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Income-Achievement Gaps in Canada

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Abstract

This paper presents new evidence on the relationship between family income and child education outcomes in Canada. We use administrative education data linked to tax records to determine the test score differentials between children from families in the top and bottom income deciles (P90-P10 gap). Across students in Grade 4 and 7, we find a P90-P10 gap of around 0.65 standard deviations from 2012 to 2015. This gap is markedly lower than documented gaps for other countries. However, there is important heterogeneity: among Indigenous children the P90-P10 gap is 0.8 standard deviations and among students with special needs it is 0.7 standard deviations. In contrast, for students who are not in either of those groups, the P90-P10 gap is only 0.4. While our findings suggest low inequities in education achievement by income overall, there are large gaps between high and low-income students for certain subpopulations that need further attention from policymakers.

JEL: I20, J15, J13

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1. Introduction

It is clear that there are achievement gaps based on family socioeconomic status (SES): children from families with higher income or higher education perform better in school.[1] Since the early cognitive skills of children are associated with their future labour market outcomes (Chetty et al. 2011; Heckman, Stixrud, and Urzua 2006; Heckman et al. 2010), unequal achievement gaps between high versus low-SES students could lead to low upward income mobility. Thus, understanding the relationship between SES and child achievement in school is key to creating more equality in opportunity.

While the gap in academic performance by socioeconomic status has been widely studied, especially for the U.S., there remains more to be learned on the test score - income gap in other countries and for minority groups. In this paper, we shed new light on the relationship between family socioeconomic status and child education outcomes in the Canadian context. On the intergenerational mobility dimension, Canada already differentiates itself from the U.S. in having a low correlation between parental income and child income, of around 0.21 (Connolly, Corak, and Haeck 2019), whereas for the U.S. this correlation is around 0.34 (Chetty et al. 2014). Simard-Duplain and St-Denis (2020) also find that there is a weak relationship between parental income and the education attainment of their children. Does Canada also have lower income - test score gaps? To answer this question, we use detailed administrative education data on child outcomes linked to the tax records of their parents. In addition, we study whether there is heterogeneity in the income-achievement gap among different groups of students.

Our study focuses on the province of British Columbia. For education outcomes, we use administrative records from the provincial government, which contain information on student test performance from standardized tests. Our main measure of achievement is the average test score from reading and math for students in Grade 4 and Grade 7. Student records are linked to the tax records of their parents, allowing us to construct measures of parental household income. We focus on the cohort of students who were in Grade 4 during the years from 2012 to 2015. For comparison, we also investigate outcomes for students in Grade 4 from 2002 to 2005, to assess whether the income-achievement gap has shifted across time. Furthermore, the education data we use contains detailed information on student demographics and allows us to document the relationship between income and test performance for Indigenous students, students with special needs, and English Language Learners (ELL). To the best of our knowledge, we are

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

the first to document socioeconomic gaps in achievements among these subgroups in Canada. As discussed by McEwen and Stewart (2014), the link between income and child outcomes for subpopulations in Canada is an area that needs further investigation.

Our measure of the income achievement gap is the average difference in test scores for students from families in the top income decile versus the bottom decile, which we refer to as the P90-P10 gap. For students in Grade 4 from 2012-2015, we find that the P90-P10 gap is roughly 0.65 standard deviations, around half of the gap documented for the U.S. (Reardon 2011). Controlling for school fixed effects, the P90-P10 achievement gap drops by about half. This drop suggests strong sorting patterns by income and average school performance, where lower income students are more likely to attend schools with lower performance on standardized tests. When studying outcomes for these same students in Grade 7, we find minimal changes in the P90-P10 gap. The low income-achievement gaps we estimate differ from the results of Haeck and Lefebvre (2021), who find large gaps in test scores by SES in Canada for high school students.

Next, we study heterogeneity in the P90-P10 gap. In 2012-2015, the raw P90-P10 achievement gap for students who do not identify as Indigenous, and do not have special needs or ELL status is 0.44 - 0.5 standard deviations, across Grades 4 and 7. The gap is similar among ELL students. In contrast, for the same cohort, among Indigenous students, we find a raw P90-P10 gap of 0.78-0.90 standard deviations, whereas the same gap for students with special needs[2] is 0.71-0.82 standard deviations.[3] These findings suggest that among these subgroups, large gaps in education performance by income exist.

In terms of changes across time, among all students, the Grade 4 P90-P10 gap is lower for the 2002-2005 cohort, at 0.52 standard deviations, compared to 0.65 standard deviations in 2012-2015. More prominently, we find larger changes among special needs students: their P90-P10 gap increased by about 0.3 standard deviations from the 2002-2005 cohort to the 2012-2015 cohort. We emphasize though that these trends should be interpreted with caution as participation rates in standardized tests have decreased over that time frame.

Note that our work is descriptive and we do not investigate the causal effect of parental income on student test scores. Nevertheless, we document several important facts. First, our results indicate that the income-achievement gap is low in British Columbia. One possible explanation is the local nature of school funding in the U.S. as opposed to the more centralized system in

[2]By students with special needs we mean students with behavioural, learning, or physical needs. We do not include gifted students.

[3]These gaps are in the range of the Black-White test score gap extensively studied in the U.S. (Magnuson and Waldfogel 2008; Rothstein and Wozny 2013).

