I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16419

Race and the Income-Achievement Gap

Ryan Bacic
Angela Zheng

SEPTEMBER 2023

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16419

Race and the Income-Achievement Gap

Ryan Bacic
McMaster University

Angela Zheng
McMaster University and IZA

SEPTEMBER 2023

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Race and the Income-Achievement Gap*

A large literature documents a positive correlation between parental income and child test scores. In this paper, we study whether this relationship, the dependence of the cognitive skills of children on the socioeconomic resources of their parents, varies across race. Using education data linked to tax records, we find that the income-achievement gap is small for East Asian children while significantly larger for Indigenous children. School-level factors explains a large portion of the variation in the gap across race. Our results suggest that the large income-achievement gap for Indigenous students may be rooted in inequality in special needs status.

JEL Classification: I20, I24, J15
Keywords: test scores, income-achievement gaps, race

Corresponding author:
Angela Zheng
McMaster University
1280 Main St W
Hamilton, ON L8S 4L8
Canada
E-mail: zhenga17@mcmaster.ca

* For many helpful suggestions we thank Arthur Sweetman, Sergei Filiasov, Michael Gilraine, Christine Neill, Melanie Jones, Kenza Elass, Alexia Olaizola, Laura Perez Cervera and participants at the 2023 CEA. We are grateful to the Social Sciences and Humanities Research Council of Canada for providing funding through an Insight Development Grant. Many thanks to Peter Kitchen and Li Wang from the Research Data Center at McMaster University for their support with the data.

1. Introduction

A large literature shows that there are achievement gaps based on family socioeconomic status (SES): children from higher-income families perform better in school.[1] From an inequality perspective, the existence of these SES achievement gaps is concerning because research has shown that the early cognitive skills of children are associated with their future labour market outcomes (Chetty et al., 2011; Heckman et al., 2006; Heckman et al., 2010; Hanushek, 2009). In addition, another area studies inequality in achievement across race, such as the Black-White test score gap in the United States (Magnuson et al., 2006; Jencks et al., 2011) and the achievement gap between Indigenous and non-Indigenous students in Canada (Friesen et al., 2010b; Barber et al., 2021).

To date though, there has been little focus on how the income-achievement gap varies by race. In this paper, we show that there are significant differences, and study what factors explain such variation, with a particular focus on outcomes for Indigenous children. Understanding the income-achievement gap across different minorities can shed light on whether certain children have more opportunity to build human capital, in that their test scores are less dependent on the socioeconomic resources of their parents. This work is thus related to a broader literature studying economic opportunity by race (Bhattacharya et al., 2011; Akee et al., 2019; Chetty et al., 2020), focusing instead on early childhood cognitive skills.

Our work uses administrative education data linked to tax records from the Canadian province of British Columbia. This data covers (nearly) the population of students in the province.[2] We study outcomes for the three most populous groups of visible minority students: Indigenous, East Asian, and South Asian. Our primary measure of the income-achievement gap is the average difference in test scores for students from families in the top before-tax household income decile versus the bottom decile, which we refer to as the P90-P10 gap, as in Reardon (2011). Following other work studying intergenerational mobility by race, income deciles are calculated across all racial groups (Chetty et al., 2020). Our main measure of achievement is performance on standardized tests when students are in Grade 4 (age nine) and Grade 7 (age twelve).

To start, we find that the income-achievement gaps in Canada are low compared to those documented for other countries. Our estimates indicate P90-P10 gaps ranging from 0.4-0.7 standard deviations across racial groups. In comparison, Reardon (2011) documents a gap of 1.25 standard deviations in the United States while Magnuson et al. (2012) finds gaps of 0.8-1.0 standard deviations for the United Kingdom. Our findings

[1] For example, see Carneiro et al. (2003), Heckman et al. (2005), Reardon (2011), Magnuson et al. (2012), Hanushek et al. (2019), and Hanushek et al. (2020) for the U.S., and Currie et al. (2001) and Bradbury et al. (2019) for the United Kingdom. For a cross-country comparison see Chmielewski et al. (2016) and Bradbury et al., 2019.

[2] We do not see Indigenous students who attend on-reserve schools run by the federal government. See Section 3 for further discussion.

on income-achievement gaps in Canada relate to other works documenting that Canada has higher economic opportunity compared to the United States (Connolly et al., 2019).

Nevertheless, there is noticeable variation in the relationship between income and test scores among minority groups. Our most striking results are for Indigenous students: across all parental income deciles, Indigenous students score significantly lower than other students on standardized tests. In addition, Indigenous students have the steepest relationship between test scores and parental income with a P90-P10 gap of around 0.7 standard deviations.

In contrast, East Asian students have the highest performance levels on tests across all parental income deciles, and the lowest P90-P10 gap, at around 0.37 standard deviations. For South Asian students, the corresponding estimate is 0.6 standard deviations. Furthermore, we find heterogeneity in the P90-P10 gap within race by subject. While Indigenous students have large P90-P10 gaps in both reading and numeracy, the raw P90-P10 gap for East Asians is noticeably lower in the latter subject. We also show that the patterns across race at age nine are consistent three years later: in fact, the P90-P10 gap grows for Indigenous students.

Next, we turn to understanding what factors contribute to the variation in the income-achievement relationship across race. This exercise is especially important for learning what policymakers could do to improve outcomes for Indigenous students. To start, controlling for school fixed effects explains about 20-30% of the P90-P10 gap across all visible minority groups. This suggests strong sorting patterns by income and average school performance, whereby lower income students are more likely to attend schools with lower performance on standardized tests. The education data we use also identifies whether a student was ever an English as a Second Language (ESL) learner or had special needs, which include behavioural, learning, or physical needs, but not gifted ones. Our estimates show that for Indigenous students, special needs status is an important factor in understanding their income-achievement gap. In fact, we find a stark pattern between income and the probability of having a special need for Indigenous students. Lastly, we find that ESL status is an important factor for Indigenous students but also for other minority groups too. Controlling for ESL status significantly reduces the East and South Asian P90-P10 gap.

Given the low education opportunity for Indigenous students, we conduct additional exercises to investigate other possible mechanisms. About a fourth of our Indigenous students are linked to the Census, and conditional on household income, Indigenous children are significantly more likely to be from single-parent families and to live in unsuitable housing compared to non-Indigenous ones. Furthermore, while we do not find heterogeneity in the income-achievement gap between Indigenous students living on versus off-reserves, we do show that on-reserve students have lower test scores conditional on household income than off-reserve students.

Our work has several policy implications that could improve the disparity in income-achievement gaps. To start, school fixed effects explains a large portion of the income-achievement gap across all groups, indicating that sorting into schools may be an important source of inequality. School funding in British Columbia is at the provincial level and so differences in school quality do not arise due to differences in property tax funding as in the United States.[3] Nevertheless, school sorting on income still occurs as British Columbia has school zone boundaries implying that the quality of schools is capitalized into property prices (Black, 1999).

In addition, also important for the Indigenous P90-P10 gap is special needs status. Indigenous students are more than twice as likely than non-Indigenous students to have a special needs diagnosis. Several works have documented the severity of the Indigenous health gap[4] and our work highlights how the link between special needs status and income worsens educational outcomes for low-income Indigenous students.

2. Literature Review

Our work is related to three strands of literature: research on achievement gaps, research on education inequality in Canada, and research on socioeconomic status and opportunity across race.

There are several works studying achievement gaps among students. In the United States, a wealth of research has studied the test score gap between Black and White students, with estimates ranging from 0.5-1 standard deviations (Magnuson et al., 2006; Jencks et al., 2011; Fryer Jr et al., 2004; Card et al., 2007). More closely related to our work, Rothstein et al. (2013) study the gap in Black and White test scores for students with the same permanent family income. The achievement gap between students of high and low socioeconomic status has also been extensively researched (Michelmore et al., 2017; Jerrim et al., 2012). Often, studies have used survey data without reliable family income information. Instead, these works have constructed an index of socioeconomic status from parental education (Hanushek et al., 2019), type of goods at home (Hanushek et al., 2019; Hanushek et al., 2011; Jerrim et al., 2012), or parental occupation(Haeck et al., 2021).

When using parental income as a measure of socioeconomic status, studies have also found large achievement gaps (Carneiro et al., 2003; Magnuson et al., 2012; Sandsør et

[3]The literature on inequality and education has shown that the United States' decentralized funding system has negative effects on opportunity and intergenerational mobility as district resources are tied to the socioeconomic status of residents. For example, see Durlauf et al. (1993), Durlauf (1996), Fernandez et al. (1996), Fernandez et al. (1998), Biasi (2022), Jackson et al. (2016), Eckert et al. (2019), and Zheng et al. (2022).

[4]For example, see King et al., 2009; Booth et al., 2008; Frohlich et al., 2006; Hajizadeh et al., 2018; Smylie, 2012; Shapiro et al., 2021.

al., 2021). Reardon (2011) estimates that the P90-P10 test score gap is 1.25 standard deviations for children born in 2001 in the U.S. and that the gap grew when compared to earlier cohorts. In a cross-country comparison of multiple countries, Chmielewski et al. (2016) find that the P90-P10 income gap is larger in the U.S. than in other OECD countries. Just like our paper, these works are descriptive, documenting the correlations between income and achievement.[5]

One of our key findings is large income-achievement gaps for Indigenous students. This result contributes to a broad literature documenting inequality for the Indigenous population in Canada. Using the same test score data as ours, Friesen et al. (2010b) study the achievement gaps between Indigenous and non-Indigenous students in British Columbia. They find that there is significant sorting of Indigenous students into lower-performing schools. Similarly, Richards et al. (2010) show that school quality explains an important component of the Indigenous test score gap in British Columbia. Across Canada, Barber et al. (2021) use a national sample of students and find an Indigenous gap of around 0.31 standard deviations that has stayed consistent from 1996 to 2008. Our main contribution here is the use of test score data linked to tax records of parental income, which allows us to study the income-achievement gap among Indigenous students.

Lastly, our work ties into the literature on economic outcomes by race. Collins et al. (2017) and Akee et al. (2019) look at historical intergenerational mobility outcomes between Black and White Americans, while Abramitzky et al. (2021) study intergenerational mobility of immigrants to the United States. Recent work on intergenerational mobility of income by Chetty et al. (2020) has highlighted that economic opportunity in the United States varies by race, with Black Americans and American Indians having worse outcomes than White and Asian Americans. We view our contribution to this literature as emphasizing that inequality in opportunity across race is a phenomenon that arises at an early point in the life-cycle. While the works mentioned above primarily focus on income as an outcome, we show that there is unequal opportunity in child human capital accumulation across race. To the extent that child test scores are associated with future labour market outcomes, our findings may be a partial explanation for the inequality in economic opportunity during adulthood documented by other works. In Section 6 we discuss in detail how our results compare to those of Chetty et al. (2020). One difference to note though is that we are not able to speak to outcomes for Black students as they are a small minority in British Columbia. Instead, we shed light on outcomes for East Asian, South Asian, and Indigenous students.

