Research Group on Human Capital
Working Paper Series

Socioeconomic Gradient Literacy and Numeracy Skills of 15-year-olds across Canadian Provinces and Years using the PISA Surveys (2000-2012)

Working Paper No. 16-03

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December 2016

http://grch.esg.uqam.ca/working-papers-series/?lang=en

Socioeconomic gradient literacy and numeracy skills of 15-year-olds across Canadian provinces and years using the PISA surveys (2000-2012)#

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December 2016

Abstract
In 2000, the OECD began the Programme for International Student Assessment (PISA), a triennial survey of the knowledge and skills of 15-year-olds. For each survey, Canadian students placed well above the OECD average and remain among the top performers for each domain assessed (reading, math and science). Canada is unique by the very large size of students' samples because education policy is decided by each of ten provincial governments. This paper investigates neglected issues related specifically to 15-year-old students' educational achievement across Canadian provinces.

The analysis estimates empirically across provinces the link between the family background, measured by socioeconomic status (SES), and educational skills measured by PISA test scores in reading and math. The SES used is more conventional then the arbitrary character of the index developed by PISA. First, average gaps in students' educational attainment between the lower and top SES quintiles, across provinces and years, provide evidence on the SES gradient in literacy and numeracy competencies. Second, gradients are estimated over the entire achievement distribution (SES gaps over nine deciles) for Canada and across provinces. The third research question relates to proficiency levels and socio-economic gradient, a forgotten subject but a decisive factor for later educational and economic success of young adults. The fourth research question assesses the trends in socio-economic inequalities from the lorgnette of skills measured over five PISA waves (2000 to 2012).

Results show large socioeconomic differences in average PISA reading and math scores across provinces. There are wide-ranging variations in the size of score gaps in the SES family background, a proxy for the extent of inequality of opportunities. Quintiles regression estimates expound that the gaps move up and down over the achievement decile scores distribution, and across provinces and waves for both reading and math scores. The association between family background and proficiency levels in both main domain tests is strong, with estimates illustrating significantly large socioeconomic gradients. Summary statistics and estimates on scores changes in bottom and top SES quintiles across provinces suggest that children's reading and math skills are still heavily linked to their family background.

JEL: I20, I21, I28
Key words: socioeconomic inequalities, PISA, literacy and numeracy skills, proficiency scales, provincial education policy, education attainment gradient, Canadian provinces

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This analysis is based on Statistics Canada's surveys which produced PISA data sets for the department of Education of the Canadian provinces and the OECD consortium. All computations on these micro-data were prepared by the author who assumes the responsibility for the use and interpretation of these data. This research was funded by two research grants from the Fonds de recherche du Québec – Société et culture (FRQSC), Subvention Équipe et Subvention Action concerté-Inégalité phase 4.

1. Introduction

Recent research in economics of education has turned its attention to a diversity of issues related to education achievement and competencies inequalities, with the background of economic growth and intergenerational mobility.

First, empirical evidence stress some limits to the traditional approach of measuring human capital by school achievements alone as the ingredient triggering economic growth and a guide to develop and promote policies for modern 'knowledge-based' economies (Hanushek and Woessman (2015a)). There is ample empirical evidence that skills – cognitive, non-cognitive, social and behavioural abilities - along with educational attainment are powerful predictors of personal economic and social outcomes (Heckman, Urzua, and Stixrud (2006)). They are strongly correlated with labour market outcomes, such as earnings (Neal and Johnson (1996); Murnane et al. (2000)). In fact, there is some evidence from such studies that types of skills complement each other, and according to an expression coined by Heckman that "skills begets skills." Although non-cognitive skills are more difficult to measure, they seem more malleable over the life cycle (Cunha and Heckman (2008)). Furthermore, a number of studies have documented the specific importance of mathematical abilities for young workers on earnings (e.g. Murnane et al. (1995); Rose and Betts (2004); Ingram and Neuman (2006)). Consistent evidence of mathematics skills measured by test scores suggests that one standard deviation in math performance at the end of high school is likely to translate into 10 to 15 percent higher annual earnings (Murnane et al. (2000)). The early career earnings certainly suffer from a downwards lifecycle bias since individuals with higher whole-life earnings systematically have higher real earnings growth rates (Haider and Solon (2006)). Moreover, individual's cognitive abilities take time to manifest themselves to prospective employers (Altonji and Pierre (2011)).

Second, the conduct of international surveys initiated by the Organization for Economic Cooperation and Development (OECD) to assess adult skills (literacy and numeracy)[1] in several countries (including Canada) offer new unique data to estimate returns to skills and provide researchers new fields to analyse the value of skills in different contexts/countries, and age-cohorts (Hanushek et al. (2015); Green and Riddell (2003, 2013); Acemoglu and Autor (2011)).

Third, on a similar front, the other initiative of the OECD, along with partner countries was to developed a common tool to improve their understanding of what makes young people—and education systems as a whole—successful. This tool, the Programme for International Student

[1] In particular, the more extensive, richer, and largest is the last 2011 Program for the International Assessment of Adult Competencies (PIAAC) a multi-cycle international program following the 2003 the Adult Literacy and Life Skills (ALL) and the International Adult Literacy Survey (IALS), the world's first internationally comparative survey of adult skills, undertaken in three rounds of data collection between 1994 and 1998.

Assessment (PISA), seeks to measure the extent to which students, at aged 15, have acquired some of the knowledge and skills that are essential for full participation in modern societies. Since the first wave conducted in 2000 with an emphasis on reading skills and again in 2003 and 2006 with a pre-eminence on mathematics and science competencies respectively, two other waves were added (in 2009 and 2012) with a replication wave of data done in 2015, and a forthcoming data set[2]. The five existing PISA waves of tests scores and competencies levels for the 15-year-olds also provided information on students' characteristics, their family background and school environment, over a large number of different schooling systems (for up to 65 countries or regions in 2012).[3] These extensive data sets produce cross-nationally – in Canada cross-provincially – comparable information on students' specific abilities at age 15. Scholastic achievement of pupils over time, sometimes widely cited in some countries opening up public policy debate on education (Bulle (2011)), can be monitored for relative performance across countries (provinces) and over time (Jerrim (2013); OCDE (2010a)). Developing these skills should be of great policy interest, and so should understanding which policy may help (or hinder) the development of these skills. A large body of research in the literature on human capital has investigated the impact of different inputs in the 'educational production function' on achievement (Hanushek, Link and Woessman (2013); OECD (2013, 2012, and 2010); Hanushek and Woessman (2011a) for a large survey; Schütz, Ursprung, and Wöbman (2008)).

Fourth, students leaving secondary education without a strong scholastic foundation may experience difficulty accessing the postsecondary education system and the labour market. So they may benefit less when learning opportunities are presented later in life. Empirical research has shown that measures of educational attainment alone may not be sufficient to perform in a knowledge based economy. Scholastic attainment in school is an important factor to later education achievement, while gaps in postsecondary education enrolment and university attendance can be related to differences in prior academic achievement of students by socio-economic status in high school (Jerrim and Vignoles (2015); Ermish and Bono (2012); Lefebvre and Merrigan (2010)). Still, studies find divergent results on the relative strength/importance of high school grades and skills versus parental education and household income (Belley and Lochner (2007); Carneiro, Crawford, and Goodman (2007)). Whereas, some recent studies present results showing that adolescent achievement, in particular math

[2] Two related international student achievement tests are conducted: the Third International Mathematics and Science Study (TIMSS) is a replication conducted since 1995 every four year for a partly different set of countries and slightly younger students (in grades 4 and 8), while the Progress in International Reading Literacy Study (PIRLS) evaluates, every five year since 2001, the success of reading literacy of students at the fourth grade.
[3] Canada has one of the largest samples in PISA's surveys to account for the school system of each province and their difference (e.g., Anglophone and Francophone).

achievement, is a stronger predictor of completed schooling than measures of non-cognitive skills (with one standard deviation increases in math scores associated with significant added years of schooling)(Duckworth et al. (2015); (Duncan and Magnuson (2011); Watts et al. (2014)). Such evidence suggests that early skills and behaviours differences related to family income and education are likely important mechanisms through which socio-economic status is transmitted from one generation to the next.

Fifth, not only does education achievement exerts a large impact on individual earnings, they also have long run consequences for economic growth. In a series of paper based on cross-country PISA test scores (cognitive skills in reading and math as well as proficiency levels) and simple models of growth, Hanushek et al. (2015a, 2015b, 2012, 2011b, 2008) show that long-term growth is closely related to the skills measured by assessments such as PISA. If countries, with a large proportion of students having low-performance scores and low proficiency levels in math or reading, could raise over the long run their schools achievements so that students can experience different high school skills trajectories, they would likely gain positive points in their growth rates. The simulations also point to positive effects for countries with a smaller (although significant) proportion of students at the bottom of the scores distribution doing poorly in school, such as Canada.

Sixth, in Canada, like in many rich countries, income inequality has increased over the past several decades, even though incomes have risen across all income groups (Green, Riddell, and St-Hilaire (2015)). Greater levels of income inequality over the years have led to the delicate issues of equality of opportunity and intergenerational mobility. Most social mobility researchers focus on income, as it can be converted to many other goods, and because it provides a robust basis for measurement, comparison and trends. However, other researchers have focused on the transmission of parental education and occupation to characterize social inequalities and stratification (Blanden (2013)). Eminent sociologists show that social origins are linked to independent and persistent components on the basis of parents' class (employment and occupational unit-group), status (status scale derived from the occupational structure), and parental education (levels of educational qualifications)(Bukodi and Goldthorpe (2013)). Many papers present evidence that education transmission has a credible key role in intergenerational mobility and income (Gregg and Macmillan (2010); Blanden, Gregg, and Macmillan (2007, 2013)). Some extensive research into social class mobility by sociologists contests the economists' finding of declining social mobility. In particular Goldthorpe (2013) results, using British multiple birth cohorts data sets, support that relative rates have remained more or less constant, while absolute mobility of the new millennium have levelled out. Thus, follows the argument that not much can be achieved through education policy, whether in regards to absolute or relative mobility.

The persistence in intergenerational education is evidently determined, from the Beckerian seminal analysis approach, by parental investment in the child's education, their interest and incentives to invest because of perceived returns to education. These behaviours, everything else being equal, will accentuate variation in skills dispersions. As highlighted above, returns to skills (in particular literacy and numeracy), in terms of education attainment and adult earnings, and their dispersion, may give rise to the Great Gatsby Curve (GGC) used by Krueger (2012) to propose the hypothesis that income inequality could reduce income mobility over the next decades in rich countries. Despite the attention given to the GGC idea, few studies have analysed the mechanisms linking income inequality and intergenerational mobility. In a paper with very simple facts, Mazumder (2015) proposes that underlying differences in cross-country inequality of adults cognitive skills may explains better the variation in intergenerational mobility than income inequality. This suggests that equalizing educational opportunities may likely impact positively income equality. This could arise, for example, if the quality of schools is uniformly high throughout a country, but also if schools serving low-income children teach more sophisticated skills or transmit them in a more efficient way.

In Canada, test scores performance of students in the international PISA surveys (and for some provinces in the TIMSS and PIRLS surveys)[4] or their changes over time are not a particularly topical subject. Very few academics have investigated the larger picture and implications of the education scholastic achievement of 15-year-olds in Canada, but some have offered more limited commentaries about the slipping high-school students' scores or questioned teaching methods (Richards (2014a, 2014b); Stokke (2015); Haeck, Lefebvre and Merrigan (2014)). In Canada, education policies are under the auspices of provinces, slipping out the top 10 in 2012, after a slow, decade-long slide, has not generate national attention unlike in many European countries (Anderson (2014)). The trend in provincial scores has been equally deflating in Québec considered, mistakenly, as an exception.[5] In

[4] The Council of Ministers of Education, Canada (CMEC) in the spring of 2007, administered the first Pan-Canadian Assessment Program (PCAP) reading test to a random sample of schools and students, all representative of the Canadian cohort of 13-year-olds in all 10 provinces and Yukon. Approximately 20,000 students wrote the assessment. For PCAP 2010, the random sample changed to Grade 8 students from 1,600 schools across the country. Math was the major focus of the assessment. In the spring of 2013, approximately 32,000 students in Grade 8 from over 1,500 schools across the country were tested. Science was the primary domain assessed, while reading and mathematics were the minor domains. Changes of domains and samples selection raise non-comparability problems.

[5] Québec is in itself a laboratory. The large sector of private high schools (see below) has boosted the mean scores, (Lefebvre (2016)), while all observers of the education scene have the presumption that Québec students are in the top international groups in math. Moreover, Haeck et al. (2014) show that a large scale educational reform had

France, the European country that experienced the strongest rise in performance variance of PISA tests, the increasing inequalities in French students' cognitive skills since 2000 has been blamed on the declining quality of the French educational system (Goussé and Le Donné (2016)).[6]

This paper investigates four neglected issues related to students' school achievement in Canada. The first research question documents empirically the link between the family background, measured by socio-economic status (SES), and educational skills measured by PISA tests scores (2000 to 2012). There is no evidence on the SES gradient in literacy and numeracy skills across provinces, the locus of education policies. The second research question analyses the dispersion of academic deciles achievement at age 15 in Canada across provinces. There is no evidence on the association between low- and high-parental SES and students' skills across the scores distribution. The third research question relates to proficiency levels and socio-economic gradient, a pass-over subject but most important for economic and social success of young adults. The fourth research question assesses the trends in socio-economic inequalities across provinces from the lorgnette of skills measured over more than the last decade PISA cycles (2000 to 2012).

Lack of evidence, on these issues in Canada, stems from the under exploitation of very good and relevant international data sets to study the social mobility implications of educational policy. European academics have analysed how country-level factors (education and school policies) could have affected social inequalities using PISA standardized measures of students' scores (Le Donné (2014); Duru-Bellat, Mons, and Suchaut (2004); Chiu and Khoo (2005); Hanushek and Woessmann (2006); Shuetz et al, (2008); Dronkers, van der Velden, and Dunne (2012); Stadelman-Steffen (2012); Raitano and Vona (2011a, 2011b)).

The analysis makes four majors contributions. Firstly, it presents the extent and distribution of socioeconomic gradient in academic skills across provinces using a comparable measure between parental SES and repeated students' test scores. Secondly, cross-province variation identifies indirectly the differences in provincial school system (Anglophone, Francophone, private school without or with subsidies) that may conduct to inequalities of opportunity. Thirdly, our estimations of socioeconomic gradient not only relate to skills in two domains (reading and math) but also to proficiency levels at different years, in the same cognitive domains and their changes in time. We

negative effects on students' scores at all points on the math skills distribution, and that the effects were larger the longer students were exposed to the reform.

[6] In Sweden, a decade of declining PISA performance after raft of changes, including introduction of a voucher system, now needed to improve quality and equity in education, according to a new OECD report (2015). This is also relevant for understanding declining PISA scores in Finland in 2009 and 2012, the longstanding pin-up model of school choice and accountability critics. Finland had topped the PISA rankings in 2000, 2003, and 2006, and consistently ranked near the top of global rankings in other years.

take advantage of the existing five extensive international student achievement PISA tests, adopting a similar approach used by Jerrim (2012), who compares England with five other countries (including Canada) mainly with PISA 2009 reading test scores. Fourthly, analysis of changes in gradient of mean gaps across provinces permits drawing the plausible trends over the 2000 to 2012 years.

The rest of the paper is organised as follows. Section 2 describes the framework, data sets and the empirical estimations methodology. Section 3 presents first the estimated socioeconomic gradients (quintile) in mean test scores, and secondly the gradients across the achievement distribution (quantile gaps) for Canada and across provinces. Section 4 reports inequalities in proficiency levels and estimated family socioeconomic quintiles marginal effects. Section 5 presents changes over years (since 2000) across provinces. Section 6 summarises the main findings and the policy implications challenges facing provinces if SES inequalities in skills are to be reduced.

2. Framework and empirical methodology

2.1 Data sets on test scores

To derive estimates of socio-economic gradients in skills over years across Canadian provinces, we use the Programme for International Student Assessment (PISA) conducted every 3 years since 2000. Each PISA survey assesses one of three core domains in depth (considered the major domain) among reading, mathematics, and science. Except for the first survey year of 2000, all students are also tested for the minor domains when the surveys rotate the major core tests, which were reading in 2000 and 2009, and math in 2003 and 2012 (science as a major test's domain was conducted in 2006 and was re-tested in 2015 (with results forthcoming in December 2016). Since for different cohorts of 15-year-olds, test scores for two repeated major domains (reading and math) were surveyed, we can focus on scores distribution and their link with socio-economic parental background over a rather long period, as the skills performances are directly comparable across time and provinces, although tests also varied slightly over time (Brochu et al. (2013); OECD (2010a)).

The survey test scores for cognitive ability in all three areas are summarized using an "item-response model" which produces five "plausible values" to estimate children's true ability from the answers to the test. Nonetheless, OECD (2010a) asserts that the first plausible value, which we use in all following analyses, represents a valid summary of each participant country/entity test scores. This variable is expressed on a scale with an average of 500 points for all of the OCDE tested children and a standard deviation of 100 points. PISA Technical report (OECD 2010b) states that a 40 PISA test points is approximatively equivalent to one additional year of schooling. The following table presents mean scores by domain and year for all Canadian children who took the test (Canada has always had higher scores among OECD countries and a lower standard deviation not presented here):

PISA estimated average score by domain and year, Canada 2000-2012

Year of survey	Reading	Math	Science
2000	534*	533#	529#
2003	528	532*	519
2006	527	527	534*
2009	524*	527	529
2012	523	518*	525

Note: * indicates year of major domain; # indicates that not all students participated in the math and science tests, randomly 50 percent were assigned to one of the two tests.
Sources: Bussière et al. (2001, 2004, 2007); Brochu et al. (2013); Knighton et al. (2009).

Considering the average scores for Canada, the country performed well for all domains and remained in the top places among PISA participants over the years. Canadian students' performance in reading remained rather stable over time, while in science the trend is less clear. Students' performance in math is strong, while results have slipped over time, both from a relative and an absolute perspective.

The Canadian samples were selected to produce reliable estimates representative of each province, and of both Francophone and Anglophone school systems in NS, NB, QC, ON, MN, AB, and BC.[7][8] The PISA tests were administered in English or French according to the respective school system, during regular school hours generally in April and May. The core test is a two-hour paper-and-pencil test; and minor domains were tested through a paper-based thirty minutes test. All students also completed a 30-minute background questionnaire providing information about themselves, home environment, and various features of their family. These characteristics include their gender and month of birth,[9] language at home (same as test or other), their mother and father level of education, whether they themselves and their parents were born in the country, and their family status (living with both parents or not). Home environment refers to material possessions of the family or the students (number of cars, bathrooms, televisions, cell-phones, books, art and poetry books, and own room, study desk, computer).

2.2 <u>Test scores and socioeconomic status</u>

[7] For the sampling procedures and responses rates in Canada across surveys, see Bussière et al. (2001, 2004, 2007), Brochu et al. (2013), and Knighton et al. (2009).
[8] Provinces acronyms are defined in the Annex.
[9] All the 15-year-olds are born on the same year, for example 1984 in the 2000 survey, 1987 in the 2003 survey and 1996 in the 2012 survey.

PISA has developed its own index of economic, social and cultural status (ESCS). But, some researchers (e.g., Cornoy and Rothstein (2013)) stress the arbitrary character of the index and its convoluted computation formula:

> "The ESCS index arbitrarily gives equal weight to parental educational attainment, parental occupational status, and a sub-index of the collection of possessions. Once OECD statisticians calculated the index for each student and weighted the ESCS index by the student weights within each country, they set the mean of the distribution in each country at zero, with a standard deviation of one, and estimated each student's ESCS as the student's standard deviation from the mean of that country's ESCS. The statisticians used the index of student "possessions in the home" to calculate each country's average position relative to the OECD mean and adjusted each student's ESCS index in that country by that constant term. Finally, they combined all the OECD country distributions of ESCS with their adjusted means into a single OECD distribution. To preserve the integrity of country distributions, the statisticians "compressed" the data into an artificial "sample" of one thousand students from each country to construct the distribution of ESCS for the OECD, with a mean of zero and standard deviation of one. The ESCS ranks the index number of each test taker, in all countries, on that single continuous standardized scale. Since each country is given equal weight in constructing the distribution, relative to the number of 15-year-olds in each country, the ESCS of students in smaller countries is weighted." (p. 41).

To measure socioeconomic status (SES) of children, within each province and over years, we use the highest international social and economic index (HISEI) of parental occupational status. This index is a predetermined variable created by the survey organisers from children's reports of their mother's and father's occupation (the higher of the two). It takes values between 11 and 90. The low-values (e.g. 11-20) regroup, for example, persons serving in restaurants and manual workers with no or minimal qualifications, while high values (e.g. 80-90) refer to professionals with high qualifications such as judges, CEO, engineers, lawyers, and medicine doctors.

