.031	0.028
	(0.039)	(0.017)	(0.044)	(0.042)	(0.047)
x First generation				0.146***	0.182***
				(0.028)	(0.030)
x Second generation				0.190***	0.186***
				(0.041)	(0.038)
Immigrant background (ref. = native)					
First generation	0.018**	0.181***	0.180***	0.163***	0.150***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Second generation	0.097***	0.197***	0.196***	0.159***	0.133***
	(0.010)	(0.009)	(0.009)	(0.011)	(0.010)
Grade point average (std.)					0.214***
					(0.002)
Student and peer covariates	No	Yes	Yes	Yes	Yes
School fixed effects	No	No	Yes	Yes	Yes
R^2	0.003	0.158	0.170	0.170	0.303
Number of students	310,742	310,742	310,742	310,742	310,742

Notes: Linear probability coefficients. Huber-White standard errors in parentheses are robust to within school clustering and heteroskedasticity. All models control for graduation cohort fixed effects. Student and peer covariates

† p <0.10; * p <0.05; ** p <0.01; *** p <0.001 (two-tailed tests).

Table 4. Estimated Effect of Immigrant Student Composition on Educational Achievement. OLS Regressions.

	Model 1	Model 2	Model 3	Model 4
Panel A: Grade point average (10th grade)				
Proportion immigrant students	-0.156*	0.050	-0.001	0.016
	(0.064)	(0.044)	(0.089)	(0.091)
x First generation				-0.168*
				(0.084)
x Second generation				0.019
				(0.085)
Immigrant background (ref. = native)				
First generation	-0.584***	0.030*	0.033*	0.057**
	(0.017)	(0.015)	(0.015)	(0.019)
Second generation	-0.178***	0.139***	0.135***	0.124***
	(0.024)	(0.017)	(0.017)	(0.023)
Student and peer covariates	No	Yes	Yes	Yes
School fixed effects	No	No	Yes	Yes
R^2	0.018	0.261	0.275	0.275
Number of students	310,742	310,742	310,742	310,742
Panel B: Mathematics exam (10th grade)				
Proportion immigrant students	-0.441***	-0.285***	-0.014	0.049
	(0.090)	(0.074)	(0.171)	(0.172)
x First generation				-0.239*
				(0.115)
x Second-generation immigrant				-0.275*
				(0.123)
Immigrant background (ref. = native)				
First generation	-0.560***	-0.035	-0.038†	-0.010
	(0.022)	(0.022)	(0.022)	(0.026)
Second generation	-0.294***	-0.005	-0.003	0.047
	(0.032)	(0.026)	(0.026)	(0.036)
Student and peer covariates	No	Yes	Yes	Yes
School fixed effects	No	No	Yes	Yes
R^2	0.018	0.204	0.232	0.232
Number of students	98,604	98,604	98,604	98,604

Notes: Unstandardized regression coefficients. Huber-White standard errors in parentheses are robust to within school clustering and heteroskedasticity. All models control for graduation cohort fixed effects. Student and peer covariates are listed in Table 1.

† p <0.10; * p <0.05; ** p <0.01; *** p <0.001 (two-tailed tests).

Table 5. Sensitivity Analysis of Effect of Immigrant Student Composition on Upper Secondary Completion. OLS Regressions.

	Proportion immigrant students		Prop. imm. students x First generation		Prop. imm. students x Second generation		Number of students
Panel A: Proportion immigrant students	0.065†	(0.034)	0.066*	(0.029)	0.145***	(0.034)	310,742
Panel B: Proportion immigrant students born abroad	0.012	(0.038)	0.145**	(0.053)	0.306***	(0.077)	310,742
Panel C: Proportion immigrant students from non-OECD countries	0.065†	(0.034)	0.066*	(0.029)	0.145***	(0.034)	310,742
Panel D: Proportion immigrant students with low-skilled parents	-0.009	(0.042)	0.114*	(0.044)	0.226***	(0.049)	310,742
Panel E: Proportion immigrant students (for all students in all schools)	0.039	(0.029)	0.057*	(0.027)	0.136***	(0.032)	340,366

Notes: Linear probability coefficients. Huber-White standard errors in parentheses are robust to within school clustering and heteroskedasticity. All models control for school fixed effects, graduation cohort fixed effects and student and peer covariates (listed in Table 1).

† p <0.10; * p <0.05; ** p <0.01; *** p <0.001 (two-tailed tests).

Table A1. Geographical Origin of Immigrant Students.

Countries of origin (30 largest)	Obs.	%
Pakistan	2,896	14.5
Vietnam	1,483	7.5
Iraq	1,360	6.8
Bosnia-Herzegovina	1,289	6.5
Kosovo	1,117	5.6
Iran	1,110	5.6
Turkey	1,074	5.4
Somalia	998	5.0
Chile	643	3.2
Sri Lanka	610	3.1
Russia	477	2.4
Morocco	466	2.3
India	454	2.3
Sweden	413	2.1
Poland	382	1.9
Afghanistan	335	1.7
Denmark	308	1.6
Phillipines	296	1.5
Thailand	270	1.4
Iceland	269	1.4
Macedonia	258	1.3
Croatia	235	1.2
China	220	1.1
Germany	178	0.9
Ethiopia	151	0.8
United Kingdom	148	0.7
Lebanon	148	0.7
The Netherlands	127	0.6
Eritrea	122	0.6
Serbia	112	0.6
Other countries	1,963	9.9
Total	19,912	100.0

Notes: Sample includes students graduating from compulsory education at ages of 15-17 in 2001-2006. Students from private schools and small schools are excluded.

Table A2. Overall and Within-School Variation in Immigrant Student Composition.

	Proportion immigrant students				
	Mean	SD	Min	Max	N
Panel A: Total variation					
All students	0.066	0.097	0.000	0.856	310,742
Native students	0.056	0.075	0.000	0.856	290,830
First-generation immigrant students	0.173	0.184	0.006	0.856	12,584
Second-generation immigrant students	0.273	0.215	0.006	0.856	7,328
Panel B: Within-school variation					
All students	0.000	0.026	-0.236	0.215	310,742
Native students	0.000	0.024	-0.236	0.215	290,830
First-generation immigrant students	0.000	0.040	-0.236	0.215	12,584
Second-generation immigrant students	0.000	0.049	-0.236	0.215	7,328

Notes: Panel A provides the overall distribution of immigrant student proportion in our sample. Panel B provides the distribution in residuals from regressions of immigrant student proportion on 751 school fixed effects and 6 graduation cohort fixed effects.

Table A3. Alternative Measures of Immigrant Student Compostion.

	Mean	SD	Min–Max	Mean (Natives)	Mean (Immigrants)	Diff. in Means
Proportion immigrant students born abroad	0.04	0.05	0.00–0.54	0.04	0.11	-0.07
Proportion immigrant students from non-OECD countries	0.06	0.09	0.00–0.85	0.05	0.20	-0.15
Proportion immigrant students with low-educated parents	0.04	0.06	0.00–0.65	0.03	0.13	-0.10
Number of schools	751			751	710	
Number of students	310,742			290,830	19,912	

Notes: Sample includes students graduating from compulsory education at ages of 15-17 in 2001-2006. Students from private schools and small schools are excluded.