Canada. The literature on inequality and education has long-argued 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.[4] Second, we show there is substantial heterogeneity among different subpopulations. The income gaps are significantly worse for Indigenous children and for children with special needs. For these groups of students, our estimates show that sorting of high-income parents into better schools explains a substantial proportion of the income-achievement gap. Therefore, access to good schools is still a limiting factor for lower-income families.

1.1. Literature Review

There are several studies documenting the existence of SES-achievement gaps. Hanushek et al. (2019) create an SES index combining information on parental education and home possessions and find gaps of around one standard deviation between U.S. students in the 90th percentile of their SES index versus the 10th percentile. Other studies using parental education include Jerrim and Micklewright (2012) who compare SES gradients across several countries. Of relevance to our work, they note no significant increase in the SES gradient in Canada as children get older. When using parental income as a measure of SES, Magnuson, Waldfogel, and Washbrook (2012) finds gaps between the top and bottom quintile of around one standard deviation for the U.S., and 0.8-1.0 standard deviations for England. Relatedly, 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 and Reardon (2016) find that the P90-P10 income gap is larger in the U.S. than in other OECD countries. More recently, Sandsør et al. (2021) calculates the P90-P10 income gap for Norway to be 0.55-0.93 standard deviations.

In terms of research focusing on Canada, Simard-Duplain and St-Denis (2020) study the determinants of intergenerational mobility. Using panel data on a sample of Canadians, they find that the educational attainment of children can explain about half of the correlation in income between parents and children. In line with our work, they also find that parental income is not strongly tied to their child's education attainment.

Closely related to this paper is Haeck and Lefebvre (2021). They study achievement gaps in Canada for high school students who take the Programme for International Student Assessment (PISA). Using parental occupation as a measure of socioeconomic status, they find that there

[4]For example, see Durlauf et al. (1993), Durlauf (1996), Fernandez and Rogerson (1996), Fernandez and Rogerson (1998), Biasi (2022), Jackson, Johnson, and Persico (2016), Eckert and Kleineberg (2019), and Zheng and Graham (2020)

is a significant gap in PISA scores between high and low SES students. Students whose parents have high socioeconomic occupations do significantly better on the assessment. We differ from Haeck and Lefebvre (2021) in that our rich dataset allows us to explicitly measure SES with parental income. In addition, we are able to document the income-achievement gap among different groups of students. On the other hand, our dataset focuses on British Columbia, while Haeck and Lefebvre (2021) study SES achievement gaps across all Canadian provinces.

Our work is also related to research that has focused specifically on educational outcomes in British Columbia. Friesen and Krauth (2010) study the achievement gaps between Indigenous and non-Indigenous students. They find that there is significant sorting of Indigenous students into lower-performing schools. Also on British Columbia is Friesen and Krauth (2011) who study peer effects among minority students. Our paper adds to this literature by presenting new findings on the income-achievement gap.

The rest of the paper is structured as follows. In Section 2 we discuss the education system in British Columbia and Section 3 presents the data. Section 4 goes over the empirical framework and Section 5 presents the results. We do several robustness exercises in Section 6 and Section 7 concludes.

2. Institutional Background

Education policy in Canada is set at the provincial level. British Columbia has a traditional public school system, in which 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.[5] In addition, British Columbia has a system of independent (private) schools. The percentage of students enrolled in these schools increased from 9% in 2002 to 12% in 2012 (FISA BC 2018). Some independent schools are funded at 35-50% of their local public school rate and must hire teachers certified by the province and adhere to the provincial curriculum.[6]

The school financing system in British Columbia is centralized, with roughly 94 % of the budgeted revenue for school boards coming from provincial grants (Ministry of Education British Columbia 2015). Additional funds are provided for Indigenous students, students with special needs, adult learners, and English/French Language Learners (Independent Funding Model Review Panel 2018). This financing system is in contrast with the U.S., where in 2013-14 funding

[5]See Friesen, Harris, and Woodcock (2015) for an analysis of the impact of the open-enrolment policy.
[6]See the B.C. Ministry of Education website.

at the district level still made up 45% of per-pupil revenue with 81% of district funding raised from local property taxes (U.S. Department of Education 2016).

3. Data

Our data comes from the Ministry of Education in British Columbia. The dataset covers the universe of students who attend public or independent schools in the province. It consists of student-grade level observations documenting student demographics including age, Indigenous status, gender, language spoken at home, marital status of the child's parents, special needs status, and school attended. 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. Note that we only consider school-aged learners and drop adult learners from our sample.

During the year that students are in Grade 4 and Grade 7, performance on provincial wide standardized exams are recorded. When students reach high school, multiple grades from Grade 10 and Grade 12 courses are recorded, as are graduation outcomes. Given the importance of early childhood skills for future outcomes (Chetty et al. 2011; Heckman, Stixrud, and Urzua 2006; Heckman et al. 2010), we focus on studying the income gradient of student test scores across Grades 4 and 7. Our main cohort of interest is students in Grade 4 (aged 9-10) from 2012 to 2015. We also make comparisons to students in Grade 4 from 2002 to 2005 so that we can study changes in the income - test score relationship over a decade.

Our key educational outcomes are test score performance on the Foundation Skills Assessment (FSA). This is a provincial-wide test given annually to all students (in both public and private schools) in Grade 4 and Grade 7, and tests 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. In a robustness check, we use the attempt in which they scored the highest.