This index, widely used in sociological research, has been built by Ganzeboom et al. (1992). It assigns to each particular occupational category a score based upon the weighted average of education level required and the earnings associated for the job. Jerrim and Micklewright (2012) present evidence that students' report of parental occupation in PISA provides a very reliable basis on which to base comparisons of socioeconomic gradients in test scores. This is less true of another proxy, also frequently used in sociological research, the number of books at home which can be interpreted as a family indicator of education esteem and academic success, and willingness to promote their child's academic effort. From this SES indicator, for estimation purposes, we create specifically for each province (and overall for Canada and survey's year) dummy variables representing quintiles of the HISEI distribution (reference is the bottom quintile). Using a 'local', that is a provincial SES index sticks more closely to the social environment of each province and their changes over the years.[10]

An alternative measure of SES is parental education, a background standard proxy widely used by economists to distinguish between more- and less-advantaged students as it is an exogenous background variable that has been identified as a powerful, independent determinant of student test performance. However, since we use the international data sets for Canada and that education is coded with five levels according to the International Standard Classification of Education (ISCED), and transformed by PISA in number of years, the information poses some problems. Parental education levels are over-stated or over-coded for a university degree in 2000. It is more difficult to transform levels to years and years in quantiles (and more cumbersome to use in econometric estimations). Jerrim and Micklewright (2012) conclude that SES gradient measure is less robust when a child instead of a parent reports parental education.

Table 1 presents for years 2000 and 2012 the HISEI distribution by province and for Canada. We can observe that all provincial SES's (measured by the HISEI index and here after designated by the term SES) are higher in 2012 than in 2000, in particular in the 75th, 90th, and 95th percentile. The ranges of the indicator of students' SES, using the median values, follow the usual ranking of provinces by disposable income.[11] Overall, these two distributions show rather large gaps in SES: for example, in 2012 for Canada, the difference between the 25th percentile indicators and the 50th, 75th, and 90th are respectively 22, 39, and 46 points, showing large increases in SES' gaps. Table 1 does not give the span of SES inequality in each province. To give a better cognizance of this magnitude, Table A1 (Statistical Appendix) presents, for years 2000 and 2012 and for each province, the number and percentage of students below and above the Canadian median index of their parents' occupational status (HISEI). When the Canadian index is used instead of each specific provincial ones, the spreading is more apparent. In 2000, the four Atlantic Provinces have a much higher proportion (more than 55 percent) of students below the median Canadian SES, as well as for SK and MN. In 2012, the median Canadian index has risen (from 53 to 58 points), but the provincial proportions of students below the median has changed marginally (with a small drop for NL, PE, MN). For some provinces (QC, ON, AB, BC), the proportion of students below the Canadian median has risen marginally. Table A2 gives another perspective on provincial SES' inequalities by showing the percentage of students in Canadian quintiles of index of occupational status (HISEI), across provinces

[10] When the calculated Canadian SESs (and quintiles) were used for all provinces, the estimated gap sizes changed but not their trends.
[11] The higher value for Québec may reflect a cultural bias (by Francophone) in the way student report their parents' occupation (e.g., a mid-supervisor in a department store may be described as a manager or director of sales).

and Canada, for 2000 and 2012. Again, the statistics indicate that from a Canadian perspective in 2012, six provinces have fewer (more) students in the highest (lowest) quintile of SES. The proportions have improved since year 2000. But having a large number of students coming from a family with low SES background, means that schools have more important challenges to instill skills in these students.

Tables 2 and 3 show, by selected percentile points, the distribution of student's PISA test score across province and overall for Canada, respectively for main tests domains (reading 2000 and 2009; math 2003 and 2012), adding as a complement, year 2009 for math, and year 2012 for reading. Tables also indicate the P90/P10 (percentiles) ratios for the same samples. There are large scores gaps across the percentile range. For reading, the differences between the 90th percentile and the 10th percentile scores are on average almost 300 points with ratios of 1.5 to 1.7. For many provinces (NL, PE, QC, MN, SK, AB), the reading test scores distributions (Table 2) have changed between 2000 and 2009 with a drop for the mean and median (50th percentile). The changes are more marked at the higher percentiles and less for the lower performing students. The math scores distributions (Table 3) also indicate a fall when comparing mean scores between the two years of major domains (2003 and 2012). The changes can be observed over the range of percentiles performance. Tables A3 and A4, respectively for reading and math, anticipate the estimation results for SES indexes. The test scores for the same percentile points are ventilated according to the bottom and top SES quintiles, and show the point differences between them. In general, for reading, the differences between the quintiles across percentiles have decreased slightly for many provinces (QC has the lowest differences). For math, the differences have increased except for NS, SK, and BC.

2.3 Provincial school systems

Elementary, secondary, and post-secondary education systems in Canada are a provincial responsibility, with many variations between the provinces. The Constitution of Canada provides constitutional protections for some types of publicly funded religious-based[12] (e.g. Catholics in ON) and language-based school systems (Anglophone and Francophone school systems in NS, NB, QC, ON, MN, AB, and BC). Within the provinces under the Department of Education auspices, there are district school boards administering the educational programs. Thus, there is in fact a distinctive education system for each province.

One point that merits consideration and could impact score tests is age of entry at a public school and grade level. In all provinces, a child can be enrolled in kindergarten at the September beginning

[12] This constitutional provision was repealed in Québec by a constitutional amendment in 1997, and for Newfoundland and Labrador in 1998. The constitutional provision continues to apply in Ontario, Saskatchewan and Alberta.

of school year if ages 5 by end of December, except in Nova Scotia and Québec where the cut-off date of eligibility is September 30th. Since this accentuates the grade range of the 15-year-olds in PISA surveys, the statistics presented and estimations samples are restricted to students in grades 9 and 10 only (this rules out very few students as shown in Table A5).

Many studies on test scores performance in PISA surveys have shown that non-resource institutional features of school systems affect student outcomes, such as accountability measures, school autonomy, competition and private involvement, school tracking, teacher quality and experience, and the pre-primary education system (for a survey Hanushek and Woessman ((2011a)); Hanushek, Link, and Woessmann ((2013)); OECD ((2010c, 2012, 2013)). Across all countries (Table 2.8 of Hanushek and Woessman (2011a)), private school management tends to be positively associated with student achievement, with a difference to publicly operated schools of 16–20 percent of an international standard deviation in the three subjects in PISA 2000 (Fuchs and Woessmann (2007)). Similar results are found in PISA 2003 (Woessmann (2009, 2007)).

A minority of students in Canada attends privately managed schools (see Table A6), at around 8% in 2012 (6% in 2000 according to PISA survey). Only, five provinces provide some partial subsidy to private schools—BC, AB, MN, SK, and QC.[13] Students attending private schools tend to be from socio-economically advantaged backgrounds and have on average much higher tests score (see Table A6). Québec has an established long tradition of public subsidy to private schools, and the transition to private schools operates for almost all students at the end of primary school. In Québec, the treatment effect on scores of this system is significant and analysed by Lefebvre and Merrigan (2010), Lefebvre (2016), and scores as mediator factor in postsecondary enrolment (Lapierre, Lefebvre, and Merrigan (2016)). Moreover, in some provinces, school boards can provide locally additional choices, such as alternative and specialized schools, schools emphasizing a particular language, music, dance, sport, or some other activity;[14] open enrolment (replacing school assignment by postal code) also introduces diversity and competition (Allison (2015); Friesen, Cerf Harris, and Woodcock (2015)). The private schools socio-economic stratification between students attending publicly and privately managed institutions will be taken into account by the SES index of occupations which will capture all family background influences, including type of school attended (see Lefebvre (2016)).

Finally, media reports on education spending in the provinces refer to cuts, gaps, caps, budget shortfalls, and expenditures decreases (see Van Pelt and Emes (2015)). If spending in government

[13] Québec sets a relatively low ceiling for the fees that depend on level of studies in exchange for a subsidy: the fee cannot be higher that the yearly subsidy which is equal to 60 percent of the subsidy to public schools (that have access to property taxation).

[14] In Québec, to compete from private schools, many school boards have introduce augmented instruction at the secondary level through one or more non-public options such as international studies, music, sports.

schools decreased over the last decade, it would be less surprising that cognitive test scores of students at the end of their secondary school level may show decline in the overall performance with decline of low-achieving students, and the score of the highest-achieving students remained roughly the same. Figure 1 presents, for each province and overall for Canada, the per-pupil governmental spending adjusted for inflation (provincial CPI 2011) from school year 1999-2000 to 2011-2012 ("headcount enrolments in regular programs for youth in public elementary and secondary schools"). Since enrolments decreased over the years, adjusted for inflation using the all-items Consumer Price Index, spending not only increased over the decade, spending in real terms have risen more than necessary to account for enrolment and price changes (Clemens, Van Pelt, and Emes (2016)).[15]

2.3 Estimations methodology

Two types of model estimate the SES economic gradient on students test scores. The first one is an OLS which measures the link between reading or math scores, and the SES index is measured by HISEI and transposed in quintiles. The first model is:

(1) OLS: $Read/Math_{isp} = \alpha + \beta_1 SES_i + \beta_2 MALE_i + \beta_3 IMMI_i + \beta_4 SES_i * IMMI_i + \beta_5 X_i + \varepsilon_{is}\ \forall p,$

where $Read/Math_{isp}$ is a student's score on a particular PISA test for student i, in school s, and province p; SES_i represents four dummies variables – quintiles - with the bottom quintile (most disadvantaged group as the reference); MALE is dummy variable of student's gender (1 for male and 0 for female); IMMI indicates if the student or father or mother were born outside Canada (student is a first- or second-generation immigrant; 1 for immigrant, 0 for native); SES_i*IMMI_i is an interaction term between SES quintiles and immigration status; the vector X_i indicates exogenous characteristics of a student, the age in year-months of the 15-year-old, the grade (grade 10 is 1 and grade 9 is 0), and two dummies indicating the language used at home (French, English, and others as the reference); ε_{is} is an error term using a clustering option of children within schools. All estimations use the students sampling weights derived by Statistics Canada and a clustering option for school identity to adjust for the estimated standard errors. Missing information for the control variables imply that the children are dropped off the analysis.[16]

The second model is based on simultaneous estimation of quantile regressions for nine quantiles (10^{th} to the 90^{th} quantile):

[15] According to their calculations, between school year 2004-05 and 2013-14 if for public schools had remained constant, the aggregate amount of education spending in Canada would have been 20.3% lower (by 12.7 billion); and respectively for each province from NL to BC, by -15.5%, -24.7%, -19.2%, -22.8%,-21.7%,-20.1%, -17.8%, -28.2%, -20.6%,-14.6%.

[16] The SES index is the variable with more missing value (approximately 6% for all years, but 12% for year 2003).

(2) SQREG: $Read/Math_{isp} = \alpha + \beta_1 SES_i + \beta_2 MALE_i + \beta_3 IMMI_i + \beta_4 SES_i * IMMI_i + \beta_5 X_i + \varepsilon_{is}\ \forall p.$

Where SQREG are quantiles (q10, q20, q30, q40, q50, q60, q70, q80, q90); the explanatory variables are the same as in equation (1). The statistical software to perform the estimations (STATA14) does not admit the use of weights, so a bootstrap procedure with replication (500) and clustering for school identity where the student is enrolled was adopted:

(3) Bootstrap, reps (500) cluster (school-id): SQREG: $Read/Math_{isp} = \alpha + \beta_1 SES_i + \beta_2 MALE_i + \beta_3 IMMI_i + \beta_4 SES_i * IMMI_i + \beta_5 X_i + \varepsilon_{is}\ \forall p.$

3. Results for socioeconomic gradients across provinces and Canada

3.1 Socioeconomic gradients in mean test scores

3.1.1 Reading (average test point differences)

Figure 2.1 shows the size of estimated socioeconomic gap in average PISA reading test scores for the two repeated main domains (2000 and 2009) across provinces and overall for Canada. Each bar represents the size in points of the estimated mean difference between students in the top quintile of SES and those in the bottom quintile. In Canada, abstracting from the provinces, the difference between 'advantaged and disadvantaged' quintiles in 2000 is 65 points (everything else being equal), more than a year of schooling. The estimated coefficient for 2009 indicates a rather large drop of 15% to 55 points. For each province, the Figure indicates much more heterogeneity in points, and rather similar gaps in 2009 (65 points in MN to 39 points in QC) compared to 2000 (80 points in NL to 50 points in SK). Some provinces (QC, MN, SK) stand out with smaller socioeconomic gradients in 2000, although they increase in 2009, except in Québec. The estimates of the five reading gap coefficients (with minor domain tests of 2003, 2006, and 2012), not represented in Figure 2.1, indicate similar magnitudes for the association between family background and average level of children's skill achievements in reading.[17] For six provinces (NL, PE, QC, MN, AB, BC), the gaps are larger for years of minor domains tests. Figure 2.2 presents the four estimated quintiles coefficients relative to the first bottom quintile for the 2009 mean reading test scores (latest main domain for reading) across province and for Canada. In two provinces (NL and AB), there is no significant difference between the bottom (reference) and second quintile. Across provinces and overall for Canada, the estimated quintiles coefficients increase relatively to the reference bottom quintile (except for NL where the third quintile coefficient is larger than the fourth, and SK for which

[17] According to Jerrim (2012) study of reading scores in 2009, Canada for the same mean test score has a low level gap among the 23 countries analysed, similar to the Scandinavian countries.

the second is larger than the third). These results indicate a pattern of growing non-linear socioeconomic gradient, with a rather large jump for the fifth quantile as presented in Figure 2.1.

3.1.2 Math (average test point differences)

Figure 3.1 presents the size of estimated socioeconomic gap in average PISA math test scores for the two main domains tested (2003 and 2012) across provinces and overall Canada. For Canada as a country, the 60 points gap has remained the same as well as for the other year-surveys considering a 95% confidence interval (not represented in Figure 3.1). Among provinces in 2012, only NS and SK have a smaller socio-economic gap than for year 2003. All the other provinces have a higher math gap, the exceptions are ON and BC with unchanged gaps at around 50 points for the two surveys. The 2012 year survey indicates increases of different extent in seven provinces (the more important estimated raises are in NL, QC, and MN with 20 to 35 points relative to 2003). Considering all the years (not represented in Figure 3.1), the mean gap for each province is in the 50 to 60 points interval between the top and bottom quintiles of SES. Figure 3.2 presents the four estimated quintiles coefficients relative to the first lowest quintile across province and for Canada. In four provinces (NS, ON, SK, and BC), the second quantile coefficient is not statistically different from the first reference quintile. Although the estimated coefficients indicate a pattern of increases for quintiles three to five in almost all provinces, the raises are less sharp than for the reading mean scores.

3.2 Socioeconomic gradients across the achievement distribution (quantile gaps)

3.2.1 Reading and math scores distribution Canada

The quantiles regressions (equations (3)) capture achievement gaps at different percentile points (deciles) of test distribution. Figure 4, left panel, presents respectively the reading and math gaps of test scores between top and bottom quintiles for Canada, estimated for the two years of the major test (reading in 2000 and 2009; math in 2003 and 2012).

For reading, the estimated gaps along the distribution of test scores are different over the two survey-years. In 2000, the 70 test point gaps persist almost up to the 70th percentile of the test distribution with a slight decline at percentiles 80 and 90. In 2009, the estimated coefficients show a continuous widening gap (from 55 points to 65 points) in reading for almost all percentile points and a small drop from percentile 70 (65 points to 59 points). The 2006 and 2012 deciles distributions estimations (not presented) indicate larger and rather increasing size in gaps, while the 2003 distribution has a 15 scores points drop from the 40th to the 90th percentile test distribution between students of the two groups of SES.

The right panel of Figure 4 shows estimations results for math test scores. They indicate a stronger association at most points of the distributions between test scores and SES status, particularly in

2012. Moreover, the deciles points suggest increasing socioeconomic test scores differences almost over all the points for both years (a slight decrease appears from the 80th decile). These estimations, for Canada, show that students in the top quintile of SES have high achievement in all deciles of scores distribution, points gaps corresponding to almost two years of education (in math). Both types of results (reading and math) suggest that over the percentiles range of tests scores, students advantaged by the SES of their parents have higher skills. It is only at the very high levels of the test scores distribution that gaps between the top and bottom quintiles decrease slightly. This suggests that few able and smart students from the bottom quintile of SES can learn and develop cognitive skills in the Canadian school systems.

3.2.2 Reading and Math scores distributions across provinces

We turn to each province to present and comment estimated gradients from scores distributions. Although the students' gradients are different in length, slope and strength for reading and math scores (Figures 5 to 14), the gaps show large and very often increasing disparities between students of a low and high SES over the percentile distribution of scores. The Figures present the same types of quantile estimations for each province where the SES quintiles are calculated specifically for each province and year of survey. Particular trends in each province are the following.

NL: The estimations for the same major domains over the two survey-years reveal strong and increasing gradients with few small variations, and some decreases in the middle range of percentiles inequalities gaps between the two opposite groups of students by their SES. The 2009 results are more tenuous since, in this province, the controls for language spoken at home and immigration status posed convergence problems and were dropped. As for math gaps, in 2012, they increase for almost all deciles.

PE: The estimations for latest reading and math tests main domains indicate increasing gaps (in particular math). The distribution follows an inverted U shape for reading and math in 2003.

NS: Although gaps in both domains increase in the percentile distribution of scores, there is a clear change in levels for the latest survey (reading in 2009 and math in 2012), which are lower at each nine points. This indicates that achievement inequalities have decreased between the bottom and top SES quintiles.

NB: The more recent estimated gaps for reading and math as main domain, respectively 2009 and 2012, are lower than first estimated gaps respectively for 2000 and 2003. From the 60th percentile, the gaps between students coming out of a low and high quintiles increase, which indicates that the gradient has not changed much for the more advantaged students.

QC: For reading, the 2000 and 2009 gaps are almost similar and increase from 35 points in the 10th decile to 45 points in the 90th decile, a rather small increase. In math, the quantiles math scores are rather flat with, curiously, higher gaps in the lower and highest percentile points. The 2003 math distribution of gaps is lower than the 2012, and increases slightly from the 60th percentile point.

ON: For math all gaps estimations over the SES distributions indicate step increases. For reading and year 2009, the picture in more mixed, with lower and decreasing gaps from the 10th percentile to 50th percentile point, and increases from the 50th percentile point. The reading 2000 estimated distribution of gaps is rather flat and much higher than the 2009 one, which suggests less dispersion between the low-SES and high-SES students.

MN: For reading, there is reversal of the gaps distribution: in 2000, they decrease over all percentile points; in 2009, they increase while starting at the 10th percentile point with the same 50 points gap. For math, the gaps in 2003 are much lower than for the 2012 distribution (around 40 to 45 points on the distribution range); the pattern changes for 2012, with larger and increasing gaps except at the 90th percentile point.

SK: The 2009 reading distribution of gaps is higher (by more than 10 points on average) than the 2000 distribution, which has rather low gaps at both extremes of the percentiles range. For math, the 2003 and 2012 gaps distribution have contradictory trends: in 2003, first increasing and then decreasing with first and last gaps at 50 points; in 2012, the estimates indicate a large decrease, from a 65 points gap to a 45 points gap, then a flat part followed with increases and a small drop.

AB: For the reading scores, both distributions follow the same pattern, from low gaps to increases, then flat gaps, and finally high gaps. In math, for the years of main domain (2003 and 2012), the 2012 gaps have much increased compare to year 2003, with an increasing portion followed by declining gaps over the distribution after the 50th percentile point.

BC: The reading gaps for 2000 and 2009 have a similar pattern, a continuous large decrease after the bottom percentile points of the distribution, with gaps larger than 65 points. But, at the 90th percentile points, the gaps are higher than 50 points. For math main both distributions follow a similar (first increases and then decreases) with gaps that are lower than in other provinces (except MN) at around 50 points.

This exercise of gradients estimation, between the 10th and 90th percentiles of scores distributions, suggests significant SES gaps across provinces. All the coefficients of the top quintile relative to the bottom quintile, except for a few for NL, are statistically significant at the 99-95 percent levels among students of the two opposite SES quintiles. In general, the gaps (differences in student performance) have not decreased in the last decade, and in most provinces are more pronounced. The relative position of the gradients illustrates that provincial differences in SES are associated with differences in performance. Alberta's higher levels of SES are associated with higher average performance, but its gradient does not overlap or intersect with any others, suggesting that students in Alberta would still perform better on average than students in other provinces with comparable levels of SES. The closeness of the Québec gradient to Alberta's suggests that performance in Québec would be more comparable if Québec students had similar SES to their peers in Alberta. Although British Columbia had a higher average performance than Québec, the gradient in British Columbia is lower than the one in Québec at all levels of SES. This comparison suggests that the high performance of students in British Columbia is related to their higher-than-average SES. The gradients of Newfoundland and Labrador, Ontario, Saskatchewan, Nova Scotia and New Brunswick intersect, despite having similar slopes, indicating that much of the difference between these provinces in average performance may be explained by differences in their SES distribution over time.

3.2.3 Estimated coefficients of each quintile by percentile distribution of scores (Reading and Math)

Tables A7 and A8 present, respectively for the latest main domain test in reading (2009) and math (2012), the estimated four quintiles coefficients (test score points) relative to bottom quintile for the quantiles (P10 to P90) distribution across province and overall for Canada. The coefficients indicate that, in general, for almost all provinces in each quintile, the coefficients (gaps) do not change much from one quantile to the other. Coefficients of test scores in the second quintile of SES across the quantiles are in general (for many provinces) not statistically different from the bottom quintile (the SES reference status). These significant coefficients (for Q2) are small compared to coefficients associated with higher quintiles across the scores distribution. The estimated coefficients for the top quintile (Q5) of SES gaps across the quantiles of test scores distribution are much higher than for the coefficients associated to the other SES quintiles. These results were presented and discussed in the last section on the achievement distribution. In other words, a student from a high SES family who performs 'poorly' in the reading or math score tests distribution (notably in the P10 to P40 percentiles) will have much larger test scores (on average typically 10 to 25 more points) than the peers in the four lower quintiles. Conversely, students from the top SES quintile would have much larger test scores, being proportionally much more present in the upper quantiles of the test scores distribution.