The rest of the paper is structured as follows. In Section 3 we discuss the education system in British Columbia and Section 4 presents the data. Section 5 goes over the empirical framework and Section 6 presents the results. We conduct robustness exercises

[5]For causal effects of income on achievement, see Dahl et al. (2012), who find that changes in the Earned Income Tax Credit led to improvements in test scores in the United States.

in Section 7 and Section 8 concludes.

3. Institutional Background

Our data is for the province of British Columbia (BC), the third most populated province in Canada. BC is diverse; at the time of the 2006 Census, it had a visible minority share of 25 percent. Table A.1 in the Appendix lists demographic characteristics from the 2006 Canadian Census of BC in comparison to Canada (Statistics Canada, 2008c; Statistics Canada, 2008b; Statistics Canada, 2008a). The racial composition of BC differs in a few key ways. First, the province has a large share of Asian residents. Ten percent of the BC population is Chinese, compared to only four percent nationwide. In addition, six percent in the province are South Asian. Second, five percent of the province's population is Indigenous, which in turn implies that almost seventeen percent of the Indigenous population of Canada resides in BC. Finally, the Black population is under-represented in BC: less than one percent of residents identify as Black, compared to two and a half percent in Canada overall.

We now discuss education policy, which in Canada is set at the provincial level. BC has a traditional public school system: students are guaranteed a seat in a school based on their catchment area. Since 2003, the province has had an open-enrolment policy in which children can attend school outside their catchment area, given available seats.[6] The school financing system in BC is centralized, with roughly 94 % of the budgeted revenue for school districts coming from provincial grants (Ministry of Education British Columbia, 2015). School districts receive the same amount of funding per full-time student. Additional funds are provided for Indigenous students, students with special needs, adult learners, and English/French Language Learners (Independent Funding Model Review Panel, 2018) and again, these rates are equalized across districts (Ministry of Education, 2023). This financing system is in contrast with the U.S., where in 2013-14, funding at the district level still made up 45% of per-pupil revenue with a large share raised from local property taxes (U.S. Department of Education, 2016). Furthermore, BC has a system of independent (private) schools. These schools must hire teachers certified by the province and adhere to the provincial curriculum. Some independent schools are funded at 35-50% of their local public school rate.[7]

A key focus of this paper is on Indigenous children. In BC, education for Indigenous students can take place in two forms. Indigenous students living on reserves may attend an on-reserve school, which are funded by the federal Canadian government. We have no data on these types of schools, but they educate a only small proportion of the Indigenous

[6] See Friesen et al. (2015) for an analysis of the impact of the open-enrolment policy.
[7] See the B.C. Ministry of Education website.

student population.[8] Drawing on the literature, we can get a sense of how the lack of on-reserve school data would affect our estimates of the Indigenous income-achievement gap. Previous findings have shown that education quality and income on-reserves are lower than those of Indigenous people off-reserve (McMahon, 2014).[9] This suggests that if we had data for federally-run on-reserve schools, our estimates of the income-achievement gap for Indigenous students would be higher.

4. Data

We use a unique administrative dataset that links the achievement data of students in British Columbia to income tax data. This dataset is part of the Education and Labour Market Longitudinal Platform (ELMLP) from Statistics Canada (Statistics Canada, 2021). In the Appendix, we provide further details on the ELMLP and how to access it.

Education Data

Our education dataset is from the British Columbia Minister of Education and covers the universe of students who attend public or independent schools in the province (BC Ministry of Education and Child Care, 2021). It consists of student-year level observations of demographics including age, Indigenous status, gender, language spoken at home, special needs status, school attended, and test scores in Grades 4,7,10, and 12. Special needs students are those with physical, behavioural, or learning needs. For the purposes of our analysis, we do not include gifted students in our classification of special needs. We only consider school-aged learners and drop adult learners from our sample.

During the year that students are in Grade 4 (age nine) and Grade 7 (age twelve), performance on the provincial wide Foundation Skills Assessment (FSA) standardized exams are recorded. This test is given annually to all students (in both public and independent schools), and assesses their skills in literacy and numeracy. Students are graded in the form of a percentage score, which we standardize within a grade, subject, and cohort. If a student repeats a grade and retakes the FSA, we use their first attempt.

While in principle, all students should take the FSA, students can miss an exam due to illness or an emergency, and exceptions are given to certain special needs and English as a Second Language students. Moreover, recently the teacher's union has pushed to have parents opt their children out of the FSA (Boynton, 2019). This movement has had some success with participation rates falling the past few years. For example, in 2017, the participation rate was 79% whereas in 2007 it was around 89% (BC Ministry of Education and Child Care, 2021).

[8]For instance Friesen et al. (2010b) estimate that only seven percent of Grade 7 (age twelve) BC Indigenous students attend a school operated by a First Nations band.

[9]See also https://www150.statcan.gc.ca/n1/daily-quotidien/210921/cg-d001-eng.htm

We focus on the cohort of students who were in Grade 4 from the academic years 2008/09 to 2012/13 and who were thus in Grade 7 from 2011/12 to 2015/16. The reason we do this is twofold. First, a fourth of our sample is linked to the 2016 Census, meaning that the census information from 2016 covers students when they are age 12 to 16 and still in school. Second, using recent cohorts is problematic due to the falling participation discussed above. In Section 6 we discuss how changing participation may bias our estimates.

Tax Return Data

Children in the BC education dataset are linked to the tax return data of their parents through the T1FF datafile from Statistics Canada. The tax return data covers the parents of children in the education dataset who file an income tax return, in addition to individuals who claim child benefits from the federal government. Our main definition of income is before-tax income at the household level. In robustness checks we also use household income after tax, and household income after tax scaled by family size. Income is defined as the sum of employment income, business income, income from agriculture, self-employment income, and benefits. We define a household as the two parents of a child.[10] To get a sense of the household finances during the child's early years, we take averages of total household income in the five years leading up to when the child is in Grade 4. We are able to match 96% of our students of interest to tax records. Of these matches, around 95% of the linkages have the full five years of income available. All income values are normalized to 2002 Canadian dollars using the Consumer Price Index (Statistics Canada, 2023).

Data on Race

The data from the Ministry of Education asks students whether they are Indigenous. We classify a student as Indigenous if a student ever answers as being so during the years observed. For other minority groups, the administrative data does not explicitly ask for a student's race. We do however, have information on the language a student speaks at home, which we use as a coarse proxy for race. We classify students who speak Chinese or Korean at home as "East Asian", and students who speak Punjabi or another South Asian language as "South Asian". For comparison, we look at students who speak English at home and who are not Indigenous; we classify these students into our "Baseline Group".

Our classification system is subject to some measurement error. While our classifications for East Asian and South Asian minorities are likely to be accurate, students who speak English at home may be White or belong to a visible minority group. This measurement error can affect our estimates in two ways. First, our classification of East Asian/South Asian students would capture those who may be less assimilated than stu-

[10] A small proportion of our sample has three parents linked in certain years, in which case we take the two individuals who appear the most often.

dents of the same ethnicity who speak English at home. By focusing on a less-assimilated group, we may be overstating the differences in test scores between minority groups and Whites. Second, if the degree of assimilation is correlated with parental income, our classification will miss out on East/South Asian students from higher-income families, which may potentially understate the P90-P10 gaps within these groups. In the Appendix, we show that our results are robust to using a more accurate measure of race from the Census.

Census Data

Around a fourth of our students are linked to the 2016 Census. For these students, we use their visible minority information from the Census as a robustness check. In addition, we make use of their family structure and dwelling information to understand mechanisms that may affect the income-achievement gaps.

5. Empirical Framework

Our baseline model is an OLS regression of standardized student test scores for child i on their household before-tax income. To start, we focus on the achievement gap between the top and bottom income decile, so that we can compare our estimates to those of Reardon (2011) for the U.S. We run the following regression separately for each of our four student groups, Baseline, Indigenous, East Asian and South Asian:

$$y_i = \alpha + \sum_{q=2}^{10} \beta_q \mathbb{1}income_{i,q} + \epsilon_i \tag{1}$$

where y_i is the average test score across reading and math of individual i in standard deviations, and $\mathbb{1}income_{i,q}$ is an indicator variable that equals one if the child's household income is in decile q. The bottom income decile is the reference level.

We calculate income deciles across all families and not within racial groups, as in Chetty et al. (2020). The coefficient β_q represents the average test score for those in income decile q relative to the bottom income decile. Standard errors are clustered at the school level to account for families sorting into schools. We call β_{10} the P90-P10 achievement gap. In certain specifications, we augment Equation (1) with controls and/or school fixed effects.

Table 1: Summary Statistics

	Full Sample	Grade 4 FSA	Grade 4 and 7 FSA
	(1)	(2)	(3)
Number of Students	207,120	174,370	148,060
Average Household Income ($)	65,600	67,900	69,500
% English Language	64	65	65
% Indigenous	13	12	11
% East Asian	7.6	7.2	7.4
% South Asian	7.5	7.7	8.2
% Special Needs	17	13	11
% English as Second Language	20	19	19
% Private School	12	13	14

Notes: Column (1) contains summary statistics for the cohort of students in Grade 4 from 2008 to 2012. Column (2) is the subset of the full sample who wrote the FSA in Grade 4. Column (3) is the subset of students who wrote the FSA in Grade 4 and Grade 7. Source: Author's calculations from the BCK-12 linked to T1FF dataset from Statistics Canada (BC Ministry of Education and Child Care, 2021; Statistics Canada, 2021).

6. Results

6.1. Summary Statistics

To start, we present summary statistics for three samples of our students. Column (1) of Table 1 is for the entire sample of students in our cohort of interest: those in Grade 4 from 2008/09 to 2012/13. Column (2) is the sample of students who take the Grade 4 FSA. Lastly, Column (3) is the sample of students who take the Grade 4 and Grade 7 FSA. Per data-release guidelines, all counts are rounded to the nearest tenth and average income values are rounded to the nearest hundredth.

In the full sample, we have 207,120 Grade 4 students over the five years with an average household income before taxes of $65,600. Sixty-four percent of students speak English at home and thirteen percent identify as Indigenous. Close to eight percent of students speak an East Asian language while seven percent of students speak a South Asian language at home. Around 17% have a special needs disorder and about 20% are English as Second Language (ESL) students.[11] We group students as ESL and special needs students based on if they were ever classified in the data as being in one of these groups. Lastly, twelve percent of students in our sample are in private (independent) schools.

Column (2) presents summary statistics for our cohort of students who have Grade 4 FSA scores. Out of all the students in Grade 4 during 2009-2013, 174,370 or roughly 85%, wrote the FSA. Students who do so have parents with around $2,000 higher household income. There are lower participation rates among Indigenous, ESL, and special needs students. The representation of students in private schools increases to thirteen percent, which is in line with private schools attracting students from higher-income families. In Column (3), we highlight the sample of students who have both Grade 4 and Grade 7 FSA scores. Participation drops from Grade 4 to Grade 7 leaving a sample of 148,060 students. The average income is higher, now at $69,500.

Table 1 shows that there is selection into exam participation, which could cause our P90-P10 gaps could be biased. From the summary statistics, we see that children who do not participate are likely to be from lower-income families, since average household income rises as we condition on participation. Furthermore, we are missing students who are likely to be special needs or ESL students. Therefore, the estimates of the P90-P10 gap that we calculate should be downwards biased.

