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Long Term Educational Attainment of Private High School Students in Québec: Estimates of Treatment Effects from Longitudinal Data

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Long term educational attainment of private high school students in Québec: estimates of treatment effects from longitudinal data#

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Abstract
Very few studies analyze the long-term educational effects of private secondary school attendance while controlling for socioeconomic status. In Québec, the second most populous Canadian province, twenty percent of students at this level are enrolled in private schools subsidized by the government that however sets a relatively low ceiling for the fees in exchange for subsidies. Selection bias arising from a host of factors, preclude simplistic comparisons of their educational results with those of their public sector peers. This study uses the first four longitudinal waves of the two cohorts from Statistics Canada's Youth in Transition Survey (YITS) to estimate the average treatment on the treated effect of private school on the high school graduation rate within the expected number of years after starting high school (5), enrolment in postsecondary institutions at age 19, university enrolment at age 21 or more, university graduation at age 24 or more, and enrolment in a professional degree program. The econometric estimation of treatment effects is based on a particular entropy balancing algorithm with a large set of key balancing covariates. Results are validated by a simulation-based sensitivity analysis for matching estimators. We find large, positive, robust, and statistically significant effects of private schooling on almost all outcomes analyzed. Most results are not sensitive to simulations of omitted variable bias.

JEL Code and key-words: I20, I21, I28
YITS, high school graduation, postsecondary education and professional programs enrolment and graduation, longitudinal data, treatment effect, entropy balancing

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1. Introduction

Recent empirical research in the economics of education shows that classical indicators of attainment (years of schooling, diplomas) are insufficient to capture the full nature of human capital and its impact on economic growth and individuals' outcomes in the labor market. Evidence indicates that concrete measures of cognitive competencies and academic skills as well as educational attainment are strongly correlated with outcomes such as employment, income and income distribution (Hanushek and Woessmann (2015a, 2015b, 2008)). Simply stated, the argument is that a nation's long-run economic growth is largely a function of its human knowledge capital. Furthermore, several studies state the specific role of abilities in mathematics for the socioeconomic success of adults (Ingram and Neumann (2006); Murmane et al (2000); Rose and Betts (2004)).

It is therefore not surprising that OECD countries dedicate an important share of their GDP towards education. It can be argued that the production of high quality education, susceptible to produce a productive labor force that sustains and creates growth, necessitates significant financial resources. However, over the last decades, studies such as Hanushek (2003) have regularly shone light on the fact that there is no clear relationship between the level of public expenditures in education in a country and the results of its students in different cognitive tests (national or international). More recently, research has turned towards other important factors or mechanisms for the production of cognitive competencies in students such as quality of teachers and principals (Hanushek and Rivkin (2006); Dhuey and Smith (2011)), the importance of what is taught, how it is taught and teaching strategies (Haeck, Lefebvre and Merrigan (2014); Echazarra et al. (2016)). As such, in recent years governments of developed countries have investigated further into the education system's organization, its governance, types of school and their financing (OECD (2013a, 2012, 2011, 2010)). Researchers in economics and social sciences have also paid more attention to the organizational characteristics of schools per se (Hanushek, Link and Woessman (2013); Bulle (2011); Hanushek and Woessmann (2012); Le Donné (2014)).

Organizational changes in the education systems of OECD countries have taken place mostly in the 2000s, with the governments' intention of promoting competition and quality among schools, and of improving students' results (Figlio and Loeb (2011); Hoxby (2000, 2003)). This decade saw the proliferation of charter schools in the United States, independent, private or subsidized religious schools in Sweden, and in the Netherlands (Böhlmark and Lindahl (2015)), academies or foundations with public subsidies in England (Eyles and Machin 2015a, 2015b, 2015c), along with a variety of private schools with partial or complete subsidies (e.g. France).

In Canada, every province recorded a decline in total K-12 enrolment from 2000–2001 to 2014–2015 (except Alberta).[1] But despite the falling number of students across Canada, every province saw enrolment in private or independent schools grow over the same period (except New Brunswick), as documented by MacLeod and Hasan (2017). The study noted that school funding models vary widely across Canada, with each province funding a unique mix of public minority language schools, Catholic and other religious schools, charter schools and International Baccalaureate schools. For instance in Ontario, Saskatchewan and Alberta, Roman Catholic schools are part of the public school system, while in B.C. all religious schools are private or independently operated, making comparisons between provinces difficult. In addition, British Columbia, Alberta, Saskatchewan, Manitoba, and Québec all provide funding for independent schools, most of which going to elementary schools apart from Québec. This ranges from 35 per cent to 50 per cent of the amount allocated to public schools on a per-student basis. Ontario and the Atlantic provinces provide no funding for independent schools.

While there has been private schools for over a century in Quebec, the second most populous province in Canada, there has been a recognition of the right for two education systems (public and private) to coexist since the early 1980s, with public financing of the private system being judicially guaranteed, making the province an interesting laboratory for the study of the impact of private schools on student achievement. Some studies have provided evidence that attending private schools in Québec causally (average treatment effect on the treated) improves scores in international cognitive tests such as PISA (Lefebvre (2015); Lapierre (2016)).

This paper takes these studies a step further to answer some questions raised indirectly by previous research. Given the fact that students who attend private schools in Quebec typically do so at the secondary level, some questions are raised. Firstly, does private schooling causally improve the probability that they obtain their high school diploma (DES acronym in French) within the expected time span (5 years after entry)? Secondly, does private schooling cause an increase in the probability of attending a post-secondary institution, such as colleges or universities, including programs leading to employment regulated by professional orders in Québec, such as engineering, law or medicine?

[1] Québec's schooling system is slightly different from the one in the rest of Canada, with K-11 years (instead of K-12) and five years of secondary schooling. Afterwards, a student can choose between a public community college (48 of them and a few private ones) – a CEGEP, the French acronym of Collège d'Enseignement Général et Professionel – with two options, two years of general education leading to university or three years of technical studies that may lead to the job market in a particular technical field (for example, electronics, nursing, lab work) or university. The entrance to a university program is in almost all cases conditional on obtaining a CEGEP degree.

This study uses Québec respondents from two longitudinal cohorts (A and B) in Statistics Canada's Youth in Transition Survey (YITS), which traces the educational and employment trajectories of young Canadians aged 15 in 2000 (cohort A) and 18 to 20 in 1999 (cohort B). Both cohorts were re-interviewed every two years afterwards, respectively 6 times until they were 25 years old and five times until they were 26-28 years old. Hence, we can determine whether or not they obtained their high school diploma and at what age they did so, as well as their post-secondary trajectory.

Our results show an important and statistically significant private school treatment effect on several outcomes, such as the high school graduation rate 5 years after entering high school, and post-secondary attendance and graduation. It is important to point out that more than 90% of students who transit from public to private schools do so following the last year of elementary schooling (grade 6), and that very few drop out of private school to attend public schools (Lefebvre, Merrigan and Verstraete (2011)). Therefore, a large majority of students who attend private high schools do not attend a public school at any time during their high school years. The treatment in this paper is therefore very similar to attending a private high school for five years.

As to the structure of the paper, Section 2 briefly describes the body of studies that have analyzed the link between private schools and results in national or international tests. Section 3 identifies the unique particularities of private schools in Québec in terms of how they function, enrolment, public subsidies and of the constraints imposed by the government. Section 4 describes the econometric methods employed for the estimation of treatment effects. Section 5 presents the data and the samples used for the estimation. Section 6 presents the results along with robustness assessments followed by a discussion. Section 7 posits some explanations for the results and reflects on their implications for public policy. A short conclusion summarizes the results.

2. Previous studies on the effects of private education

In the United States, several studies have attempted to measure the effect of private (essentially catholic) schools, and more recently, that of charter schools with public funding. For elementary catholic schools, recent studies show negative effects on reading and mathematics scores in the United States (Elder and Jepsen (2014)) and Australia (Nghien et al. (2015)). In Canada, 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 (although school boards do admit non-Catholic students if there is adequate room).[2] 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.

In the case of charter schools, there are a large number of studies considering their recent expansion. Those that use data from schools employing a lottery-based admission process find positive and significant effects on results in mathematics and reading, notably in urban regions where students hail from lower socio-economic backgrounds (Epple, Romano and Urquiola (2015a, 2015b); Booker et al. (2008); Bettinger (2005); Inberman (2011); Carruthers (2012); Angrist, Pathak and Walters (2013)).

Most studies based on PISA do not find significant effects of private schools on standardized scores. Canada, in these studies, is sometimes classified as a country with low private sector attendance (8%), but this is certainly not the case for the province of Québec, where the percentage of students in private high schools is around 20% in the mid-2000s (see Table A1).

There are few studies on the effect of private schools on students in Québec, even though its private sector enrollment is the highest of all Canadian provinces, by far at the high school level. Economic studies focusing on this matter find statistically significant positive average treatment on the treated (ATT) effects of private secondary school attendance on student test scores (Lefebvre, (2015); Lapierre, (2016) using five PISA surveys and similar statistical frameworks as used here; Lefebvre, Merrigan and Verstraete, (2011) find statistically significant positive (ATT) effects of private school attendance on student math test scores, with panel data, controlling for individual and parental characteristics and student fixed effects).[3]

Empirical research shows that usual indicators of educational performance may not be enough to succeed in a knowledge-based economy. Cognitive and behavioral abilities acquired during secondary education are important factors for ulterior educational success (Anderson and Bergman (2011)). Furthermore, differences in post-secondary enrollment, university attendance and graduation may be linked to differences in the academic achievement of students based on their socio-economic status in high school (Jerrim and Vignoles (2015); Ermish and Bono (2012); Lefebvre and Merrigan

[2] These independent catholic schools are publicly funded since 1984 and operate more as private schools. For school year 2012-2013 there were 233,000 and 209,000 students respectively enrolled at the primary and secondary levels.
[3] Frenette and Chan (2014) analyze the differences between students from both sectors in many provinces in terms of a few indicators of academic performances (PISA 2000 scores, high school graduation, post-secondary enrollment and graduation) with a very particular sample which is not representative of the Québec education system (see Lefebvre (2015)). Our study focuses exclusively on Québec where a much larger proportion of students attend private schools and where the treatment effect is better understood as 5 years in a private high school.

(2010); Chowdry et al. (2013)). Even though studies have shown divergent results regarding the impact and relative importance of high school results and cognitive abilities, related to parental education and family income, some recent studies demonstrate that skills acquired during adolescence, notably mathematical competencies, are stronger predictors of educational completion than measures of non-cognitive abilities. A rise of one standard deviation in mathematics scores is thus associated with multiple years of additional education (Duckworth et al. (2015); Belley and Lochner (2007); Duncan and Magnuson (2011); Watts et al. (2014)). The evidence suggests that differences in cognitive competencies acquired early and linked to income and family education are probably important mechanisms through which socio-economic status is transmitted between generations. Because of the evidence that private schools in Quebec increase test scores it is natural to ask whether they causally improve educational attainment.

3. The unique character of Québec's private schools

Québec's private school system has unique characteristics compared to the other provincial school systems in Canada where the federal government has no responsibility. In 1982, Québec adopted a new subsidy program for private schools. First, abstracting from expenditures in infrastructure and equipment, the annual subsidies for operation costs were fixed along the lines of financial aid given to public schools. Second, the percentage of costs covered by public subsidies was reduced from 80% to 50% of direct (see below) subsidies to public schools for all levels (kindergarten, primary, secondary).