4. Results for socioeconomic gradients in proficiency scales

PISA reports not only student performance as standardized scores, but also what they typically know and can do when they achieve a given level on a PISA scale described as "proficiency scales" rather than “performance scales”. PISA organisers estimate the ability of all students taking the PISA assessment, and the difficulty of all PISA items, locating these estimates of student ability and item difficulty on a single continuum (see OECD technical reports, and Annex A1 for presentation of Literacy in each PISA domain). Scales are defined on a multi-level scale, from very low levels of literacy (in reading, math, and sciences) through to very high levels. These proficiency competencies levels, where tasks at the lower end of the scale (level 1) are deemed easier and less complex than tasks at the higher end (levels 6 or 7), can be considered as more important skills in achievement.

Table 4 presents, for Canada and all survey years, the percentage of students in five proficiency levels in reading and math, the percentage difference between the lowest (Q1) and the highest (Q5) quintiles of SES, and total percentage in each scale. The first two scale levels (1 and 2) are considered as low and very basic (insufficient to perform as an adult in our society). At levels 6 and 7 students demonstrate complex understanding of text structure and its implications. At the same levels in math, students can apply insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for attacking novel situations. At levels 3 to 5, students complete test items of moderate to relatively higher difficulty. Statistics in the Table 4 clearly show the inequalities between SES Q1 and Q5 in proficiency levels. In 2009 (last year of main domain in reading, first panel), there is 10 percentage points more students of the bottom quintile in the lowest two levels; in the upper two levels, they are behind their advantaged SES peers by 16 percentage points. In math (second panel) for year 2012, the respective percentage points are 14 and -20. For the low proficiency level, the percentage of low-achievers from the top quintile is much lower than their peers from the bottom quintile, in particular in math. The bottom part of each panel indicates that over survey-years, the picture of levels has not changed.

Table 5 presents similar statistics of proficiency levels for years of major domains, including sciences in 2006, from the perspective of provinces. In the reading domain, QC and AB have very notable performance for students in their school system (ON and BC are not very outdistanced): low percentage in the very low basic level and high percentage in the outstanding levels. The Atlantic Provinces have more feeble scores for proficiency levels. In math, for year 2003, QC and AB appear to leave behind the other provinces, except for year 2012 (major domain) for AB. For sciences as a major domain in 2006, the levels of proficiency for Canada and the provinces reveal some weaknesses compared to reading and math insofar as there are large percentages in the middle scale levels (less students in the 4 to 6 levels of proficiency).

Appendix Tables A9 and A10 present, respectively for reading and math proficiency levels, for years of main domain per per-wise column, the percentage difference in number of students in each level according to bottom and top quintiles, and total percentage of students by level. For example, in Table A9, the first line NL and the first column of 2000 indicates that 16 percent of the more disadvantaged students according to their SES status are in proficiency scale 2, while column 2 indicates that, for all the SES quintiles status, 12 percent of students have a scale level of 2 in proficiency. Going down the level, we can notice important changes in the percentages. For NL, year 2000 and level 6, the difference between low (Q1) and high (Q5) SES is -26 percentage points; over all the SES status (allQ), only 13 percent students are at this level.

Going over all provinces and years, we observe a static picture of proficiency levels dynamic. Percentages in Tables A9 and A10 can characterize the changes in a specific proficiency level between low and high quintiles as well as number of students in a low, middle or high level of proficiency. Very few provinces are observed with gains in reading and math on both ends: there is less difference between extreme quintiles and progress in number of students in the upper levels.

Table 6 presents marginal probability estimates of proficiency levels by SES for years of main domain in reading and math. The first two columns in each panel simply present the ratio of students observed in the three lower scales (1+2+3) compared to higher scales (4+5+ 6+7), and total number of students. In reading from 2000 to 2009, the ratios have increased by more than 5 percentage points in five provinces (NL, PE, MN, SK, and AB), and by 1 to 3 points in the other provinces (3 for overall Canada) with a 1 point decrease in NS. In math from 2003 to 2012, the ratios have increased by 4 points or more in all provinces except QC, with a 3 points increase for Canada. The four next columns in each panel present the marginal effects (logit estimates) of the respective probability for students of being in the low regrouped proficiency levels (1+2+3) instead of the higher regrouped levels (4+5+6+7) conditionally on each quintile group (Q2 to Q5) compared to the reference gradient (Q1). A very large majority of estimates for both main domain and years indicate that probabilities decrease significantly from quintiles 3 to 5. In other words, students from middle to high SES have a much lower probability of being in the low, basic or with some limits of proficiency levels in reading and math. These estimates sustain the affirmation that a significant and increasing proportion of 15 year old Canadian students over the years are not doing very well in literacy and numeracy.

5. Changes in gradients of mean gaps over years

How has socioeconomic achievement gradients changed since the first 2000 PISA survey? Bearing in mind, that each survey gives in rotation more weight, that is test time, to a main domain completed with two added tests for secondary domains (except in 2000 when students were randomly given only one complementary test), changes over time for all domains are more tentative. Table 7 illustrates in two panels (reading and math) across provinces the socioeconomic average achievement gradients and the extent to which test score gaps have increased or decreased between each PISA surveys from 2000 to 2012.

The emerging general picture on gaps between the lowest and highest SES's quintiles is very mixed. In reading tests, if the 2009 results are considered as giving the right state of gradient, for overall Canada, there is a small statistical positive change (see column change) over 2000. But, across provinces there are few statistically significant changes and two significant deteriorations coming from MN and SK with a 19 percentage points amelioration from ON. Reading tests for the most recent year 2012 suggest an increase in four provinces (NL, NB, QC, AB), deceases in the other six provinces, giving an impression of a very small (4 percentage points) falling out overall for Canada.

In math tests, overall Canada, there is no change in mean test scores in three of the four surveys (at 61 points). Across provinces, considering all years, there is no clear trend direction. On the basis of the 2012 and 2003 comparison, there are three statistically significant increases (NL, QC, and MN) and one large decrease (NS) of scores gaps.

6. Summary, policy responses and conclusion

6.1 Summary

This analysis used mainly four repeated main international students' achievement tests (of representative 15-year old Canadians) in reading and math, that very robust research identify as a major predictor of later academic performance or success in life. The econometric investigation, covering the years 2000 to 2012, is based on samples across provinces, positing the exogenous character of each provincial educational policy, and presuming that estimated effects would reveal the likely socioeconomic inequalities in educational attainment. Studying differences in achievement associated with socioeconomic gradient across-provinces and trends over years, by looking at the distribution of scores within each province student's population with overall Canada as a benchmark, signals the extent of equality in opportunities and eventually intergenerational mobility.

Five strong results become apparent from the link (gradient) between family backgrounds measured by parental SES (occupational status) and achievement. First, there are strong average gaps in students' educational attainment (PISA's scores in reading and math) between the lower and top SES quintiles across all provinces and years. Abstracting from provincial educational policy, these gaps may be interpreted as a proxies for the extent of inequality of opportunities. Second, crossprovinces variation in SES (and other family backgrounds characteristics) at the individual student level imply the existence in many cases (and years main domain) large impacts of inequalities of opportunities. There are large variations in the size of average gaps across provinces and years. Third, quantile regression estimates expose more than OLS mean estimates, that the gaps, for each province (and overall Canada), vary across the achievement deciles distribution. Across provinces, the association between family SES and achievement stands out as strong at most points of the PISA distribution. Fourth, the percentage estimated differences in proficiency levels for reading and math, reaffirm the large socioeconomic gradients across provinces. Fifth, average and deciles socioeconomic gradient do not indicate declines over time.

6.2 Policy responses

The results on the estimated links between students' family background (SES) and cognitive achievements, as well as descriptive statistics such as percentile ratios (number of students at the 90th percentile and those at the 10th percentile or in different proficiency scale levels) signify that the provincial school systems are associated with significant inequities in educational outcomes. It is more delicate to identify the organisational features of each education system that may affect educational opportunity beyond pre-existing inequalities (in the case of 15-year-olds, these may have been reinforced over many years of schooling). Each public interest group would probably support different sources of improvement for public schools.

American research, equipped with longitudinal data regarding teachers, primary and secondary school students and their results, shows that teacher quality is probably schools' most valuable asset, including principals (Chetty, Friedman and Rockoff (2014); Dhuey and Smith (2011), Hanushek (2011)). Teachers' academic performances or competencies are strong predictors of their efficiency, which is empirical measured as the value-added cognitive abilities of their students (Rockoff et al. (2011); Hanushek and Rivkin (2006)). While the economics profession widely accepts these value-added effects, there remains a lack of consensus concerning appropriate policies that could be implemented, such as better salaries and working conditions, in order to insure a pool of qualified teachers (Dolton and Marcenaro-Gutierrez (2011); Loeb and Page (2000); Hanushek, Ruhose and Woessman (2015)).[18] Unfortunately, we do not have data that could give evidence on teachers' competencies in Canadian provinces.

[18] Research shows that these initiatives generally induce improvements in students' scholastic outcomes. In the Canadian context Jonhson (2015) presents not totally convincing evidence that teacher compensation compares very well to remuneration of other university graduates working in the public and private sector.

Teachers and their unions would likely suggest spending increases, even though the number of pupils has declined in the last decade with concomitant and also planned reduction in ratios (class size) to better support students from disadvantaged family.

Other general interrelated policies, beside blames assigned to inadequate teacher training or quality, funding inequalities, lack of universal preschool, tend to dominate these discussions. One is the incentives that have a locking effect in hiring and retaining high-quality teachers and administrators. But attempts to measure the relationship between teachers' salaries and student performances in various American states are surveyed in Hanushek (2006) who comes to conclude that any evidence linking broad measures of school resources (assuming these translate into teacher compensation) and academic results is weak. Working on the selective and retention margins seems better strategies.

Low achievement by able and disadvantaged students is a reflection of the different schools attended: students from more affluent background access better schools, including private schools with tuitions. A diversity of interventions could turnaround low-performing schools by school boards (Hirsch 2016) (local schools must be submitted to students testing and measurement to reveal sources of low performance), giving enough time to generate positive effects.

On this front are enhancements of local school control and autonomy over hiring. Organizational changes in the education systems of OECD countries have taken place mostly in the new millennium, with the governments' intention of promoting competition and quality among schools, and of improving students' results (Figlio and Loeb (2011)). This decade saw the proliferation of charter schools in the United States, independent, private or subsidized religious schools in Sweden (Böhlmark and Lindahl (2015)) and Netherland, academies or foundations with public subsidies in England (Eyles and Machin 2015), along with a variety of private schools with partial or complete subsidies (e.g. France).

In Canada, some provinces have taken initiatives to introduce competition by extending school choices. Card, Dolley and Payne (2010) obtain positive significant effects of catholic schools on the scores of elementary school students in the Province of Ontario, where parents have the choice between two fully provincially funded systems, one open to all and the second restricted to students with a catholic ancestry.[19] Using longitudinal administrative data from British Columbia's elementary school system, Azimil, Friesen, and Woodcock (2015) find that private schools (secular or confessional) lead to significantly higher standardized test results in reading and mathematics.

[19] Open access to Catholic secondary schools was introduced in the political negotiations following Ontario's 1984 decision to extend full public funding to separate high schools. Prior to this change, grades 11-13 in Catholic high schools functioned as private schools (Allison (2015)).

Lefebvre (2016) find statistically significant positive average treatment on the treated (ATT) effects of private school attendance on students' PISA test scores, controlling for individual and parental characteristics (including SES).[20]

Another policy pursued in British Columbia is the introduction of "open enrolment", which provides an opportunity to estimate the extent to which increased public school choice affects student achievement, concentrates minority students in enclave schools and promotes cream-skimming. According to Friesen, Cerf Harris, and Woodcock (2015) greater school choice has improved the reading and numeracy scores of grade 4 students in some areas of British Columbia. Allison (2015)) argues that Ontario progress on key educational indicators (e.g. high school graduations, PISA's test scores) can be attributed to a more recently established set of sponsored choices available in Ontario's secondary schools that builds on the Ministry of Education's 2005 Student Success Initiative. The program relies on individual boards and schools to design and implement a range of optional programs intended to retain students in school and assist them to gain the course credits required to graduate. The Ontario approach has been used by PISA (2013a) in their recent "Lessons from PISA 2012 for the United States" (also Japan, Korea) to emphasize the province cultural support for universal high achievement (extraordinary performance of Canada's immigrant children.

The last general policy can be the delicate subject of a 'Common Core', that is the establishment of province-wide curricula. Although, many observers pretend that autonomy is overblown in the provinces – many of the textbooks used by the provinces are identical, teacher education programs have much similarities, the levels of schooling (kindergarten, elementary, middle, high) and unionisation so much similar, school administration personnel shuffles between provinces with little problem. One American well-reputed educator suggests that the most significant education reform and force for equality of opportunity, and greater social cohesion is the reform of fundamental educational ideas. Hirsch (2016) advocates for updated policies based on a set of ideas that are consistent with current cognitive science, developmental psychology, and social sciences.

6.3 Conclusion

From media reporting each survey results for 15 years old students from the PISA, Canadians have become accustomed to hearing that their provincially-run education systems are among the best in the world. In Québec it is a creed where it is less known that students' performance in private schools, where a significant proportion are enrolled at the secondary level, raise substantially the reported mean scores. But, considerations about equity have been neglected. Not enough attention has been

[20] The analysis also conducts a falsification exercise with Ontarians students as a control group relative to Québec's students in the private or public sector. Increasing private schools enrolments over the years have stimulated the public schools to offer more optional programs (interpreted as external effects from school competition).

paid to better support disadvantaged students who are doing rather well to lead them to attain higher achievement in competencies. On the other hand the tail of low achievement is rather long with a large proportion of disadvantaged students who merit more investment to help them attain at least the basic level of skills to function competently in society later on in life.

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Annex A1: Literacy in PISA

"In the PISA context, the term "reading" is used for "reading literacy" which is meant to focus on the active, purposeful and functional application of reading in range of situations and for various purposes: Reading literacy is understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society."

"In the PISA context, "mathematics" denotes "mathematical literacy," which implies a focus on students' active engagement in mathematics and their preparedness for life in a modern society. As such, it is expected that students can demonstrate their capacity to use mathematical content and language in contexts that are appropriate for 15-year-olds, when they are close to the end of their formal mathematics training. Mathematical literacy is defined as: As an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens."

"Scientific literacy (hereafter referred to as science): An individual's scientific knowledge, and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions about science-related issues; an understanding of the characteristic features of science as a form of human knowledge and enquiry; an awareness of how science and technology shape our material, intellectual, and cultural environments; and a willingness to engage in science uses, and with the ideas of science, as a reflective citizen."

Source: OECD (2013) "PISA 2012 Assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy." Paris.

A2: Acronym used for each province and Canada

Acronym	English name
NL	Newfoundland and Labrador
PE	Prince Edward Island
NS	Nova Scotia
NB	New Brunswick
QC	Québec
ON	Ontario
MN	Manitoba
SK	Saskatchewan
AB	Alberta
BC	British Columbia
CA	Canada

Table 1: Percentile distribution of students' family highest international social and economic index of occupational status (HISEI) across province and for Canada, 2012 and 2000

Province	N	Mean	SD	P5	P10	P25	P50	P75	P90	P95
Year					2012					
NL	1,210	52	22	18	24	31	52	71	79	82
PE	1,156	54	21	17	24	35	57	71	79	82
NS	1,289	53	21	21	25	31	55	71	80	82
NB	1,662	55	20	24	26	36	57	71	79	82
QC	3,746	57	20	24	27	41	60	75	81	82
ON	3,361	55	21	22	25	34	58	75	81	82
MN	1,931	53	21	22	25	31	55	71	79	82
SK	1,808	54	20	22	26	35	56	71	80	82
AB	1,895	56	21	24	26	38	58	75	81	82
BC	1,697	55	21	21	25	34	57	73	81	82
CANADA	19,755	55	21	22	26	36	58	75	81	82
Year					2000					
NL	2,172	48	16	25	28	32	49	59	69	73
PE	1,510	49	17	25	28	34	51	60	69	77
NS	2,708	52	16	28	30	40	53	66	69	77
NB	2,820	50	17	25	29	34	51	65	69	77
QC	3,655	53	16	29	30	42	53	67	70	77
ON	4,017	54	16	29	30	43	54	69	71	77
MN	2,491	50	16	25	30	36	51	66	69	74
SK	2,587	51	16	25	29	38	51	66	69	77
AB	2,568	54	16	28	30	43	53	69	71	77
BC	2,874	53	16	27	30	43	53	67	70	77
CANADA	27,402	53	16	28	30	43	53	67	70	77

Notes: The HISEI index is the highest score, between 16 and 90, assigned to each occupation (father or mother) by the PISA survey. The index was calculated for each province and year. N: number of students in grades 9 or 10; SD: standard deviation; P5 indicates the 5th percentile of the distribution, P10 the 10th percentile, etc.
Source: Author computation from PISA weighted data sets (2000 and 2012).

Table 2: Percentile distribution of students' PISA reading test scores across provinces and for Canada, 2000, 2009 and 2012

Year	2000	2009	2012	2000	2009	2012	2000	2009	2012
Province		NL			PE			NS	
Mean	519	506	502	517	483	488	525	516	507
SD	97	91	95	93	96	93	93	88	88
P5	357	356	339	361	319	326	367	365	353
P10	393	389	375	398	354	362	403	401	388
P25	455	444	440	447	419	427	461	459	456
P50	521	506	508	515	485	490	526	519	513
P75	587	566	564	584	554	555	590	576	568
P90	641	621	621	638	603	604	646	626	616
P90/P10	1.6	1.6	1.7	1.6	1.7	1.7	1.6	1.6	1.6
Province		NB			QC			ON	
Mean	503	498	498	555	528	528	534	529	528
SD	94	92	90	79	82	90	94	88	92
P5	338	342	345	419	387	371	370	378	366
P10	378	376	376	452	419	408	410	415	408
P25	443	435	442	503	475	470	472	473	470
P50	508	498	502	557	532	532	539	532	534
P75	569	561	559	610	586	589	599	592	590
P90	625	612	614	655	629	638	650	642	643
P90/P10	1.7	1.6	1.6	1.4	1.5	1.6	1.6	1.5	1.6
Province		MN			SK			AB	
Mean	533	495	495	530	505	505	550	532	525
SD	93	95	93	89	92	88	96	96	91
P5	371	330	341	379	346	354	381	366	367
P10	409	368	376	414	384	393	425	405	406
P25	472	430	435	471	445	450	487	468	467
P50	536	496	498	532	508	508	554	532	527
P75	597	564	563	593	568	566	618	598	591
P90	650	615	613	639	623	614	671	654	638
P90/P10	1.6	1.7	1.6	1.5	1.6	1.6	1.6	1.6	1.6
Province		BC						Canada	
Mean	538	525	535				539	525	524
SD	95	90	88				92	89	91
P5	375	371	384				380	372	366
P10	411	405	419				416	408	405
P25	475	466	479				479	467	467
P50	546	530	539				543	529	529
P75	605	588	595				603	588	587
P90	657	638	642				653	637	638
P90/P10	1.6	1.6	1.5				1.6	1.6	1.6

Notes: First plausible value of each test; restricted to students in grades 9 or 10; SD: standard deviation; P5 indicates the 5th percentile of the distribution, P10 the 10th percentile, etc.; reading was major test domain in years 2000 and 2009. Source: Author computation from PISA weighted data sets.

Table 3: Percentile distribution of students' PISA math test scores across provinces and Canada, 2003, 2009 and 2012

Year	2003	2009	2012	2003	2009	2012	2003	2009	2012
Province		NL			PE			NS	
Mean	518	503	491	499	485	477	516	512	496
SD	83	81	86	86	85	83	85	83	81
P5	384	372	350	355	334	342	372	370	356
P10	411	400	375	388	371	369	409	404	392
P25	459	449	430	439	431	420	458	456	443
P50	518	502	491	500	487	476	515	514	492
P75	577	559	551	558	545	534	577	568	549
P90	624	607	606	605	587	585	628	620	602
P90/P10	1.5	1.5	1.6	1.6	1.6	1.6	1.5	1.5	1.5
Province		NB			QC			ON	
Mean	514	503	503	552	549	542	535	524	514
SD	84	85	83	83	86	88	86	83	87
P5	378	365	366	409	409	391	389	380	370
P10	406	395	396	445	438	427	422	416	401
P25	457	448	446	495	493	482	477	468	455
P50	512	506	504	557	552	546	536	528	512
P75	572	558	561	609	608	603	595	583	573
P90	628	617	611	659	657	651	644	629	627
P90/P10	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.6
Province		MN			SK			AB	
Mean	528	501	492	517	506	506	550	517	528
SD	86	86	89	86	87	85	86	90	90
P5	383	360	347	372	353	365	402	370	379
P10	418	392	376	408	397	401	437	398	411
P25	467	442	430	457	449	446	493	453	465
P50	528	504	489	518	511	506	550	519	526
P75	589	563	555	577	567	566	612	581	592
P90	636	611	610	627	615	615	660	634	646
P90/P10	1.5	1.6	1.6	1.5	1.5	1.5	1.5	1.6	1.6
Province		BC						Canada	
Mean	538	522	521				538	527	519
SD	85	86	85				86	86	88
P5	399	377	379				392	381	372
P10	429	411	409				427	416	404
P25	479	465	463				479	469	458
P50	540	524	522				540	529	518
P75	598	583	582				599	587	580
P90	646	634	634				648	637	633
P90/P10	1.5	1.5	1.6				1.5	1.5	1.6

Notes: First plausible value of each test; restricted to students in grades 9 or 10; SD: standard deviation; P5 indicates the 5th percentile of the distribution. P10 the 10th percentile, etc.; math was major test domain in years 2003 and 2012. Source: Author computation from PISA weighted data sets.