[11] While these ESL rates may seem high, note that populous regions in British Columbia have a significant immigrant population. For example, reporting from the Vancouver Sun in 2014 stated that ESL students make up more than 50% of their school's population in over 60 schools in Vancouver (Skelton, 2014).

6.2. Raw Income-Achievement Gaps

We now present estimates of the raw income-achievement gap across race. Figure 1 presents a binscatter of the P90-P10 gap for students in Grade 4 across our four groups of interest: Baseline, Indigenous, East Asian, and South Asian. Each dot on the graph is the average test score from reading and math for students from a group in a certain income decile.

The first thing to note is that there are stark differences in the level of achievement among the different groups. Indigenous students perform worse on standardized tests across all parental income deciles: their test scores range from -0.6 to 0.2 standard deviations (σ). On the other hand, students in the baseline group have a minimum average performance of -0.2σ. South Asian students perform slightly worse while East Asian students perform very well: from around 0.3 to 0.8σ.[12]

Next, we present our findings on how the income-achievement gap varies by race by looking at how the slope between parental income and test scores differs among our groups of students. In particular, we look at the difference in outcomes between an average student whose family income is in the top income decile versus one whose family income is in the bottom decile (P90-P10 gap). For the Baseline group this is 0.54σ and South Asians have a slightly larger value, at 0.61σ. The P90-P10 gap for East Asian students is smaller, at 0.37σ . For Indigenous students though, the P90-P10 gap is noticeably larger, at 0.69σ.

While Figure 1 points to differences in the P90-P10 gap across race, for each of our three visible minority groups, we test whether their P90-P10 gap is statistically significantly different from the Baseline group. For example, to test differences between the Baseline and Indigenous group, we run a regression of test scores on income deciles interacted with an indicator for whether a student is in the Baseline Group or Indigenous. We test for differences between the Baseline Group and East/South Asian students in a similar way. Table A.2 in the Appendix presents the results. In Column (1), the interaction between Indigenous and P90-P10 is 0.16 and significant. Column (2) shows that the lower P90-P10 gap for East Asian students is significant while Column (3) indicates there is no significant difference in the P90-P10 gap between South Asian and Baseline students.

Figure 2 shows that the patterns in test scores and parental income stay consistent when students are three years older, in Grade 7. The lowest level of test scores for East Asian students rises from 0.3σ in Grade 4 to just under 0.6σ in Grade 7. In contrast, the level of test scores decreases for Indigenous students: from -0.6σ at the bottom decile of parental income in Grade 4 to close to -0.8σ in Grade 7. Moving on to the income-achievement gap, we see that the P90-P10 difference widens to around 0.75σ for

[12]In related work for Australia, Jerrim (2015) document that East Asian students perform better than Australian-born students in school.

Indigenous students while for East Asian students it stays close to around 0.35σ. For both the Baseline group and South Asian, the gap is similar at around 0.6σ.

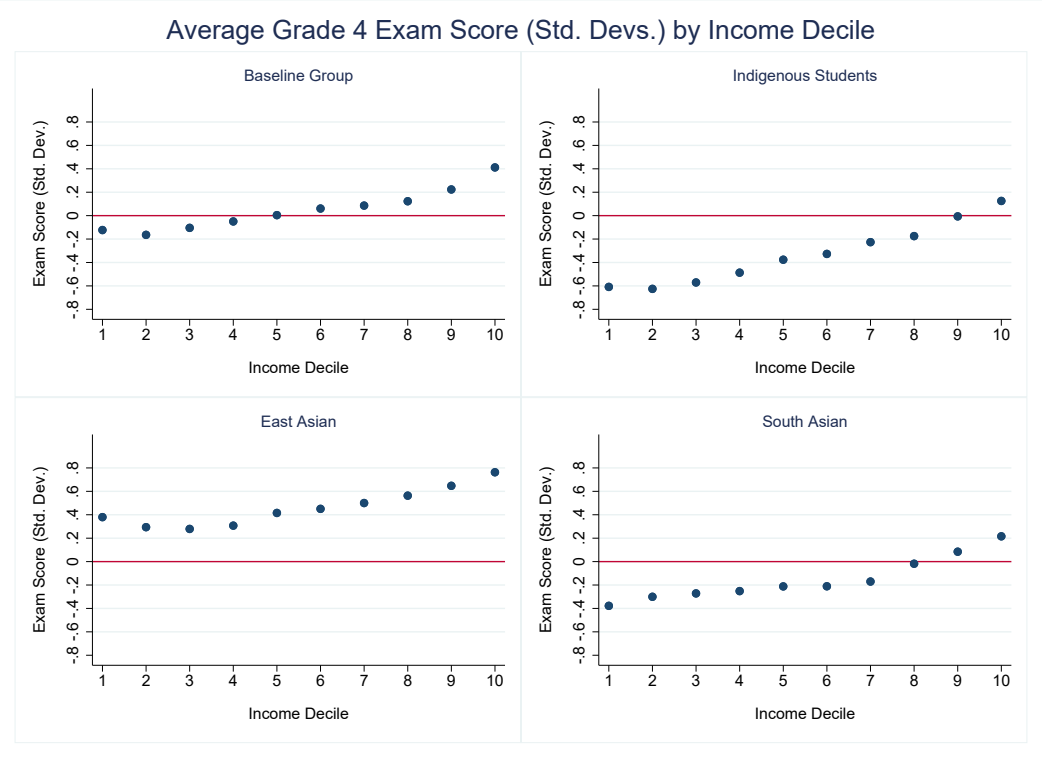
For context, we can compare the P90-P10 gap to the United States which Reardon (2011) documented to be around 1.5σ. Our results indicate that among all groups of students in BC, the income-achievement gaps are substantially lower than that in the United States. Nevertheless, there is important heterogeneity across different student groups. More broadly, our findings show that even when children are as young as nine, there are already patterns between test scores and parental income that vary across race and that are suggestive of the future relationships between child income and parental income documented by Chetty et al., 2020. Just like they find that Asians have higher relative mobility and absolute mobility, we find that East Asians specifically, have lower income-achievement gaps and higher levels of test scores. One possible reason is that our main classification of students is based on language spoken at home, and will skew towards more recent immigrants rather than East Asians who have been in Canada for longer. For those who recently immigrated to Canada, income may be a poor proxy for parental human capital as immigrants tend to experience downward occupational mobility upon arrival in a new labour market (Abramitzky et al., 2021). Furthermore, Chetty et al., 2020 find worse absolute mobility outcomes for American Indians. In a similar vein, our estimates show that Indigenous students have low test scores levels across parental income. In addition, we find that Indigenous students have the largest P90-P10 gap, at around 0.7σ. Since cognitive skills are related to future earnings, our work suggests that one way to improve economic opportunity across race is to target early stage inequalities in human capital accumulation across race.

6.3. Mechanisms

We then focus on understanding what factors explain the income-achievement gap across the four groups of students. To do so we utilize the richness of our administrative dataset and include different controls such as: school characteristics, peer characteristics, and individual student information. Table 2 presents the results for the Grade 4 exams. For reference, Column (1) contains the estimates for the raw P90-P10 achievement gaps, which were presented in the discussion of Figure 1 above.

To start, we investigate whether school resources can explain the income-achievement gaps we estimate. In British Columbia, school districts get funding largely from the provincial government, according to a formula that gives the same amount per full-time student equivalent. There is no available data on how monetary resources are distributed from a school district to individual schools, but there is data on average class size by school. Jackson et al. (2016) show that part of the benefits of increased school funding come through smaller class sizes. In Column (2), we include as controls average class

Figure 1: Income-Achievement Gaps in Grade 4

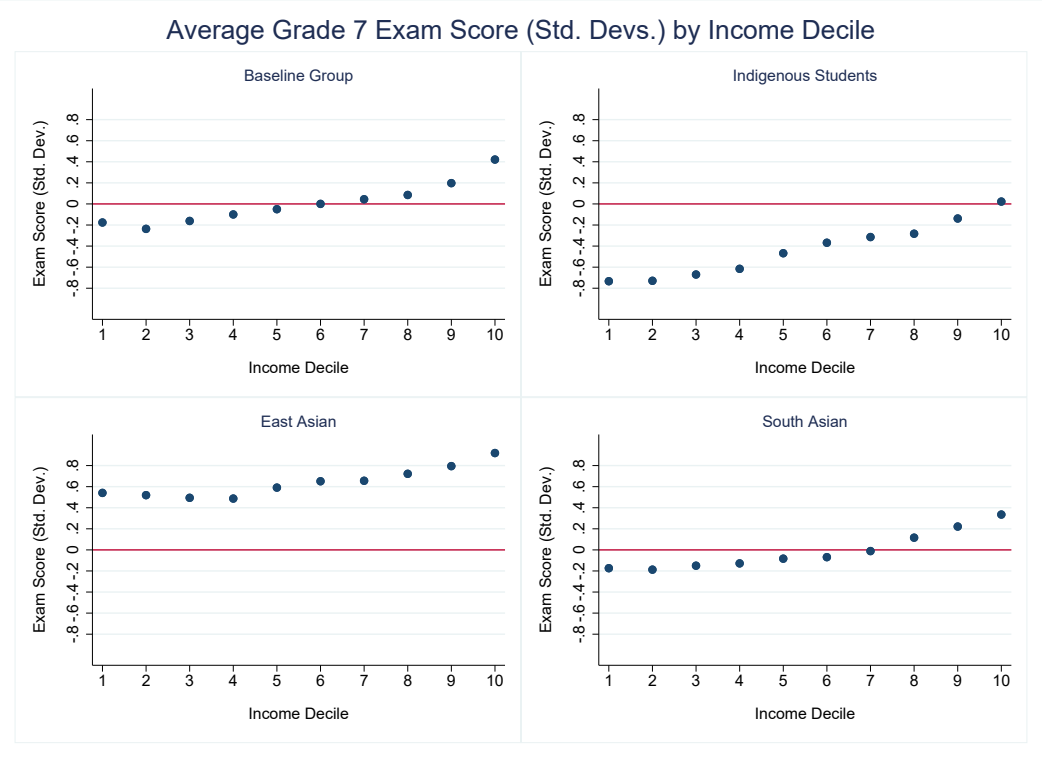


Notes: Each figure plots the average Grade 4 FSA score across both reading and numeracy by each income decile. Top left figure is for the baseline group of students, who speak English at home. Top right figure is for Indigenous students. Bottom left figure is for students speaking Chinese or Korean at home. Bottom right figure is for students speaking a South Asian language at home. Income deciles are calculated from before-tax household income and the deciles are calculated across the entire cohort of students.
Source: Author's own calculations using data from B.C. Minister of Education, Statistics Canada.

sizes in the schools (British Columbia Data Catalogue, 2023). Class size reduces the income-achievement gap for our Baseline and East Asian students by about 10-15%. For South Asian students, class sizes matter more with the P90-P10 gap falling from 0.61σ to 0.49σ. On the other hand, class size does not seem to be important for the Indigenous P90-P10 gap, which only changes to 0.65σ.