Note that while in principle, all students should take the FSA, there are some exceptions. Students can miss an exam due to illness or an emergency, and exceptions are given to students with serious disabilities and for students who are not yet at a proficiency level of English that would allow them to take the test. Moreover, in practice, there has been a trend in parents opting their children out of the FSA (Boynton 2019). The exam participation rate for our 2012-2015 cohort is 83%, down from 93% in 2002-2005. Non-participation in the FSA can bias the estimates of the average test gap between groups (Friesen and Krauth 2010). On the other

hand, even the participation rate of 83% for our 2012-2015 cohort is in line with previous work in the literature (Hanushek, Kain, and Rivkin 2002; Friesen and Krauth 2010). In Section 5 we present summary statistics for the sample of all students versus only FSA takers and as expected, special needs students and ELL students are under-represented in the FSA only sample. Therefore, it is important to keep in mind that our estimates of socioeconomic gradients apply to the sample of FSA takers only. Despite the participation rate decreasing, we believe that our study is still worth pursuing as the FSA tests are the only measure of early childhood progress available.

Importantly, we have parent identifiers for the children in our education data. We link these parents to tax return data from Statistics Canada (T1FF datafile). 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. 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. To get a sense of the household finances during the child's early years, we take averages of total household income before-tax in the 5 years leading up to when the child is in Grade 4. We are able to match 86% of our students of interest to tax records. Of these matches, 90% of the linkages have the full 5-years of income available. Following Reardon (2011), we do not scale parental income by family size. All income values are normalized to real Canadian dollars using the Consumer Price Index from Statistics Canada. As we are interested in the achievement gap between the top and bottom decile, we classify households into deciles within the 2012-2015 cohort and within the 2002-2005 cohort. In Section 5 we present summary statistics for our sample of students.

4. Empirical Framework

We use a standard OLS regression to document the test score-income gap and how it has changed over time. Our baseline model is a 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. We use deciles so that we can compare our estimates to those of Reardon (2011) for the U.S. and Sandsør et al. (2021) for Norway. We run the following regression separately for students when they are in Grade 4 and in Grade 7, and for each of our two cohorts:

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

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. 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 raw P90-P10 achievement gap. In certain specifications, we augment Equation (1) with a vector of school fixed effects to study the within-school P90-P10 gap.

5. Results

5.1. Summary Statistics

Table 1 presents summary statistics for the 2012-2015 cohort (Column (1)) and the 2002-2005 cohort (Column (2)) for our whole sample (Panel A) and the sample of students with non-missing Grade 4 FSA results (Panel B). Note that 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 171,830 Grade 4 students from 2012 to 2015 and 184,090 for the 2002 to 2005 cohort. The average household income before taxes was $55,300 for our first cohort and $77,600 for the second cohort. Roughly 13 percent of students were enrolled in a British Columbia private school in 2012-2015, up from 10 percent in 2002-2005.

The remaining rows in Panel A of Table 1 report the percentage of individual student demographics. Around 50% of students are female, and 11-13% identify as Indigenous. Roughly 13 percent of students have special needs and about 20% are ELL.[7] Note that we group students as Indigenous, special needs, and ELL based on if they were ever classified in the data as being in one of these groups.[8] Indigenous status is self-reported and so we classify a student as Indigenous based on if they ever identified as being so. Second, ELL and special needs status are not constant over time, with some students only being identified as ELL or requiring special needs in later years.

[7] While these ELL 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 ELL students make up more than 50% of their school's population in over 60 schools in Vancouver (Skelton 2014). Furthermore, statistics from the British Columbia Ministry of Education report similar proportions of ELL students for its larger school districts in 2015. For instance, Surrey, the largest school district, reported 23% of its students as ELL (British Columbia Minister of Education 2016).

[8] We test this assumption in a robustness test.

In Panel B we focus on the sample of students in Grade 4 who take the FSA. The average income of parents whose children take the FSA is higher, by $2,800 for the 2012-2015 cohort and by roughly $1,000 for the 2002-2005 cohort. As expected, the percentage of students who are special needs in the FSA sample of students is lower than in the sample of all students, by about 3 percentage points. The percentage of students who classify as ELL is also slightly lower in the sample of students taking the FSA.

Table 2 summarizes the participation rates in the Grade 4 FSA for 2012-2015 (Column (1)) and 2002-2005 (Column (2)) for different subgroups. As previously discussed, the FSA participation rate for all students was 83% in 2012-2015, down from 93% in 2002-2005. For individuals in British Columbia private schools, the participation rate remained high, at 92% in the 2012-2015 years. Indigenous, ELL, and students with special needs have significantly lower participation rates. For instance, in 2012-2015 only sixty percent of students classified as special needs participated in the FSA.

Figures 1a and 1b present bin scatters of the income gradient in test scores for the 2012-2015 cohort and the 2002-2005 cohort, respectively. On the x-axis is our measure of household income deciles and on the y-axis is the average test score, in standard deviations, in the FSA across Grade 4 and 7, and across reading and numeracy. There are not steep income gradients for test scores. For students in the 2012-2015 cohort (Figure 1a), the P90-P10 gap is around 0.6 standard deviations. For the 2002-2005 cohort, the average test score difference across the bottom and top decile is around 0.5 standard deviations.