Table 4: Percentage of students in five proficiency levels of reading and math for the lowest and highest quintiles of socioeconomic status (HISEI), percentage point difference between the quintiles, and total percentage in each scale, for Canada years 2000 to 2012

Year	Quintile	1+2	3	4	5	6+7	Total	N
				Reading				
2000	Q1	15	25	30	23	7	100	5,480
	Q5	3	10	24	35	28	100	5,743
	Q1-Q5	12	14	6	-12	-20		
	Total	9	18	27	29	18	100	27,402
2003	Q1	11	24	35	26	4	100	4,921
	Q5	4	10	27	39	19	100	5,111
	Q1-Q5	7	14	8	-13	-15		
	Total	8	17	31	33	12	100	26,423
2006	Q1	14	26	33	22	5	100	4,123
	Q5	4	12	25	37	21	100	4,189
	Q1-Q5	10	14	8	-16	-16		
	Total	9	19	29	30	13	100	21,513
2009	Q1	14	26	34	20	6	100	4,093
	Q5	4	13	27	34	22	100	4,100
	Q1-Q5	10	13	7	-13	-16		
	Total	9	20	30	27	14	100	21,920
2012	Q1	14	25	34	21	6	100	3,830
	Q5	4	13	28	34	21	100	3,863
	Q1-Q5	10	12	7	-13	-16		
	Total	9	19	31	27	13	100	19,755
2003-2000	Total	-1	-1	4	4	-6		
2006-2000	Total	0	2	2	1	-4		
2009-2000	Total	0	2	3	-2	-4		
2012-2000	Total	0	1	4	-1	-4		
				Math				
2003	Q1	14	24	30	22	10	100	4,921
	Q5	4	10	22	29	35	100	5,111
	Q1-Q5	9	14	8	-7	-25		
	Total	9	17	26	26	23	100	26,423
2006	Q1	15	26	30	20	8	100	4,123
	Q5	4	12	24	32	29	100	4,189
	Q1-Q5	11	14	7	-12	-21		
	Total	9	19	27	26	19	100	21,513
2009	Q1	17	25	30	19	8	100	4,093
	Q5	4	13	23	28	32	100	4,100
	Q1-Q5	13	13	7	-9	-24		
	Total	11	19	26	24	20	100	21,920
2012	Q1	19	27	29	17	7	100	3,830
	Q5	5	14	25	28	28	100	3,863
	Q1-Q5	14	13	4	-11	-20		
	Total	12	21	27	23	18	100	19,755
2006-2003	Total	1	2	1	0	-4		
2009-2003	Total	2	2	0	-2	-2		
2012-2003	Total	3	4	1	-3	-5		

Notes: Band definitions of scales from level 7 to level 1 are respectively: for reading >698, 698-626, 626-553, 553-480, 480-407, 407-335, 335-262; for math >669, 669-607, <607-544, 544-482, <484-420, <420-358, <358.
Percentages are calculated for students in grades 9 or 10 only.
Source: Author computation from PISA weighted data sets (2000 to 2012), and PISA for band definitions of scales.

Table 5: Percentage of students in five proficiency levels for tests in main domain of PISA across provinces and for Canada, reading (2000 and 2009) math (2003 and 2012), and sciences (2006)

Scale	NL	PE	NS	NB	QC	ON	MN	SK	AB	BC	CANADA
					Reading 2000						
1+2. Low + Basic	11	10	9	12	3	7	8	7	6	7	6
3. Some limits	20	23	21	24	13	19	19	20	16	18	17
4. Very good	31	29	30	32	31	29	31	31	27	27	29
5. Excellent	25	25	25	21	34	29	26	29	29	30	29
6+7. Outstanding	14	12	15	10	19	17	17	14	23	18	18
4+5+6+7	69	67	70	64	84	74	73	73	79	75	76
N	2,160	1,494	2,727	2,754	3,682	4,028	2,602	2,650	2,563	2,905	27,396
					Reading 2009						
1+2. Low + Basic	10	16	9	13	7	7	13	11	8	8	8
3. Some limits	27	27	22	26	19	19	28	25	19	20	20
4. Very good	32	30	33	32	34	31	28	31	29	32	32
5. Excellent	21	20	26	21	29	28	23	23	28	27	27
6+7. Outstanding	9	7	10	8	11	15	8	10	16	14	13
4+5+6+7	63	57	69	61	74	74	59	64	72	72	72
N	1,368	1,275	1,585	1,810	3,503	3,962	1,858	1,885	2,397	2,277	21,920
					Math 2003						
1+2. Low + Basic	12	19	13	13	6	10	10	13	7	8	9
3. Some limits	22	24	22	23	15	18	20	22	15	18	17
4. Very good	29	26	29	28	23	27	26	25	25	26	26
5. Excellent	23	21	21	22	30	26	24	25	26	26	26
6+7. Outstanding	14	10	15	14	26	20	19	15	27	21	22
4+5+6+7	66	57	65	64	79	72	70	65	78	73	74
N	2,209	1,578	2,838	3,738	2,994	2,390	2,738	2,337	2,360	2,893	26,423
					Math 2012						
1+2. Low + Basic	21	25	17	17	9	14	22	16	16	13	14
3. Some limits	25	28	28	23	16	22	25	24	21	20	21
4. Very good	26	25	29	29	24	28	24	27	25	27	26
5. Excellent	18	16	18	21	27	21	18	21	22	24	23
6+7. Outstanding	10	6	9	11	23	15	10	12	17	16	16
4+5+6+7	54	47	55	60	75	64	53	60	64	67	66
N	1,310	1,237	1,362	1,772	3,993	3,664	2,063	1,918	2,009	1,798	21,126
					Sciences 2006						
1. Low	10	14	10	12	7	8	9	11	5	7	8
2. Basic	22	24	23	28	19	19	20	22	18	19	19
3. Good	30	30	31	31	31	29	33	31	30	29	30
4. Very good	24	21	26	22	27	30	25	26	28	30	29
5+6. Excellent	15	11	10	8	16	14	13	10	18	15	15
4+5+6	38	32	35	30	43	44	38	36	47	45	43
N	1,705	1,421	2,038	2,332	3,680	2,942	1,920	1,767	1,881	1,827	21,513

Notes: Band definitions of scales from level 7 to level 1 are respectively: for reading >698; 698-626; 626-553; 553-480; 480-407; 407-335; 335-262; for math >669; 669-607; <607-544; 544-482; <484-420; <420-358; <358; for science >708; 708-633; 633-559; 559-484; 484-410; 410-335. Scales are for students in grades 9 and 10 only.
Sources: Author computation from PISA weighted data sets; and PISA for band definitions of scales.

Table 6: Estimated marginal probability of a lower group of proficiency levels (1+2+3) by socioeconomic status, years of main domains tests (read 2000 and 2009. math 203 and 2012) across provinces and for Canada

	Ratio		Reading estimated probability by SES					Ratio		Math estimated probability by SES			
	1/0	N	(2 vs 1)	(3 vs 1)	(4 vs 1)	(5 vs 1)		1/0	N	(2 vs 1)	(3 vs 1)	(4 vs 1)	(5 vs 1)
Canada							Canada						
2000	25	27,158	-0.10	-0.11	-0.15	-0.21	2003	33	24,483	-0.08	-0.11	-0.16	-0.21
2009	28	21,065	-0.06	-0.10	-0.15	-0.19	2012	38	19,275	-0.05	-0.15	-0.18	-0.25
NL							NL						
2000	31	2,140	-0.05#	-0.11#	-0.16	-0.25	2003	34	2,071	-0.11	-0.19	-0.26	-0.32
2009	36	1,298	-0.04#	-0.14	-0.06#	-0.24	2012	46	1,191	-0.21	-0.32	-0.44	-0.54
PE							PE						
2000	32	1,485	-0.09	-0.11	-0.12	-0.25	2003	43	1,472	-0.08#	-0.10#	-0.16	-0.26
2009	39	1,210	-0.09	-0.14	-0.11	-0.26	2012	52	1,131	-0.14	-0.23	-0.22	-0.31
NS							NS						
2000	31	2,696	-0.09	-0.15	-0.14	-0.27	2003	35	2,648	-0.11#	-0.21	-0.27	-0.34
2009	30	1,506	-0.08	-0.08	-0.18	-0.25	2012	44	1,255	0.04#	-0.09#	-0.12	-0.22
NB							NB						
2000	35	2,780	-0.04#	-0.14	-0.16	-0.25	2003	36	3,454	0.00#	-0.11#	-0.11	-0.19
2009	37	1,784	-0.06#	-0.12	-0.12	-0.18	2012	40	1,608	-0.08#	-0.11	-0.14	-0.28
QC							QC						
2000	24	3,631	-0.07	-0.07	-0.08	-0.11	2003	28	2,828	-0.01#	-0.04#	-0.10	-0.12
2009	27	3,294	-0.05	-0.07	-0.10	-0.11	2012	28	3,651	-0.08	-0.10	-0.12	-0.18
ON							ON						
2000	25	4,005	0.03#	-0.13	-0.22	-0.23	2003	30	2,191	-0.15	-0.15	-0.19	-0.23
2009	26	3,777	-0.05	-0.09	-0.16	-0.18	2012	36	3,273	0.04#	-0.16	-0.17	-0.25
MN							MN						
2000	27	2,449	-0.04#	-0.10	-0.10	-0.19	2003	30	2,517	-0.02#	-0.05#	-0.13	-0.11
2009	39	1,824	-0.09#	-0.11#	-0.22	-0.23	2012	47	1,868	-0.06#	-0.19	-0.20	-0.32
SK							SK						
2000	27	2,574	-0.01#	-0.04#	-0.03#	-0.11	2000	36	2,107	-0.21	-0.22	-0.25	-0.29
2009	34	1,856	-0.14	-0.05#	-0.16	-0.21	2012	40	1,768	0.05#	-0.05#	-0.16	-0.21
AB							AB						
2000	21	2,535	-0.12	-0.09	-0.12	-0.16	2000	22	2,189	-0.05#	-0.08#	-0.13	-0.20
2009	27	2,287	-0.10#	-0.08	-0.19	-0.22	2012	36	1,856	-0.11#	-0.15	-0.19	-0.30
BC							BC						
2000	25	2,860	-0.10	-0.12	-0.16	-0.22	2000	26	2,667	-0.09	-0.13	-0.17	-0.23
2009	27	2,229	-0.07	-0.14	-0.16	-0.19	2012	32	1,674	-0.03#	-0.14	-0.19	-0.24

Notes: 1/0: Observed ratio of band scales (1+2+3 versus 4+5+6+7); see Table 5 for band scales definition. All estimated effects are statistically significant at the .05 percent level of less. Estimates restricted to students in grades 9 or 10.

Sources: Author computation from PISA weighted data sets; and PISA for band definitions of scales.

Table 7: Estimated socio-economic mean test scores gradient and changes for main domain tests scores, across provinces and for Canada, PISA 2000 to 2012

Year	Estimated socioeconomic gradient in reading test scores					Change 2009-2000		
	2000	2003	2006	2009	2012	Diff.	SE	t-stat
NL	81	75	97	66	97	-16	13	1.27
PE	62	57	65	69	67	7	12	0.57
NS	71	61	76	62	51	-9	13	0.83
NB	62	56	58	52	55	-10	13	0.84
QC	44	35	56	39	58	-5	9	0.59
ON	73	50	66	54	51	-19	9	2.07
MN	40	40	59	67	63	27	13	2.08
SK	31	53	63	55	44	24	9	2.67
AB	59	56	60	61	70	2	13	0.15
BC	66	40	76	64	54	-2	12	0.17
CANADA	66	53	63	55	59	-11	5	2.20
Year	Estimated socioeconomic gradient in math test scores					Change 2012-2003		
	-	2003	2006	2009	2012	Diff.	SE	t-stat
NL	-	77	78	56	97	20	12	1.70
PE	-	55	51	66	64	9	9	1.01
NS	-	69	67	54	39	-20	12	1.71
NB	-	57	65	54	61	4	10	0.36
QC	-	42	56	48	61	19	10	1.96
ON	-	56	59	50	56	0	0	0.00
MN	-	38	56	63	70	32	14	2.24
SK	-	58	49	54	48	-10	11	0.93
AB	-	62	58	67	67	5	13	0.40
BC	-	51	64	69	53	2	14	0.14
CANADA	-	60	61	57	61	1	6	0.18

Note: SE is standard error. Estimates restricted to students in grades 9 or 10.

Table 8: PISA tests scores achievement difference in the bottom and top SES quintiles for selected percentile points for years of main domain in reading (2000 and 2009) and math (2003 and 2012) across provinces and for Canada

Province and Canada	Quintile	Percentile achievement in reading			Percentile achievement in math		
		P10	P50	P90	P10	P50	P90
		Change 2009 - 2000 by quintile			Change 2012 - 2003 by quintile		
NL	Bottom Q	10	-7	-16	-19	-47	-44
	Top Q	1	-20	-7	-16	-26	-18
PE	Bottom Q	-36	-20	-7	-24	-27	-22
	Top Q	-45	-30	-21	-17	-37	-14
NS	Bottom Q	20	13	3	-6	10	16
	Top Q	-14	-13	-13	-22	-24	-23
NB	Bottom Q	14	2	-11	-20	-18	-28
	Top Q	-33	-11	0	0	-6	6
QC	Bottom Q	-24	-21	-24	-31	-11	-4
	Top Q	-31	-23	-30	-10	-4	-1
ON	Bottom Q	22	9	5	-22	-10	-18
	Top Q	-1	-10	-12	-20	-17	-16
MN	Bottom Q	-36	-57	-64	-37	-45	-43
	Top Q	-51	-23	-32	-33	-19	-12
SK	Bottom Q	-30	-37	-53	11	17	5
	Top Q	-10	-15	-24	8	-6	-5
AB	Bottom Q	9	0	-12	-17	-46	-45
	Top Q	-26	-16	-4	-47	-38	-28
BC	Bottom Q	1	0	-21	-10	-7	0
	Top Q	-3	-17	-22	-26	-22	-10
CA	Bottom Q	4	-3	-8	-20	-16	-14
	Top Q	-15	-16	-19	-19	-17	-12

Note: P10 indicates the 10th percentile of the distribution, P50 the 50th percentile, and P90 the 90th percentile.
Source: Author computation from PISA weighted data sets of Tables A3 and A4.

Statistical Appendix

Table A1: Number and percentage of students below and above the Canadian median index of occupational status (HISEI) across provinces and for Canada, 2012 and 2000

Province	N	Percent	N	Percent	Total N	N	Percent	N	Percent	Total N
	≈<58		>≈58			≈<53		>≈53		
	2012					2000				
NL	726	60	484	40	1,210	1,378	63	794	37	2,172
PE	609	53	547	47	1,156	842	56	668	44	1,510
NS	718	56	571	44	1,289	1,424	53	1,284	47	2,708
NB	926	56	736	44	1,662	1,527	54	1,293	46	2,820
QC	1,697	45	2,049	55	3,746	1,596	44	2,059	56	3,655
ON	1,576	47	1785	53	3,361	1,729	43	2,288	57	4,017
MN	980	51	951	49	1,931	1,304	52	1,187	48	2,491
SK	967	53	841	47	1,808	1,372	53	1,215	47	2,587
AB	938	49	957	51	1,895	1,108	43	1,460	57	2,568
BC	840	49	857	51	1,697	1252	44	1,622	56	2,874
Canada	9,977	51	9,778	49	19,755	13,532	49	13,870	51	27,402

Notes: N refers to number of students in grades 9 or 10. Median index score of 58 in 2012 and 53 in 2000 refers to Canada. The percentages have been rounded.
Source: Author computation from PISA weighted data sets (2000 and 2012).

Table A2: Percentage of students in Canadian quintiles of occupational index status (HISEI) across provinces and for Canada, 2012 and 2000

HISEI	Canada	NL	PE	NS	NB	QC	ON	MN	SK	AB	BC
Quintiles						2012					
1	20	25	21	23	20	17	21	25	20	18	21
2	20	22	19	21	22	20	19	20	22	22	20
3	20	18	23	22	22	20	20	19	23	19	20
4	20	18	21	17	21	21	20	20	19	20	20
5	20	17	16	17	16	22	20	16	17	21	19
Total	19,755	1,210	1,156	1,289	1,662	3,746	3,361	1,931	1,808	1,895	1,697
Quintiles						2000					
1	20	32	28	21	27	20	17	25	23	17	19
2	20	20	22	22	21	22	19	23	23	20	18
3	20	18	18	20	19	22	19	18	19	20	21
4	20	16	16	20	17	17	22	19	18	21	22
5	20	13	15	17	16	20	22	16	17	22	20
Total	27,402	2,172	1,510	2,708	2,820	3,655	4,017	2,491	2,587	2,568	2,874

Note: Percentage conditional on number of students in grades 9 or 10.
Source: Author computation from PISA weighted data sets. 2000 and 2012

Table A3: Distribution of student's PISA reading test scores for mean, standard deviation, and selected percentile points for bottom and top quintiles of SES (HISEI) across provinces and for Canada, main domain years 2000 and 2009

Province	Quintile	Reading 2000							Reading 2009						
		Mean	SD	P10	P25	P50	P75	P90	Mean	SD	P10	P25	P50	P75	P90
NL	1	481	82	368	423	488	535	588	479	77	378	424	481	527	572
	5	567	95	438	512	573	624	679	548	91	439	491	553	608	672
	Q5-Q1	86	13	70	89	85	89	91	69	14	61	67	72	81	100
PE	1	482	83	369	417	482	547	589	456	94	333	388	462	520	582
	5	553	89	434	499	567	614	662	526	96	389	469	537	592	641
	Q5-Q1	71	6	65	82	85	67	73	70	2	56	81	75	72	59
NS	1	481	86	364	429	481	538	588	490	80	384	438	494	545	591
	5	566	85	459	511	571	631	667	553	86	445	507	558	611	654
	Q5-Q1	85	-1	95	82	90	93	79	63	6	61	69	64	66	63
NB	1	466	90	347	407	468	527	587	470	83	361	415	470	531	576
	5	546	86	440	495	547	607	657	530	96	407	467	536	599	657
	Q5-Q1	80	-4	93	88	79	80	70	60	13	46	52	66	68	81
QC	1	528	78	427	478	529	581	624	502	77	403	455	508	556	600
	5	580	79	477	531	579	636	681	554	80	446	498	556	613	651
	Q5-Q1	52	1	50	53	50	55	57	52	3	43	43	48	57	51
ON	1	494	94	369	429	494	562	616	503	88	391	447	503	562	621
	5	571	86	457	517	572	627	681	562	83	456	502	562	628	669
	Q5-Q1	77	-8	88	88	78	65	65	59	-5	65	55	59	66	48
MN	1	506	94	388	435	510	579	630	459	85	352	404	453	519	566
	5	564	83	462	508	562	621	671	532	92	411	471	539	591	639
	Q5-Q1	58	-11	74	73	52	42	41	73	7	59	67	86	72	73
SK	1	514	92	395	455	515	578	635	475	86	365	418	478	532	582
	5	552	83	435	500	556	605	663	535	86	425	481	541	592	639
	Q5-Q1	38	-9	40	45	41	27	28	60	0	60	63	63	60	57
AB	1	510	93	387	450	508	575	628	504	90	396	440	508	568	616
	5	586	93	460	526	594	651	695	569	99	434	507	578	638	691
	Q5-Q1	76	0	73	76	86	76	67	65	9	38	67	70	70	75
BC	1	506	94	386	439	504	577	632	500	87	387	442	504	558	611
	5	571	90	451	515	574	635	681	555	86	448	503	557	618	659
	Q5-Q1	65	-4	65	76	70	58	49	55	-1	61	61	53	60	48
CA	1	502	91	383	441	503	568	619	498	86	387	442	500	557	611
	5	574	86	460	520	577	631	682	558	86	445	501	561	618	663
	Q5-Q1	72	-5	77	79	74	63	63	60	0	58	59	61	61	52

Notes: The HISEI index is the highest score, between 16 and 90, assigned to each occupation (father or mother) by the PISA survey. The index was calculated for each province and year. Scores for students in grades 9 or 10; SD: standard deviation; P10 indicates the 10^{th} percentile of the distribution, P25 the 25^{th} percentile, etc.
Source: Author computation from PISA weighted data sets (2000 and 2009).