There are several other factors besides class size at the school level that we cannot observe, such as quality of teachers. In Column (3), we include school fixed effects only and the P90-P10 achievement gaps fall by around 20-30% across all student groups. Thus, the sorting of high income parents into good quality schools explains a significant proportion of the raw P90-P10 achievement gap. As discussed in Section 2, British Columbia has a traditional public school system with catchment schools. Given that school quality is capitalized into house prices (Black, 1999), higher-income families are more likely to live in good school catchments. While British Columbia does have an open-enrolment policy, Friesen et al. (2015) showed that in 2006, the majority of students still attended their in-catchment school. Focusing on Indigenous students, the importance of

Figure 2: Income-Achievement Gaps in Grade 7



Notes: Each figure plots the average Grade 7 FSA score across both reading and numeracy by each income decile. Top left figure is for the baseline group of students, who speak English at home. Top right figure is for Indigenous students. Bottom left figure is for students speaking Chinese or Korean at home. Bottom right figure is for students speaking a South Asian language at home. Income deciles are calculated from before-tax household income and the deciles are calculated across the entire cohort of students.
Source: Author's own calculations using data from B.C. Minister of Education, Statistics Canada.

school fixed effects in explaining the P90-P10 gap is in line with work by Friesen et al. (2010b) who study the test score gap between Indigenous and non-Indigenous students. They show that school characteristics account for around half of the raw difference in the Indigenous and non-Indigenous test score gap.

Another factor that may be correlated with both parental income and test scores is peer composition. In earlier work, Friesen et al. (2010b) do not find that peer composition is an important factor in explaining the Indigenous test score gap. However, Friesen et al. (2011) do find that having more Chinese speaking peers raises the test scores of Chinese students, while having more Punjabi speaking peers lowers the test scores of Punjabi students. In Column (4) we keep school fixed effects and then include variables to capture peer effects: the percentage of Baseline, Indigenous, East Asian, and South Asian students in a grade-school-year. Note that we cannot see the classroom assignments of students and therefore, our peer effects capture interactions among students of the same grade in a school, including those in the same classroom. Comparing Column (4) to Column (3), we see that adding peer fixed effects explains very little of the P90-P10 gap above what

school fixed effects did. The coefficients do not change. This could be because there is little fluctuation in the composition of peers from year to year within a school-grade, and so school fixed effects essentially capture peer effects as well.

In Column (5) we keep school fixed effects as a control, but add in an indicator variable for if a student is ESL. Since our student population includes those who speak a language besides English at home, many of them may be immigrants who are learning English. As expected, ESL status does little to explain the income-achievement gap for English-Language students. However, ESL status explains about ten percent of the P90-P10 Indigenous gap, reducing it from 0.49 to 0.44σ. More striking, for East Asian students, including a control for ESL reduces the P90-P10 gap from 0.29 to 0.14σ. For South Asians, the gap falls from 0.42 to 0.32σ.

Table 2: Income Achievement Gaps: English-Language, Indigenous, East Asian, and South Asian Students

	Grade 4					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Baseline						
P90-P10	0.54***	0.46***	0.34***	0.34***	0.33***	0.31***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
N	113170	92410	113170	113170	113170	113170
R^2	0.040	0.037	0.184	0.184	0.186	0.216
Panel B: Indigenous						
P90-P10	0.69***	0.65***	0.49***	0.49***	0.44***	0.44***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
N	19820	17950	19820	19820	19820	19820
R^2	0.055	0.059	0.243	0.243	0.280	0.270
Panel C: East Asian						
P90-P10	0.37***	0.33***	0.29***	0.29***	0.14***	0.29***
	(0.04)	(0.05)	(0.04)	(0.04)	(0.03)	(0.04)
N	11630	9520	11630	11630	11630	11630
R^2	0.025	0.026	0.156	0.157	0.219	0.175
Panel D: South Asian						
P90-P10	0.61***	0.49***	0.42***	0.42***	0.32***	0.41***
	(0.08)	(0.08)	(0.07)	(0.07)	(0.06)	(0.06)
N	12560	10350	12560	12560	12560	12560
R^2	0.013	0.021	0.294	0.294	0.334	0.314
Average School Size	No	Yes	No	No	No	No
School Fixed Effects	No	No	Yes	Yes	Yes	Yes
Peer Effects	No	No	Yes	No	No	No
English as a Second Language	No	No	No	No	Yes	No
Special Needs Status	No	No	No	No	No	Yes

Notes: This table presents the average test score gap in standard deviation units between the top and bottom income decile for the Grade 4 FSA. FSA scores are averaged across subjects. Column (1) presents results with No Controls, Column (2) adds school fixed effects, with peer effects also included in Column (3). Column (4) includes school fixed effects and an indicator for whether the student is English as a Second Language. Column (5) includes school fixed effects and an indicator for whether the student has special needs. Panel A presents the P90-P10 gap for our "baseline" group: students who speak English at home. Results for Indigenous students are in Panel B. Panel C presents results for East Asian students and Panel D for South Asian students. In the case of multiple FSA attempts, the first attempt is used. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

To get a deeper understanding of how ESL status affects income-achievement gaps, we present the percentage of ESL students by income quintile for our four student groups in Figure 3.[13] As expected, for our baseline group of students, very few are ESL since they speak English at home. For the rest of the students, there is a clear link between ESL status and income. Twenty percent of Indigenous students from families in the bottom income quintile are ESL compared to around five percent in the top income quintile. For East Asian speaking and South Asian speaking students, the relationship is even starker. We see that the majority of both groups in the bottom income quintile are ESL students. Thus, the relationship between income and ESL explains why when controlling for ESL status, the income-achievement gap falls substantially.

Lastly, in Column (6) of Table 2 we add an indicator for special needs status. Controlling for special needs has little effect on the P90-P10 achievement gap (comparing Columns (4) and (6)) except for Indigenous students. For them, the gap falls from 0.49 to 0.44σ. The link between special needs and income is highlighted in Figure 4, which presents the proportion of special needs students by income quintile for each student group. Almost forty percent of Indigenous students in the bottom income quintile have special needs in comparison to twenty percent in the top income quintile. This explains why controlling for special needs status reduces the P90-P10 income achievement gap for Indigenous students but not for other groups of students. The higher prevalence of special needs among Indigenous students is related to work on the health disparities between Indigenous and non-Indigenous children.[14] Work by Smylie, 2012 highlights that the rate of pre-term births and low-weight births among Indigenous mothers is higher compared to the rate for all Canadians, and both these conditions may lead to developmental disabilities. We also find that there is a pronounced decrease in the rate of special needs diagnosis for Indigenous students as income increases. In line with our findings, Booth et al. (2008), Frohlich et al. (2006), and Hajizadeh et al. (2018) document a large health gap between Indigenous and non-Indigenous Canadians, of which income can be an important mediator.

6.4. Achievement Gaps across Time and Subject

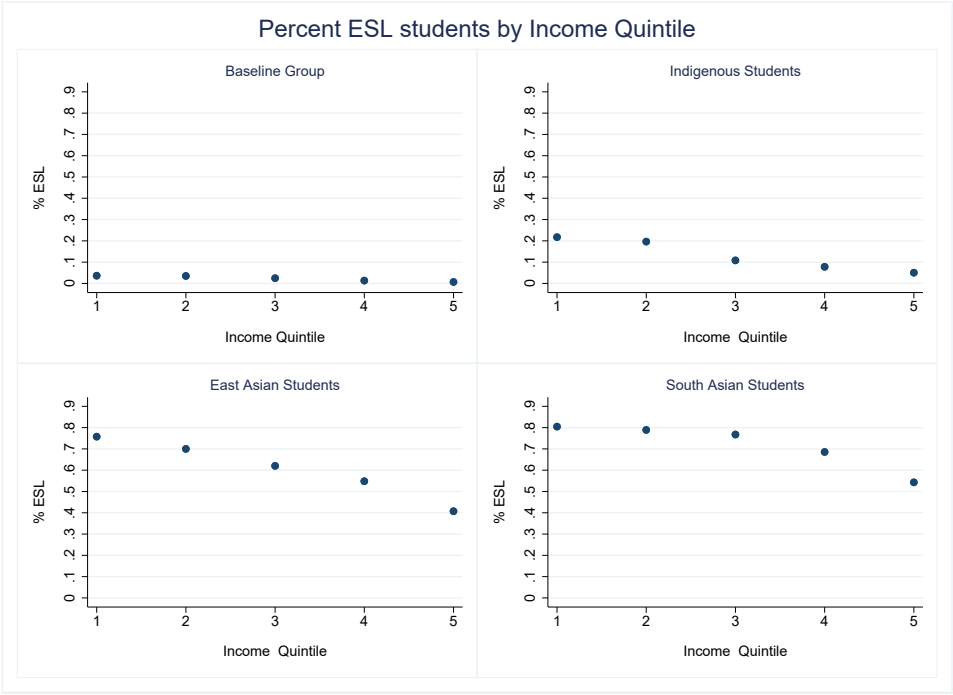
We now study how income-achievement gaps vary by subject and across time. Panel A (B) in Table 3 presents the raw P90-P10 gaps in numeracy (reading) results for Grade 4, and Panel C (D) presents the raw P90-P10 gaps in numeracy (reading) results for Grade 7.

We start by discussing subject differences. First, for English Language speakers, there is more inequality in test scores by income for numeracy with a gap of 0.59σ in Grade

[13] Due to data disclosure reasons we use income quintiles here instead of deciles.

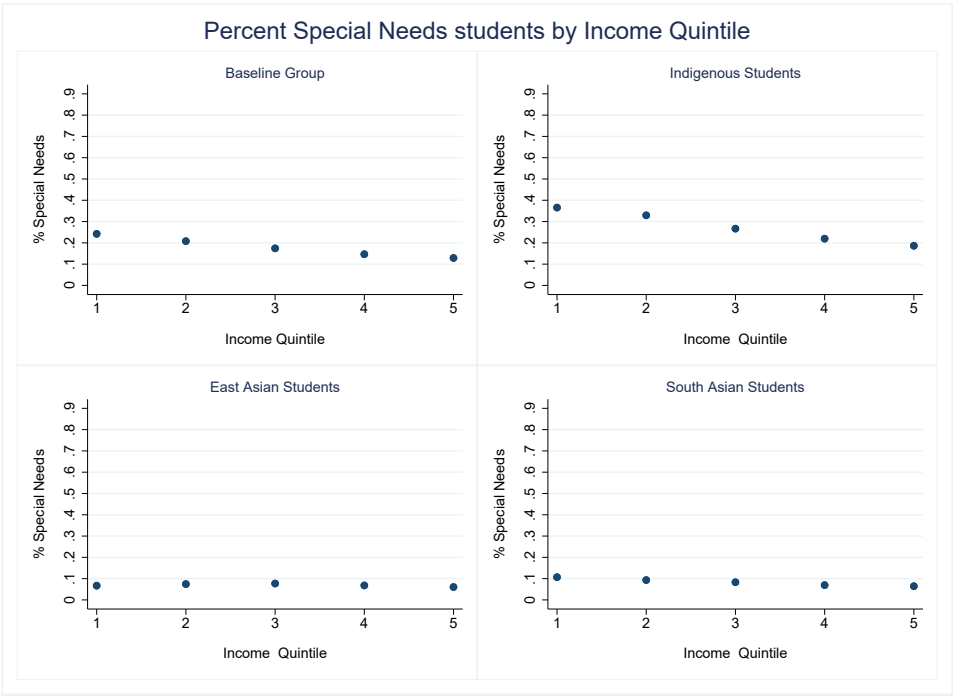
[14] Relatedly, Elder et al. (2021) study the identification of special needs students among Black and Hipsanic children in the United States.