5.2. Overall Achievement Gaps

We now turn to formally estimating the P90-P10 gap. In Table 3 we present results from Equation (1). We start by focusing on the cohort of students in Grade 4 from 2012-2015, as they represent the most recent picture. Panel A presents the results for the test score income gradient in Grade 4, and Panel B does the same for Grade 7. The row "P90-P10" presents the coefficient on β_{10}: the achievement gap between the top and bottom income decile. Column (1) shows that in 2012-2015, the raw P90-P10 gap is 0.65 standard deviations. In Column (2) we add individual demographics as controls, which reduces the gap to 0.52 standard deviations.[9] Furthermore, adding school fixed effects (Column (3)) cuts the achievement gap by about 40 percent to 0.33 standard deviations.

In Panel B we study the same set of students but turn to achievement gaps three years later,

[9]The individual demographics we include are: gender, language spoken at home, special needs status, Indigenous status, English Language Learners, family composition, and birth year.

Table 1: Sample Summary

Panel A: All Students	2012-2015 Cohort (1)	2002-2005 Cohort (2)
Number of Students	171,830	184,090
Average Household Income	$77,600	$55,300
% Private School	13	10
% Female	49	49
% ESL	20	18
% Indigenous	13	11
% Special Needs	14	13
Panel B: FSA Students		
Number of Students	142,880	170,750
Average Household Income	$80,400	$56,400
% Private School	15	10
% Female	49	49
% ESL	19	17
% Indigenous	12	10
% Special Needs	10	10

Notes: Summary statistics for students in Grade 4 from 2012-2015 (Column (1)) and from 2002-2005 (Column (2)). Panel A contains the sample of all students, while Panel B is only for students in Grade 4 who took the FSA. Household income is calculated over the 5-years leading up to the child entering Grade 4. Household income values are rounded to the nearest hundredth. Counts are rounded to the nearest tenth. *Source: British Columbia Minister of Education and Statistics Canada.*

Table 2: FSA Participation Rates

	2012-2015 Cohort (1)	2002-2005 Cohort (2)
All	83%	93%
Female	85%	94%
Private School	92%	95%
ESL	78%	87%
Indigenous	79%	87 %
Special Needs	60%	74%

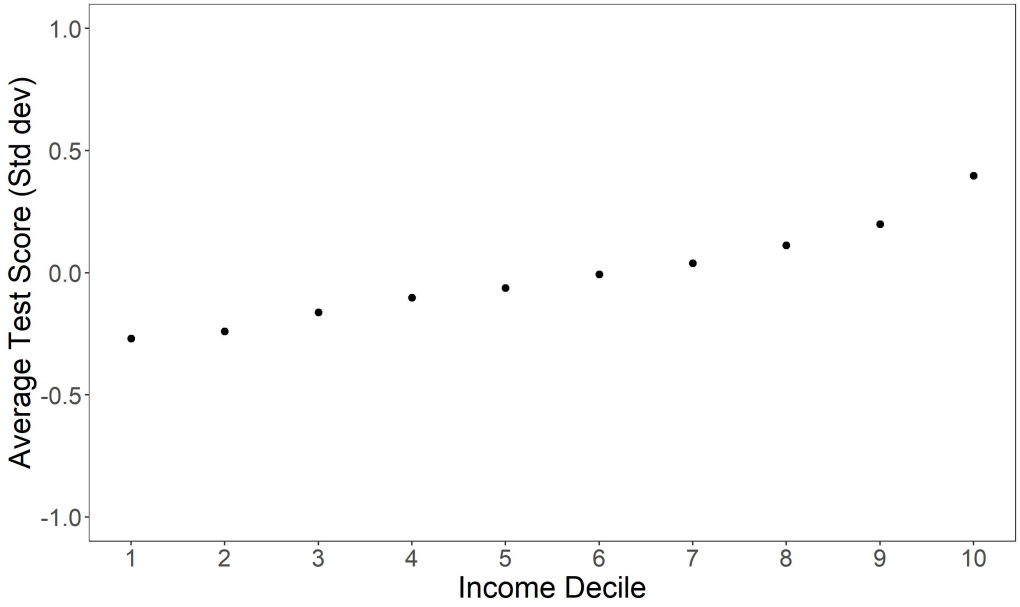
Notes: FSA participation rates for students in Grade 4 in 2012-2015 (Column (1)) and in Grade 4 in 2002-2005 (Column (2)). *Source: British Columbia Minister of Education.*

when the students take the Grade 7 FSA. We find very similar income-test score gaps compared to when the students were in Grade 4. The raw P90-P10 gap for Grade 7 students is 0.68, quite close to the Grade 4 one. Adding student demographics and school fixed effects (Column (3)) also produces comparable estimates to those from Grade 4. Thus, we do not find any noticeable change in the size of the P90-P10 gap as students progress from Grade 4 to Grade 7. This finding is in line with Jerrim and Micklewright (2012), who note no marked difference in the SES-test score gap for Canadian children from age 10 to age 15.