Table A1 presents, for selected years, the evolution of student's enrollment in both public and private sectors by level. Demographic statistics (not shown) demonstrate that the decreasing enrollment in public schools is explained by a decline in fertility rate over the years but with a small increase at the end of the 2000s. At the opposite, for private schools, there is a tendency for a modest increase at the primary level and a substantial hike at the secondary level containing 70% of students from the private sector. There are 128 private schools at the primary level, 124 at the secondary level, and 68 offer school services at both levels. In general, private schools offering only the primary level of schooling are much smaller than those offering a secondary level of education.

Table A2 presents the subsidies in Canadian dollars (approximately USD 0.70-0.90 for this period) for selected years, in particular for the early 2000s the period of our analysis. Table A3 shows the authorized maximum fee according to the regulation and the actual maximum fee charged by private schools by schooling level. Very few private schools charge the maximum permitted. On average, the private school admission fee is 68.3% of the authorized maximum fee and this gap varies by region (from 39% to 84.3% in Montreal), which suggests that families are price sensitive and that the market is competitive.

For public schools, 90% of revenues are publicly provided by direct transfers from the provincial government (74%), property school taxes (16%), and the rest by related activities. The government strictly requires that public school boards finances certain type of expenses while fixing a yearly ceiling for each school board.[4] A third regulation requires that the fees of subsidized private schools not exceed their public subsidy per student. All private schools in Québec must have a permit delivered by the Ministry of education to operate legally. To be eligible for subsidies from the government, the school must operate as a not-for-profit organization and have an approved cursus. Their students must pass the same final exams at the end of their upper secondary levels (grades 10 and 11) in French or English (main teaching language or secondary), History, Mathematics and Sciences prepared by the Ministry of Education to obtain their high school diploma. Therefore, the requirements to graduate from high school are the same for both private and public systems.

At the primary and secondary levels, almost 90% of private schools are subsidized, while a small number of students in private schools are enrolled in “elite” schools. Most of said elite schools are English speaking schools with bilingual teaching, with students of the same gender, very high pedagogical supervision, located in Montréal (the largest city in Québec), and have fees that are much higher than the average private school fee the public subsidy. Finally, 12 schools are specialized for handicapped youths, 20 schools offering trade or vocational training.

It is also important in the context of this paper to provide a proper description of the admission process in private schools. In a 2006 document on admissions, the Federation of Private Schools and Institutions (FEEP, 2006) reports that “70.0% of students who took an admission exam for grade one in secondary school were admitted, 17.6% had their application rejected because of space limitations, and 5.4% were turned away because the school did not have the specialized human resources to respond to the special needs of these students” (p.3). Therefore, very few are turned away because of a lack of basic skills. Even those turned away can end up in a private school as they can apply to several schools. Selection is used when admissions are higher than available spaces.

The most recent information (2017) can be retrieved from the FEEP. Their web site provides information on membership for 171 schools with their admission process and schedule for autumn 2017. From the list we can identify three distinct school policies: 1) for 120 schools (70%), the only

[4] These include the maintenance of buildings and equipment, energy consumption, management of schools and centers and part of the school bus transportation; school boards on the Island of Montreal received a small amount of taxes for educational catch-up measures for underprivileged schools.

procedure is to admit and enroll the child after he applies to the school; 2) among secondary schools only, 22 (13%) have a sorting categorization exam; 3) again for secondary schools only, 20 (12%) have an admission exam, which also serves as a sorting exam. The latter schools are almost all in the two largest cities (Québec and Montréal), where there is an excess demand for spaces in schools that are considered as excellent in most rankings based on provincial official exams at the end of grade 11. At the primary school level there is no selection process, and students who are in these schools are automatically admitted to the secondary level if the school also offers secondary level schooling. Because very few students applying to private schools are not admitted in the system, bias from selection because of admission tests should not be of great concern in our analysis.

4. Analytical framework

This study aims to estimate the ATT of private schooling on high school graduation rates and post-secondary trajectories (enrollment in and graduation from CEGEPs and universities, attendance in post-graduate programs and other programs leading to professions regulated by professional orders in Quebec). Estimation and modeling rest on two cohorts of Quebec youth, representative of the population and selected for the YITS. Cohort A corresponds to the sample produced for the first wave of OECD's PISA in 2000 focused on measuring 15 year-old student abilities in mathematics, reading and sciences for a large cross-section of countries. Cohort B targeted slightly older respondents (aged 18-20 in 1999 for the 2000 YITS cycle 1), but also gathered information on the type of high school these individuals attended and age at graduation, along with enrollment and degrees obtained from different levels of post-secondary education. There were no cognitive tests available for respondents in Cohort B.

Our goal is to estimate the long run effects of attending a private school on educational attainment. Clearly, treatment assignment is not random. The decision to send a child to a private school is without a doubt conditioned by both observable and unobservable characteristics of the student and his family. The econometric challenge to evaluate a policy effect is to estimate a credible, unobserved counterfactual, obtained by econometric manipulation of non-treated subjects. These are matching methods that seek to compare treated and non-treated subjects with similar observed characteristics, introduced by Rubin (1974, 1977) and now subsumed in a more general approach based on a reweighting of the untreated in the case of ATT estimation. These estimators are widely used in economics, social sciences and epidemiology to calculate a causal treatment effect by controlling for differences in observed covariates between treated and untreated groups.

Formally, let D denote a binary indicator of treatment, Y the outcome and X a vector of observable covariates. The average treatment effect on the treated estimators (ATT) compares the average outcome of the treated group (D = 1) to that of a sample of non-treated individuals with the same distribution of X as the treated. These estimators assume that the potential outcome in the non-treated state is independent of treatment conditional on X. There are many types of estimators proposed in econometric literature on treatment effects (Imbens (2015)). Many exploit the conditional probability of treatment (P ($D = 1|X$)), also known as propensity scores. These types of ATT estimators can be semi or non-parametric and use propensity scores in a matching procedure. Other types of non-parametric estimators directly employ X to determine the weight assigned to each untreated observation without estimating propensity scores.

This paper employs entropy balancing (EB) to construct the counterfactual mean of the treated if untreated, proposed by Hainmueller (2012), and Hainmueller and Xu (2013). This method seeks to balance covariates between groups by way of a maximal entropy weighting scheme,[5] which is to say that the reweighting of untreated subjects offers an exact balancing of the specified moments of the distribution of every element of X. The weights are found using a numerical optimizing procedure that produces weights as a solution. Instead of depending on a propensity score model, EB uses analyst-supplied base (initial) sampling weights. Re-estimated weights are then calculated in order to minimize the Kullback-Leibler divergence from the initial weights, subject to balancing constraints. Hainmueller (2012) draws attention to the fact that, similarly to the traditional estimator based on inverse propensity score weighting, the estimator could have a large variance when a few observations receive large weights caused by a significant difference in the covariate distributions between groups.

Formally, the procedure is the following:

$$\min_{\omega_i} \sum_{\{i:D_i=0\}} h(\omega_i). \qquad (2)$$

Subject to the balancing constraint in (3),

$$\sum_{\{i:D_i=0\}} \omega_i X_i = \frac{1}{N_1} \sum_{\{i:D_i=1\}} X_i \text{, for all } X. \quad (3)$$

And normalization constraints,

$$\sum_{\{i:D_i=0\}} \omega_i = 1 \; and \; \omega_i \geq 0, \;\; \forall i, \;\; D_i = 0. \; (4)$$

[5] Frölich, Hubert, and Wiesenfarth (2015) analyze the performance of a large group of treatment estimators, both semi- and non-parametric, on the basis of mean quadratic error. The EB estimators are part of the group with the best performance.

Where ω_i is the weight to be estimated for individual *i*, *h*(.) is a distance metric, *X* is a covariate, and *D* is the treatment indicator. Hainmueller (2012) suggests the Kullback-Leibler function $h(\omega_i) = \omega_i \log\left(\frac{\omega_i}{q_i}\right)$ as the loss function. It measures the difference between the distribution of the estimated weights $\omega_1, \ldots, \omega_{iN_0}$ and the base weights, in our case sample probability weights.

For the first stage of estimations presented in this paper, weights are generated with EB in order to balance the selected moments of the chosen covariates between the two groups while minimizing the distance with the base sampling weights supplied by Statistics Canada. Therefore, the algorithm finds weights that will ensure the equality between the sample weighted moments of the treated *X*'s and the EB weighted X moments of the untreated. In the second stage, a weighted linear regression of *Y* on *D* is performed to estimate the treatment effect (ATT). For almost all of the covariates, which are dummy variables, we impose only that the first moment of the distribution be balanced. When family income is included in the model, equality of the second moments is imposed for this specific covariate.

5. Statistical framework

5.1 Data, samples and descriptive statistics

The data used for estimations are provided by the YITS cohort A cycles 1-4 (2000-2006), and YITS cohort B cycles 1-4 (2000-2006). The sample used for the estimations was restricted to individuals who reside in Quebec in cycle 1 for both cohorts, and to students in secondary school grades 9 and 10 in Quebec for cohort A and students who had not repeated a grade while in primary (elementary) school for cohort B. These restrictions are imposed because almost no student in private schools repeated a grade, and because we are estimating the ATT effect of private schooling.

Selected respondents in cycle 1 are longitudinal for both cohorts. For each estimate, all original respondents present in the cycle of interest (i.e. that for which the outcome is available) are included, without consideration for their potential future non-response in later waves. Sample and replicate weights used are those provided by Statistics Canada, adjusted for non-response in each cycle.

Probit estimations were performed to ascertain which factors are susceptible to affect non-response probabilities. Results show that the only available variable that is statistically significant is family income (available only for cohort A), which would positively affect the probability of response. As such, the sample is likely to be biased in favor of individuals coming from higher income families in cycles following the first. Given the strong correlation between income and educational attainment, the results obtained from the study's estimates are very likely to be conservative, as individuals from lower socio-economic backgrounds appear to be under-sampled in later cycles and would negatively affect public school results had there been no attrition.

Table A4, constructed from official administrative data on all students in Québec entering high school, displays the graduation rate (high school diploma and other qualifications) by cohort, time since entering high school in years, gender, type of school and language of instruction (French/English). For each cohort (2001 to 2007), graduation by number of years since entering high school is computed by the Ministry of Education, for 5, 6, and 7 years (6 and 5 years respectively for the 2008 and 2009 cohorts). These administrative statistics indicate very important differences between the public and private school system graduation rates.

Table 1 presents, both for the unrestricted and restricted sample (the latter for estimation) descriptive statistics on high school graduation rates for both cohorts, A and B, selected from the YITS survey. The rates (with restriction) are similar between the cohorts since cohort A, for the same cycle, is only 3 to 5 years younger. The computed rates with YITS data sets in the unrestricted sample are consistent with population data of the later cohorts in Table A4. The gaps observed, related to high school graduation, are also close to the official administrative rates displayed in Table A4.

Québec's Ministry of Education does not provide longitudinal administrative data on educational trajectories of youth leaving high school (graduated or not). The usual annual statistics on enrollment and graduation rates in postsecondary institutions cannot identify these trajectories according to characteristics of high school students (cohort, gender, and language of instruction). Table 2 computed with YITS data sets offers unique statistics on these trajectories. For all levels of education (attendance and graduation rates) and both cohorts, large differences stand out (see last three columns) between individuals by gender and high school type. Significant gaps are observed at most education levels, reaching 36 percentage points in the case of university attendance for respondents in cohort B cycle 3.

5.2 Empirical models and covariates

For the ATT estimations with the EB approach, two specifications apply for cohort A and only one for cohort B. They differ slightly in terms of available covariates in the YITS, identified hereinafter.