Figure 3



Notes: Each figure plots the share of ESL students each income quintile. Top left figure is for the baseline group of students, who speak English at home. Top right figure is for Indigenous students. Bottom left figure is for students speaking Chinese or Korean at home. Bottom right figure is for students speaking a South Asian language at home. Income quintiles are calculated from before-tax household income and the quintiles are calculated across the entire cohort of students.
Source: Author's own calculations using data from B.C. Minister of Education, Statistics Canada.

Figure 4



Notes: Each figure plots the share of special needs students each income quintile. Top left figure is for the baseline group of students, who speak English at home. Top right figure is for Indigenous students. Bottom left figure is for students speaking Chinese or Korean at home. Bottom right figure is for students speaking a South Asian language at home. Income quintiles are calculated from before-tax household income and the quintiles are calculated across the entire cohort of students.
Source: Author's own calculations using data from B.C. Minister of Education, Statistics Canada.

4 (Column (1) Panel A) compared to 0.49σ in reading (Column (1) Panel B). On the contrary, the P90-P10 gap for Indigenous students is large for both numeracy (Column (2) Panel A) and reading (Column (2) Panel A) at around 0.7σ.

Differences across subjects are most pronounced for East Asian students. In Grade 4, the East Asian P90-P10 gap in numeracy is 0.33σ (Column (3) Panel A) compared to 0.48σ in reading (Column (3) Panel A). Relatedly, previous work has documented that East Asian students outperform other racial groups in mathemathics (Kao, 1995). Part of this difference may stem from the fact that lower-income East Asian students are more likely to be ESL and thus may struggle more in reading comprehension. For South Asian students, we also see slightly higher gaps in reading though there is less of a difference (Column (4) of Panel A and B).

How do the income-achievement gaps change as students progress through school? Jerrim et al., 2012 study the difference in achievement gaps by socioeconomic status for Canada and find no significant increase from ages ten to fifteen.[15] However, we find that the gaps from Grade 4 to Grade 7 change differently by subject and student group. For English Language students, the Numeracy gap widens by 0.1σ, to 0.69σ (Panel C Column (1)) while the Reading gap only grows slightly, to 0.52σ (Panel D Column (1)). We saw in Grade 4 that Indigenous students have the largest P90-P10 gap among the groups of students we study and this holds true in Grade 7 as well. The P90-P10 gap in Reading for Indigenous students grows to 0.76σ in Grade 7 (Panel D Column (2)). For East Asian students the gap in Numeracy in Grade 7 falls to 0.29σ (Panel C Column (3)) while the reading gap is similar at 0.46σ (Panel D Column (3)). For South Asian students, the gap in numeracy narrows to 0.46σ (Panel C Column (4)) while the gap in reading stays around 0.54σ (Panel D Column (4)).

In summary, our findings point to important differences in the relationship between income and achievement across different minority groups. For Indigenous students, there is the biggest disparity in test scores across income, while the gap for East Asian students is almost twice as small. Students who speak English at home and South Asian students have similar income-achievement gaps. These gaps arise by the fourth grade, when children are aged nine, and they persist into the seventh grade, three years later.

[15] While they use parental education and number of books at home as a measure of socioeconomic status, we use before-tax household income. We also use panel data and our time frame is from ages nine to twelve.

Table 3: Income-Achievement Gaps by Subject Across Grades 4 and 7

Panel A: Grade 4 Numeracy				
	English Language	Indigenous	East Asian	South Asian
	(1)	(2)	(3)	(4)
P90-P10	0.59***	0.71***	0.33***	0.61***
	(0.02)	(0.05)	(0.04)	(0.10)
Number of Students	113860	20100	11820	12630
R^2	0.04	0.04	0.02	0.01
Panel B: Grade 4 Reading				
	English Language	Indigenous	East Asian	South Asian
	(1)	(2)	(3)	(4)
P90-P10	0.49***	0.69***	0.48***	0.62***
	(0.02)	(0.05)	(0.05)	(0.08)
Number of Students	114320	20190	11690	12630
R^2	0.03	0.04	0.02	0.01
Panel C: Grade 7 Numeracy				
	English Language	Indigenous	East Asian	South Asian
	(1)	(2)	(3)	(4)
P90-P10	0.69 ***	0.73***	0.29***	0.39 ***
	(0.03)	(0.05)	(0.05)	(0.09)
Number of Students	105060	18010	12260	12660
R^2	0.05	0.06	0.02	0.01
Panel D: Grade 7 Reading				
	English Language	Indigenous	East Asian	South Asian
	(1)	(2)	(3)	(4)
P90-P10	0.52***	0.76***	0.46***	0.54***
	(0.02)	(0.06)	(0.04)	(0.07)
Number of Students	105940	18290	12240	12710
R^2	0.03	0.05	0.020	0.01

Notes: P90-P10 achievement gaps by for numeracy (reading) for Grade 4 in Panel A (B). P90-P10 achievement gaps by for numeracy (reading) for Grade 7 in Panel C(D). Columns (1)-(4) present the raw P90-P10 gaps for English Language, Indigenous, East Asian and South Asian students. Standard errors in parentheses. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

6.5. The Income-Achievement gap among Indigenous students

The results presented thus far highlight that there is variation in the relationship between parental income and test scores across race. The findings that especially stand out are for Indigenous students: they have low levels of test scores across all parental income deciles and the largest income-achievement gap. We further investigate the mechanisms driving the results for Indigenous students in this section.

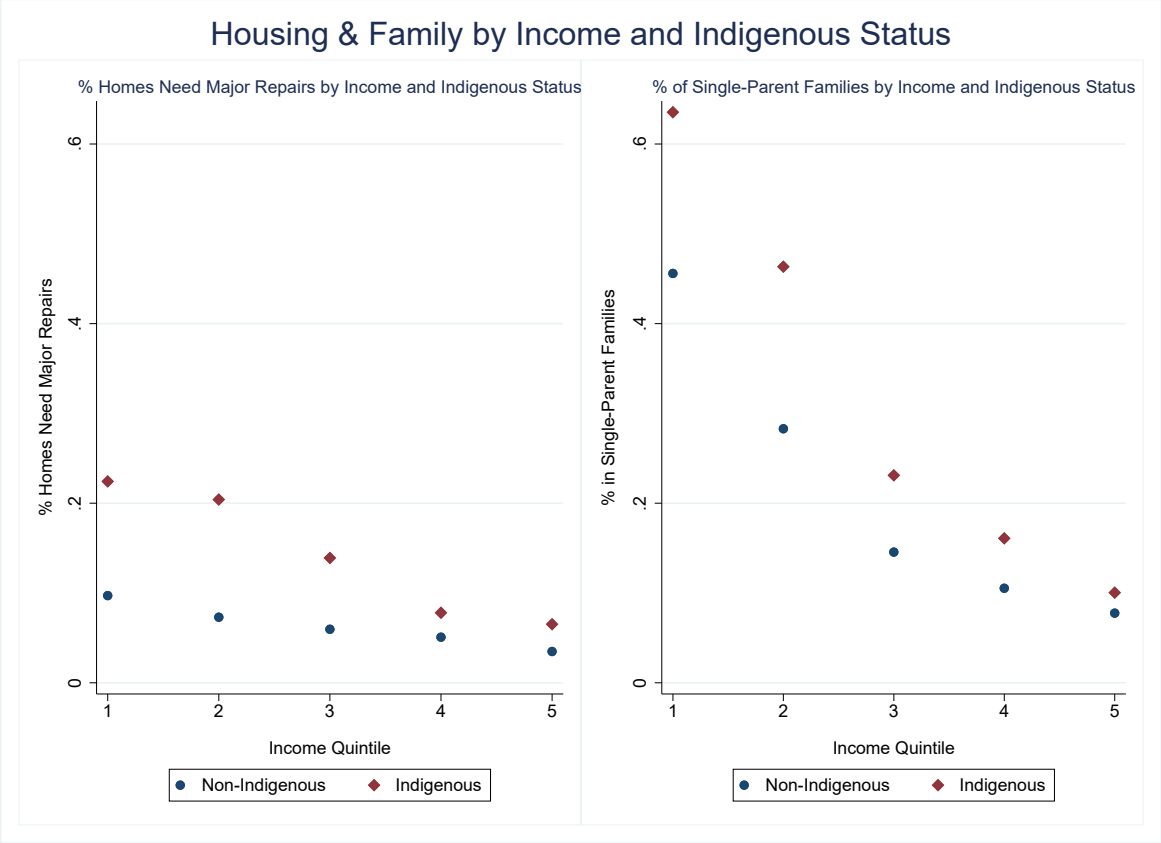
Census Linkage: To start, we use the Census linkage to study the housing conditions and family structure of Indigenous versus non-Indigenous students. Previous research has emphasized that Indigenous people are more likely to live in unsuitable housing (Shapiro et al., 2021). The 2016 Census asks respondents to identify whether their dwelling needs major repairs, defined as a home where plumbing or electrical wiring is not functioning properly, or where structural repairs are required.

In the left graph of Figure 5 we plot the percentage of children living in homes that need major repairs across income quintiles and by Indigenous status. Conditional on being in the same quintile of the income distribution, Indigenous children have far worse housing conditions than non-Indigenous children. For instance, for families in the bottom income quintile, around 25% of Indigenous children live in a dwelling needing major repairs while only around 10% of Non-Indigenous children do. The difference in the share of Indigenous versus non-Indigenous children living in unsuitable housing falls drastically as the income quintiles increase. The right graph of Figure 5 shows the percentage of Indigenous and non-Indigenous children with single-parent families across income quintiles. Over 50% of Indigenous students in the bottom quintile live in a single-parent family compared with close to 40% for non-Indigenous children. Again, the gap between Indigenous and non-Indigenous children narrows across the income quintiles.

In Table A.3 in the Appendix we calculate the raw P80-P20 gap for Indigenous students in the census and add in separately as controls, an indicator for major repairs in Column (2), and an indicator for single-parent family in Column (3). Controlling for major repairs, the point estimate of the P80-P20 gap falls only slightly from 0.69 to 0.67, while controlling for single-parent, the gap falls to 0.63.

Thus, we show that family structure and possibly housing quality may play a role in the large income-achievement gap among Indigenous students. Ferrer et al. (2018) show that children who change from intact to non-intact families have worse performance on reading test scores. Single parents may have less resources, or there may be family conflicts that create a stressful childhood environment(Amato, 2000). In addition, safe housing conditions are crucial for child development. In the United States, Howell et al. (2005) found that children living in low-quality housing were more likely to develop asthma, which is associated with absenteeism from school and can be disruptive to skill development (Kinney et al., 2002).