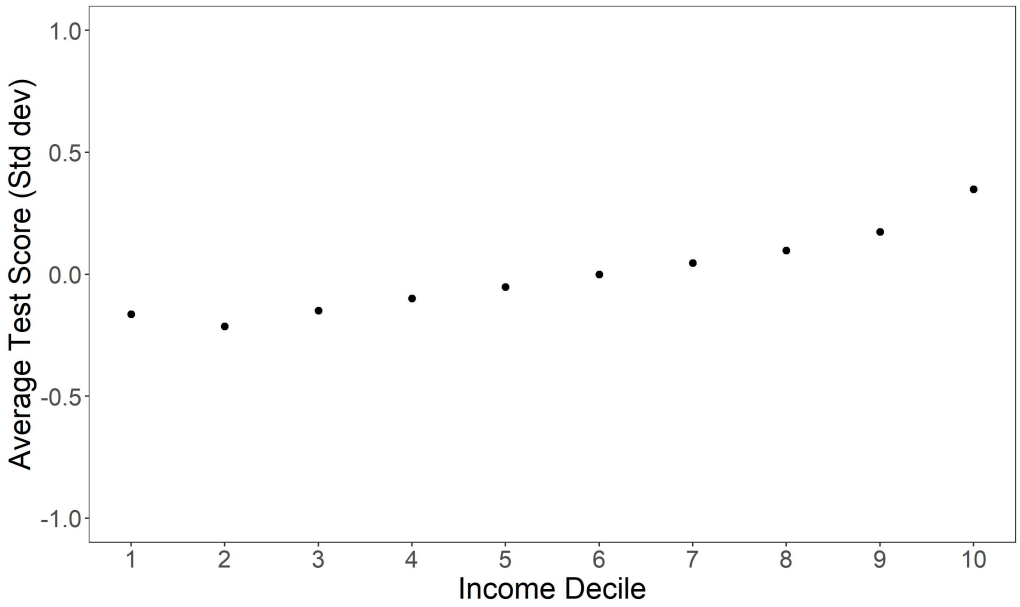
Columns (4) - (6) in Panel A of Table 3 present the results for the 2002-2005 Grade 4 cohort of students. There were small increases in the raw P90-P10 gap for Grade 4 students: in 2002-2005 it is 0.52 standard deviations (Column (4)) compared to 0.65 in 2012-2015 (Column (1)). On the other hand, with school fixed effects the P90-P10 gap is quite similar across the decade at 0.32 standard deviations in 2002-2005 (Column (6)), compared to 0.33 in 2012-2015. Columns (4) - (6) in Panel B show that the Grade 7 P90-P10 gap changed comparably from 2002-2005 to 2012-2015 relative to the Grade 4 P90-P10 gap.

In summary, the raw P90-P10 achievement gap for Grade 4 students is low, at 0.65 standard deviations for the 2012-2015 cohort. That the P90-P10 achievement gap drops substantially with school fixed effects suggests that there is strong sorting by parental income into schools. This is in spite of the open-enrolment policy in British Columbia, which increased the percentage of students attending out-of-catchment schools (Friesen, Harris, and Woodcock 2015). Nevertheless, the achievement gaps for British Columbia are significantly smaller than that of the U.S., which has a P90-P10 gap of around 1.25 standard deviations (Reardon 2011). The

Figure 1: Average standardized test score by income decile.



(a) Income Deciles and Average FSA scores, 2012-2015.



(b) Income Deciles and Average FSA scores, 2002-2005.

These two figures plot the average FSA score across grades and subjects by income decile. Figure 1a contains estimates for students in Grade 4 from 2012-2015. Figure 1b contains estimates for students in Grade 4 from 2002-2005. Test scores are in standard deviation units. Income deciles are based on household income before-tax in the 5-years leading up to the child being in Grade 4.

achievement gaps we document are also lower than for Norway as calculated by Sandsør et al. (2021), who find values of 0.55 to 0.93 standard deviations. Thus, among British Columbia students, it seems that there is more equal opportunity to do well in school irrespective of parental background.

Table 3: Income Achievement Gaps in Grade 4 and 7

Cohort:	(1) 2012-15	(2) 2012-15	(3) 2012-15	(4) 2002-05	(5) 2002-05	(6) 2002-05
Panel A: Grade 4 FSA						
P90-P10	0.65***	0.52***	0.33***	0.52***	0.41***	0.32***
	(0.023)	(0.020)	(0.011)	(0.014)	(0.012)	(0.010)
Observations	142,880	142,880	142,880	170,750	170,750	170,750
Adjusted R^2	0.05	0.13	0.27	0.03	0.13	0.20
Panel B: Grade 7 FSA						
P90-P10	0.68***	0.61***	0.35***	0.50***	0.43***	0.30***
	(0.028)	(0.025)	(0.013)	(0.017)	(0.015)	(0.011)
Observations	129,560	129,560	129,560	162,880	162,880	162,880
Adjusted R^2	0.05	0.17	0.32	0.03	0.15	0.23
Controls Used:						
Student Demographics	No	Yes	Yes	No	Yes	Yes
School Fixed Effects	No	No	Yes	No	No	Yes

Notes: This table presents the average test score gap in standard deviation units between the top and bottom income decile. Panel A (B) presents results for Grade 4 (7) students. Columns (1) to (3) are for the cohort of students in Grade 4 between 2012 to 2015. Columns (4) to (6) are for the Grade 4 cohort from 2002 to 2005.