Cohort A

Cohort A respondents are aged 15 in cycle 1 (2000) of the YITS-PISA. For this cohort, four outcomes of interest are identified. 1. Graduated from high school 5 years and 7 years after entering high school, respectively computed in cycles 2 (2002) and 3 (2004). 2. Enrolled in CEGEP or university at respectively ages 19 and 21 (cycle 3 and 4, 2004 and 2006). 3. Attended university at age 21, as in general, students have graduated from CEGEP by this age (cycle 4, 2006). 4. Enrollment in programs leading to occupations regulated by professional orders in Québec (medicine, law, engineering, etc.) in cycle 4 (for students in university). For respondents born after September 30, cycle 3 was used in order to determine whether high school graduation occurred at the expected time as their admission to kindergarten was delayed by one year. We remind the reader that the sample is restricted to students in secondary grades 9 or 10 in cycle 1 in both private and public schools, as there are no students in lower grades in private schools and we are estimating the ATT.

For each of these outcomes, two models are estimated (i.e. two sets of covariates are used for balancing). The first model, which will be referred to as the “base model”, includes as the following matching variables: the student’s gender, his or her socioeconomic status (SES) quintile (determined by his or her parents’ highest occupational status), his or her age in months, the presence of a family member born outside of Canada, his or her mother’s education level (no diploma; high school diploma; college diploma or university degree), and language spoken at home (French, English or other). Our measure of social disparities is the parents’ highest international socio economic index (ISEI) as measured by PISA analysts. This measure, frequently used in sociological analysis, attributes a score between 11 and 90 to different occupations based on professional characteristics, such as the required level of education and associated income. The index’ creators (Ganzeboom et al, 1992) aimed to improve the measure of socio-economic status for research purposes. The index has been intensively used in the literature on socio-economic gradients (Chowdry et al, 2010; Crawford et al, 2010). The values regroup individuals with different professions; levels 11-20 include individuals working in service sectors and unskilled workers, while levels 80-90 include highly qualified professions such as a physician, judge, CEO, etc. Values are grouped by quintiles for our empirical analysis.

The second model, henceforth referred to as the “complete model”, comprises every covariate included in the first model, and adds income in thousands of 1999 Canadian dollars, the number of books at home (widely considered as an acceptable proxy for the importance granted to education by the parents along with the student’s access to cultural possessions), family status (nuclear or other) along with the number of siblings (none, one, two or more).

All variables are coded in cycle 1 of the study. The EB algorithm is then applied in order to balance the means of the matching variables in the treated and untreated groups. When family income is included in the model, we also balance the variance of this covariate. Table 3 describes in detail (mean and frequency) the differences between individuals of both cohorts for those who attended a private high school and those who attended a public institution. The characteristics (covariates used in the estimations) are described and commented below.

Cohort B

The cohort B respondents were 18-20 years old in cycle 1 of the YITS. Six outcomes of interest are estimated for this group. 1. High school graduation after 5 years. 2. Post-secondary attendance at cycle 1. 3. University enrollment in cycles 2 through 4. 4. University graduation in cycles 3 and 4. 5. Post-graduate program attendance in cycles 3 and 4. 6. Enrollment in programs leading to occupations regulated by professional orders in Québec in cycles 2 through 4.

Only one model is estimated for this cohort. The covariates used for balancing include the individual's gender, his age, his or her mother's or guardian's education level (no diploma, high school diploma, college diploma or university diploma), the language spoken at home (French, English or Other), the immigration status of family members, and, at age 15, his family status (two-parent or single-parent home) and finally the number of siblings. No further information is available regarding family income, the number of books at home or a variable directly usable for SES. However, using the occupation codes available for both cohorts, ISEI values for cohort B were imputed using regressions (described in the next section).

5.3 Differences in covariates between cohorts by school type

Table 3 describes in detail the differences between respondents of both cohorts for those who attended a private high school and those who attended a public institution. Of primary interest is the difference in private school enrollment between cohorts A and B, knowing that there is a 3-5 year gap in age between these groups. During this time, private school enrollment grew by 52% (from 12.9% to 19.6%), a result that is in line with those from the PISA data sets, presented in Table A1, showing a continuous progress in attendance for these schools over the last two decades.

The difference in gross family income (expressed in thousands of 1999 dollars) is also worth noting for cohort A (unavailable for cohort B). Public school students are in families with an average income of $47,532, while their privately educated counterparts' mean family income reaches $59,396. These differences are also reflected in the socio-economic composition of school attendees. The quintiles of SES, constructed from parental occupation value scores for cohort A show that private school numbers are strongly correlated with SES. As SES progresses, public school attendance drops from 23% to 16.1% in the fifth quintile, while private school enrollment grows from 8.4% to 27.8% in the fourth quintile and 37.2% for the fifth quintile.

Unfortunately, the OECD ISEI was not supplied for YITS cohort B, neither was family income Because parental occupations were reported, along with standardized international profession and industry codes, ISEI was imputed for cohort B on the basis of equivalent information provided in cohort A and distributed into quintiles in the same fashion. We observe a similar pattern in cohort B regarding the discrepancies between private and public school students, particularly in the first SES quintile with only 11.4% private school attendees.

A sharp difference is also observed for the family's immigration status, defined in cohort A as the individual being a first or a second-generation immigrant. Individuals corresponding to this category represent 13.8% of the public school attendees, while in private school they represent 34.3% of students. For cohort B, there was no question regarding the parent's immigration status, only the respondent's. Overall numbers are much lower but a difference is still observed, with 7% of private school students born outside Canada, while they amount to 4.9% in public schools.

The number of books at home is often used as a proxy for cultural possessions and parents' interest in culture and in their child's education. Once again we observe a significant difference between the families of children in the two types of schools. While 36.2% of children in public schools live in homes with 50 books or fewer, only 24.4% of their private school counterparts live in such homes. Conversely, 33.7% of private school students live in homes containing over 250 books, a number reaching 20.2% for public school attendees.

Cohort A's private school students are more likely to speak English at home (15.1% against 10.1% in public schools) or another language than French (84.2% of public schools students are French speakers at home, while they number only 70.9% in private schools). Similar numbers are found in cohort B, where French language speakers at home fall from 86.5% in public schools to 79% in private schools, while English speakers increase from 6.9% to 9.4%. The difference in statistics on language between cohorts may be explained by the different wording employed by the questionnaire. Cohort A students were asked what language was spoken at home, while cohort B students were asked the first learned language at home that they could still understand. Private school students are also more likely to live in two-parent families. Such individuals represent 69.8% of students in public schools, while they number 76.8% for private school students in cohort A, and they are respectively 69.5% and 78.3% in cohort B.

The mother's education level is also used as a balancing covariate. Four categories are used to describe the mother's education level: less than high school graduation (or no diploma reported), high school diploma, college degree, or university degree. The characteristics of both cohorts are very similar and conform to the expectation that students in private schools are much more likely to come from households with a higher education level. Over twice as many individuals in private schools have mothers with a university degree than those in public schools (35.5% vs 16.9% in cohort A; 41.7% vs 16.8% in cohort B). Inversely, 32.6% of public school students in cohort A have a mother with a high school diploma as their highest education level (34% in cohort B), while only 21.5% students in private schools come from such a household (21.8% in cohort B).

6. Results and robustness checks

We start by comparing the mean value of the covariates of the treated and EB weighted means of the untreated. In all cases, the algorithm used to construct the EB weights converged quickly and computed weights which, when applied to the non-treated, produced means almost identical to the treated means. Table A.5 in the appendix displays the means of covariates for the treated, the untreated and EB means of the untreated computed with the sample of Cohort B respondents used for the estimation of the effect of private schooling on high school graduation (in 5 years). A close inspection shows that the EB means of the untreated and those of the treated are practically the same. All estimations balanced covariates with this kind of precision.

We present the estimated causal ATT effects by cohort, A and B, for the full sample and by sex, with two sets of matching covariates for cohort A, the second set being an enlarged version of the first (as described previously). Estimations with the later outcomes related to postsecondary schooling are performed with a smaller number of observations than for secondary school graduation because of attrition. However, the attrition is larger for the untreated and is negatively related to higher social status. Therefore, the mean counterfactual outcomes are computed with individuals who are probably more skilled academically than the samples in earlier cycles, producing conservative ATT estimates. Tables 4.1-4.3 and 5.1-5.3 present the estimation results for cohorts A and B, respectively. The first column (EB-NC) presents our main findings, which are the ATT estimates obtained with the maximal entropy balancing scheme. As explained earlier, the estimates are the sample weighted means outcomes of the treated minus the EB weighted mean of the non-treated (a weighted regression of the outcome on a private school dummy). The next four columns are robustness checks.

We perform four exercises to assess robustness with the full sample. The first (column EB-WC) is simply a weighted regression of outcomes on the treatment dummy and the covariates used for the EB procedure. The results are nearly identical to the estimates without the covariates. Second, we perform the regressions excluding the observations where the assigned entropy weight is over the 99th percentile of the weight distribution. Again, the results are very similar to those with all observations. Third, we estimate the ATT effects with a kernel propensity score matching procedure. Again, results are generally remarkably similar.

Finally, we perform a simulation where the outcome's sensitivity to omitted variables is assessed using STATA's SENSATT package written by Nannicini (2007). Despite the use of EB, as for all models where selection is on observables, the ATT estimator is biased if a variable correlated with both the outcome and private school attendance is omitted from the model, as the conditional independence assumption (CIA) is violated. A simulation of confounding variables is thus employed to assess the robustness of our estimates to omitted variable bias. The method consists in including a generated binary variable in the group of *X*'s, which is both linked to treatment assignation and the variable of interest, disregarding assignation to the treatment. The ATT is then re-estimated for each simulation of the confounder, and a comparison between the estimates without the confounder and the ones obtained with the simulation measures the robustness of the matching estimator (Nannicini (2007); Ichino, Mealli and Nannicini (2008)). The complex sampling structure of the survey imposes the use of replicated weights supplied by Statistics Canada for inference.

The sensitivity analysis method (SENSATT) employed in this paper is based on the hypothesis that the CIA holds when a binary confounding factor *U* is taken into account alongside the observable variables *W*:

$$\Pr\,(T = 1|Y_0, Y_1, W) \neq \Pr\,(T = 1|W)$$

While:

$$\Pr(T = 1|Y_0, Y_1, W, U) = \Pr\,(T = 1|W, U)$$

The distribution of the unobserved binary confounding factor *U* is characterized by the parameters

$$p_{ij} \equiv \Pr(U = 1|T = i, Y = j, W) = \Pr\,(U = 1|T = 1, Y = j)$$

with $i,j \in \{0,1\}$ giving the probability that $U = 1$ in each of the four groups defined by the treatment and outcome status.

This method has several advantages. First, the hypothetical link between *Y*, *U* and *T* is stated in proportions characterizing the distribution of $U|T, Y, W$, thus avoiding an invalid parametric specification of $Y|T, U, W$. Second, the parameters $p_{i,j}$ can be specified in a way as to mimic the distribution of some observed binary covariate, allowing the econometrician to determine the robustness of the initial estimates to deviations from the CIA. Third, one can set up the parameters $p_{i,j}$ in a way that drives the ATT down to zero, and then assess the plausibility of their distribution. Lastly, the SENSATT method can be employed regardless of the algorithm used to match the observations, when matching methods are used the estimation.