Table A4: Distribution of student's PISA math test scores for mean, standard deviation, and selected percentile points for bottom and top quintiles of SES (HISEI) across provinces and for Canada, main domain years 2003 and 2012

Province	Quintile	Math 2003							Math 2012						
		Mean	SD	P10	P25	P50	P75	P90	Mean	SD	P10	P25	P50	P75	P90
NL	1	479	76	381	425	482	535	579	443	69	362	400	435	483	535
	5	561	80	450	508	571	618	665	544	79	434	498	545	602	647
	Q5-Q1	82	4	69	83	89	83	86	101	10	72	98	110	119	112
PE	1	471	80	369	418	469	528	575	446	78	345	391	442	499	553
	5	535	80	435	480	540	591	633	513	77	418	458	503	571	619
	Q5-Q1	64	0	66	62	71	63	58	67	-1	73	67	61	72	66
NS	1	477	79	380	423	472	529	581	484	78	374	440	482	530	597
	5	556	80	447	506	559	614	653	531	80	425	480	535	595	630
	Q5-Q1	79	1	67	83	87	85	72	47	2	51	40	53	65	33
NB	1	492	84	390	435	491	555	600	473	78	370	426	473	531	572
	5	549	80	444	491	546	603	647	543	81	444	499	540	590	653
	Q5-Q1	57	-4	54	56	55	48	47	70	3	74	73	67	59	81
QC	1	525	80	429	470	522	581	621	509	84	398	457	511	569	617
	5	582	81	477	533	586	640	684	577	84	467	521	582	636	683
	Q5-Q1	57	1	48	63	64	59	63	68	0	69	64	71	67	66
ON	1	501	80	403	444	500	558	603	486	80	381	430	490	537	585
	5	567	88	454	514	570	637	681	550	86	434	492	553	609	665
	Q5-Q1	66	8	51	70	70	79	78	64	6	53	62	63	72	80
MN	1	504	82	404	443	505	561	617	464	81	367	402	460	517	574
	5	553	88	437	493	556	610	661	531	95	404	468	537	599	649
	Q5-Q1	49	6	33	50	51	49	44	67	14	37	66	77	82	75
SK	1	473	82	368	415	468	532	589	488	87	379	432	485	544	594
	5	544	83	431	489	553	602	646	541	79	439	482	547	604	641
	Q5-Q1	71	1	63	74	85	70	57	53	-8	60	50	62	60	47
AB	1	521	87	404	448	527	585	637	488	80	387	432	481	544	592
	5	588	81	483	533	597	641	695	557	84	436	501	559	618	667
	Q5-Q1	67	-6	79	85	70	56	58	69	4	49	69	78	74	75
BC	1	509	81	405	456	506	568	614	498	83	395	437	499	551	614
	5	573	80	467	522	576	623	673	555	83	441	503	554	615	663
	Q5-Q1	64	-1	62	66	70	55	59	57	0	46	66	55	64	49
CA	1	506	81	402	450	506	563	611	489	82	382	433	490	545	597
	5	573	85	462	520	576	634	677	556	86	443	499	559	615	665
	Q5-Q1	67	4	60	70	70	71	66	67	4	61	66	69	70	68

Notes: The HISEI index is the highest score, between 16 and 90, assigned to each occupation (father or mother) by the PISA survey. The index was calculated for each province and year. Scores for students in grades 9 or 10; SD: standard deviation; P10 indicates the 10th percentile of the distribution, P25 the 25th percentile, etc.
Source: Author computation from PISA weighted data sets (2000 and 2009).

Table A5: Number and percentage of students by grade across provinces and for Canada. PISA 2000 and 2012

Grade	CANADA	NL	PE	NS	NB	QC	ON	MN	SK	AB	BC
						Percentage 2000					
7	0	0	0	0	0	1	0	0	0	0	0
8	2	0	0	2	1	8	0	1	1	0	0
9	13	9	16	33	13	30	4	11	15	13	7
10	83	90	80	65	87	59	94	87	83	83	92
11	2	0	4	0	0	1	2	1	1	3	1
Total	323,772	5,709	1,601	9,557	7,607	70,502	126,928	11,441	12,136	34,733	43,416
						Percentage 2012					
7	0	0	0	0	0	0	0	0	0	0	0
8	1	0	0	0	0	5	0	0	0	0	0
9	13	5	6	33	11	36	4	11	12	11	3
10	85	95	89	66	89	59	95	88	87	85	96
11	1	0	4	1	0	0	1	1	1	3	1
Total	338,052	4,094	1,292	10,144	6,233	75,902	136,455	13,047	10,267	37,064	43,554

Source: Author computation from PISA weighted data sets, 2000 and 2012,

Table A6: Number and percentage of all 15-year-old students and students in private school by province; and mean score test in math or reading, public and private school, by province and Canada, 2000 and 2012

Province	All students		Students in private schools			Mean score in Math Students in grades 9-10		
	N	Percent in Canada	N	Percent in Canada	Percent in province	N	Public	Private
2012								
NL	4,089	1	58	0	0	4,031	489	553
PE	1,237	0	7	0	0	1,230	478	505
NS	10,047	3	0	0	0	10,047	496	0
NB	6,189	2	30	0	0	6,159	504	544
QC	71,686	22	16,481	61	23	55,205	529	585
ON	135,179	41	4,215	16	3	130,89	513	530
MN	12,929	4	755	3	6	12,066	486	560
SK	10,189	3	417	2	4	9,772	505	520
AB	35,709	11	406	2	1	35,303	516	556
BC	43,086	13	4,771	18	11	38,315	518	549
CANADA	330,340	100	27,140	100	8	303,018	515	568
						Mean score in Reading Students in grades 9-10		
						N	Public	Private
2000								
NL	5,781	2	0	0	0	5,781	519	-
PE	1,632	1	14	0	1	1,618	517	578
NS	9,780	3	54	0	1	9,726	522	600
NB	7,720	2	0	0	0	7,72	502	-
QC	78,289	24	13,085	62	17	65,204	530	569
ON	124,51	38	2,586	12	2	12,1924	533	593
MN	11,355	3	698	3	6	10,657	527	590
SK	12,158	4	300	1	2	11,858	528	566
AB	34,346	10	702	3	2	33,644	551	529
BC	43,003	13	3,701	18	9	39,302	535	560
CANADA	328,574	100	21,140	100	6	307,434	532	569

Source: Author computation from PISA weighted data sets, 2000 and 2012,

Table A7: Estimated top quintile coefficient (test scores point) relative to bottom quintile of socioeconomic status by decile distribution of test scores for main domain in reading 2009, across provinces and for Canada

	2009 Reading											
	Q2	Q3	Q4	Q5	Q2	Q3	Q4	Q5	Q2	Q3	Q4	Q5
	NL				PE				NS			
P10	#	#	#	53	#	#	28	54	21	29	38	58
P20	#	25	25	61	26	26	35	67	23	23	47	55
P30	#	30	30	73	27	29	32	73	24	19	33	50
P40	#	28	28	68	28	30	37	85	20	25	27	55
P50	#	25	25	65	28	34	41	80	19	25	42	63
P60	#	26	26	68	29	34	38	80	21	23	38	58
P70	19	38	38	64	27	26	46	72	21	26	36	54
P80	22	37	37	73	31	31	46	77	25	35	50	67
P90	20	36	36	82	#	#	#	58	21	36	42	66
	NB				QC				ON			
P10	#	#	#	26	#	23	20	36	21	42	46	68
P20	#	19	#	38	14	28	24	38	#	30	30	51
P30	#	24	28	37	13	21	25	40	#	20	33	46
P40	#	22	29	43	18	31	32	46	11	23	40	49
P50	#	24	29	43	18	32	35	53	#	24	35	47
P60	#	18	24	38	22	28	35	49	16	28	43	58
P70	13	21	28	43	24	32	33	48	12	31	48	60
P80	#	28	29	47	23	27	30	46	#	29	47	56
P90	#	25	38	51	#	25	30	46	#	25	36	52
	MN				SK				AB			
P10	#	26	46	52	#	#	37	53	#	#	#	#
P20	27	33	50	60	22	#	21	52	#	18	36	52
P30	21	35	54	67	23	#	28	47	#	23	41	61
P40	26	37	54	73	26	#	33	48	#	#	36	52
P50	29	27	50	73	34	24	50	59	#	20	33	52
P60	34	27	53	71	38	24	49	61	#	27	33	58
P70	33	29	49	65	37	25	48	58	#	31	36	52
P80	32	30	47	67	30	16	44	53	#	28	26	53
P90	34	24	39	57	23	#	48	54	#	17	49	54
	BC								CANADA			
P10	31	36	45	65					19	30	34	53
P20	#	32	45	72					16	28	39	59
P30	16	34	50	76					19	29	41	61
P40	25	37	55	70					21	31	43	63
P50	27	40	51	67					26	33	48	64
P60	28	32	49	59					25	34	47	65
P70	18	35	47	63					24	35	48	65
P80	#	37	56	58					22	34	48	63
P90	#	34	54	53					20	30	42	59

Note: # indicates that the coefficient is statistically not significant relative to the reference quintile (Q1). The other coefficients are all statistically significant at the 5% or less level, P10 indicates the 5th percentile of the distribution, P25 the 25th percentile, etc.

Table A8: Estimated top quintile coefficient (test scores point) relative to bottom quintile of socioeconomic status by decile distribution of test scores for main domain in math 2012, across provinces and for Canada

	2012 Math											
	Q2	Q3	Q4	Q5	Q2	Q3	Q4	Q5	Q2	Q3	Q4	Q5
	NL				PE				NS			
P10	#	35	62	73	24	38	40	71	24	18	39	37
P20	#	38	53	76	27	41	40	59	#	18	28	37
P30	25	49	65	89	24	38	35	60	#	22	26	48
P40	27	51	69	95	31	47	41	67	#	28	38	49
P50	29	53	74	94	24	53	44	61	#	22	37	49
P60	28	52	67	98	25	54	36	64	#	25	39	51
P70	30	62	75	109	29	58	46	69	#	24	38	54
P80	29	56	73	99	#	42	40	78	#	24	32	64
P90	22	71	63	107	26	44	34	76	#	#	#	36
	NB				QC				ON			
P10	15	21	#	52	38	51	55	76	#	21	28	41
P20	#	23	#	49	27	41	51	64	#	34	36	49
P30	#	25	16	51	24	36	46	69	#	38	40	63
P40	11	22	22	49	21	31	48	65	#	38	42	67
P50	17	23	29	46	19	28	44	64	18	37	48	72
P60	19	21	27	51	22	29	41	67	20	41	52	76
P70	18	33	31	59	15	28	42	62	15	43	53	73
P80	#	32	33	58	24	34	48	75	22	48	55	78
P90	19	35	39	70	26	42	50	74	#	36	45	62
	MN				SK				AB			
P10	#	29	20	47	24	31	20	66	#	31	34	60
P20	#	32	34	59	16	24	34	57	#	32	37	75
P30	#	33	30	62	#	#	32	44	#	33	44	77
P40	#	31	27	63	#	#	33	46	#	32	59	80
P50	#	38	38	67	#	#	29	46	#	28	58	79
P60	#	32	39	68	#	#	26	45	#	28	60	75
P70	#	28	38	74	#	#	29	55	#	26	61	76
P80	#	33	40	88	#	#	24	57	#	27	61	71
P90	#	23	29	69	#	#	31	47	27	30	49	61
	BC								CANADA			
P10	#	32	35	53					18	37	38	57
P20	21	36	42	55					23	40	42	65
P30	#	27	31	58					22	40	45	67
P40	#	28	37	53					18	37	46	67
P50	#	32	45	51					18	39	48	68
P60	#	37	43	50					19	38	50	72
P70	#	36	52	50					22	37	49	72
P80	#	31	46	51					22	37	51	76
P90	#	25	33	49					20	33	49	69

Note: # indicates that the coefficient is statistically not significant relative to the reference quintile (Q1). The other coefficients are all statistically significant at the 5% or less level, P10 indicates the 5th percentile of the distribution, P25 the 25th percentile, etc.

Table A9: Percentage difference in proficiency levels between lower and higher quintiles of SES by year of PISA reading test, and difference between years of main test domain across provinces, 2000-2009

Province	Proficiency Scale	2000 Q1-Q5	2000 allQ	2003 Q1-Q5	2003 allQ	2006 Q1-Q5	2006 allQ	2009 Q1-Q5	2009 allQ	2012 Q1-Q5	2012 allQ	2009 less 2000
NL	2	16	12	14	9	18	14	11	12	10	12	-5
	3	16	21	17	19	22	20	18	25	10	22	2
	4	12	29	5	33	4	27	6	31	2	35	-6
	5	-17	25	-23	30	-20	27	-20	23	-11	22	-3
	6	-26	13	-13	9	-23	12	-15	9	-10	9	11
PE	2	14	14	18	17	14	19	19	22	10	17	6
	3	18	20	15	22	14	25	17	22	5	25	-1
	4	1	28	-11	33	-4	26	-8	28	-2	34	-9
	5	-16	26	-14	24	-12	21	-22	20	-7	17	-6
	6	-17	13	-7	5	-12	9	-7	8	-6	7	10
NS	2	15	11	13	11	19	16	10	10	4	11	-6
	3	21	20	18	22	17	23	20	21	4	21	-2
	4	3	31	5	33	-3	27	3	31	6	33	-1
	5	-19	23	-26	28	-21	25	-17	27	-7	24	2
	6	-20	15	-10	7	-12	8	-15	11	-7	11	5
NB	2	19	16	13	13	15	16	9	14	9	16	-9
	3	16	22	16	19	16	24	12	27	8	26	-4
	4	-3	30	7	33	-2	30	7	28	-2	31	10
	5	-19	23	-27	26	-22	25	-15	21	-8	19	4
	6	-13	10	-9	9	-7	6	-14	9	-7	8	-1
QC	2	3	3	5	6	8	10	8	7	4	8	5
	3	11	15	14	16	8	17	8	19	7	20	-3
	4	14	29	2	32	12	28	9	34	4	31	-5
	5	-7	34	-7	34	-8	29	-11	29	-7	28	-4
	6	-21	19	-15	13	-20	15	-14	11	-8	13	7
ON	2	15	11	4	8	9	6	9	8	4	9	-6
	3	15	19	12	17	17	20	13	18	5	17	-2
	4	2	27	11	31	7	32	7	31	5	32	5
	5	-13	28	-12	32	-22	31	-11	27	-6	28	1
	6	-19	16	-15	12	-10	11	-17	16	-8	15	2
MN	2	11	10	8	10	12	12	18	18	8	18	7
	3	13	19	11	20	12	20	16	26	7	25	3
	4	-3	29	3	33	6	31	-2	27	0	26	1
	5	-8	26	-13	28	-14	27	-22	22	-9	23	-13
	6	-13	16	-9	9	-16	10	-11	8	-6	9	2
SK	2	8	8	14	13	16	16	9	14	6	12	1
	3	8	18	16	24	17	22	19	22	5	21	11
	4	5	30	-3	31	-8	30	-2	34	-1	35	-7
	5	-10	31	-18	25	-13	23	-16	22	-6	22	-6
	6	-10	13	-10	7	-12	10	-9	8	-4	10	1
AB	2	10	8	9	6	9	7	8	10	6	8	-1
	3	12	16	15	16	17	20	12	19	8	21	0
	4	12	27	6	28	1	26	9	25	3	29	-3
	5	-8	25	-10	33	-11	32	-8	27	-8	27	0
	6	-26	24	-19	18	-16	15	-22	18	-9	14	5
BC	2	11	10	7	7	15	12	11	10	4	8	1
	3	15	17	14	17	13	17	9	20	6	17	-6
	4	2	26	7	30	7	28	7	29	5	29	5
	5	-11	28	-13	34	-10	27	-12	27	-7	31	-1
	6	-17	19	-15	12	-26	17	-16	14	-8	15	1

Source: Author computation from PISA weighted data sets; and PISA for band definitions of scales (see Table 5).

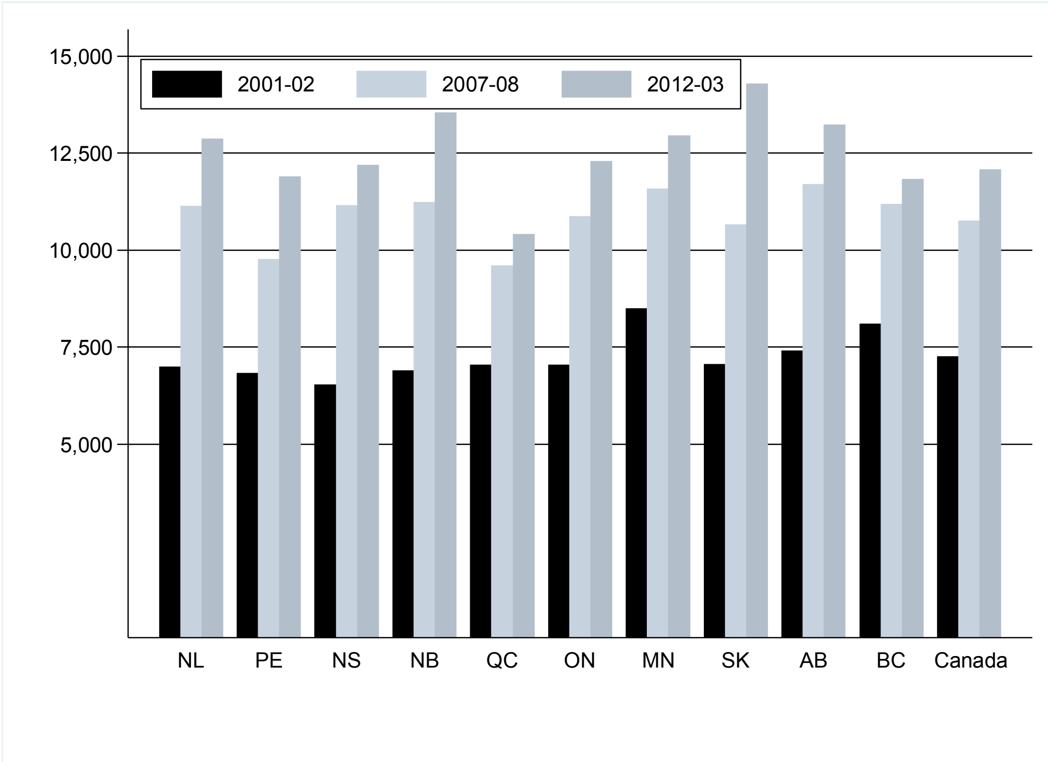
Table A10: Percentage difference in proficiency levels between lower and higher quintiles of SES by year of PISA math test, and difference between years of main test domain across provinces, 2003-2012

Province	Proficiency Scale	2003 Diff Q1-Q5	2003 Total all Q	2006 Diff Q1-Q5	2006 Total all Q	2009 Diff Q1-Q5	2009 Total all Q	2012 Diff Q1-Q5	2012 Total all Q	2012 less 2003
NL	2	20	14	20	14	17	13	34	22	14
	3	13	22	21	21	12	23	16	23	3
	4	8	26	2	27	-1	30	-8	26	-16
	5	-17	24	-21	24	-15	24	-22	17	-4
	6	-24	15	-22	14	-13	10	-20	12	4
PE	2	16	16	15	17	20	20	27	24	11
	3	15	25	14	25	11	28	5	27	-11
	4	1	26	-4	28	-2	26	-7	26	-8
	5	-18	23	-11	21	-18	19	-17	16	1
	6	-14	10	-14	9	-10	8	-8	7	6
NS	2	18	14	19	15	11	11	10	13	-8
	3	19	22	17	25	19	24	15	25	-4
	4	1	26	3	27	-2	27	3	31	2
	5	-18	23	-22	21	-10	22	-16	20	2
	6	-19	15	-16	12	-18	15	-12	11	8
NB	2	15	11	20	14	16	15	18	16	3
	3	14	20	15	24	12	23	15	22	0
	4	0	29	2	26	4	30	-3	30	-3
	5	-15	25	-18	24	-14	20	-10	20	5
	6	-15	15	-19	12	-18	11	-20	12	-5
QC	2	6	5	7	6	6	6	11	8	5
	3	11	14	9	15	17	16	12	17	1
	4	10	25	16	27	11	26	10	24	1
	5	-1	30	1	24	-5	25	-10	26	-9
	6	-26	26	-34	28	-28	28	-23	25	3
ON	2	8	10	11	9	14	11	14	12	6
	3	15	19	14	21	10	19	12	22	-3
	4	8	27	2	28	5	27	5	28	-3
	5	-4	23	-15	28	-11	26	-10	22	-6
	6	-26	21	-12	14	-19	17	-20	16	6
MN	2	8	10	13	12	20	17	17	21	9
	3	12	20	12	18	12	24	17	24	6
	4	3	28	10	30	3	27	-6	25	-9
	5	-7	24	-15	26	-18	22	-9	18	-2
	6	-15	18	-19	15	-18	11	-18	12	-3
SK	2	18	16	17	13	17	16	15	14	-3
	3	14	23	12	24	12	23	8	23	-6
	4	-3	25	1	28	3	26	2	28	5
	5	-12	23	-15	22	-17	23	-10	19	2
	6	-17	13	-15	13	-15	12	-15	16	2
AB	2	11	8	14	9	13	12	18	14	7
	3	14	13	12	16	11	20	13	22	-1
	4	5	22	7	28	11	21	-1	25	-6
	5	0	27	-11	28	-3	23	-12	22	-12
	6	-30	29	-21	19	-31	24	-18	17	13
BC	2	10	9	13	11	14	13	11	11	0
	3	14	17	16	22	16	17	15	20	0
	4	10	23	8	25	5	28	1	29	-9
	5	-16	29	-16	25	-12	24	-9	22	8
	6	-18	22	-21	18	-23	19	-18	18	0

Source: Author computation from PISA weighted data sets; and PISA for band definitions of scales (see Table 5).

FIGURES

Figure 1: Spending for public elementary and secondary education expenditures by enrolments in regular programs for youth, adjusted for annual prices changes (dollars 2011) by school year, 2001-20012 to 2012-2013



Note: Per-student spending is deflated by the CPI.
Sources: Table 478-0014, Public and Private Elementary and Secondary Education Expenditures, Statistics Canada, Table 477-0025; Enrolments in Regular Programs for Youth in Public Elementary and Secondary Schools by Grade and Sex, Canada, Provinces and Territories, Statistics Canada; Table 326-0021, Consumer Price Index (CPI), 2011 Basket, Annual (2002=100), Statistics Canada.

