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Why Subsidize Independent Schools? Estimating the Effect of a Unique Canadian Schooling Model on Educational Attainment

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Why Subsidize Independent Schools? Estimating the Effect of a Unique Canadian Schooling Model on Educational Attainment

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Abstract

Canada is recognized as one of the top 10 countries in secondary education according to PISA results. A particularly intriguing case in this country is the large system of highly subsidized independent schools in the province of Québec where students also perform extremely well in PISA testing. This paper uses the year Canadian 2000 PISA cohort of 15-year-olds to estimate the ATT effect of independent schooling on educational attainment. We find large, positive, robust, and statistically significant effects of independent schooling on attainment. The robustness of the results to omitted variable bias is addressed through a sensitivity analysis for matching estimators.

JEL Code and keywords: I20, I21, I28
YITS, high school graduation, postsecondary education and professional programs enrollment and graduation, longitudinal data, treatment effect, entropy balancing

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1. Introduction

There is undoubtedly a movement taking place around the western world in the last decades towards the liberalization of schooling choices. 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). These decades saw the proliferation of charter schools in the United States, independent 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), with a variety of independent schools partially or completely subsidized by the state (e.g. France who subsidizes almost all schools, including those affiliated with religious denominations).

Canada, where independent schools play an important part in the country's education systems, has received significant attention because 15-year-olds students achieve much higher average PISA scores than most OECD countries (regularly in the top 10 or 15 countries or regions in reading, math, and sciences) with apparently a more equitable distribution of educational achievement (Coughlan, 2017). It has many similarities with other Western nations with regards to its education systems, however the country has unique cultural, linguistic and historical attributes.

Canada does not have a national education system. Ten autonomous provinces and three territories are responsible for the administration of all education levels.[1] Moreover, at the regional level, schooling organizations are heterogeneous in origin and composition, blending diverse culture, traditions and public choices. Public

[1] The federal government provides substantial research funds giving grants to academic researchers and R&D research infrastructure as well as providing scholarships and loans directly or via the provinces to postsecondary students across the country.

schools coexist with large sectors of totally subsidized separate catholic schools in three provinces (Ontario, Saskatchewan, and Alberta). These features, originally enacted in 1867 in The British North America Act, are a major aspect of the Constitution of Canada, which created a federal dominion and gave Provinces jurisdiction over education, as well as in many other domains. At the same time were adopted significant restrictions designed to protect minority religious rights during a time when there was a significant controversy brewing between Protestants and Catholics in Canada over the parochial or non-denominational nature of school boards. These special protections were part of a solemn compact and historic compromise between Québec and Ontario, Canada's main founding provinces. But gradually over the decades, the public education system became no longer Protestant but secular. Finally, the Constitution of Canada also provides protections for language-based school systems (Anglophone and Francophone school systems in seven provinces (British Columbia, Alberta, Manitoba, Ontario, Québec, New Brunswick, and Nova Scotia).

The last two provinces with such a special protection were rewarded with a Constitutional Amendment in 1997 to replace their faith-based school boards with linguistic (French and English), secular ones. This is important for our paper, as the data used are for students living in Québec who were 15 in 2000 and are therefore no longer in religiously denominated schools.

In 2014/15, Canada's ten provinces were home to 1,935 independent schools. They enrolled 368,717 students from Kindergarten to Grade 12, equivalent to 6.8 percent of total enrolments in Canada's ten provinces. Their geographic enrolment distribution roughly matched the population distribution across the country, as a third attended independent schools in Quebec (33.4 percent), almost a third in Ontario (31.4 percent), a fifth (20.4 percent) in British Columbia, and 7.6 percent in Alberta (Allison et al. 2016). Currently, only five provinces, (percentage enrollment in parenthesis), offer partial funding for independent schools: British Columbia (12.9%), Alberta (4.4%),

Saskatchewan (2.4%), Manitoba (7.9), and Québec (12.3% all students; 24% in high school). The accredited independent schools must teach the same provincial curriculum as public schools as well satisfy criteria of hiring provincially certified teachers. They receive provincial funding which is 30 to 80 per cent of public school net operating expenditures (Québec sets every year per pupil subsidies approximately at 60 percent of funds allocated to public schools). Allison, Hasan, and Van Pelt (2017) present a complete discussion of the independent school regulations in Canada as well as an overview of the different funding categories across provinces.

Every province saw enrollment in independent schools grow since the early 2000s (except New Brunswick), as documented by MacLeod and Hasan (2017) and Hill, Li, and Emes (2019). Despite this fact, there are few, as will be seen in the next section, studies that try to estimate the impact of independent schools on student achievement and attainment in Canada.