Figure 5



Notes: The left figure plots the share of students from each income quintile who live in a house that needs major repairs by Indigenous status. Major repairs are defined as defective electrical wiring, plumbing, or structure. The right figure plots the share of students from each income quintile who live with a single parent. Indigenous classification is based on the 2016 Census. Income quintiles are calculated from before-tax household income and the quintiles are calculated across the entire cohort of students.
Source: Author's own calculations using data from B.C. Minister of Education, Statistics Canada.

Indigenous Students On-Reserves: Our administrative education data contains information on whether students live on reserves. Previous work has documented that Indigenous people living on-reserve have on average lower incomes, and higher unemployment (Milke, 2011) than those living off-reserves. We study whether there are heterogeneous income-achievement relationships for Indigenous students living on versus off-reserve by interacting an indicator for on-reserve living with income quintiles (we use quintiles due to sample size limitations). Table A.4 in the Appendix presents the results. Column (1) is without school fixed effects while Column (2) includes them. Starting with Column (1), the coefficient for the indicator on reserves is -0.38 and significant at the 5% level, indicating that on-reserve Indigenous students have lower test scores on average than off-reserve ones. There is not any difference in the P80-P20 gap: the on-reserve indicator interacted with an indicator for the fifth income quintile is not significant. With school fixed effects included in Column (2), the indicator on reserves falls to -0.28, indicating that on-reserve students have worse outcomes in part because of differences in school quality. However, we find no heterogeneity in the P80-P20 gap.

Special Needs Status and School Resources: In Section 6.3 we showed that a contributing factor to the large Indigenous income-achievement gap was the high rates of special needs diagnoses among these students. Here, we investigate whether the importance of special needs status in explaining the Indigenous income-achievement gap differs based on funding. At the district level, funding for special needs is provided on a per-student basis, with different rates depending on the kind of special need. At the school level, we proxy for resources using average class size as in Section 6. We rerun our estimates of the income-achievement gap for Indigenous students but split our sample into the subsample of students who attend a school below and above the median class size. For each subsample, we estimate the raw income-achievement gap, and the income-achievement gap with special needs controls included.

Columns (1) and (2) of Table A.5 in the Appendix show the results for the raw Indigenous P80-P20 gap and the gap when special needs status is controlled for, respectively, for schools with class sizes below the median. Columns (3) and (4) use the same specifications, but for schools with class sizes above the median. In all, we do not find that controlling for special needs affects the P80-P20 gap differently depending on average class size. This suggests that monetary resources - at least those that go towards smaller class sizes, will not help reduce the income-achievement gap for Indigenous students.

7. Robustness

Census Race Classification: To get a more accurate measure of race, we can restrict our sample to those who are linked to the census. The census has a question explicitly asking for the visible minority group that a student belongs to. We recalculate our income-achievement gaps using racial groups based on the census definition, but do not find large differences in our results. Section A.2 in the Appendix goes into more details on the estimation and presents the results.

Alternative Measures of Income: Here we show that our results are robust to two different definitions of income. In our main results, the measure of income we used was before-tax household income. We check the sensitivity of our results using after-tax household income. We group our students into deciles based on the after-tax household income across the entire distribution. Then,we separately calculate the P90-P10 gaps using our new definition of income for each student group. In Panel A of Table A.6 in the Appendix we have our original P90-P10 estimates using before-tax household income for comparison, and Panel B presents the new P90-P10 gap estimates using after-tax household income results. Comparing our estimates between Panel A and Panel B, we see that using after-tax household income hardly changes our results. The P90-P10 gaps for each group of students is essentially the same as our original estimates.

Another check we do is to scale our measure of income by household size. Children in our dataset come from families varying in size and a household income of $40,000 for a family of three is not equivalent to the same income for a family of six. Controlling for household size may also be important since one of our subgroups of interest is Indigenous students. The Indigenous population in Canada has lower-income and higher birth rates than non-Indigenous people (Smylie et al., 2014). Therefore, using income that is not scaled by household size may overstate the resources that can be allocated to each child in the family. We follow the Statistics Canada guidelines for scaling and divide after-tax household income by the square root of family size, which takes into consideration that resources can be shared among household members[16]. We then calculate each student's decile of scaled after-tax family income across all students.

Panel C of Table A.6 presents our results using the scaled measure of income. Again, using this definition of income does not changes our measures of the P90-P10 gap substantially. Thus, our estimates of the income-achievement gap across racial groups are robust to different definitions of income.

[16]See https://www23.statcan.gc.ca/imdb/p3Var.pl?Function=DEC&Id=103386

8. Conclusion

In this paper we studied the income-achievement gaps among race using administrative education data from British Columbia. We find income-achievement gaps between the bottom and top income decile ranging from 0.37 to 0.7σ at age nine. The range in gaps widens slightly when children are aged 12. While these magnitudes are lower than the average of around one standard deviation documented for the United States, there is important heterogeneity.

East Asian students have the lowest income-achievement gaps and the highest level of test scores, while Indigenous students have the highest gaps and the lowest level of test scores. We note that school factors explains a significant part of the income-achievement gap across all student groups, while ESL status is important for East Asian and South Asian students.

We are able to link the high income-achievement gap among Indigenous students to special needs status: conditional on being low-income, Indigenous students are much more likely to be diagnosed with special needs. Further, we present some suggestive evidence that the gap may also be associated with family structure. In all, our findings point to the need for policies targeted at creating more equitable outcomes for Indigenous students, and students with special needs.

References

Abramitzky, Ran, Leah Boustan, Elisa Jácome, and Santiago Pérez, "Intergenerational mobility of immigrants in the United States over two centuries", *American Economic Review* 111 (2021), 580–608.

Akee, Randall, Maggie R Jones, and Sonya R Porter, "Race matters: Income shares, income inequality, and income mobility for all US races", *Demography* 56 (2019), 999–1021.

Amato, Paul R, "The consequences of divorce for adults and children", *Journal of marriage and family* 62 (2000), 1269–1287.

Barber, Michael and Maggie EC Jones, "Inequalities in test scores between Indigenous and non-Indigenous youth in Canada", *Economics of Education Review* 83 (2021), 102139.

BC Ministry of Education and Child Care, *K to 12 Student Demographics and Achievements Data set*, 2021.

Bhattacharya, Debopam and Bhashkar Mazumder, "A nonparametric analysis of black–white differences in intergenerational income mobility in the United States", *Quantitative Economics* 2 (2011), 335–379.

Biasi, Barbara, "School Finance Equalization Increases Intergenerational Mobility", *Journal of Labor Economics* 0 (2022), null, DOI: 10.1086/718980, eprint: https://doi.org/10.1086/718980, URL: https://doi.org/10.1086/718980.

Black, Sandra E, "Do better schools matter? Parental valuation of elementary education", *The quarterly journal of economics* 114 (1999), 577–599.

Booth, Alison L and Nick Carroll, "Economic status and the Indigenous/non-Indigenous health gap", *Economics Letters* 99 (2008), 604–606.

Boynton, Sean, *BCTF says parents can opt out of FSA test, despite school boards saying it's mandatory*, 2019, URL: https://globalnews.ca/news/5952017/fsa-testing-fight-bc/ (visited on 04/15/2022).

Bradbury, Bruce, Jane Waldfogel, and Elizabeth Washbrook, "Income-related gaps in early child cognitive development: Why are they larger in the United States than in the United Kingdom, Australia, and Canada?", *Demography* 56 (2019), 367–390.

British Columbia Data Catalogue, *BC Schools - Class Size; Class Size Definitions*, 2023, URL: https://catalogue.data.gov.bc.ca/dataset/bc-schools-class-size/resource/3c830c70-2866-4523-88a8-fc34a0f77f2e.

Card, David and Jesse Rothstein, "Racial segregation and the black–white test score gap", *Journal of Public Economics* 91 (2007), 2158–2184.

Carneiro, Pedro Manuel and James J Heckman, "Human capital policy" (2003).

Chetty, Raj, John N Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan, "How does your kindergarten classroom affect your

earnings? Evidence from Project STAR", *The Quarterly journal of economics* 126 (2011), 1593–1660.

Chetty, Raj, Nathaniel Hendren, Maggie R Jones, and Sonya R Porter, "Race and economic opportunity in the United States: An intergenerational perspective", *The Quarterly Journal of Economics* 135 (2020), 711–783.

Chmielewski, Anna K and Sean F Reardon, "Patterns of cross-national variation in the association between income and academic achievement", *Aera Open* 2 (2016), 2332858416649593.

Collins, William J and Marianne H Wanamaker, *African American intergenerational economic mobility since 1880*, tech. rep., National Bureau of Economic Research, 2017.

Connolly, Marie, Miles Corak, and Catherine Haeck, "Intergenerational Mobility between and within Canada and the United States", *Journal of Labor Economics* 37 (2019), S595–S641.

Currie, Janet and Duncan Thomas, "Early test scores, school quality and SES: Longrun effects on wage and employment outcomes", *Worker wellbeing in a changing labor market*, Emerald Group Publishing Limited, 2001.

Dahl, Gordon B and Lance Lochner, "The impact of family income on child achievement: Evidence from the earned income tax credit", *American Economic Review* 102 (2012), 1927–1956.

Durlauf, Steven N, "A theory of persistent income inequality", *Journal of Economic growth* 1 (1996), 75–93.

Durlauf, Steven N et al., *Neighborhood feedbacks, endogenous stratification, and income inequality*, Social Systems Research Institute, University of Wisconsin, 1993.

Eckert, Fabian and Tatjana Kleineberg, "Can We Save the American Dream?" (2019).

Elder, Todd E, David N Figlio, Scott A Imberman, and Claudia L Persico, "School segregation and racial gaps in special education identification", *Journal of Labor Economics* 39 (2021), S151–S197.

Fernandez, Raquel and Richard Rogerson, "Income distribution, communities, and the quality of public education", *The Quarterly Journal of Economics* 111 (1996), 135–164.

— "Public education and income distribution: A dynamic quantitative evaluation of education-finance reform", *American Economic Review* (1998), 813–833.

Ferrer, Ana M and Yazhuo Pan, *Family structure and child cognitive outcomes: Evidence from Canadian longitudinal data*, tech. rep., Working Paper Series, 2018.

Friesen, Jane, Benjamin Harris, and Simon D Woodcock, "Expanding school choice through open enrolment: Lessons from british columbia", *CD Howe Institute Commentary* (2015).

Friesen, Jane, Ross Hickey, and Brian Krauth, "Disabled peers and academic achievement", *Education Finance and Policy* 5 (2010), 317–348.

Friesen, Jane and Brian Krauth, "Ethnic enclaves in the classroom", *Labour Economics* 18 (2011), 656–663.

— "Sorting, peers, and achievement of Aboriginal students in British Columbia", *Canadian Journal of Economics/Revue canadienne d'économique* 43 (2010), 1273–1301.