5.3. Achievement Gaps for Indigenous, Special Needs, and ELL Students

While the income gradient of test scores among all British Columbia students is low, it is worth investigating whether this relationship varies among different groups of students. Previous work on economic opportunity has shown substantial heterogeneity in income mobility by race (Davis and Mazumder 2018; Chetty et al. 2020). For example, Chetty et al. (2020) find that in the U.S., Black and Indigenous individuals have significantly less mobility, even when controlling for neighbourhood fixed effects.

In this section, we present results for the P90-P10 gap among Indigenous students, ELL, and students with special needs. Table 4 lists the estimates for Grade 4 (7), in Columns (1) to (2) (Columns (3) to (4)), with and without school fixed effects, respectively. The rows "P90-P10 (2012-2015)" are estimates for the cohort in Grade 4 from 2012-2015 and the rows "P90-P10 (2002-2005)" are the estimates for the earlier cohort.

Panel A of Table 4 presents estimates of the test score gap between the top and bottom income decile for the sample of children who are not Indigenous, ELL, or students with special needs. We refer to this group as the "baseline" group. In 2012-2015, the overall P90-P10 Grade 4 test score gap is 0.44 and 0.26 standard deviations, without and with school fixed effects, respectively. While the raw P90-P10 gap increases slightly to 0.5 standard deviations once the students are in Grade 7, with school fixed effects the gap is steady at 0.29 standard deviations (Column (4)). Looking at the row "P90-P10 (2002-2005)", the raw P90-P10 gap has widened by 0.1 standard deviations across the cohorts while the within-school P90-P10 gap has remained stable. In summary, the P90-P10 gap for this subgroup is lower than among all students in the province.

Previous work has documented that Indigenous people in Canada have worse labour market outcomes and larger earnings inequality.[10] Here, we document the P90-P10 gap for test scores among Indigenous students. Column (1) of Panel B indicates that the raw P90-P10 gap for Grade 4 Indigenous students in 2012-2015 was 0.78 standard deviations. To put this in perspective, estimates of the Black-White test score gap in the U.S. range from 0.75 to 1 standard deviation (Magnuson and Waldfogel 2008; Rothstein and Wozny 2013). Including school fixed effects reduces the gap to about 0.5 standard deviations. For these same Indigenous students, their raw P90-P10 achievement gap increases to 0.90 standard deviations in Grade 7 (Column (3)), while with school-fixed effects it is 0.61 standard deviations (Column (4)). Our findings are in line with Friesen and Krauth (2010), who show that sorting of Indigenous students into

[10] For examples, see Hu, Daley, and Warman (2019), Lamb (2013), and Pendakur and Pendakur (2011)

schools with lower test scores explains a significant proportion of the difference in test scores between Indigenous and non-Indigenous students. In all, what is striking here is that even when controlling for school fixed effects, the P90-P10 gap for Indigenous students is roughly twice as large compared to the baseline group across both Grades 4 and 7. In terms of changes over time, looking at the "P90-P10 (2002-2005)" row in Panel B, the Grade 4 and Grade 7 achievement gaps for Indigenous students grew from 2002-2005 to 2012-2015. These trends should be interpreted with caution though as the FSA participation rate among Indigenous students also fell during that time.

Research in the health economics literature has found that higher income families may be able to better manage health conditions in their children (Currie and Hyson 1999; Case, Lubotsky, and Paxson 2002). With this in mind, Panel C of Table 4 presents outcomes for students with special needs, starting with the 2012-2015 cohort. As a reminder, our definition of special needs includes students with physical, behavioural, or learning needs, but does not include gifted students. The raw P90-P10 gap for these students in 2012-2015 is 0.71 standard deviations (Column (1)), about 0.3 standard deviations larger than the baseline group. One explanation for the larger achievement gap among this subpopulation is that parents with higher income are more likely to be able to provide additional resources to support their child's learning needs and help them succeed. Of note, when controlling for school fixed effects, the P90-P10 gap drops by more than half, to 0.3 standard deviations (Column (2)). In fact, the within-school P90-P10 gap among special needs students is quite close to that of the baseline group. This suggests that school quality is an important factor in the P90-P10 gap for special needs students especially: parents of higher incomes send their children to better-performing schools. There are small increases in achievement gaps among special needs students once they are in Grade 7: the raw achievement gap rises to 0.82 standard deviations (Column (3)), while with school fixed effects, it is 0.39 (Column (4)). When looking at outcomes for special needs students from 2002-2005, the P90-P10 gap is lower. While this difference could indicate a trend of more inequitable outcomes for these students, note that from 2002-2005 to 2012-2015 the FSA participation rate among this group of students fell from 74% to 60%. Thus, part of the reason for the change could be related to special needs students with better academic records choosing to take the exam.

Of interest as well is the link between income and test scores for English Language Learners. Work by Aydemir, Chen, and Corak (2013) find significantly lower intergenerational transmission of education attainment among those born to immigrant parents in Canada.[11] While we

[11]See Sweetman and Ours (2015) for a review on the intergenerational mobility of immigrants.

do not have precise information on immigration status of the student, ELL students tend to be from an immigrant or refugee family. With the high proportion of ELL students in British Columbia, it is important to understand how they fare in the education system relative to Canadian-born students. Panel D of Table 4 presents the P90-P10 achievement gap for ELL students. Looking at the 2012-2015 cohort, the raw P90-P10 achievement gap of 0.42 (Column (1)) is close to that of the baseline group of students. There is not a noticeable difference in gaps for ELL students from Grades 4 to 7, and furthermore, the results for the 2002-2005 cohort are similar to the gaps from the 2012-2015 cohort. In all, there are similar income-test score gaps for students who are ELL and likely to be from immigrant families. This is in line with Worswick (2004), who finds that at a young age, students with immigrant parents have some disadvantages, but later on they perform similarly in tests to those of Canadian-born parents.