Figure 2.1: Estimated PISA mean reading test scores gradient
Across provinces and for Canada, 2000 and 2009

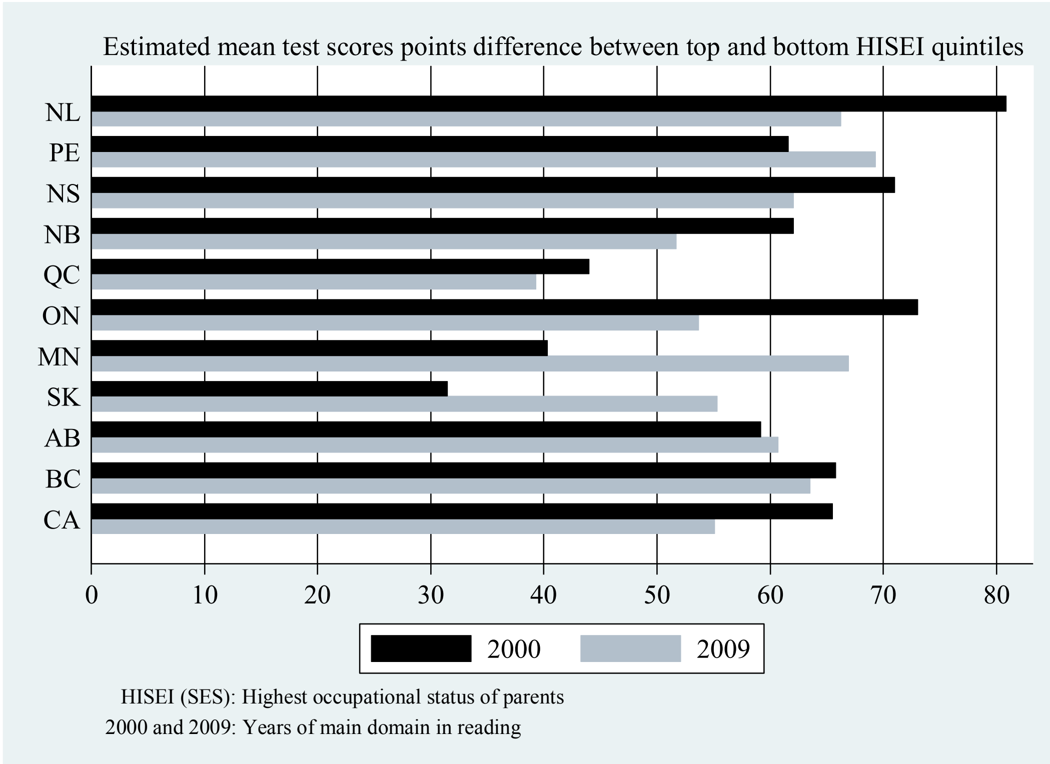


Figure 2.2: Estimated PISA mean reading quintiles coefficients (Q2 to Q5)
Across provinces and for Canada, 2009

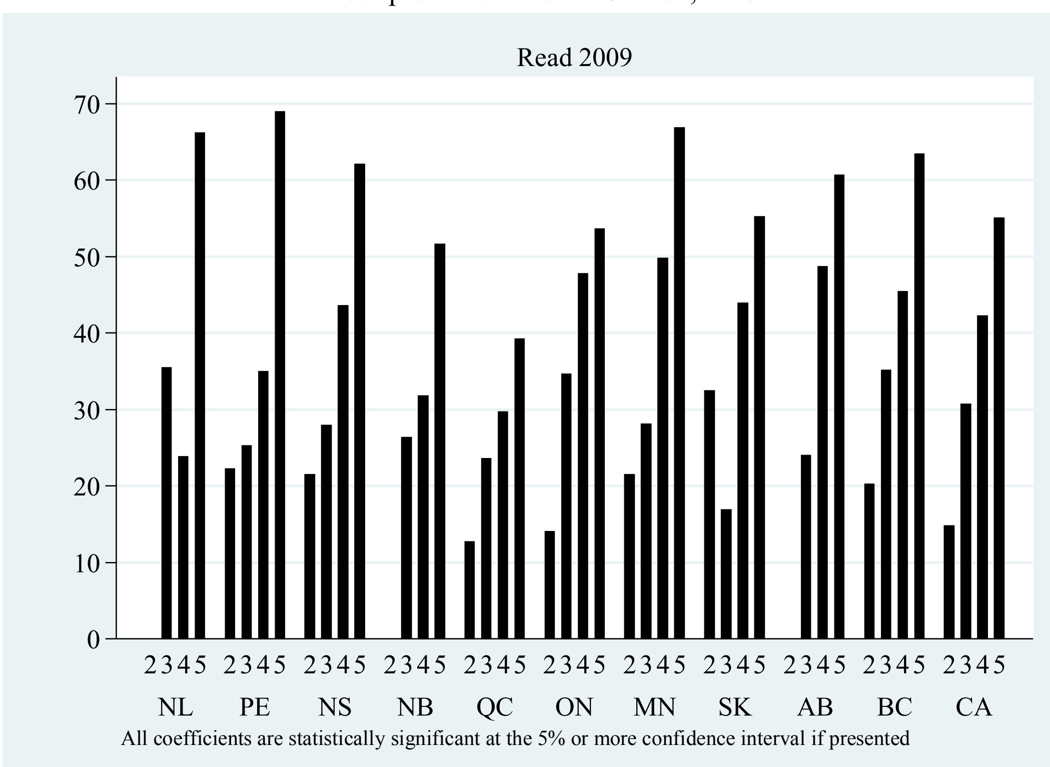


Figure 3.1: Estimated PISA mean math test scores gradient
Across provinces and for Canada, 2000 and 2009

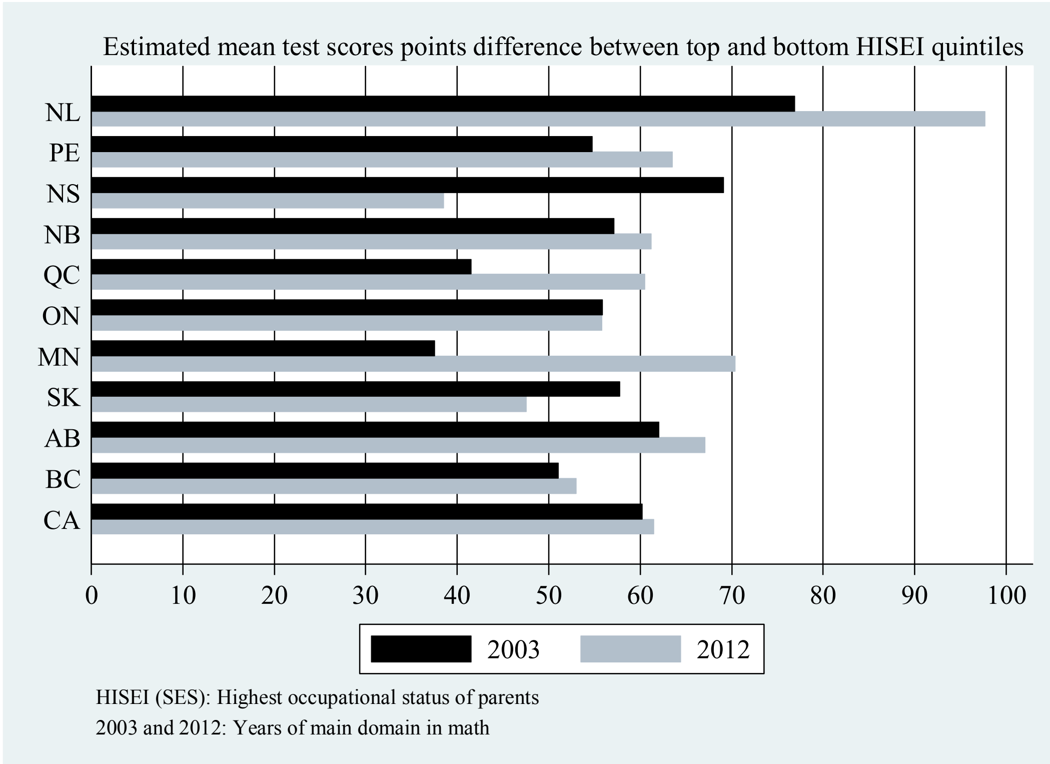


Figure 3.2: Estimated PISA mean math quintiles coefficients (Q2 to Q5)
Across provinces and for Canada, 2009

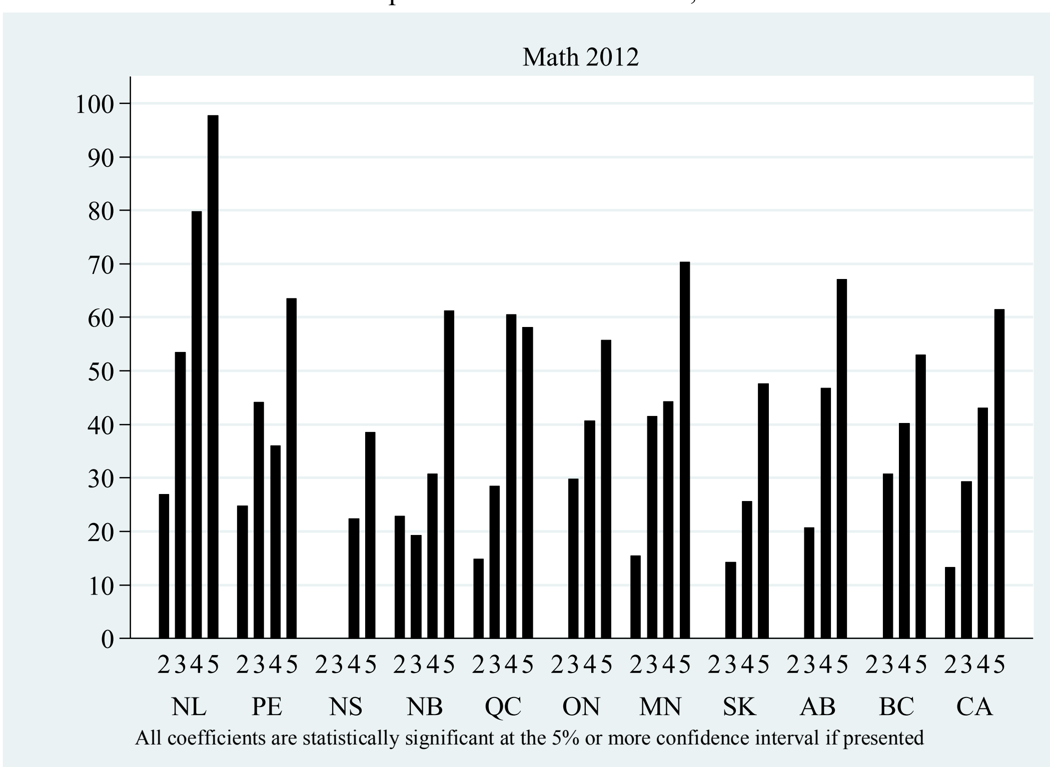


Figure 4: Estimated socioeconomic achievement gaps at various points of test scores
Canada: Reading (2000 and 2009) and math (2003 and 2012)

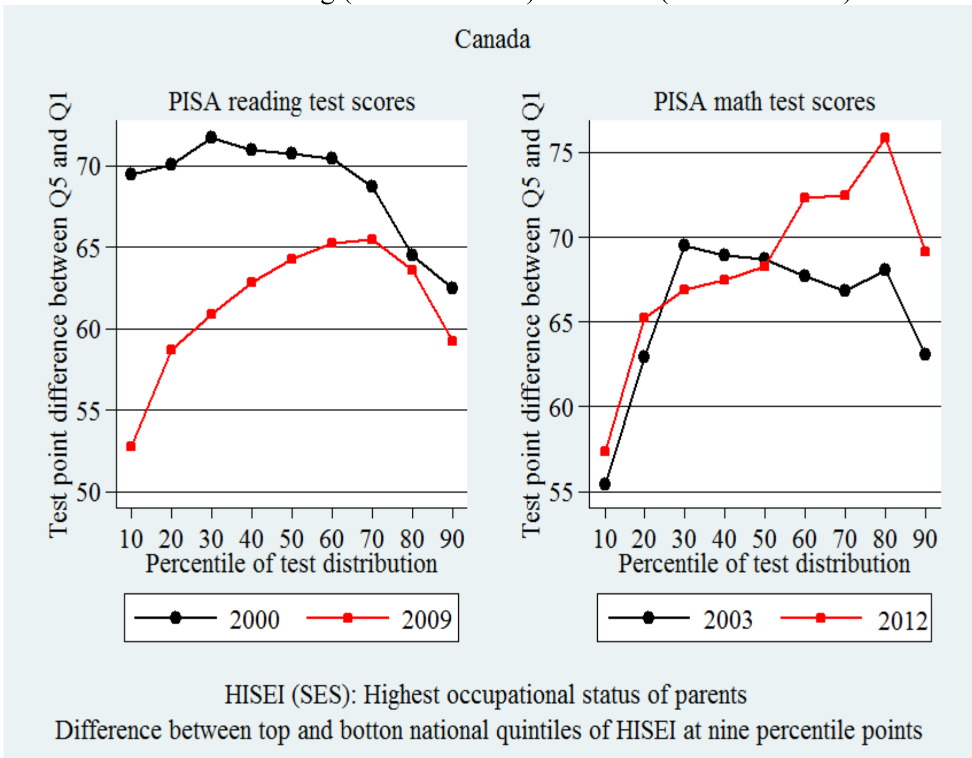


Figure 5: Estimated socioeconomic achievement gap at various points of test scores
Newfoundland and Labrador: Reading (2000 and 2009) and math (2003 and 2012)

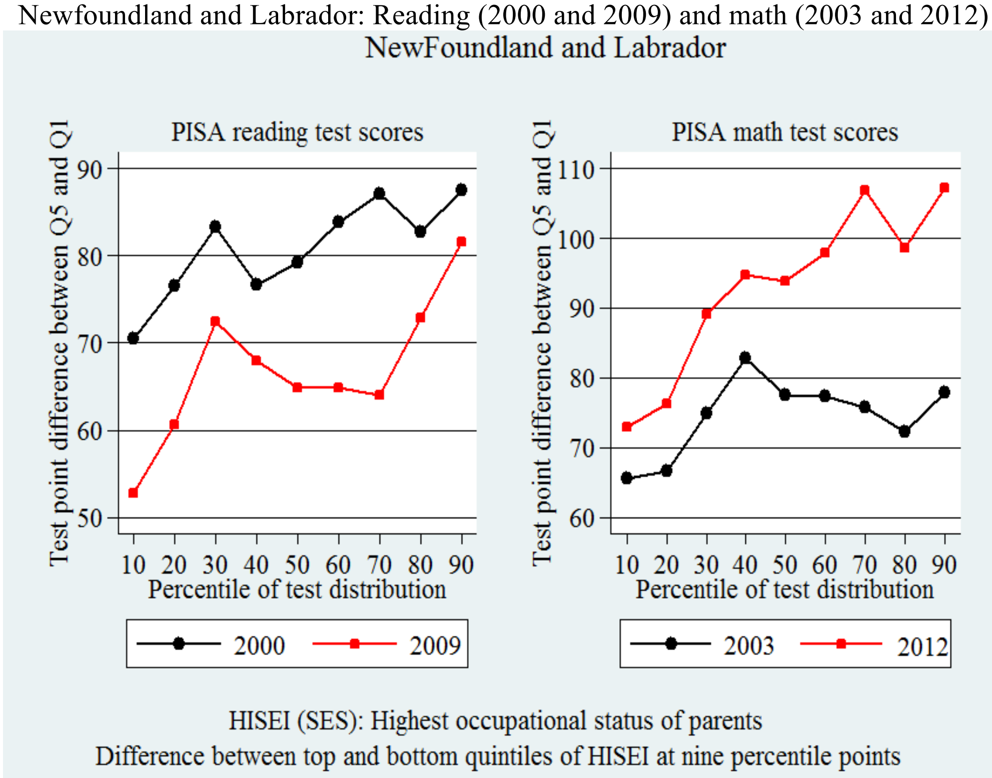


Figure 6: Estimated socioeconomic achievement gap at various points of test scores
Prince Edouard Island: Reading (2000 and 2009) and math (2003 and 2012)

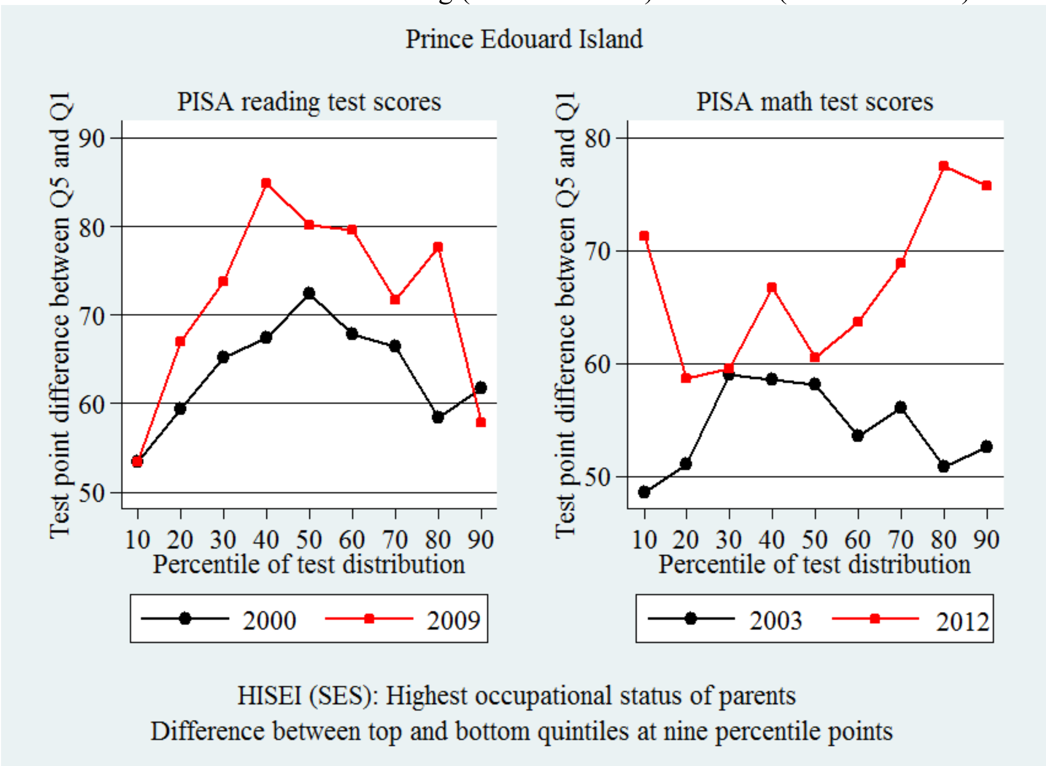


Figure 7: Estimated socioeconomic achievement gap at various points of test scores
Nova Scotia: Reading (2000 and 2009) and math (2003 and 2012)

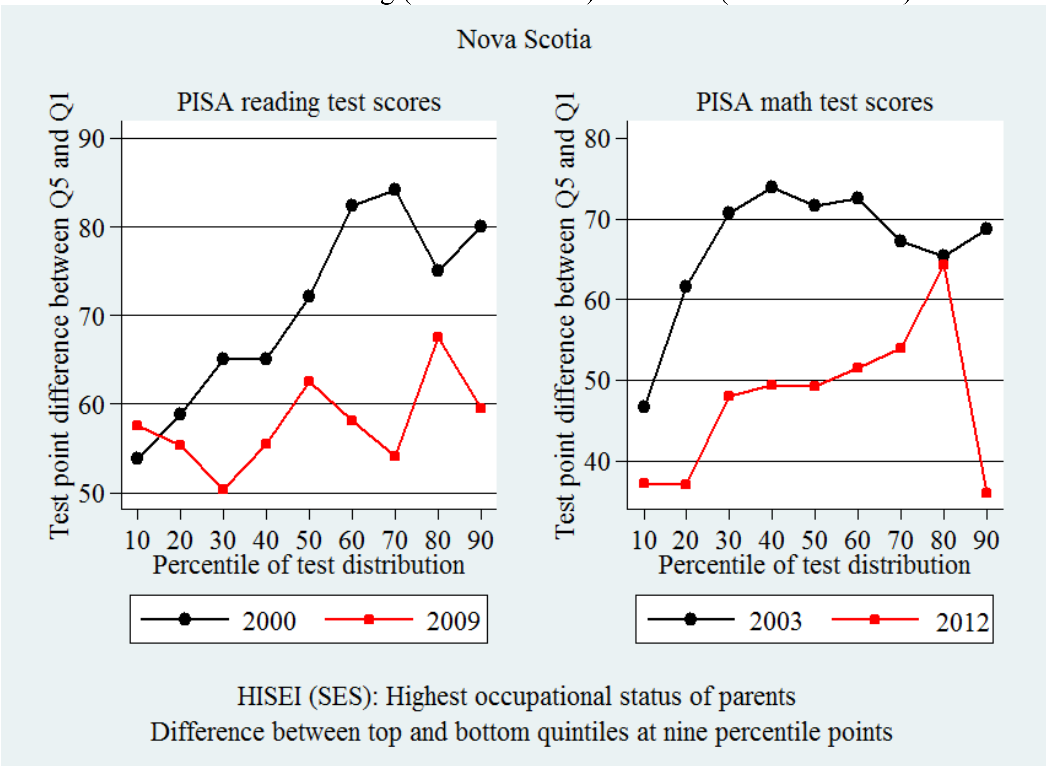


Figure 8: Estimated socioeconomic achievement gap at various points of test scores
New Brunswick: Reading (2000 and 2009) and math (2003 and 2012)