What are the unobserved variables that may cause our estimation method to produce a biased estimate of private schooling? Potential candidates are unobserved ability, or unobserved characteristics of the parents that increase an individual's human capital such as stimulating his or her interest in reading, sciences or mathematics. These factors would of course increase both the probability a child graduates from high school or a post-secondary institution and the probability he attends a private school. Parents who observe a child's ability in grade school may be induced to send him or her to a high school where most of the students are skillful if they perceive that he is academically gifted. In addition, parents who send their child to a private school possibly value education and thus probably spend more money on goods and services that will increase the human capital of their child. We therefore assume that this omitted variable is strongly positively correlated with both private schooling and the outcome. The simulated variable is calibrated using the observed correlation between income, private schooling, and outcomes in cohort A as it is highly correlated with the latter two variables. The SENSATT procedure is performed with a kernel matching procedure; however, because this procedure produces results very similar to EB, we believe it is an appropriate robustness exercise.

Cohort A

Tables 4.1-4.3 present, for cohort A, the estimated ATT (multiplied by 100 gives the estimated difference in percentage points) by level of study, cycle, sample (all, males, females), and specification. Most estimated effects are large, statistically significant ($p<0.01$), and are robust to all alternative methods and specifications described above. While the addition of other control covariates, notably family income, in the complete model lessens the effect somewhat; the estimated ATT is still important and significant.

Table 4.1 shows the results for high school graduation five (seven) years after entry in cycles 2 (and 3). Large and statistically significant ($p<0.01$) effects are estimated in all cases. For the base model, the effect is estimated at 11.4 percentage points (pp) for the whole sample. Restrictions on gender provide estimates of 13.8 pp for male and 9.1 pp for female students. For the complete model, the estimate is 10.4 pp for all students, while it is 12.7 pp and 8.1 pp for males and females respectively.

The effect on high school graduation is also estimated in cycle 3 when the respondents are 19, 7 years after they started high school (Table 4.1). The coefficients are much smaller, as the estimated gap between treatment and counterfactual narrows. Base model estimates are 5.6 pp for the whole sample, 5.6 pp for females, and 6.1 pp for males. As for the complete model, effects are slightly smaller, estimated at 5.2 pp for the whole sample, 5.5 pp for males and 5.5 pp for females.

The second outcome evaluated in cycle 3 is attending a community college (CEGEP) or university enrollment. All results present in Table 4.2 are significant at the 1% level, regardless of method or specification. For the base model, effects are estimated at 13.7 pp - 13.9 pp. As for the complete model, the estimated ATT is 12.5 pp for the whole sample, 11.9 pp for males and 13.5 pp for females.

In cycle 4, university enrollment is the outcome. Once again, the estimated coefficients (Table 4.3) are significant at the 1 percent level in all cases. For the base model, the whole-sample estimate is 17.9 pp, while it is 17.4 pp for males and 19.7 pp for females. In the case of the complete model, the ATT is 16.2 pp for the whole sample, 15.4 pp for males and 17.7 pp for females.

Alternatively, college or university enrollment is also estimated in cycle 4 and results appear in Table 4.2. All p-values are once again below 0.01. The base model effects are 16.2 pp for the whole sample, 16.5 pp for males and 15.1 pp for females. For the complete model, the estimated effect is 15.1 pp for the whole sample, and 14.5 pp and 15 pp respectively for males and females. Therefore the results are similar to when only university enrollment is considered. This is because in most cases those who attend college (CEGEP) have graduated by cycle 4.

The last outcome analyzed in cycle 4 is professional program enrollment amongst university students, with results presented in Table 4.3. In the case of the base model, the ATT for the whole sample is 13 pp; for males it is 27.3 pp and 4.3 pp for females. They are statistically significant at 1% for the first two cases, but not significant for females. For the complete model, the whole-sample effect is 13 pp. The estimated effect is 20.8 pp for males (99% significant), and 5.7 pp for females (not significant).

This last result is certainly intriguing: private school has a large and significant effect on enrolment in professional programs for male university students, while it is null for females. This would imply that the effect operates on a different level depending on gender, as it appears that it encourages male students to pursue a specific academic path, which is to say that mediating factors might differ across genders.

Cohort B

Tables 5.1-5.3 show in the same format but with only one set of covariates the results for cohort B, which widely corroborate the cohort A findings. Most estimates unrelated to professional programs are large and statistically significant.

In cycle 1, the first estimations for the high school graduation outcome are shown in Table 5.1. The whole-sample estimate is 17.3 pp, significant at the 1% level. For males and females, estimates are 21.8 pp and 14.2 pp respectively, both significant at the 95% level. Also in cycle 1, we find the estimated effect on enrollment in college or university (Table 5.1), with all p-values being under 0.01. The ATT for males is estimated at 21.3 pp, while females' ATT is 9.6 pp. The whole-sample estimate is 14.7 pp.

University enrollments are estimated for cycles 2 through 4. In cycle 2, significant (5%) effects (Table 5.1) are estimated for both the whole sample (22.7 pp) and for females (23.7 pp), while for males a large effect is estimated (21.5 pp), but is not statistically significant.

In cycle 3 (Table 5.2), all estimates are higher. The whole-sample effect is 25.2 pp ($p<0.01$), for females it is 24.1 pp and 24.8 pp for males, with $p<0.05$ in both cases. Finally, in cycle 4 (Table 5.3), for the whole-sample ATT is 22 pp ($p<0.05$). For males, the ATT is estimated at 22.2 pp (not significant), while it is 20 pp for females ($p<0.10$).

Professional program enrollment among university students effects were also estimated for cycles 2 through 4. There was no significant result, as seen in Tables 5.1 to 5.3. Also, the size of the estimates is also considerably smaller than for cohort A. However, there is, as for Cohort A, a large difference between males and females.

In cycles 3 and 4, the ATT on university graduation estimates are also presented. Results are significant for cycle 4 (Table 5.3), but not for cycle 3 (Table 5.2). For the whole-sample estimate in cycle 4, an ATT of 18.6 pp ($p<0.05$) is estimated. Results are also large for males (17.9 pp) and females (17.7 pp), but are not statistically significant. Finally, as to the private school ATT for post-graduate program enrollment estimates for cycle 4, no significant results are found, as seen in Table 5.3. Stronger effects of private schooling in later cycles could be partly explained by lower dropout rates for private school students. These are displayed in Table 6, for cohort B, which is 4 years older on average than cohort A. Drop-out rates are clearly higher for students who attended public high school.

The last columns present the results with a kernel matching regression and for SENSATT. In the latter case a kernel matching method with the simulation of an omitted variable correlated with both the treatment and the outcome is used to estimate the treatment effect (100 simulations were performed). The simulated variable is simply added to the list of matching covariates for each simulation and the kernel matching procedure is performed with the enriched set of covariates. First, the kernel matching results are very close to EB, and the simulations show that the added covariate generally slightly reduces the treatment effect. Therefore, our robustness exercises reinforce the idea that private schooling has a strong effect on the probability of graduating from high school in five years and attending a post-secondary institution as well as graduating from it.

7. Interpretation and public policy implications

Discussion

The magnitude of the estimated effects of private school attendance on various educational outcomes is large in many cases. The estimated effects are larger for cohort B, for whom the percentage of respondents from private schools is much smaller. In a model with heterogeneous effects, it is possible that, on average, individual effects are larger for the treated, which could be explained by the fact that the treated are those that will thrive in private schools. The larger cohort B effect may be explained by the fact that cohort A children in private schools are closer to middle class children (for example, 35% of respondents in private schools have a university educated mother in cohort A, the same number is 42% in cohort B), for whom individual treatment effects could be smaller. The results may also simply be due to the less extensive set (in cohort B) of covariates for balancing purposes.

The discussion will focus on cohort A results, as it is a more recent cohort and the set of key covariates for balancing is larger than for cohort B, in particular we observe family income for students of cohort A. The effect of private schooling on the probability of graduating in 5 years is very large and robust at 11 points, while the effect of graduating from high school after 7 years is much smaller and is even smaller with kernel matching (rather small given that the raw differences for graduating in 5 years is over 25 points). This is an interesting result, as the effect on post-secondary attendance is robust at close to 10 points in cycle 3 and goes up to 15 points in cycle 4. Graduating in 5 years is therefore a key indicator for post-secondary studies. The increase in cycle 4 is partly due to a lower post-secondary retention rate for the public school students. Therefore, mechanisms that are driving the effect on graduating in 5 years are also certainly playing some role in post-secondary attendance. A large majority of the public school comparison group eventually passes the exams to graduate from high school, but several need 6 or 7 years to achieve this goal. What makes private school students' graduate faster? Obvious reasons are assiduous work patterns, a better understanding of testing material, more discipline, etc. These qualities are crucial for post-secondary studies: once the student experiences success with a pattern of work, he or she might feel more confident in the pursuit of post-secondary degrees. Therefore, the important ATT effect of private schooling is on post-secondary attendance as the impact on high-school graduation, once a respondent is 19 years old, is not that important.

<u>The issue of selection on non-observables</u>

This begs the question as to why effects of private education on educational choices at the post-secondary level are so important. One possible mechanism is the improvement in math, reading or science test scores. We estimate the effects for the full sample adding these scores in the set of balancing covariates one at a time and report the ATT estimates for the full sample. Unfortunately, we cannot include all test results in the estimation as the first 2000 PISA wave focuses on one particular subject, in this case reading. Math and sciences tests scores are reported for half the students, as the students who did not take the math test took the science test and vice-versa, with selection being random. Of course, the estimates of private schooling are no longer causal, because test scores depend on type of schooling, but the exercise can reveal the role of test scores as a mediator of private school effects.

Again, we focus on cohort A, the younger cohort. The results appear in Tables 7.1 to 7.2. As expected, the estimate of the private schooling effect was reduced for all outcomes and in most cases by between 25 and 30 percent. The largest impact on the private school coefficient of the addition of scores in the set of covariates is for university attendance in the case of men. In this case, adding math scores reduces the private schooling coefficient by 40 percent, but for girls it is only 9 percent. Therefore, the impact of private schooling on math scores for boys is crucial for their future. This relationship between private schooling, math scores and university attendance for boys is certainly intriguing. Although attendance in technical or hard sciences programs for women is rapidly increasing, they were male-dominated fields at the time.

According to our computations from YITS data, 25.3% of male university students are enrolled in such programs, while the same statistics are only 3.8% for female university students.[6] These programs are in general costly, as they require labs and equipment spaces. Most universities are therefore forced to highly constrain the number of spaces in these areas (Fortin 2005). This link between math and university attendance trough private schooling is an important result as university attendance is crucial for a well-paid job and long-term success in the labor market. Therefore the mechanisms that are driving the effects of private schooling on educational attainment are linked to those that have an impact on test scores, in particular math scores for males. Math is generally the topic that students find the hardest. To obtain strong scores in math tests, generally, one must be disciplined, and do homework regularly. Therefore, private schools may develop skills necessary for higher education. Also, obtaining higher scores in math could provide confidence in oneself to apply and attend universities. Finally, certain degrees necessitate high math marks simply to be admitted, so that private schooling may have an effect through that channel as well. Clearly, our results demonstrate that test scores mediate the impact of private schooling on educational attainment, more for males at the university level.

Although math scores cannot be considered as a background variable like the others as they reflect the outcome that one tries to quantify, which is the ability (or lack thereof) of different types of

[6] We selected in the YITS the following degrees as technical or "hard" science degrees: Computer and Information Sciences and Support Services, Engineering, Mathematics and Statistics, Mathematics and Computer Science, Astronomy and Astrophysics, Atmospheric Sciences and Meteorology, Chemistry, Geological and Earth Sciences / Geosciences and Physics.

schools to foster attainment. However, they may also be considered as being (partially) a background variable, something that schools do not produce but that they automatically get with the pupils they enroll. If one assumes that the level of PISA scores is entirely selection driven, and consequently controls for that hypothetical selection by including them into the EB algorithm, then the fact that one still obtains positive and statistically significant private school effect on educational attainment makes the latter result even stronger.