Frohlich, Katherine L, Nancy Ross, and Chantelle Richmond, "Health disparities in Canada today: Some evidence and a theoretical framework", *Health policy* 79 (2006), 132–143.

Fryer Jr, Roland G and Steven D Levitt, "Understanding the black-white test score gap in the first two years of school", *Review of economics and statistics* 86 (2004), 447–464.

Haeck, Catherine and Pierre Lefebvre, "Trends in Cognitive Skill Inequalities by Socio-Economic Status across Canada", *Canadian Public Policy* 47 (2021), 88–116.

Hajizadeh, Mohammad, Min Hu, Amy Bombay, and Yukiko Asada, "Socioeconomic inequalities in health among Indigenous peoples living off-reserve in Canada: trends and determinants", *Health Policy* 122 (2018), 854–865.

Hanushek, Eric A, "The economic value of education and cognitive skills", *Handbook of education policy research* (2009), 39–56.

Hanushek, Eric A, Paul E Peterson, Laura M Talpey, and Ludger Woessmann, *Long-run trends in the US SES-achievement gap*, tech. rep., National Bureau of Economic Research, 2020.

— *The unwavering SES achievement gap: Trends in US student performance*, tech. rep., National Bureau of Economic Research, 2019.

Hanushek, Eric A and Ludger Woessmann, "The economics of international differences in educational achievement", *Handbook of the Economics of Education* 3 (2011), 89–200.

Heckman, James J, Alan B Krueger, et al., "Inequality in America: What role for human capital policies?", *MIT Press Books* 1 (2005).

Heckman, James J, Seong Hyeok Moon, Rodrigo Pinto, Peter A Savelyev, and Adam Yavitz, "The rate of return to the HighScope Perry Preschool Program", *Journal of public Economics* 94 (2010), 114–128.

Heckman, James J, Jora Stixrud, and Sergio Urzua, "The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior", *Journal of Labor economics* 24 (2006), 411–482.

Howell, Embry, Laura E Harris, and Susan J Popkin, "The health status of HOPE VI public housing residents", *Journal of health care for the poor and underserved* 16 (2005), 273–285.

Independent Funding Model Review Panel, *Improving Equity and Accountability*, 2018, URL: %5Curl%7Bhttps://www2.gov.bc.ca/assets/gov/education/administration/resource-management/k12funding/funding-model-review/independent_review_panel-final_report_2018.pdf%7D.

Jackson, C Kirabo, Rucker C Johnson, and Claudia Persico, "THE EFFECTS OF SCHOOL SPENDING ON EDUCATIONAL AND ECONOMIC OUTCOMES: EVIDENCE FROM SCHOOL FINANCE REFORMS", *The Quarterly Journal of Economics* 131 (2016), 157–218.

Jencks, Christopher and Meredith Phillips, *The Black-White test score gap*, Brookings Institution Press, 2011.

Jerrim, John, "Why do East Asian children perform so well in PISA? An investigation of Western-born children of East Asian descent", *Oxford Review of Education* 41 (2015), 310–333.

Jerrim, John and John Micklewright, "Children's cognitive ability and changes over age in the socioeconomic gradient", *Inequality from childhood to adulthood: a cross-national perspective on the transmission of advantage* (2012), 262–284.

Kao, Grace, "Asian Americans as Model Minorities? A Look at Their Academic Performance", *American Journal of Education* 103 (1995), 121–159, ISSN: 01956744, 15496511, URL: http://www.jstor.org/stable/1085574 (visited on 01/24/2023).

King, Malcolm, Alexandra Smith, and Michael Gracey, "Indigenous health part 2: the underlying causes of the health gap", *The lancet* 374 (2009), 76–85.

Kinney, Patrick L, Mary E Northridge, Ginger L Chew, Erik Gronning, Evelyn Joseph, Juan C Correa, Swati Prakash, and Inge Goldstein, "On the front lines: an environmental asthma intervention in New York City", *American Journal of Public Health* 92 (2002), 24–26.

Magnuson, Katherine, Jane Waldfogel, and EV Washbrook, "SES gradients in skills during the school years", *From parents to children: The intergenerational transmission of advantage*, Russell Sage Foundation, 2012, pp. 235–261.

Magnuson, Katherine A and Greg J Duncan, "The role of family socioeconomic resources in the black–white test score gap among young children", *Developmental Review* 26 (2006), 365–399.

McMahon, Tamsin, "https://www.macleans.ca/news/canada/why-fixing-first-nations-education-remains-so-far-out-of-reach/" (2014), URL: https://www.macleans.ca/news/canada/why-fixing-first-nations-education-remains-so-far-out-of-reach/ (visited on 01/31/2023).

Michelmore, Katherine and Susan Dynarski, "The gap within the gap: Using longitudinal data to understand income differences in educational outcomes", *AERA Open* 3 (2017), 2332858417692958.

Milke, Mark, "For many Aboriginals, life is better off-reserve" (2011).

Ministry of Education, *Operating Grants*, 2023, URL: https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/resource-management/k-12-funding-and-allocation/operating-grants.

Ministry of Education British Columbia, *Annual Budget Analysis and Revenue and Expenditure Tables Overview*, 2015, URL: http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs2018/683885/2015_16_analysis_overview.pdf.

Reardon, Sean F, "The widening academic achievement gap between the rich and the poor: New evidence and possible explanations", *Whither opportunity* 1 (2011), 91–116.

Richards, John G, Aidan R Vining, and David L Weimer, "Aboriginal performance on standardized tests: Evidence and analysis from provincial schools in British Columbia", *Policy Studies Journal* 38 (2010), 47–67.

Rothstein, Jesse and Nathan Wozny, "Permanent income and the black-white test score gap", *Journal of Human Resources* 48 (2013), 510–544.

Sandsør, Astrid Marie Jorde, Henrik Daae Zachrisson, Lynn A Karoly, and Eric Dearing, "Achievement Gaps by Parental Income and Education" (2021).

Shapiro, Gabriel D, Amanda J Sheppard, Angela Mashford-Pringle, Tracey Bushnik, Michael S Kramer, Jay S Kaufman, and Seungmi Yang, "Housing conditions and adverse birth outcomes among Indigenous people in Canada", *Canadian Journal of Public Health* 112 (2021), 903–911.

Skelton, Chad, *ESL students in the majority at more than 60 schools in Metro Vancouver*, July 2014, URL: https://vancouversun.com/news/metro/esl-students-in-the-majority-at-more-than-60-schools-in-metro-vancouver#:~:text=Of%20the%20560%2C000%20students%20attending,district%20and%20school%20to%20school. (visited on 04/15/2022).

Smylie, Janet, "Our babies, our future: Aboriginal birth outcomes in British Columbia" (2012).

Smylie, Janet and Dalla Lana, *Strong women, strong nations: Aboriginal maternal health in British Columbia*, National Collaborating Centre for Aboriginal Health Prince George, British ..., 2014.

Statistics Canada, *Aboriginal identity population by age groups median age and sex 2006 counts for both sexes for Canada provinces and territories - 20 sample data (table)*, 2008.

— *Education and Labour Market Longitudinal Platform and Associated Datasets*, 2021.

— *Highest level of educational attainment for the population aged 25 to 64 2006 counts for both sexes for Canada provinces and territories - 20 sample data (table).* 2008.

— *Table 18-10-0005-01*, 2023, URL: https://www2.gov.bc.ca/assets/gov/data/statistics/economy/cpi/cpi_annual_averages.pdf.

— *Visible minority groups 2006 counts for Canada provinces and territories - 20 sample data (table)*, 2008.

U.S. Department of Education, *Biennial Survey of Education in the United States, 1919-20 through 1949-50; Statistics of State School Systems, 1959-60 and 1969-70; Rev-*

enues and Expenditures for Public Elementary and Secondary Education, 1979-80; and Common Core of Data (CCD), "National Public Education Financial Survey," 1989-90 through 2013-14. 2016, URL: https://nces.ed.gov/programs/digest/d16/tables/dt16_235.10.asp.

Zheng, Angela and James Graham, "Public education inequality and intergenerational mobility", *American Economic Journal: Macroeconomics* 14 (2022), 250–282.

A. Online Appendix

A.1. Tables

Table A.1: Demographics in British Columbia and Canada, 2006 Census

	British Columbia	Canada
% Indigenous	4.8	3.7
% Chinese	10	3.9
% Southeast Asian	1.0	0.8
% South Asian	6.4	4.0
% Black	0.7	2.5
% No High School	12	15
% University Degree	23	24

Notes: Demographic shares from British Columbia in Column (1) and Canada overall in Column (2). *Source: Statistics Canada, 2008a; Statistics Canada, 2008c; Statistics Canada, 2008b*

Table A.2: Income-Achievement Gap by Baseline and Visible Minority Group

	(1) Grade 4 Test Score	(2) Grade 4 Test Score	(3) Grade 4 Test Score
P90-P10	0.53***	0.53***	0.53***
	(0.02)	(0.02)	(0.02)
P90-P10 · Indigenous	0.16***		
	(0.05)		
P90-P10 · East Asian		-0.16***	
		(0.04)	
P90-P10 · South Asian			0.08
			(0.08)
Indigenous	-0.49***		
	(0.03)		
East Asian		0.52***	
		(0.03)	
South Asian			-0.26**
			(0.08)
Constant	-0.12***	-0.12***	-0.12***
	(0.02)	(0.02)	(0.02)
N	133160	124970	125900
R^2	0.086	0.049	0.048

Notes: This table presents regression results that test the difference in income-achievement gaps between Baseline students and Indigenous (Column (1)), East Asian (Column (2)), and South Asian (Column (3)) students. Income deciles are interacted with an indicator for the minority group in question. Standard errors are in parentheses. The dependent variable is the average of Grade 4 numeracy and reading FSA in standard deviations. Income deciles are calculated from before-tax household income. $^{*}p < 0.05,^{**} p < 0.01,^{***} p < 0.001$. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

Table A.3: Indigenous Income-Achievement Gap: Housing and Family Composition Controls

	(1) Grade 4 Test Score	(2) Grade 4 Test Score	(3) Grade 4 Test Score
P80-P20	0.69***	0.67***	0.63***
	(0.06)	(0.05)	(0.06)
Controls	None	Major Repairs	Single-Parent
N	5030	5030	4850
R^2	0.060	0.063	0.060

Column (1) presents the raw P80-P20 estimates for Indigenous students in the Census. Column (2) includes an indicator for if the student lives in a dwelling that needs major repairs. Column (3) includes an indicator for if the student is from a single-parent family. Standard errors in parentheses. $^{*}p < 0.05,^{**} p < 0.01,^{***} p < 0.001$. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

Table A.4: Income-Achievement Gap for Indigenous Students by On/Off-Reserve

	(1) Grade 4 Test Score	(2) Grade 4 Test Score
P80-P20	0.59***	0.44***
	(0.03)	(0.03)
On-Reserve	-0.38***	-0.28***
	(0.05)	(0.04)
P80-P20 ·On-Reserve	-0.26	-0.10
	(0.14)	(0.12)
Constant	-0.56***	-0.53***
	(0.02)	(0.01)
School Fixed Effects	No	Yes
N	19820	19820
R^2	0.08	0.25