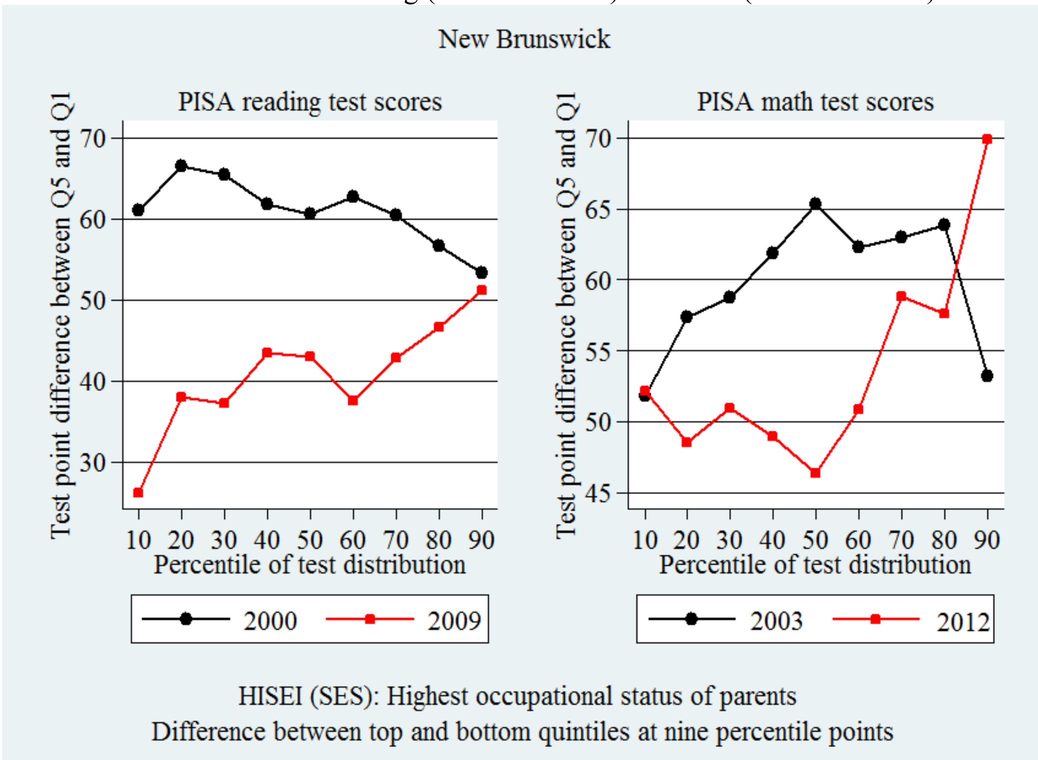


Figure 9: Estimated socioeconomic achievement gap at various point test scores
Québec: Reading (2000 and 2009) and math (2003 and 2012)

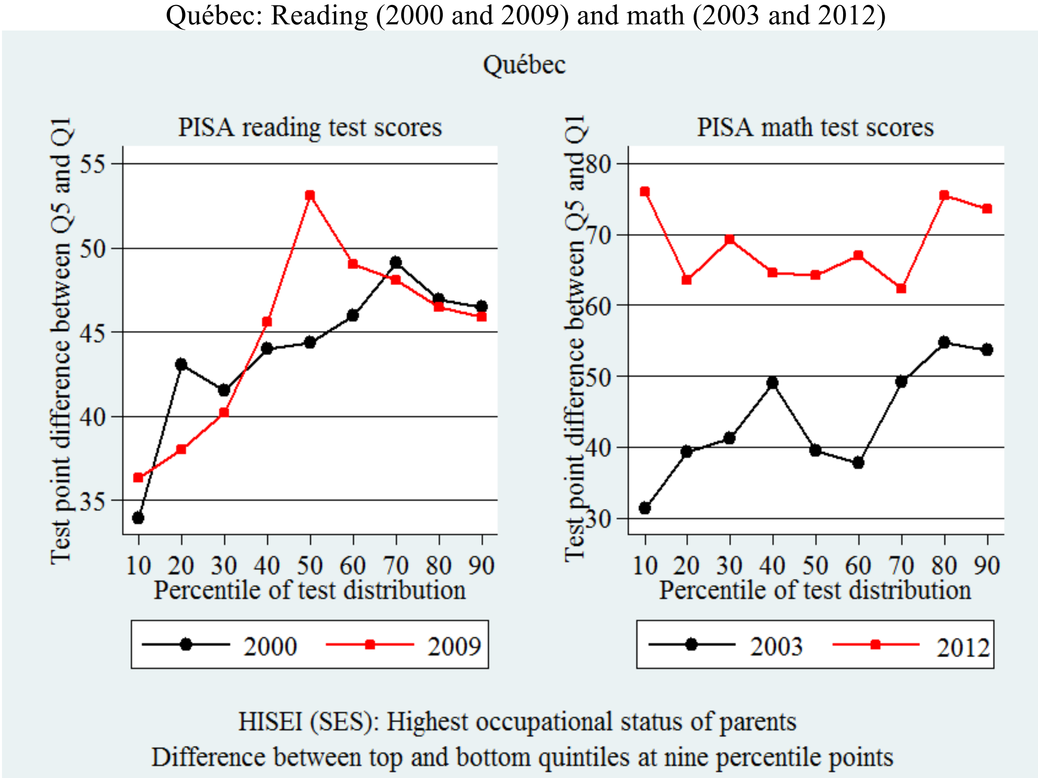


Figure 10: Estimated socioeconomic achievement gap at various points of test scores
Ontario: Reading (2000 and 2009) and math (2003 and 2012)

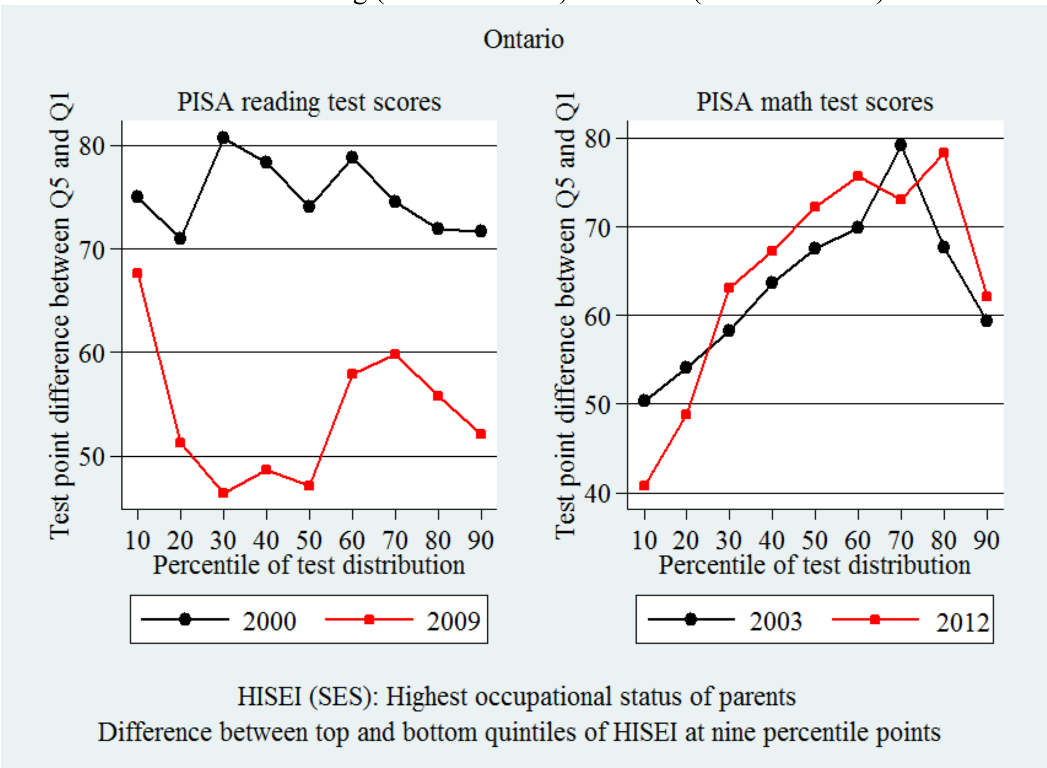


Figure 11: Estimated socioeconomic achievement gap at various points of test scores
Manitoba: Reading (2000 and 2009) and math (2003 and 2012)

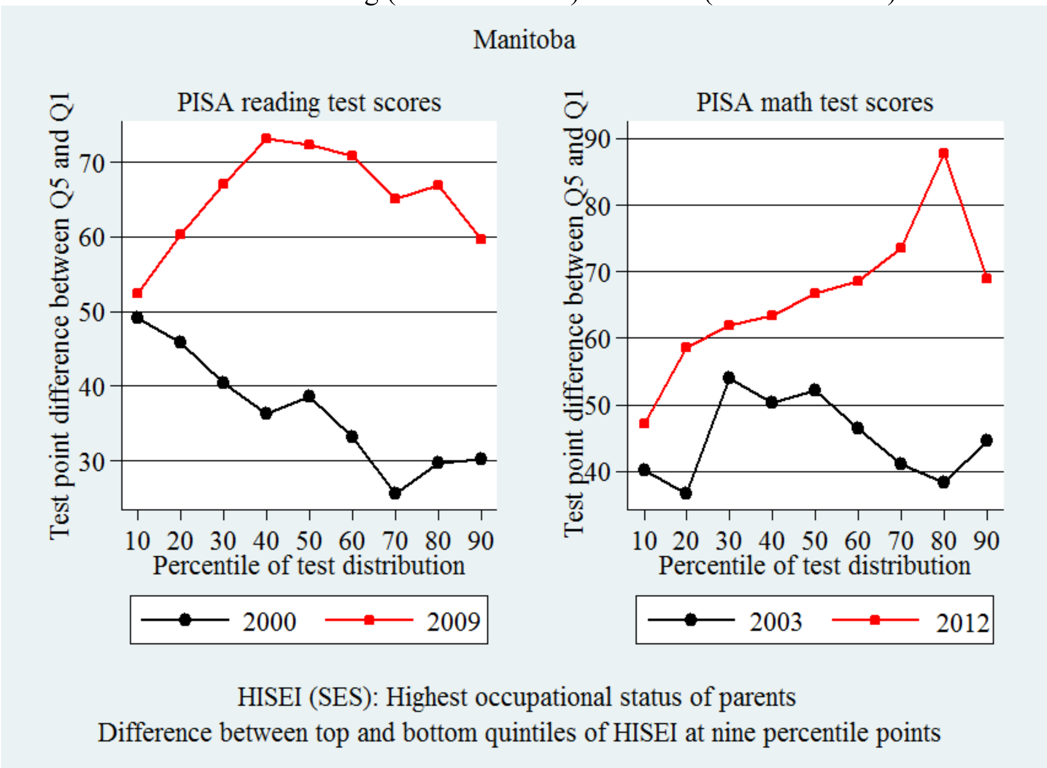


Figure 12: Estimated socioeconomic achievement gap at various points of test scores
Saskatchewan: Reading (2000 and 2009) and math (2003 and 2012)

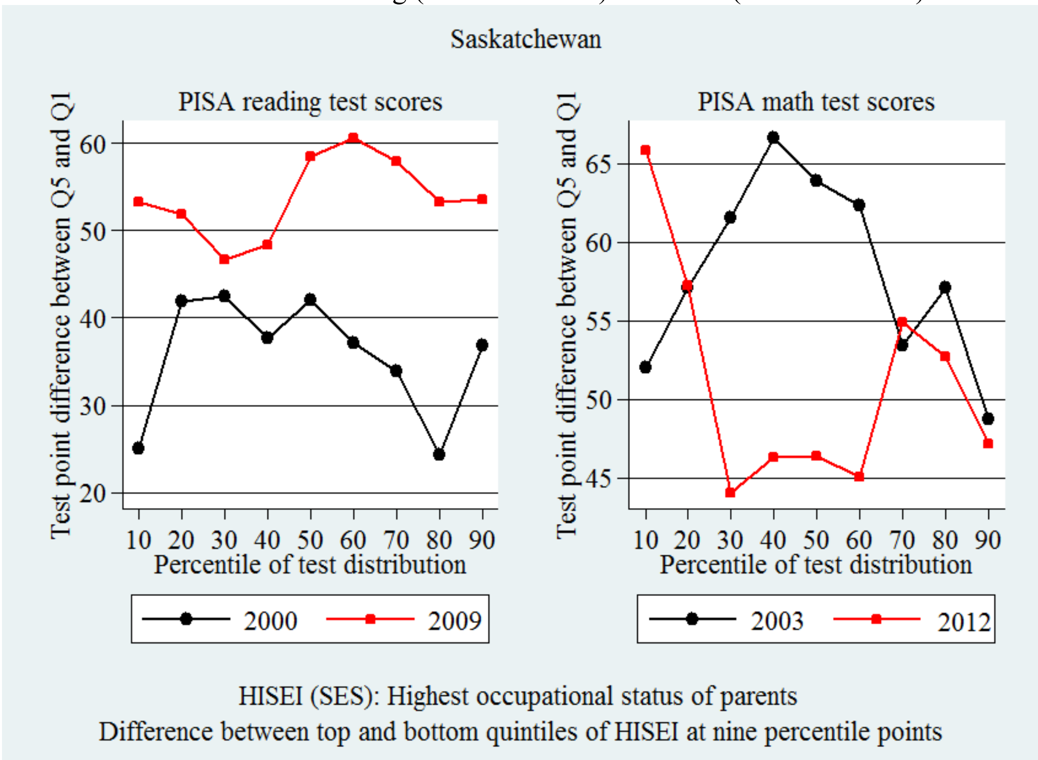


Figure 13: Estimated socioeconomic achievement gap at various points of test scores
Alberta: Reading (2000 and 2009) and math (2003 and 2012)

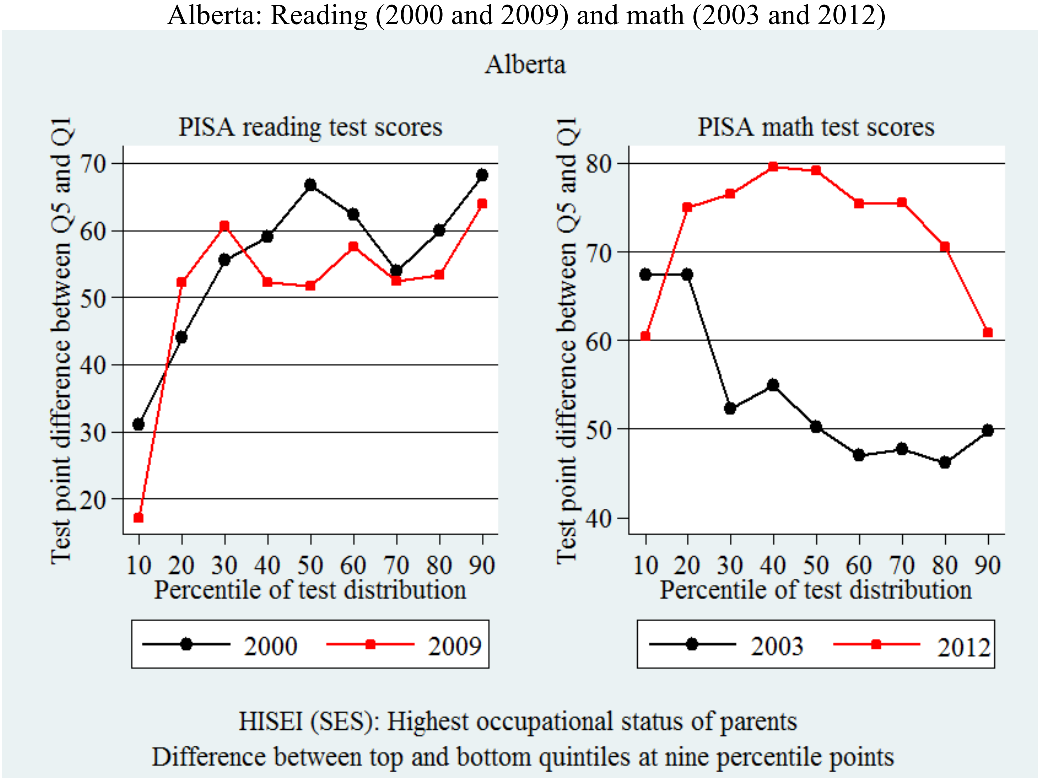
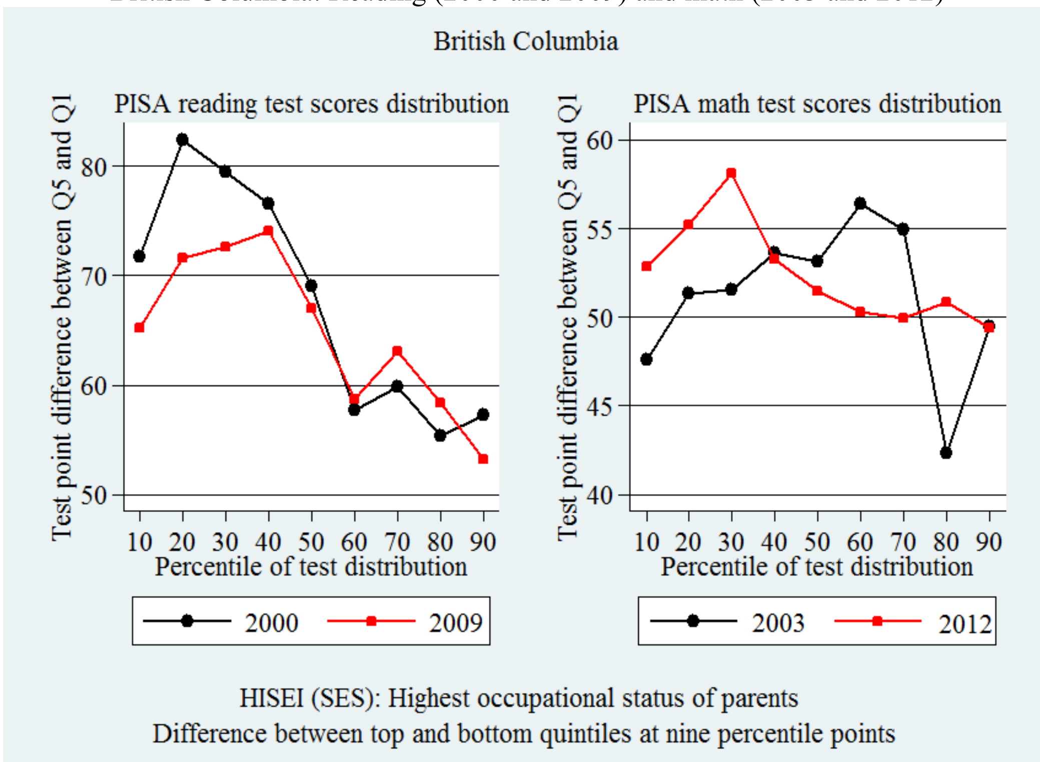
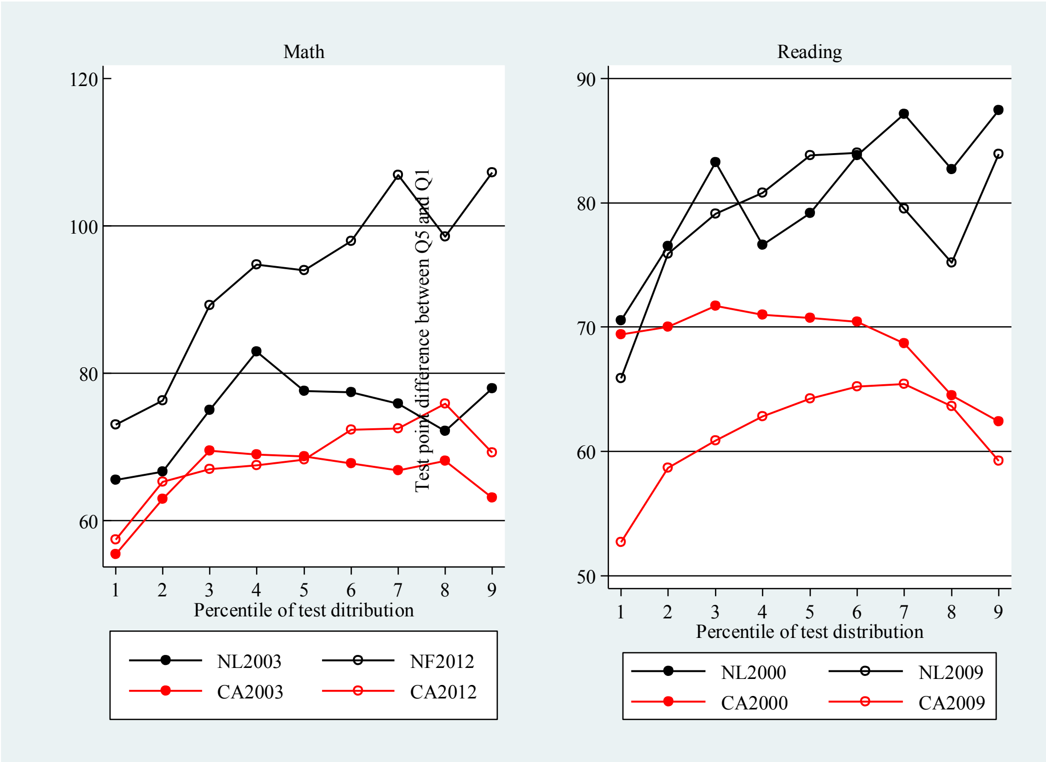