Of course, other mechanisms could be driving the effects. Although it is difficult to provide strong evidence for this, private schools may attract good teachers and principals who prefer working in a more disciplined, "zero tolerance environment." Second, the large number of private schools in Québec, coupled with the public system, may cause private schools to be more responsive to competition, making them particularly sensitive to statistics on national testing and graduation rates. Peer effects might be another candidate, but our dataset cannot be used to provide evidence for such a mechanism.

Public policy implications

The evidence shows that private high school education has a strong positive effect (ATT) on individuals who attend private schools. The strategy of subsidizing public schools should therefore increase the aggregate stock of human capital in the province, unless the policy considerably reduces the human capital of individuals educated in the public sector. To our knowledge, no evidence of such an effect has been produced in Québec. In fact, public sector students perform better on a math test than their counterparts in the rest of Canada (Lefebvre, Merrigan and Verstraete (2011)). Unfortunately, data sets in Canada do not permit an estimation strategy that could identify the key factors producing these strong effects.

Private sector teachers are not particularly different from their public school counterparts; they graduate from the same university programs, and are often members of the same union and have similar working conditions. However, there is a lack of information regarding teacher quality in Québec (and Canada). 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) Dhuey and Smith (2011), Hanushek (2011)).

Many studies insist on the relative predictive power of acquired cognitive abilities and of certain behaviors adopted during early adolescence on ulterior academic and professional success (see section 2). We have provided evidence that increasing test scores is part of the mechanism that explains the effect of private schools on educational attainment. However, certain abilities, typically qualified by economists as non-cognitive, such as "attention abilities" which refer to competencies related to impulse control and task focus can also play a role. They increase engagement and participation times for the completion of academic activities. These competencies, such as task persistence and self-regulation, can strongly predict a student's educational achievement. Initial advantages can be reinforced if students attend a high school that improves their performances year to year and does a better job of preparing their students for higher education. Such a process can open the door to an accumulation of advantages. This type of scheme corresponds to Cunha and Heckman's (2008) dynamic factor models for the development of children's cognitive and non-cognitive skills, in which intermediary results at each stage influence ulterior results, but can also affect input productivity in later stages (that skills beget skills in a simple formula).

Faced with the evidence, it is challenging to draw conclusions that could offer potential solutions for public policy to improve students' educational results and competencies. Measures that would simultaneously improve both types of students (low and high social status) would not reduce the dispersion of student abilities. Conversely, cutting back or eliminating Québec's private school subsidies, as suggested by proponents of public education, would only cause a decline in abilities and competencies for students that attend it.

To summarize, the foundation of Québec's educational policy is about offering parents the choice of school for their children at a reasonable cost. Another policy pursued in British Columbia is the introduction of "open enrolment", which allows children to attend a school outside of their regular attendance zone. This policy provides an opportunity to estimate the extent to which increased public school choice affects student achievement, concentrates minority students in enclave schools, and induces 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. In the same vein, Allison (2015) argues that Ontario progress on key educational indicators (e.g. high school graduation, PISA 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 (OECD 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. Similarly, public schools in Québec have started to expand so-called "options" programs, concentrating in specific areas such as music, sports, or international baccalaureate. It is reasonable to assume that the growth in popularity of such programs in the public sector was induced by the competition from the rising subscription levels of private schools, which have been offering such programs for over a decade.

8. Conclusion

Recent studies that seek to establish a causal link between high school establishment type and students' educational performance focused on pupils' performances on standardized tests. These include those given through the National Longitudinal Study of Children and Youth (NLSCY) led by Statistics Canada from 1994-1995 through 2008-2009 (Lefebvre, Merrigan and Verstraete (2011); Haeck et al. (2014)), or the ones led by international studies such as PISA (Lefebvre (2015); Lapierre (2016)), or with administrative data (Azimil, Friesen, and Woodcock (2015)). Results from these estimates lead to a common conclusion: the average treatment effect on the treated of private schools is positive and significant.

This study focuses on the private school ATT on educational attainment, such as high school graduation in the "expected" number of years, along with attendance and graduation from postsecondary establishments, with specific attention lent to programs leading to programs regulated by professional orders in Québec. The results potentially imply the development in private schools of cognitive abilities or working habits facilitating access to and success in postsecondary education.

Numerous studies have focused on the returns to education of different degrees and additional schooling years on working incomes of individuals throughout their lives. The magnitude of treatment effects estimated in this research brings into focus important questions on this subject, suggesting potentially significant gaps in the future income of treated and non-treated individuals.

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Table 1: High school graduation rate by sex and type of school (private, public), cohorts A and B of the YITS

	All			Male			Female		
	All	Private	Public	All	Private	Public	All	Private	Public
				Cohort A no restriction					
%	66.3	84.7	62.6	60.7	81.6	56.2	72.2	88.4	69.2
S-D	0.8	1.5	0.9	1.2	2.2	1.3	1.1	2	1.3
N	4,043	722	3,321	2,090	394	1,696	1,953	328	1,625
				Cohort A with restriction					
%	73.9	86	71.2	69.5	83.8	66	78.3	88.5	76.2
S-D	0.8	1.5	0.9	1.2	2.1	1.4	1.1	2	1.2
N	3,548	694	2,854	1,779	376	1,403	1,769	318	1,451
				Cohort B no restriction					
%	67.6	92.9	63.6	60.8	91.2	56.3	74.8	94.6	71.4
S-D	1	1.7	1.1	1.5	2.6	1.6	1.3	2	1.5
N	4,412	491	3,921	2,256	222	2,034	2,156	269	1,887
				Cohort B with restriction					
%	77.5	95.1	74.2	72.8	94.2	68.9	81.9	96	79.1
S-D	1	1.6	1.1	1.6	2.4	1.7	1.3	2	1.4
N	3,566	460	3,106	1,722	206	1,516	1,844	254	1,590

Notes: The restriction excludes students who have repeated grades during their studies; S-D: standard deviation.
Source: Authors' computation from cycles 1-3 YITS weighted data sets.

Table 2: Enrollment and graduation rate by sex, cycle, level of studies, type of high school, and difference by school type, cohorts A and B

	All			Public			Private			Private - Public		
Level of studies	All	M	F	All	M	F	All	M	F	All	M	F
				Cohort A cycle 2 (17 years old)								
Graduation high school	74	70	78	71	66	76	86	84	89	15	18	13
N	3,548	1,779	1,769	2,854	1,403	1,451	694	376	318			
				Cohort A cycle 3 (19 years old)								
Enrollment CEGEP/university	71	65	77	67	61	73	88	82	95	21	21	22
N	3,016	1,495	1,521	2,430	1,174	1,256	586	321	265			
Enrollment prof. program	14	24	10	12	21	9	19	29	12	7	8	3
N	390	137	253	256	79	177	134	58	76			
				Cohort A cycle 4 (21 years old)								
Enrollment CEGEP/university	72	66	78	68	61	74	91	85	97	23	24	23
N	2,532	1,255	1,277	2044	985	1,059	488	270	218			
Enrollment university	33	25	40	28	20	35	54	46	65	26	26	30
N	2,532	1,255	1,277	2,044	985	1,059	488	270	218			
Enrollment prof. program	17	26	12	13	17	12	25	41	13	12	24	1
N	352	129	223	231	74	157	121	55	66			
				Cohort B cycle 1 (18-20 years old)								
Graduation high school	77	73	82	74	69	79	95	94	96	21	25	17
N	3,566	1,722	1,844	3,106	1,516	1,590	460	206	254			
Enrollment CEGEP/university	80	75	85	77	71	83	97	96	98	20	25	15
N	3,566	1,722	1,844	3,106	1,516	1,590	460	206	254			
				Cohort B cycle 2 (20-22 years old)								
Enrollment university	32	25	38	27	21	33	59	51	66	32	30	33
N	3,097	1,502	1,595	2,688	1,320	1,368	409	182	227			
Enrollment prof. program	14	20	10	14	22	10	12	16	10	-2	-6	0
N	882	339	543	660	250	410	222	89	133			
				Cohort B cycle 3 (22-24 years old)								
Enrollment university	39	32	45	33	26	40	69	62	74	36	36	34
N	2,541	1,212	1,329	2,194	1,058	1,136	347	154	193			
Enrollment graduate studies	4	2	5	3	2	5	5	3	7	2	1	2
N	2,541	1,212	1,329	2,194	1,058	1,136	347	154	193			
University diploma	15	10	19	13	9	17	25	17	31	12	8	14
N	2,541	1,212	1,329	2,194	1,058	1,136	347	154	193			
Enrollment prof. program	12	17	9	12	16	10	13	18	9	1	2	-1
N	926	376	550	697	280	417	229	96	133			
				Cohort B cycle 4 (24-26 years old)								
Enrollment university	43	36	49	37	31	44	72	68	74	35	37	30
N	2,208	1,040	1,168	1,900	905	995	308	135	173			
Enrollment graduate studies	8	5	11	7	4	9	17	10	22	10	6	13
N	2,208	1,040	1,168	1,900	905	995	308	135	173			
University diploma	29	23	36	25	19	31	53	46	59	28	27	28
N	2,208	1,040	1,168	1,900	905	995	308	135	173			
Enrollment prof. program	11	14	9	11	11	10	12	20	7	1	9	-3
N	911	379	532	699	288	411	212	91	121			

Notes: Enrollment prof. program is enrollment in a professional program at the university level. M: male; F: female. Private-Public: difference between Private and Public schools.
Source: Authors' computation from cycles 1-4 YITS weighted data sets.

Table 3: Mean characteristics of respondents by type of high school, cohorts A and B cycle 1

High school		All	Public	Private	All	Public	Private
Variable	Statistic	Cohort A cycles 1-2 15-17 years old			Cohort B cycle 1 18-20 years old		
Type of high school		100%	80.4%	19.6%	100%	87.1%	12.9%
Family income	Mean	49,622	47,532	59,396	-	-	-
	S-D	3.19	2.98	3.92	-	-	-
Male	Mean	49.7%	48.7%	53.9%	48.2%	48.5%	46.7%
Age (months)	Mean	186	186	186	228	228	228
	S-D	3	3	3	9.84	9.84	9.84
Immigrant	Mean	17.6%	13.8%	34.3%	5.2%	4.9%	7%
	S-D	0.38	0.34	0.47	0.22	0.22	0.25
English	Mean	11%	10.1%	15.1%	7.3%	6.9%	9.4%
	S-D	0.31	0.30	0.36	0.26	0.25	0.29
French	Mean	81.7%	84.2%	70.9%	85.3%	86.5%	79%
	S-D	0.39	0.36	0.45	0.35	0.34	0.41
Two-parent	Mean	71.1%	69.8%	76.8%	70.8%	69.5%	78.3%
	S-D	0.45	0.46	0.42	0.45	0.46	0.41
Quintiles ISEI							
1		20%	23%	8.4%	20%	21.6%	11.4%
2		20%	21.6%	11.9%	20%	18.9%	25.9%
3		20%	21%	14.8%	20%	19.2%	24.3%
4		20%	18.3%	27.8%	20%	19.4%	23%
5		20%	16.1%	37.2%	20%	20.9%	15.3%
Siblings							
0		8.8%	8.3%	8.8%	9.9%	9.3%	13.1%
1		45.7%	45.5%	45.7%	46.2%	45.2%	51.5%
2 or more		45.6%	46.2%	45.6%	43.9%	45.5%	35.4%
Number of books at home							
Books 1 (0-10)		10.3%	10.9%	7.6%	-	-	-
Books 2 (11-50)		23.7%	25.3%	16.8%	-	-	-
Books 3 (51-100)		22%	23%	17.7%	-	-	-
Books 4 (101-250)		21.4%	20.7%	24.3%	-	-	-
Books 5 (>250)		22.7%	20.2%	33.7%	-	-	-
Mother's education level					-	-	-
Less than high school		23.9%	25.4%	17.3%	25.8%	27.8%	15.5%
High school		30.5%	32.6%	21.5%	32.1%	34%	21.8%
>High school and <University		25.7%	25.2%	25.7%	21.4%	21.5%	21%
University diploma or more		20.3%	16.9%	35.5%	20.7%	16.8%	41.7%
N		3,548	2,854	694	3,566	3,106	460

Note: Quintiles of occupation values are constructed from derived values of ISEI.
Source: Authors' computation from cycles 1-2 YITS weighted data sets.