Table 4: Income Achievement Gaps by Indigenous, Special Needs, and ELL Students

	Grade 4		**Grade 7**	
	(1)	(2)	(3)	(4)
Panel A: Baseline				
P90-P10	0.44***	0.26***	0.50***	0.29***
(2012-2015)	(0.02)	(0.01)	(0.03)	(0.02)
P90-P10	0.36***	0.28***	0.40***	0.28***
(2002-2005)	(0.01)	(0.01)	(0.02)	(0.01)
Observations (2012-2015)	91,250	91,250	82,050	82,050
Observations (2002-2005)	114,290	114,290	108,370	108,370
Panel B: Indigenous				
P90-P10	0.78***	0.49***	0.90***	0.61***
(2012-2015)	(0.05)	(0.04)	(0.05)	(0.04)
P90-P10	0.63***	0.44***	0.64***	0.46***
(2002-2005)	(0.05)	(0.04)	(0.05)	(0.04)
Observations (2012-2015)	17,710	17,710	15,930	15,930
Observations (2002-2005)	18,060	18,060	17,030	17,030
Panel C: Special Needs				
P90-P10	0.71***	0.32***	0.82***	0.39***
(2012-2015)	(0.04)	(0.03)	(0.05)	(0.04)
P90-P10	0.43***	0.24***	0.54***	0.35***
(2002-2005)	(0.04)	(0.03)	(0.04)	(0.03)
Observations (2012-2015)	14,970	14,970	13,710	13,710
Observations (2002-2005)	18,050	18,050	17,100	17,100
Panel D: ELL				
P90-P10	0.42***	0.21***	0.47***	0.27***
(2012-2015)	(0.04)	(0.04)	(0.05)	(0.04)
P90-P10	0.37***	0.24***	0.22***	0.16***
(2002-2005)	(0.05)	(0.04)	(0.05)	(0.04)
Observations (2012-2015)	26,690	26,690	25,150	25,150
Observations (2002-2005)	28,520	28,520	28,300	28,300
School Fixed Effects	No	Yes	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. Columns (1)-(2) are Grade 4 scores for the cohort in Grade 4 from 2012-2015. Columns (3)-(4) are Grade 7 scores for the same cohort. Panel A presents the P90-P10 gap for our "baseline" group: students who are not Indigenous, not ELL, and do not have a special need. Results for Indigenous students are in Panel B. Panel C presents results for students with Special Needs. Panel D presents results for ELL. In the case of multiple FSA attempts, the first attempt is used.

6. Robustness

We conduct several robustness exercises to test the sensitivity of our findings on the heterogeneity of the P90-P10 gap among subgroups. For ease of exposition, we focus here on Grade 4 FSA scores from the 2012-2015 cohort.

6.1. Subgroup Classification

In our main analyses we classified Indigenous, Special Needs, and ELL students based on if they were ever classified as such - even if it was not in the year that they wrote the FSA. Here, we re-run our analysis using the classification from the year that they wrote the FSA.

Columns (1) (without school fixed effects) and (2) (with school fixed effects) of Table A.1 in the Appendix presents the results from this reclassification exercise for Grade 4 FSA scores. As expected, the number of individuals decreases within each subgroup as students who were not classified under a subgroup during the writing of their FSA may be in a later year. While the number of Indigenous and ELL students does not change substantially, the number of special needs students drops from 14,970 to 6,790 when only using their classification from Grade 4. A large proportion of special needs students are identified in the later years of school. Despite the change in classification, we find similar results: the raw P90-P10 gap is substantially larger among Indigenous students and those with special needs.

6.2. FSA attempts

Our main results make use of a student's outcomes in their first-recorded attempt of the FSA. However, some students within our sample take the FSA multiple times. Moreover, test repetition is more prevalent among those with special needs (Morgan et al. 2019), and ELL students (Callahan, Wilkinson, and Muller 2010). Accordingly, employing the first recorded FSA results in our regression analysis may upward bias the P90-P10 gap as the second attempt of the students most at-risk for repetition is ignored.

Columns (3) and (4) of Table A.1 in the Appendix presents the results when we instead employ each student's best attempt at the FSA. We find there is little change in the P90-P10 gap for any group.

6.3. Quintiles

We reported the P90-P10 gap for ease of comparability with works in the literature (Reardon 2011; Sandsør et al. 2021). However, these results may be driven by extreme values of income.

To account for this, in Columns (5) and (6) of Table A.1 we report the gap between the top and the bottom income quintile. As expected, the P80-P20 gaps are narrower than the P90-P10 gaps. Nevertheless, there remains a large difference among subgroups when using quintiles. For example, the raw P80-P20 gap for our baseline group of students is 0.36 standard deviations, whereas the corresponding value among Indigenous students is 0.68. The gap among special needs students is 0.62 standard deviations.