Notes: This table presents regression results that test for heterogeneity in the income-achievement gap between on versus off-reserve Indigenous students. Income quintiles are interacted with an indicator for an Indigenous student living on-reserve. Standard errors are in parentheses. The dependent variable is the average of Grade 4 numeracy and reading FSA in standard deviations. Income deciles are calculated from before-tax household income. $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

Table A.5: Income-Achievement Gap for Indigenous Students by Class Size

	(1) Grade 4 Test Score	(2) Grade 4 Test Score	(3) Grade 4 Test Score	(4) Grade 4 Test Score
P80-P20	0.65***	0.59***	0.63***	0.59***
	(0.07)	(0.07)	(0.04)	(0.04)
Special Needs		-0.36***		-0.36***
		(0.03)		(0.02)
Sample	Small Class Size	Small Class Size	Large Class Size	Large Class Size
N	7630	7630	12190	12190
R^2	0.051	0.084	0.053	0.081

Standard errors in parentheses
$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Notes: This table presents regression results that split the sample of Indigenous students into those attending schools with class sizes below the median (Columns (1) and (2)) and above the median (Columns (3) and (4)). Columns (1) and (3) present the raw P80-P20 gap, while Columns (2) and (4) include a control for special needs. Standard errors are in parentheses. The dependent variable is the average of Grade 4 numeracy and reading FSA in standard deviations. Income quintiles are calculated from before-tax household income. $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

Table A.6: Income Achievement Gaps: English-Language, Indigenous, East Asian, and South Asian Students: Different Measures of Income

	Grade 4			
	Baseline	Indigenous	East Asian	South Asian
	(1)	(2)	(3)	(4)
Panel A: Before- Tax				
P90-P10	0.54***	0.69***	0.37***	0.61***
	(0.02)	(0.04)	(0.04)	(0.08)
N	113170	19820	11630	12560
R^2	0.04	0.05	0.03	0.01
Panel B: After Tax				
P90-P10	0.55***	0.68***	0.38***	0.58***
	(0.02)	(0.04)	(0.04)	(0.08)
N	113170	19820	11630	12560
R^2	0.04	0.05	0.02	0.01
Panel C: After Tax Scaled by Family Size				
P90-P10	0.55***	0.71***	0.42***	0.55***
	(0.02)	(0.04)	(0.040)	(0.07)
N	110820	18970	11620	12540
R^2	0.04	0.06	0.03	0.01

Notes: This table presents the average test score gap in standard deviation units between the top and bottom income decile for the Grade 4 FSA. FSA scores are averaged across subjects. Column (1) presents estimates for the Basline group (those who speak English at home), Column (2) for Indigenous students, Column (3) for East Asian Students and Column (4) for South Asian Students. No controls are included. Panel A presents estimates where income deciles are computed across all students using before-tax household income. Panel B presents estimates where income deciles are computed across all students using after-tax household income. Panel C presents estimates where income deciles are computed across all students using after-tax household income scaled by family size. The scaling is done by dividing after-tax household income by the square root of family size. *Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

A.2. Results using the Census

The results in the main body of the paper characterized East Asian and South Asian students using language spoken at home. While it seems likely that students who speak an Asian language at home are likely to be of an East Asian or South Asian race, students who speak English at home may also be East or South Asian. Section 4 discussed possible biases from this measurement error. Here, we use the subsample of our data that is linked to the census. The census asks respondents to identify which visible minority group they belong in and we focus again on East Asian (Chinese/Korean)[17], South Asian and Indigenous students. As our baseline group, we use students who identify as White.

Figure A.1 below presents the average test score across both subjects in Grade 4 for White, Indigenous, East Asian, and South Asian students as defined by the Census. Due to the smaller sample size and data reporting guidelines, we bin income by before-tax household quintile (instead of decile). We see very similar patterns across race for the level of test scores and the income-achievement gradients in the census as previously reported using the administrative data. Namely, the slope of the gradient for East Asian students is the lowest among the four groups of students, and they also have the highest intercept. White and South Asian students have similar gradients, while Indigenous students have the lowest test scores in terms of level and also the steepest income gradients.

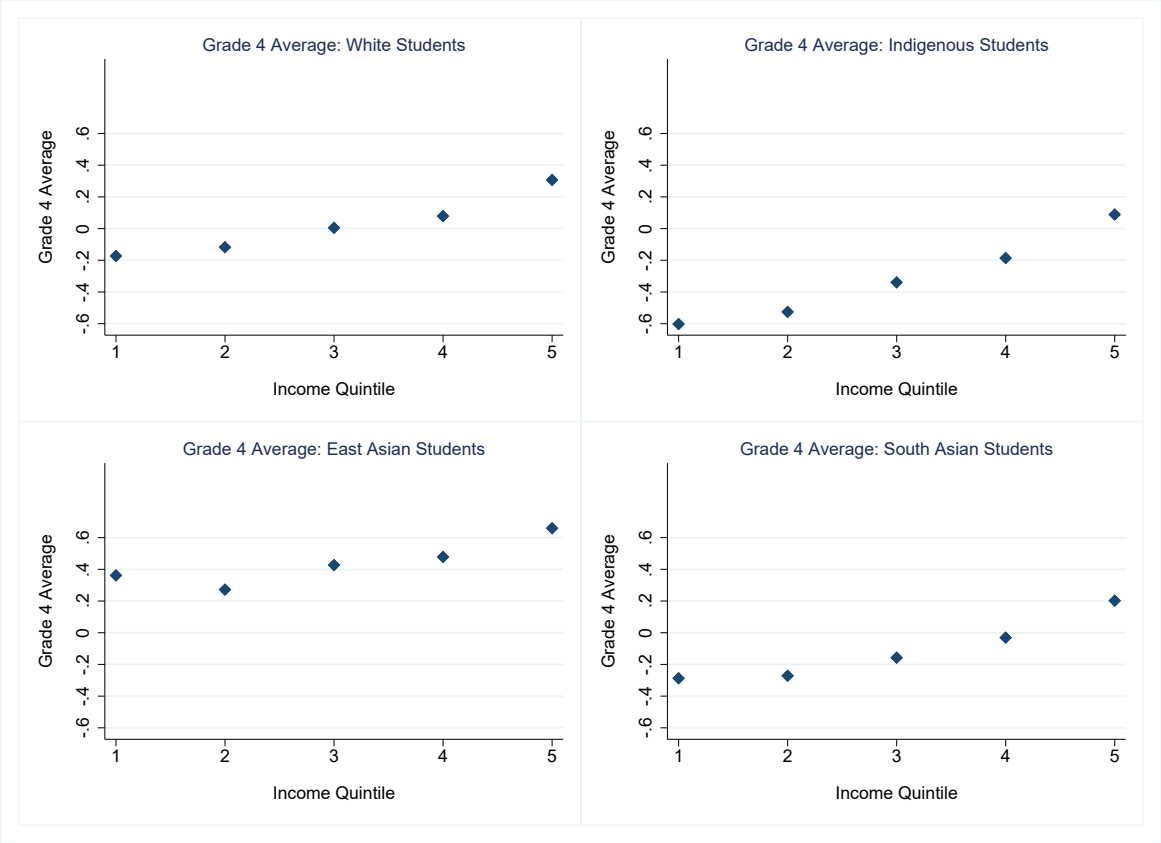
Table A.7 presents the average score in the top quintile relative to the bottom quintile (P80-P20 gap). The first column uses the administrative data and the definition of the student groups from that dataset. The second column presents P80-P20 estimates using the definitions of students from the census. We start with Panel A, which compares English-Language speaking students in Column (1) from the administrative data to students identifying as White in the Census in Column (2). We find similar estimates among these two groups. Over eighty percent of students who speak English at home identify as White in the Census and the remainder are mostly East Asian or South Asian. The P80-P20 gap for White students is similar to that for English-speaking students (0.48σ versus 0.47σ).

Panel B of Table A.7 calculates the P80-P20 gap for Indigenous students in the administrative data (Column (1)) and the Census (Column (2)). The Census point estimate is slightly higher, though not statistically significantly different. In Panel C, for East Asian students, we find that using the Census definition reduces the P80-P20 gap by 0.1σ. On the other hand, the gap for South Asian students (Panel D) only changes by 0.01 σ.

Thus, whether using language at home as a proxy for race from the administrative education data, or visible minority definitions from the census we find that the following facts are consistent: East Asian students have the smallest income-achievement gradients. The relationship between income and test scores is similar between White students and

[17]We select these two groups so that it matches with the language groups in the BC administrative data

Figure A.1: Income-Achievement Gaps: Census



Notes: Each figure plots the average Grade 4 FSA score across both reading and numeracy by each income quintile. Top left figure is for the group of students who identify as White. Top right figure is for Indigenous students. Bottom left figure is for students who are East Asian. Bottom right figure is for students who are South Asian. Visible minority classifications are based on the census. Income quintiles are calculated from before-tax household income and the quintiles are calculated across the entire cohort of students.
Source: Author's own calculations using data from B.C. Minister of Education, Statistics Canada.

South Asian students. Indigenous students have significantly larger income-achievement gaps.

A.3. Accessing the BCK-12 Data

The data used here comes from the the Education and Labour Market Longitudinal Platform (ELMLP) run by Statistics Canada. The ELMLP links administrative data on the education and labour market outcomes of Canadians. This paper utilized linkages of tax records to test scores from British Columbia and census responses. Other linkages available, but not utilized here include: apprenticeship information, post-secondary enrolment, student loans, and immigration records. For more information on accessing data from the ELMLP, see https://www150.statcan.gc.ca/n1/pub/37-20-

Table A.7: Grade 4 Income Achievement Gaps: Group classification from Administrative Data and Census

	(1) Admin	(2) Census
Panel A: English Language and White		
P80-P20	0.47***	0.48***
	(0.01)	(0.02)
N	113170	22410
R^2	0.04	0.04
Panel B: Indigenous		
P80-P20	0.65***	0.69***
	(0.03)	(0.06)
Number of Students	19820	5030
R^2	0.054	0.053
Panel C: East Asian		
P80-P20	0.38***	0.30***
	(0.03)	(0.04)
Number of Students	11630	4200
R^2	0.022	0.026
Panel D: South Asian		
P80-P20	0.48***	0.49***
	(0.05)	(0.06)
Number of Students	12560	4210
R^2	0.01	0.03

Notes: Column (1) presents the raw P80-P20 estimates using student classification groups from the Administrative data. Column (2) presents the raw P80-P20 estimates using student classification groups from the 2016 Census.*Source: BC Ministry of Education and Child Care (2021) and Statistics Canada (2021)*

0001/372000012021006-eng.htm.

There are several previous papers that have used the BC K-12 data (without the tax linkage) including: Friesen et al. (2011), Friesen et al. (2010b), and Friesen et al. (2010a). At this time, several projects are using various datasets from the ELMLP and Statistics Canada has a repository of current projects at https://www.statcan.gc.ca/en/microdata/data-centres/data/projects#wb-auto-2.