Table 4.1: Estimated effects of private high school on high school graduation by sex and estimation methods, cohort A cycles 2 and 3, YITS

Level of studies	C	Model	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Graduation high school	2	Base	All	Coef.	0.114 (†††)	0.114 (†††)	0.102 (†††)	0.106 (†††)	0.096 (†††)	-9.2
				S-D	0.019	0.019	0.019	0.012	0.003	
				N	3,548	3,548	3,520	3,548	3,548	
Graduation high school	2	Base	M	Coef.	0.138 (†††)	0.138 (†††)	0.132 (†††)			
				S-D	0.031	0.031	0.031			
				N	1,779	1,779	1,769			
Graduation high school	2	Base	F	Coef.	0.091 (†††)	0.091 (†††)	0.070 (†††)			
				S-D	0.022	0.022	0.024			
				N	1,769	1,769	1,754			
Graduation high school	2	Complete	All	Coef.	0.104 (†††)	0.104 (†††)	0.087 (†††)	0.098 (†††)	0.088 (†††)	-10.3
				S-D	0.018	0.018	0.017	0.016	0.003	
				N	3,548	3,548	3,520	3,548	3,548	
Graduation high school	2	Complete	M	Coef.	0.127 (†††)	0.125 (†††)	0.111 (†††)			
				S-D	0.030	0.030	0.026			
				N	1,779	1,779	1,765			
Graduation high school	2	Complete	F	Coef.	0.081 (†††)	0.081 (†††)	0.063 (†††)			
				S-D	0.022	0.022	0.024			
				N	1,769	1,769	1,752			
Graduation high school	3	Base	All	Coef.	0.056 (†††)	0.056 (†††)	0.057 (†††)	0.05 (†††)	0.044 (†††)	-11.4
				S-D	0.011	0.011	0.012	0.008	0.002	
				N	3,016	3,016	2,987	3,016	3,016	
Graduation high school	3	Base	M	Coef.	0.061 (†††)	0.061 (†††)	0.058 (†††)			
				S-D	0.019	0.019	0.021			
				N	1,495	1,495	1,481			
Graduation high school	3	Base	F	Coef.	0.056 (†††)	0.056 (†††)	0.059 (†††)			
				S-D	0.009	0.009	0.010			
				N	1,521	1,521	1,506			
Graduation high school	3	Complete	All	Coef.	0.052 (†††)	0.051 (†††)	0.048 (†††)	0.047 (†††)	0.041 (†††)	-12.8
				S-D	0.011	0.011	0.011	0.009	0.002	
				N	3,016	3,016	2,986	3,016	3,016	
Graduation high school	3	Complete	M	Coef.	0.055 (†††)	0.053 (†††)	0.045 (†††)			
				S-D	0.019	0.019	0.017			
				N	1,495	1,495	1,481			
Graduation high school	3	Complete	F	Coef.	0.055 (†††)	0.055 (†††)	0.058 (†††)			
				S-D	0.010	0.010	0.012			
				N	1,521	1,521	1,506			

Notes: C: cycles 2 (17 years old), 3 (19 years old); M: male; F: female; Param.: Estimated parameter; EB-NC: Entropy balancing no control; EB-WC: Entropy balancing with control; EB-99 : Entropy balancing removing individuals who have a weight higher than the 99th percentile of the weight distribution; Kernel: kernel matching with propensity scores; Sensatt: estimated simulation with confounding variable; Δ%: difference in percentage between coefficient estimated by kernel matching and Sensatt. †: 90% statistical significance, ††: 95%., †††: 99%.

Table 4.2: Estimated effects of private high school on CEGEP or university enrollment by sex and estimation methods, cohort A cycles 3 and 4

Level of studies	C	Model	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Enrollment CEGEP/university	3	Base	All	Coef.	0.137 (†††)	0.137 (†††)	0.130 (†††)	0.121 (†††)	0.108 (†††)	-10.3
				S-D	0.018	0.018	0.017	0.016	0.003	
				N	3,016	3,016	2,987	3,016	3,016	
Enrollment CEGEP/university	3	Base	M	Coef.	0.138 (†††)	0.138 (†††)	0.128 (†††)			
				S-D	0.029	0.028	0.027			
				N	1,495	1,495	1,481			
Enrollment CEGEP/university	3	Base	F	Coef.	0.139 (†††)	0.139 (†††)	0.133 (†††)			
				S-D	0.022	0.022	0.022			
				N	1,521	1,521	1,506			
Enrollment CEGEP/university	3	Complete	All	Coef.	0.125 (†††)	0.123 (†††)	0.114 (†††)	0.11 (†††)	0.098 (†††)	-11.1
				S-D	0.019	0.018	0.018	0.018	0.004	
				N	3,016	3,016	2,986	3,016	3,016	
Enrollment CEGEP/university	3	Complete	M	Coef.	0.119 (†††)	0.116 (†††)	0.102 (†††)			
				S-D	0.029	0.029	0.026			
				N	1,495	1,495	1,481			
Enrollment CEGEP/university	3	Complete	F	Coef.	0.135 (†††)	0.135 (†††)	0.125 (†††)			
				S-D	0.022	0.022	0.024			
				N	1,521	1,521	1,506			
Enrollment CEGEP/university	4	Base	All	Coef.	0.162 (†††)	0.162 (†††)	0.142 (†††)	0.126 (†††)	0.116 (†††)	-7.5
				S-D	0.019	0.019	0.017	0.02	0.003	
				N	2,532	2,532	2,507	2,532	2,532	
Enrollment CEGEP/university	4	Base	M	Coef.	0.165 (†††)	0.165 (†††)	0.126 (†††)			
				S-D	0.031	0.031	0.029			
				N	1,255	1,255	1,243			
Enrollment CEGEP/university	4	Base	F	Coef.	0.151 (†††)	0.151 (†††)	0.145 (†††)			
				S-D	0.018	0.018	0.018			
				N	1,277	1,277	1,265			
Enrollment CEGEP/university	4	Complete	All	Coef.	0.151 (†††)	0.147 (†††)	0.120 (†††)	0.114 (†††)	0.105 (†††)	-7.7
				S-D	0.018	0.018	0.017	0.014	0.003	
				N	2,532	2,532	2,507	2,532	2,532	
Enrollment CEGEP/university	4	Complete	M	Coef.	0.145 (†††)	0.139 (†††)	0.097 (†††)			
				S-D	0.031	0.030	0.026			
				N	1,255	1,255	1,243			
Enrollment CEGEP/university	4	Complete	F	Coef.	0.150 (†††)	0.150 (†††)	0.140 (†††)			
				S-D	0.018	0.018	0.017			
				N	1,277	1,277	1,265			

Notes: C: cycles 3 (19 years old), 4 (21 years old); M: male; F: female; Param.: estimated parameter; EB-NC: Entropy balancing no control; EB-WC: Entropy balancing with control; EB-99 : Entropy balancing removing individuals who have a weight higher than the 99^{th} percentile of the weight distribution; Kernel: kernel matching with propensity scores; Sensatt: estimated simulation with confounding variable; Δ%: difference in percentage between coefficient estimated by kernel matching and Sensatt. †: 90% statistical significance, ††: 95%., †††: 99%.

Table 4.3: Estimated effects of private high school on university enrollment or professional program enrollment by sex and estimation methods, cohort A cycle 3-4

Level of studies	C	Model	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Enrollment university	4	Base	All	Coef.	0.179 (†††)	0.179 (†††)	0.184 (†††)	0.191 (†††)	0.176 (†††)	-7.5
				S-D	0.032	0.032	0.032	0.023	0.004	
				N	2,532	2,532	2,507	2,532	2,532	
Enrollment university	4	Base	M	Coef.	0.174 (†††)	0.174 (†††)	0.180 (†††)			
				S-D	0.044	0.044	0.041			
				N	1,255	1,255	1,243			
Enrollment university	4	Base	F	Coef.	0.197 (†††)	0.196 (†††)	0.190 (†††)			
				S-D	0.058	0.058	0.058			
				N	1,277	1,277	1,265			
Enrollment university	4	Complete	All	Coef.	0.162 (†††)	0.160 (†††)	0.152 (†††)	0.175 (†††)	0.16 (†††)	-8.1
				S-D	0.032	0.032	0.029	0.027	0.005	
				N	2,532	2,532	2,507	2,532	2,532	
Enrollment university	4	Complete	M	Coef.	0.154 (†††)	0.153 (†††)	0.158 (†††)			
				S-D	0.042	0.042	0.039			
				N	1,255	1,255	1,243			
Enrollment university	4	Complete	F	Coef.	0.177 (†††)	0.177 (†††)	0.157 (†††)			
				S-D	0.059	0.059	0.052			
				N	1,277	1,277	1,265			
Enrollment prof. program	4	Base	All	Coef.	0.130 (†††)	0.129 (†††)	0.117 (††)	0.093 (††)	0.098 (†††)	5.5
				S-D	0.045	0.045	0.049	0.044	0.009	
				N	352	352	349	352	352	
Enrollment prof. program	4	Base	M	Coef.	0.273 (†††)	0.272 (†††)	0.234 (††)			
				S-D	0.093	0.093	0.097			
				N	129	129	128			
Enrollment prof. program	4	Base	F	Coef.	0.043	0.043	0.055			
				S-D	0.050	0.050	0.052			
				N	223	223	221			
Enrollment prof. program	4	Complete	All	Coef.	0.130 (†††)	0.133 (†††)	0.146 (†††)	0.113 (†††)	0.115 (†††)	1.8
				S-D	0.046	0.044	0.042	0.04	0.009	
				N	352	352	349	352	352	
Enrollment prof. program	4	Complete	M	Coef.	0.208 (††)	0.125 (†††)	0.138 (†††)			
				S-D	0.082	0.000	0.000			
				N	129	129	128			
Enrollment prof. program	4	Complete	F	Coef.	0.057	0.063	0.081			
				S-D	0.049	0.050	0.050			
				N	223	223	221			

Notes: C : cycle 4 (21 years old); prof. program: professional program at university level; M: male; F: female; Param.: Parameters from estimation; EB-NC: Entropy balancing no control; EB-WC: Entropy balancing with control; EB-99 : Entropy balancing removing individuals who have a weight higher than the 99^{th} percentile of the weight distribution; Kernel: kernel matching with propensity scores; Sensatt: estimated simulation with confounding variable; Δ%: difference in percentage between coefficient estimated by kernel matching and Sensatt. †: 90% statistical significance, ††: 95%., †††: 99%.