6.4. P90-P10 by Subject

All our results thus far have taken the average test score across reading and numeracy FSA. Here, we separate our analysis by subject. Table A.2 presents our findings for Reading (Columns (1) and (2)) and Numeracy (Columns (3) and (4)). Across all groups, the P90-P10 gap is slightly higher in Numeracy than in Reading. We do not find though that the difference in P90-P10 gaps between our baseline group (Panel A) and Indigenous students (Panel B) is notably higher for one subject or the other. The same applies to the group of students with special needs. Thus, while it seems that there are stronger income gaps in math than in reading, this is consistent across the different groups of students.

7. Conclusion

In this paper we studied the income-achievement gaps among students in British Columbia. Our estimates indicate that there are stark differences in the P90-P10 gap among different groups of students. For students who are not Indigenous, special needs, or ELL, the raw P90-P10 achievement gap is small, at around 0.44 standard deviations. The value is similar among ELL students. On the other hand, the raw P90-P10 gap among Indigenous students is notably higher, at 0.8 standard deviations, whereas it is 0.7 among students with special needs.

The low aggregate achievement gap we estimate is in line with previous work documenting high mobility in Canada (Connolly, Corak, and Haeck 2019; Simard-Duplain and St-Denis 2020). However, the aggregate finding masks important heterogeneity. That Indigenous students have a significantly higher P90-P10 gap is in line with work by Chetty et al. (2020) who find lower upward mobility for Indigenous Americans. In addition, that the gap for special needs students is cut by more than half when estimating within-school suggests that low-income families with special need students will especially benefit from access to higher-quality schools. In all, our findings point to the need for policies targeted at creating more equitable outcomes for Indigenous students and students with special needs.

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8. Appendix

Table A.1: Robustness Checks

	Subgroup		Best FSA		P80-P20	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Baseline						
Income Gap	0.47***	0.28***	0.44***	0.26***	0.36***	0.24***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Observations	97,370	97,370	91,250	91,250	91,250	91,250
Adjusted R^2	0.02	0.10	0.03	0.20	0.02	0.20
Panel B: Indigenous						
Income Gap	0.78***	0.49***	0.78***	0.49***	0.68***	0.46***
	(0.05)	(0.04)	(0.05)	(0.04)	(0.03)	(0.03)
Observations	17,650	17,650	17,710	17,710	17,710	17,710
Adjusted R^2	0.06	0.23	0.06	0.23	0.06	0.23
Panel C: Special Needs						
Income Gap	0.67***	0.37***	0.71***	0.32***	0.62***	0.32***
	(0.06)	(0.05)	(0.04)	(0.03)	(0.03)	(0.03)
Observations	6,790	6,790	14,970	14,970	14,970	14,970
Adjusted R^2	0.05	0.21	0.05	0.22	0.05	0.22
Panel D: ELL						
Income Gap	0.43***	0.22***	0.42***	0.21***	0.40***	0.24***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Observations	25,830	25,830	26,690	26,690	26,690	26,690
Adjusted R^2	0.01	0.26	0.01	0.26	0.01	0.26
School Fixed Effects	No	Yes	No	Yes	No	Yes

Notes: This table presents the average test score gap in standard deviation units between the top and bottom income decile. FSA scores are averaged across subjects. Columns (1)-(2) are for the robustness check using the subgroup classification from the year the student wrote the Grade 4 FSA. Columns (3)-(4) are using the best FSA attempt. Columns (5)-(6) estimate quintile gaps. Panel A presents the income gap for our "baseline" group: students who are not Indigenous, not ELL, and do not have a special need. Results for Indigenous students are in Panel B. Panel C presents results for students with Special Needs. Panel D presents results for ELL students. The income gaps are P90-P10 gaps except for Columns (5)-(6), which use P80-P20 gaps.

Table A.2: Subject Grade 4 Income Achievement Gaps by Indigenous, Special Needs, and ELL Students

	Reading		**Numeracy**	
	(1)	(2)	(3)	(4)
Panel A: Baseline				
P90-P10	0.40***	0.25***	0.48***	0.27***
	(0.02)	(0.01)	(0.03)	(0.02)
Observations	91,250	91,250	91,250	91,250
Adjusted R^2	0.02	0.12	0.02	0.21
Panel B: Indigenous				
P90-P10	0.75***	0.46***	0.80***	0.52***
	(0.05)	(0.05)	(0.05)	(0.04)
Observations	17,710	17,710	17,710	17,710
Adjusted R^2	0.05	0.17	0.05	0.23
Panel C: Special Needs				
P90-P10	0.67***	0.29***	0.75***	0.35***
	(0.05)	(0.04)	(0.05)	(0.04)
Observations	14,970	14,970	14,970	14,970
Adjusted R^2	0.04	0.16	0.05	0.21
Panel D: ELL				
P90-P10	0.40***	0.20***	0.45***	0.23***
	(0.05)	(0.04)	(0.05)	(0.05)
Observations	26,690	26,690	26,690	26,690
Adjusted R^2	0.01	0.16	0.01	0.27
School Fixed Effects	No	Yes	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. Columns (1)-(2) are for reading and Columns (3)-(4) are for numeracy. We include school fixed effects in Columns (2) and (4). Panel A presents the P90-P10 gap for our "baseline" group: students who are not Indigenous, not ELL, and do not have a special need. Results for Indigenous students are in Panel B. Panel C presents results for students with Special Needs. Panel D presents results for ELL. In the case of multiple FSA attempts, the first attempt is used.