Figure 14: Estimated socio-economic achievement gap at various points of test scores
British Columbia: Reading (2000 and 2009) and math (2003 and 2012)

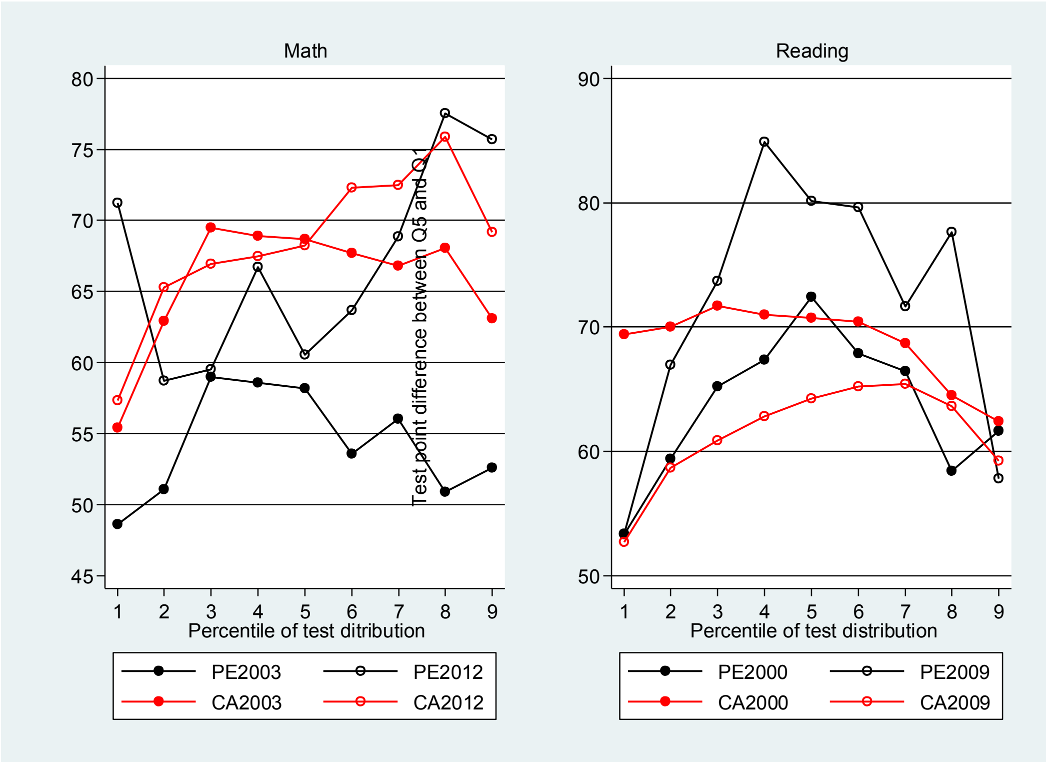


Supplementary Figures

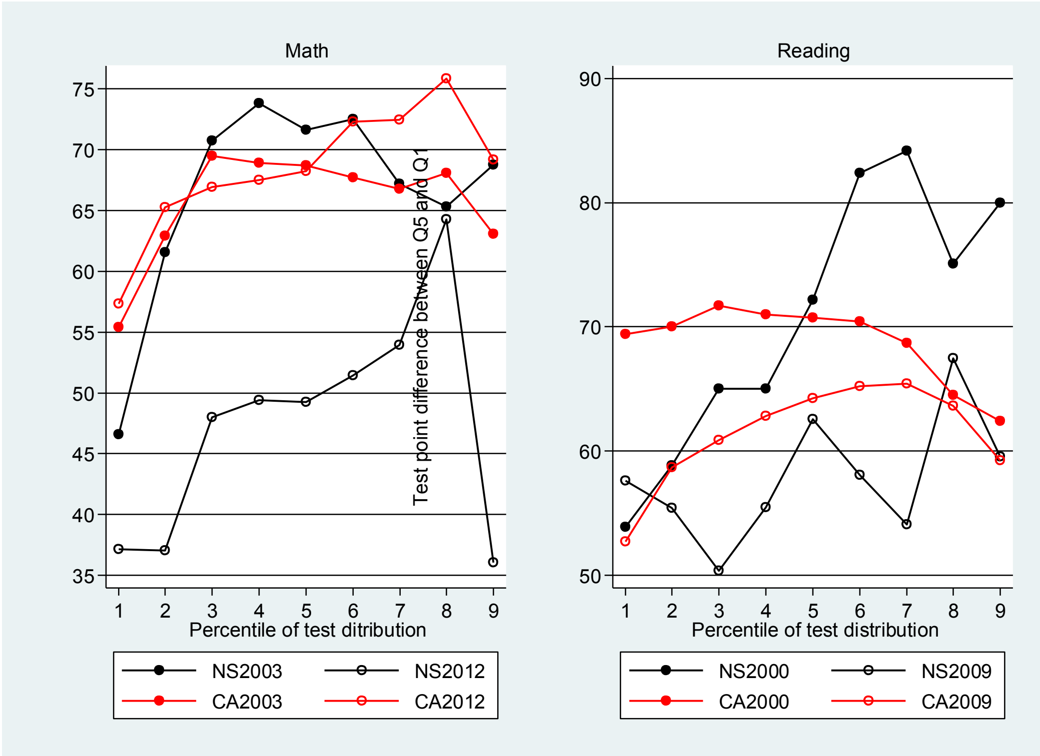
Newfoundland and Labrador and Canada, math and reading



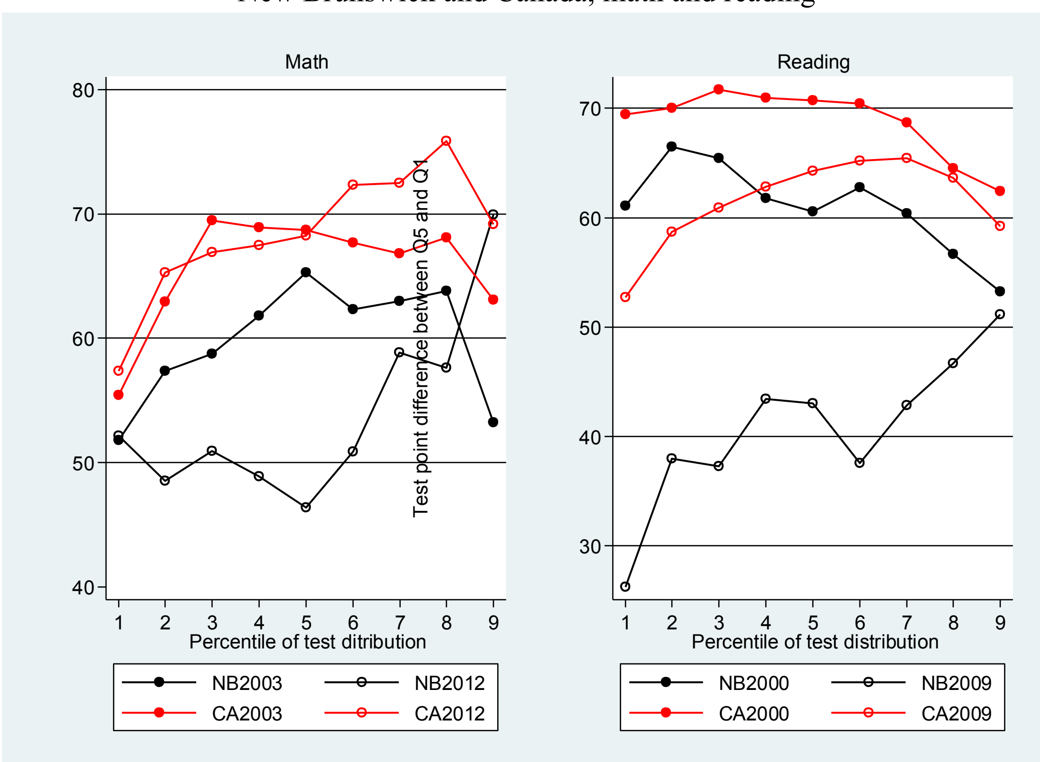
Prince Edouard Island and Canada, math and reading



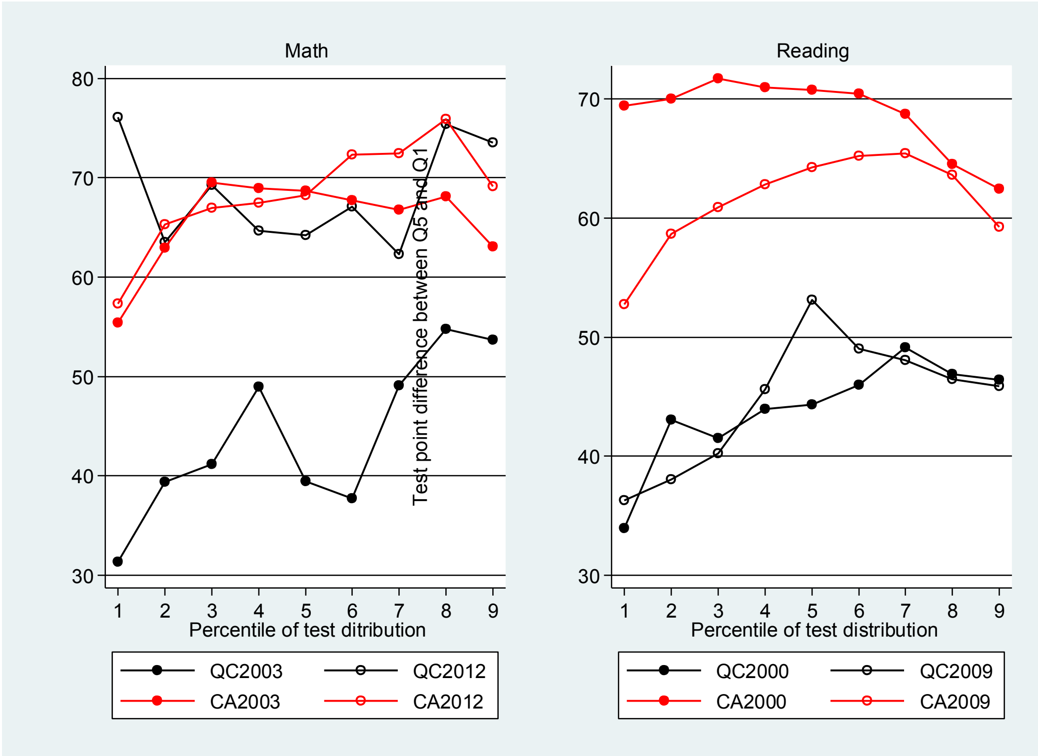
Nova Scotia and Canada, math and reading



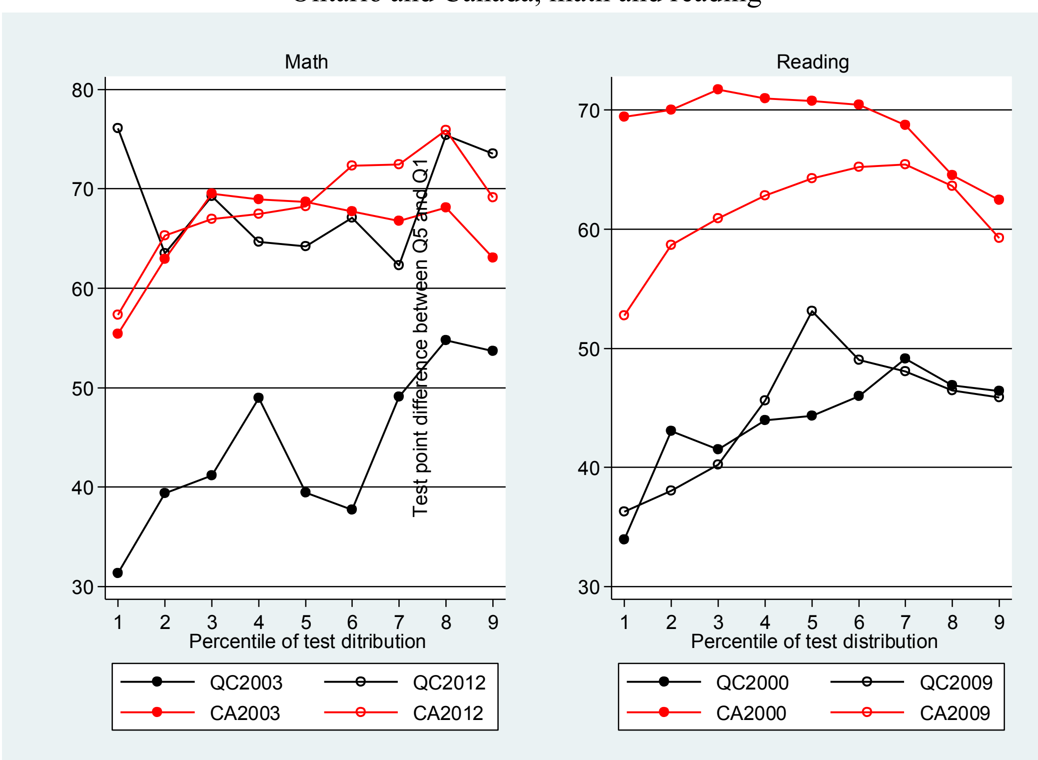
New Brunswick and Canada, math and reading



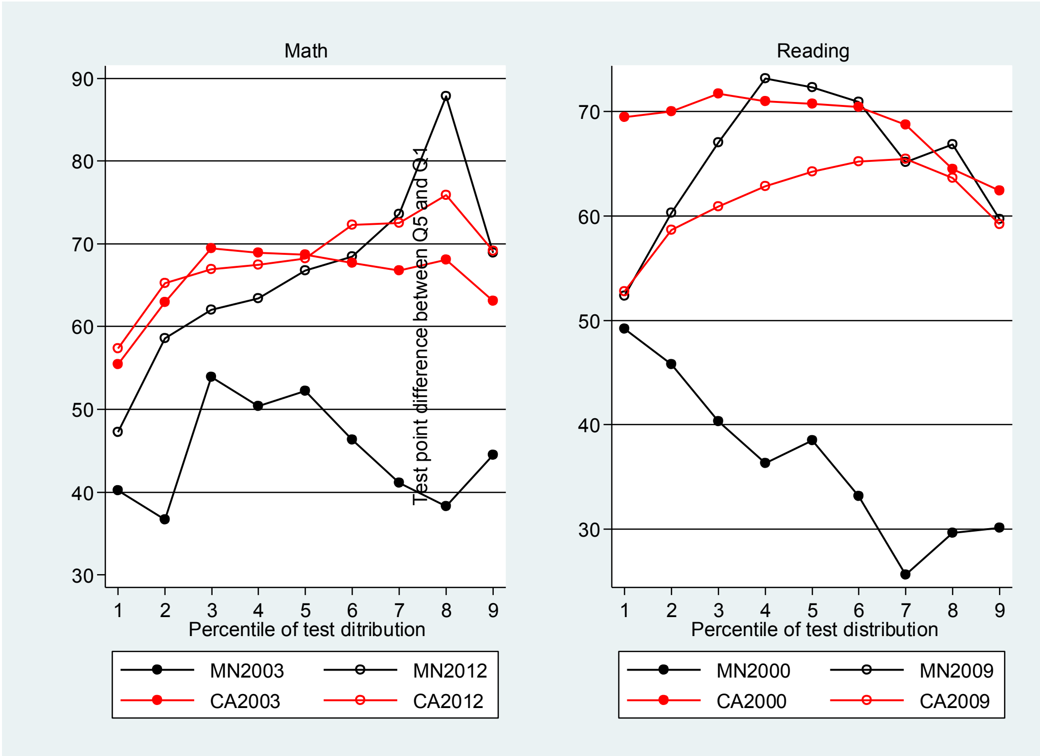
Québec and Canada, math and reading



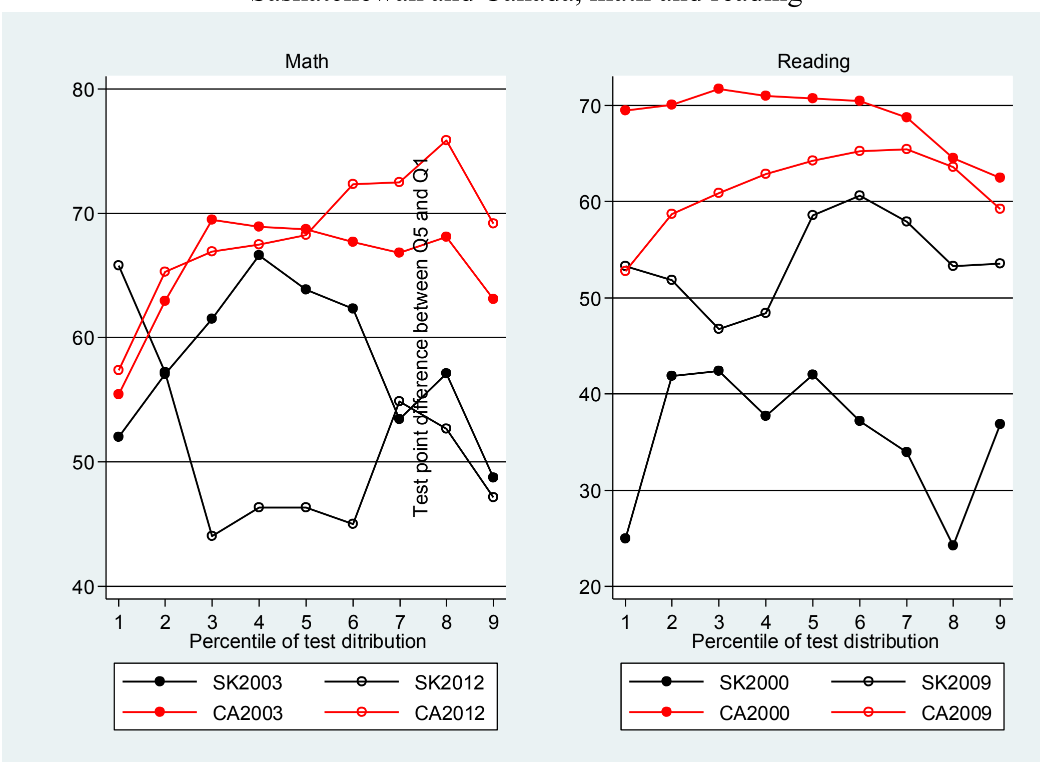
Ontario and Canada, math and reading



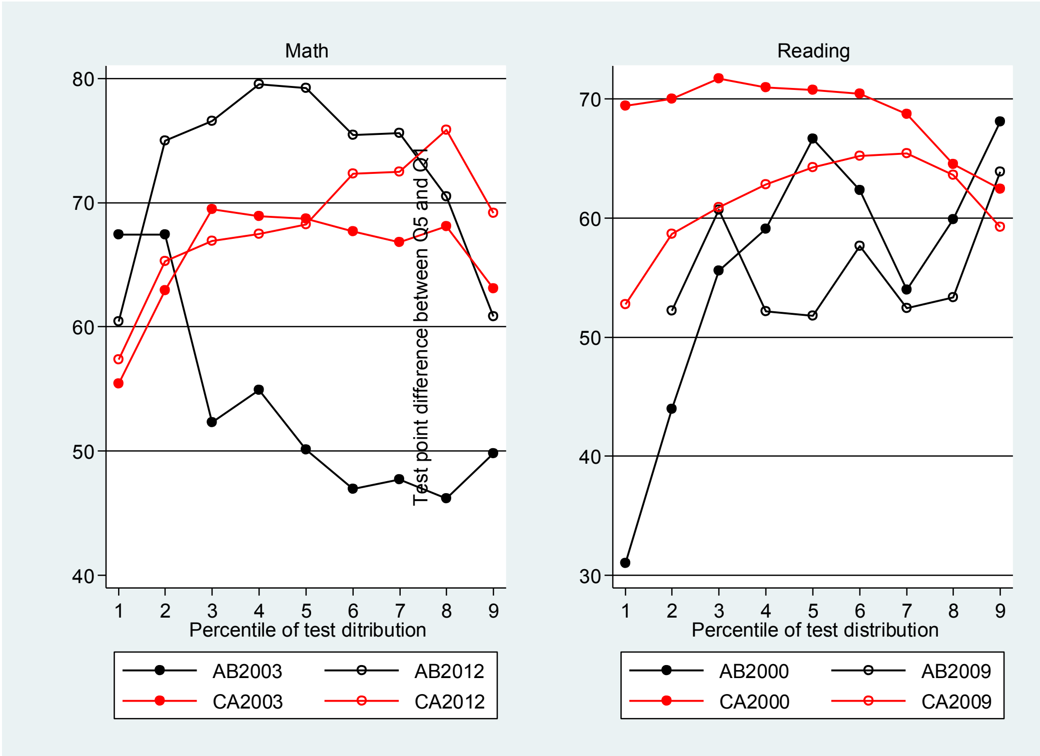
Manitoba and Canada, math and reading



Saskatchewan and Canada, math and reading



Alberta and Canada, math and reading



British Columbia and Canada, math and reading