Table 5.1: Estimated effects of private high school on high school graduation and enrollment in CEGEP or university or professional program, by sex and estimation methods, cohort B cycles 1 and 2

Level of studies	C	Model	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Graduation high school	1	Base	All	Coef.	0.173 (†††)	0.173 (†††)	0.186 (†††)	0.168 (†††)	0.16 (†††)	-5.3
				S-D	0.046	0.046	0.032	0.015	0.003	
				N	3,566	3,566	3,531	3,566	3,566	
Graduation high school	1	Base	M	Coef.	0.218 (††)	0.218 (††)	0.217 (†††)			
				S-D	0.087	0.087	0.064			
				N	1,722	1,722	1,705			
Graduation high school	1	Base	W	Coef.	0.142 (††)	0.142 (††)	0.157 (†††)			
				S-D	0.061	0.061	0.045			
				N	1,844	1,844	1,826			
Enrollment CEGEP/university	1	Base	All	Coef.	0.147 (†††)	0.147 (†††)	0.155 (†††)	0.154 (†††)	0.146 (†††)	-5.4
				S-D	0.038	0.038	0.031	0.014	0.002	
				N	3,566	3,566	3,531	3,566	3,566	
Enrollment CEGEP/university	1	Base	M	Coef.	0.213 (†††)	0.212 (†††)	0.219 (†††)			
				S-D	0.081	0.081	0.049			
				N	1,722	1,722	1,705			
Enrollment CEGEP/university	1	Base	F	Coef.	0.096 (†††)	0.096 (†††)	0.099 (††)			
				S-D	0.034	0.034	0.039			
				N	1,844	1,844	1,826			
Enrollment university	2	Base	All	Coef.	0.227 (††)	0.227 (††)	0.232 (†††)	0.259 (†††)	0.243 (†††)	-6.2
				S-D	0.090	0.090	0.075	0.025	0.005	
				N	3,097	3,097	3,067	3,097	3,097	
Enrollment university	2	Base	M	Coef.	0.215	0.214	0.245 (††)			
				S-D	0.136	0.136	0.099			
				N	1,502	1,502	1,487			
Enrollment university	2	Base	F	Coef.	0.237 (††)	0.236 (††)	0.225 (††)			
				S-D	0.114	0.114	0.108			
				N	1,595	1,595	1,580			
Enrollment prof. program	2	Base	All	Coef.	-0.032	-0.032	-0.014	0.006	0	-108.0
				S-D	0.078	0.078	0.074	0.028	0.004	
				N	882	882	874	882	882	
Enrollment prof. program	2	Base	M	Coef.	-0.067	-0.066	-0.052			
				S-D	0.164	0.164	0.133			
				N	339	339	336			
Enrollment prof. program	2	Base	F	Coef.	0.013	0.012	0.034			
				S-D	0.086	0.086	0.085			
				N	543	543	538			

Notes: C: cycle 1 (18-20 years old), cycle 2 (20-22 years old); prof. program: professional program at university level; M: male; F: female; Param.: estimated parameter; EB-NC: Entropy balancing no control; EB-WC: Entropy balancing with control; EB-99 : Entropy balancing removing individuals who have a weight higher than the 99^{th} percentile of the weight distribution; Kernel: kernel matching with propensity scores; Sensatt: estimated simulation with confounding variable; Δ%: difference in percentage between coefficient estimated by kernel matching and Sensatt. †: 90% statistical significance, ††: 95%., †††: 99%.

Table 5.2: Estimated effects of private high school on enrollment or graduation in university, professional or graduate studies program, by sex and estimation methods, cohort B cycle 3

Level of studies	C	Model	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Enrollment university	3	Base	All	Coef.	0.252 (†††)	0.251 (†††)	0.250 (†††)	0.273 (†††)	0.255 (†††)	-6,4
				S-D	0.077	0.077	0.076	0.031	0.005	
				N	2,541	2,541	2,516	2,541	2,541	
Enrollment university	3	Base	M	Coef.	0.248 (††)	0.248 (††)	0.285 (††)			
				S-D	0.114	0.114	0.120			
				N	1,212	1,212	1,200			
Enrollment university	3	Base	W	Coef.	0.241 (††)	0.240 (††)	0.249 (†††)			
				S-D	0.112	0.112	0.095			
				N	1,329	1,329	1,316			
Enrollment graduate studies	3	Base	All	Coef.	-0.006	-0.006	0.008	0.029 (††)	0.026 (†††)	-8,8
				S-D	0.037	0.037	0.041	0.015	0.001	
				N	2,541	2,541	2,516	2,541	2,541	
Enrollment graduate studies	3	Base	M	Coef.	0.001	0.001	0.004			
				S-D	0.043	0.043	0.051			
				N	1,212	1,212	1,200			
Enrollment graduate studies	3	Base	W	Coef.	-0.008	-0.008	0.025			
				S-D	0.058	0.058	0.070			
				N	1,329	1,329	1,316			
University diploma	3	Base	All	Coef.	0.056	0.056	0.059	0.087 (†††)	0.079 (†††)	-9,2
				S-D	0.076	0.076	0.069	0.023	0.003	
				N	2,541	2,541	2,516	2,541	2,541	
University diploma	3	Base	M	Coef.	0.061	0.061	0.059			
				S-D	0.098	0.098	0.095			
				N	1,212	1,212	1,200			
University diploma	3	Base	W	Coef.	0.053	0.052	0.069			
				S-D	0.119	0.119	0.100			
				N	1,329	1,329	1,316			
Enrollment prof. program	3	Base	All	Coef.	0.019	0.019	0.051	0.029	0.023 (†††)	-22,1
				S-D	0.064	0.064	0.077	0.03	0.003	
				N	926	926	917	926	926	
Enrollment prof. program	3	Base	M	Coef.	0.039	0.039	0.055			
				S-D	0.131	0.131	0.148			
				N	376	376	373			
Enrollment prof. program	3	Base	W	Coef.	0.017	0.017	0.037			
				S-D	0.071	0.071	0.088			
				N	550	550	545			

Notes: C: cycle 3 (22-24 years old); prof. program: professional program at university level; M: male; F: female; Param.: estimated parameter; EB-NC: Entropy balancing no control; EB-WC: Entropy balancing with control; EB-99: Entropy balancing removing individuals who have a weight higher than the 99^{th} percentile of the weight distribution; Kernel: kernel matching with propensity scores; Sensatt: estimated simulation with confounding variable; Δ%: difference in percentage between coefficient from kernel matching and Sensatt. †: 90% statistical significance, ††: 95%., †††: 99%.

Tableau 5.3: Estimated effects of private high school on enrollment or graduation in university, professional or graduate studies program, by sex and estimation methods, cohort B cycle 4

Level of studies	C	Model	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Enrollment university	4	Base	All	Coef.	0.220 (††)	0.220 (††)	0.233 (†††)	0.252 (†††)	0.234 (†††)	-6.8
				S-D	0.091	0.091	0.090	0.031	0.006	
				N	2,208	2,208	2,186	2,208	2,208	
Enrollment university	4	Base	M	Coef.	0.222	0.222	0.264 (†)			
				S-D	0.148	0.148	0.135			
				N	1,040	1,040	1,030			
Enrollment university	4	Base	W	Coef.	0.200 (†)	0.200 (†)	0.220 (††)			
				S-D	0.103	0.103	0.099			
				N	1,168	1,168	1,157			
Enrollment graduate studies	4	Base	All	Coef.	0.055	0.055	0.085	0.073 (†††)	0.068 (†††)	-6.8
				S-D	0.072	0.072	0.060	0.022	0.002	
				N	2,208	2,208	2,186	2,208	2,208	
Enrollment graduate studies	4	Base	M	Coef.	0.015	0.015	0.060			
				S-D	0.093	0.093	0.081			
				N	1,040	1,040	1,030			
Enrollment graduate studies	4	Base	W	Coef.	0.080	0.080	0.088			
				S-D	0.117	0.117	0.093			
				N	1,168	1,168	1,157			
University diploma	4	Base	All	Coef.	0.186 (††)	0.186 (††)	0.178 (††)	0.186 (†††)	0.172 (†††)	-7.5
				S-D	0.089	0.089	0.084	0.031	0.005	
				N	2,208	2,208	2,186	2,208	2,208	
University diploma	4	Base	M	Coef.	0.179	0.179	0.190			
				S-D	0.112	0.112	0.126			
				N	1,040	1,040	1,030			
University diploma	4	Base	W	Coef.	0.177	0.177	0.177			
				S-D	0.138	0.138	0.126			
				N	1,168	1,168	1,157			
Enrollment prof. program	4	Base	All	Coef.	0.041	0.041	0.042	0.03	0.025 (†††)	-17.5
				S-D	0.066	0.066	0.066	0.028	0.003	
				N	911	911	902	911	911	
Enrollment prof. program	4	Base	M	Coef.	0.118	0.118	0.156			
				S-D	0.130	0.130	0.149			
				N	379	379	376			
Enrollment prof. program	4	Base	W	Coef.	-0.014	-0.014	-0.004			
				S-D	0.073	0.073	0.087			
				N	532	532	527			

Notes: C: cycle 4 (24-26 years old); prof. program: professional program at university level; M: male; F: female; Param.: estimated parameter; EB-NC: Entropy balancing no control; EB-WC: Entropy balancing with control; EB-99: Entropy balancing removing individuals who have a weight higher than the 99^{th} percentile of the weight distribution; Kernel: kernel matching with propensity scores; Sensatt: estimated simulation with confounding variable; Δ%: difference in percentage between coefficient from kernel matching and Sensatt. †: 90% statistical significance, ††: 95%., †††: 99%.

Table 6: Post-secondary dropout rates and standard deviations in parentheses by level of studies, cohort, cycle, and high school type

Cohort	Cycle	Level	Public	Private
A	3	CEGEP / University	3.1% (0.5%)	2.7% (0.8%)
A	4	CEGEP / University	3.0% (0.6%)	3.0% (0.9%)
A	4	University	5.1% (1.5%)	0.0% (0.0%)
B	2	CEGEP / University	12.8% (0.8%)	11.1% (1.7%)
B	2	University	7.1% (1.0%)	9.3% (1.9%)
B	3	CEGEP / University	10.4% (0.9%)	3.6% (1.1%)
B	3	University	5.8% (0.9%)	3.4% (1.2%)
B	4	CEGEP / University	13.3% (1.2%)	5.1% (1.6%)
B	4	University	11.6% (1.3%)	3.2% (1.3%)

Source: Authors' computation from YITS weighted data set.

Table 7.1: Estimated effects of private high school on academic outcomes by sex and PISA scores as additional matching covariate, cohort A cycles 2-3

Outcome	Cycle	Sex	Para.	Math subsample	PISA-Math	Δ math	Read. subsample	PISA-Read.	Δ read.	Science subsample	PISA-Science	Δ science
Graduation	2	A	Coef.	0.085 (†††)	0.060 (†††)	-28.8%	0.103 (†††)	0.071 (†††)	-31.7%	0.128 (†††)	0.089 (†††)	-30.1%
high school			S-D	0.021	0.018		0.018	0.017		0.029	0.027	
			N	1987	1987		3548	3548		1950	1950	
		M	Coef.	0.108 (†††)	0.078 (†††)	-27.5%	0.125 (†††)	0.087 (†††)	-30.4%	0.152 (†††)	0.110 (†††)	-27.6%
			S-D	0.031	0.026		0.029	0.024		0.044	0.038	
			N	1009	1009		1779	1779		989	989	
		F	Coef.	0.051 (†)	0.035	-31.3%	0.081 (†††)	0.054 (†††)	-32.7%	0.111 (†††)	0.081 (†††)	-26.7%
			S-D	0.031	0.032		0.022	0.020		0.026	0.024	
			N	978	978		1769	1769		961	961	
Graduation	3	A	Coef.	0.042 (†††)	0.032 (††)	-25.1%	0.051 (†††)	0.039 (†††)	-23.6%	0.041 (†††)	0.027 (††)	-33.6%
high school			S-D	0.015	0.016		0.011	0.010		0.014	0.013	
			N	1693	1693		3016	3016		1663	1663	
		M	Coef.	0.046	0.027	-40.6%	0.053 (†††)	0.037 (††)	-30.6%	0.042 (†)	0.027	-35.9%
			S-D	0.029	0.029		0.019	0.016		0.023	0.020	
			N	839	839		1495	1495		840	840	
		F	Coef.	0.046 (†††)	0.040 (†††)	-12.0%	0.055 (†††)	0.047 (†††)	-15.0%	0.053 (†††)	0.047 (†††)	-12.3%
			S-D	0.012	0.014		0.010	0.010		0.014	0.013	
			N	854	854		1521	1521		823	823	
Enrollment	3	A	Coef.	0.104 (†††)	0.083 (†††)	-20.0%	0.123 (†††)	0.098 (†††)	-20.0%	0.118 (†††)	0.087 (†††)	-26.8%
CEGEP /			S-D	0.023	0.023		0.018	0.019		0.022	0.022	
university			N	1693	1693		3016	3016		1663	1663	
		M	Coef.	0.085 (††)	0.051	-40.0%	0.116 (†††)	0.084 (†††)	-28.0%	0.115 (†††)	0.083 (†††)	-27.3%
			S-D	0.035	0.034		0.029	0.027		0.035	0.030	
			N	839	839		1495	1495		840	840	
		F	Coef.	0.115 (†††)	0.104 (†††)	-9.1%	0.135 (†††)	0.119 (†††)	-11.9%	0.138 (†††)	0.116 (†††)	-16.4%
			S-D	0.029	0.025		0.022	0.022		0.033	0.034	
			N	854	854		1521	1521		823	823	

Notes: Param.: estimated parameter; Math/Read/Science subsample: EB estimate for respondents who took math/read/science test; PISA-Math/Read/Science:EB estimate for respondents who took math/read/science test including PISA score as a control; Δ math/read/science: difference in estimate between original estimate and estimate with PISA score as control in percent. †: 90% statistical significance, ††: 95%., †††: 99%.

Table 7.2: Estimated effects of private high school on academic outcomes by sex and PISA scores as additional matching covariate cohort A cycle 4

Outcome	Cycle	Sex	Para.	Math subsample	PISA-Math	Δ math	Read. subsample	PISA-Read.	Δ read.	Science subsample	PISA-Science	Δ science
Enrollment	4	A	Coef.	0.127 (†††)	0.094 (†††)	-26.2%	0.147 (†††)	0.114 (†††)	-22.6%	0.151 (†††)	0.116 (†††)	-22.9%
CEGEP/			S-D	0.022	0.017		0.018	0.017		0.024	0.022	
university			N	1426	1426		2532	2532		1388	1388	
		M	Coef.	0.120 (†††)	0.075 (†††)	-37.7%	0.139 (†††)	0.102 (†††)	-26.7%	0.140 (†††)	0.109 (†††)	-22.2%
			S-D	0.032	0.029		0.030	0.027		0.042	0.033	
			N	704	704		1255	1255		708	708	
		F	Coef.	0.098 (†††)	0.081 (†††)	-17.2%	0.150 (†††)	0.126 (†††)	-16.3%	0.171 (†††)	0.136 (†††)	-20.7%
			S-D	0.028	0.021		0.018	0.018		0.025	0.027	
			N	722	722		1277	1277		680	680	
Enrollment	4	A	Coef.	0.147 (†††)	0.103 (††)	-30.0%	0.160 (†††)	0.123 (†††)	-22.8%	0.180 (†††)	0.135 (†††)	-24.9%
university			S-D	0.041	0.043		0.032	0.033		0.052	0.053	
			N	1426	1426		2532	2532		1388	1388	
		M	Coef.	0.099 (††)	0.045	-54.5%	0.153 (†††)	0.117 (†††)	-23.1%	0.165 (†††)	0.135 (††)	-18.0%
			S-D	0.040	0.041		0.042	0.035		0.069	0.062	
			N	704	704		1255	1255		708	708	
		F	Coef.	0.172 (†††)	0.154 (††)	-10.2%	0.177 (†††)	0.141 (††)	-20.3%	0.187 (††)	0.110	-41.1%
			S-D	0.060	0.061		0.059	0.060		0.084	0.090	
			N	722	722		1277	1277		680	680	

Notes: Param.: estimated parameter; Math/Read/Science subsample: EB estimate for respondents who took math/read/science test; PISA-Math/Read/Science: EB estimate for respondents who took math/read/science test including PISA score as a control; Δ math/read/science: difference in estimate between original estimate and estimate with PISA score as control in percent. †: 90% statistical significance, ††: 95%., †††: 99%.

Statistical Annex

Table A1: Number of students by school level and type, selected years 1994-1995 to 2013-2014, Québec

School year	Public schools			Private schools (ratio private/public)		
	Kindergarten	Primary	Secondary	Kindergarten	Primary	Secondary
1994-95	86,091	522,714	421,467	3,821 (4,2)	24,681 (4.5)	76,839 (15.4)
1997-98	91,001	531,816	404,333	3,098 (3.3)	25,350 (4.5)	73,806 (15.4)
2000-01	83,073	546,444	373,504	4,010 (4.6)	27,831 (4.8)	73,343 (16.4)
2001-02	80,006	543.546	370,197	4,362 (5.2)	28,995 (5.1)	74,964 (16.8)
2002-03	76,421	533,276	376,409	4,303 (5.3)	29,462 (5.2)	77,913 (17.1)
2003-04	72,223	517,996	385,139	4,372 (5.7)	29,473 (5.4)	81,310 (17.4)
2006-07	69,043	460,502	402,946	4,776 (6.5)	31,101 (6.3)	88,203 (18.0)
2009-10	70,319	429,950	369,759	4,968 (6.6)	32,136 (7.0)	88,779 (19.4)
2012-13	98,561	438,711	327,216	5,414 (5.2)	32,688 (6.9)	86,181 (20.8)
2013-14	102,415	449,352	318,132	5,484 (5.1)	32,898 (6.8)	84,898 (21.6)

Source: Statistics of education 2015, Ministry of Education, Leisure and Sports (MELS).

Table A2: Public subsidy per student to Québec's private schools by schooling level, selected years, in Canadian dollars

Year	Kindergarten schools	Primary schools	Secondary schools
1997-1998	2,275+82	2,092+82	2,919+122
1998-1999	2,297+82	2,108+82	2,944+122
2000-2001	2,496+85	2,292+85	3,179+122
2002-2003	2,807+88	2,421+88	3,331+131
2004-2005	3,006+93	2,582+93	3,556+139
2005-2006	3,064+95	2,808+95	3,612+142
…………			
2016-2017	3,875+35	3,515+35	4,512+157

Note: The subsidy is based on teaching and non-teaching personals, other costs and location value of premises. Source: Ministry of Education, Leisure and Sports (MELS), Budgetary Rules for Schools under Agreement, annual.

Table A3: Authorized and actual maximum schooling fees charged by Québec's private schools, by education level, and selected school years 2003-04 and 2004-05

Level	Year	Maximum fee according to regulation	Average fee asked	Number of schools with maximum fee
Kindergarten	2003-2004	$2,886	$1,650	1 out of 48
	2004-2005	$2,924	$1,679	
Primary	2003-2004	$2,488	$1,724	2 out of 72
	2004-2005	$2,518	$1,813	
Secondary	2003-2004	$3,421	$2,122	2 out of 142
	2004-2005	$3,464	$2,219	

Source: Ministry of Education, Leisure and Sports (MELS), Financial Reports of Subsidized Private Schools, and Budgetary Rules for Schools under Agreement, annual.

Table A4: High school graduation rate by cohort, number of years since entrance in high school, sex, schooling system and language of instruction, cohort 2001 to cohort 2009, Québec

Cohort year	Cohort 2001					Cohort 2002					Cohort 2003					Cohort 2004				
Duration year	5	6	7			5	6	7			5	6	7			5	6	7		
Coverage	A	A	A	M	F	A	A	A	M	F	A	A	A	M	F	A	A	A	M	F
All	61	69	72	66	80	59	68	72	66	78	61	69	72	66	79	61	70	73	68	80
Public schools	56	65	69	62	76	54	64	68	61	75	55	64	68	61	75	56	65	69	63	76
Private schools	83	88	89	86	93	84	89	90	87	94	85	89	91	88	94	85	90	91	88	94
Private-Public	**27**	**23**	**20**	**24**	**17**	**30**	**25**	**22**	**26**	**19**	**30**	**25**	**23**	**27**	**19**	**29**	**25**	**22**	**25**	**18**
French	60	68	72	65	78	59	68	71	65	78	60	68	72	65	79	60	69	73	67	79
English	72	79	81	76	86	70	77	80	76	84	69	77	79	75	84	72	79	82	78	86

Cohort year	Cohort 2005					Cohort 2006					Cohort 2007					Cohort 2008				2009
Duration year	5	6	7			5	6	7			5	6	7			5	6			5
Coverage	A	A	A	M	F	A	A	A	M	F	A	A	A	M	F	A	A	M	F	A
All	63	72	75	70	81	64	72	76	71	81	65	74	78	73	83	66	75	69	81	67
Public schools	58	67	71	65	77	58	68	72	66	78	60	69	74	68	80	60	70	64	77	62
Private schools	86	90	92	89	95	87	91	92	90	95	87	91	93	90	95	87	92	89	94	88
Private-Public	**28**	**23**	**21**	**24**	**18**	**29**	**23**	**20**	**24**	**17**	**27**	**22**	**19**	**22**	**15**	**27**	**22**	**25**	**17**	**26**
French	62	71	74	69	80	63	75	75	81	81	64	73	77	72	83	65	74	68	80	67
English	74	80	82	78	87	76	85	85	88	88	76	82	85	80	89	76	82	78	86	76

Notes: A= All. M=Male. F=Female. The high school graduation rate presented is the proportion of students who received a high school diploma or a GED within the cohort. The public network is formed by 72 school boards excluding native nation boards. Duration year measure number of years since the cohort entered in secondary school (since September). Private-Public: Private rate minus the Public rate. Main language of instruction, F: French, E: English.
Source: "High school certificate and qualifications by school boards. 2015 Edition," Ministry of Education, Leisure and Sports (MELS).

Table A.5: Mean value of covariates for the treated, untreated, and weighted untreated with EB weights: cohort B cycle 1: Outcome is high school graduation, full sample

Variable	Mean (treated)	Mean (untreated)	Mean (post-EB-balancing)
Male	0.46736949	0.48512894	0.46738827
Age	19.0195001	19.018291	19.0194602
Immigrant	0.06959542	0.04900075	0.06961251
English	0.09446669	0.06924085	0.09441897
French	0.79021311	0.86500566	0.79024301
Mother's education (1)	0.21798413	0.34029987	0.21817938
Mother's education (2)	0.21005134	0.21451845	0.20988272
Mother's education (3)	0.41692364	0.16756368	0.41647782
Siblings (1)	0.51538963	0.45226685	0.51520421
Siblings (2+)	0.35404365	0.45513386	0.35430468
Two parents	0.78257708	0.69458397	0.78238163
Quintile. ISEI (2)	0.25919813	0.1888632	0.25896064
Quintile ISEI (3)	0.24312933	0.19173079	0.24292269
Quintile ISEI (4)	0.23008467	0.19435552	0.2300147
Quintile ISEI (5)	0.15333892	0.20870015	0.15338284

Note: Authors' computation.