If these trends towards independent schooling across Canada are rather recent, this is not case for the province of Québec which performs very well in international tests. For example, in the latest PISA cycle in 2018, the Province of Quebec ranked, as a region, fifth in the world in math, seventh in science, and eight in reading (O'Grady et al. 2019, see Table A1, in the Statistical Annex). These rankings were higher than most of the other Canadian provinces (in math it is the top province, and in science it is ranked second in Canada). These are results are remarkable, even more given that Québec ranked fifth in 2000 for per capita GDP in Canada (52nd considering all states and provinces in Canada and the United States). Furthermore, these numbers are not outliers as Québec 15-year-olds have been doing well since the creation of the first PISA samples in 2000. Additionally, inequality measures are very favorable to Québec relative to other provinces, and this in a country which already does well in this area (Lefebvre and Merrigan 2020). These results could be tied to the long-standing commitment in Québec to independent schools.

For this reason and others, we argue in this paper that this province, the second most populous in Canada, provides an interesting case for the study of independent schooling effects on achievement. There has been in this province recognition of the right for two non-confessional education systems (public and independent, with very few independent schools with no subsidies) to coexist since the early 1980s. The public financing of the independent system is judicially guaranteed, making the province a social laboratory for the main topic of this paper.

It is difficult to obtain credible estimates of the impacts of independent schools on student achievements because of selection. For example, in Québec, parents must pay tuition fees (although relatively very low because of very high public subsidies, see Section 3) for their children to attend independent schools (all of them are independent of the public system) and therefore are on average from wealthier households and some independent schools choose students based on their results to admission tests. Therefore, children observed entering independent schools possess higher human capital and abilities than children in public schools because of these simple mechanisms.

The educational system and high public subsidies in Québec provide the opportunity for middle-class households to educate their children in independent institutions. In fact, in our sample of 15-year-old high school students, approximately 20% of students attend independent schools, clearly not all from privileged households. Therefore, for a large proportion of independent school attendees, good matches can be found in the public-school system. To estimate the impact of independent schools in Quebec on educational attainment, we use the 2000 PISA cohort which served as the first longitudinal sample of Québec students in Statistics Canada's Youth in Transition Survey (YITS), tracing the educational and employment trajectories of young Canadians aged 15 in 2000. Identifying the type of school (public or independent) in which they are enrolled in high school, we estimate the impact of independent school attendance on high school graduation rates and enrollment in

postsecondary institutions.[2] Respondents were re-interviewed every other year, 6 times altogether, until they reached the age of 25. Hence, we can determine whether they obtained their high school diploma, at what age they did so, and what has been their postsecondary trajectory. Finally, the PISA sample was enriched by Statistics Canada with a very large array of control variables (not appearing in the PISA survey). Examples are household income, parental education and expectations, and social class which are key controls for the estimation of unbiased effects of independent school on attainment.

Some studies have provided evidence that attending independent schools in Québec causally (average treatment effect on the treated) improves scores in international cognitive tests such as PISA (Lefebvre, 2015, 2018b; Lapierre, 2016) or other math tests (Lefebvre, Merrigan and Verstraete, 2011). This paper takes these studies a step further to answer some additional questions. Firstly, does independent schooling in high school causally improve the probability that students in these high schools obtain their diploma (DES acronym in French) within the expected time span (5 years). Secondly, does independent schooling cause an increase in the probability of attending a postsecondary institution, such as colleges or universities, including programs leading to employment regulated by professional orders in Québec, such as engineering, law or medicine?

To produce estimates of independent schooling on outcomes, we basically use entropy balancing that works very well producing balancing weights. These weights render the control group means of explanatory variables practically identical to the treatment group means. With this method, we find strong effects of independent schooling on postsecondary enrollment. We then perform several robustness tests. The most important one is based on the estimation of treatment effects adding a simulated

[2] We consider the very large majority of schools that are not in the public system in Québec as independent and not private because of the high rate of public subsidization. A tiny minority are independent and totally private. The latter cannot be identified in the data set we use for estimation are thus grouped within the independent school class.

omitted variable highly correlated with the outcome and treatment status to the set of matching variables (Nannicini, 2007; Ichino, Mealli and Nannicini, 2008). Our overall results show a robust, important and statistically significant independent school treatment effect on postsecondary enrollment in particular university.

It is important to point out that more than 90 percent of students who transit from public to independent schools in Québec do so following the last year of elementary schooling (grade 6 in Québec and Canada). Furthermore, very few drop out of independent school to attend public schools (Lefebvre, Merrigan and Verstraete, 2011). Therefore, a large majority of students who attend independent high schools do not attend a public school at any time during their high school years. Lefebvre et al. (2011) also show that very few students attend independent schools at the elementary level (see Table A1 in the Statistical Appendix). The treatment in this paper is therefore very similar to attending an independent high school for five years. We believe our results provide strong arguments for public mechanisms that enhance school choice.

As to the structure of the paper, Section 2 briefly describes the body of studies analyzing the link between independent schools or other types of schools where choice matters and scores results in national or international tests. Section 3 identifies the unique particularities of independent schools in Québec in terms of their functioning, enrollment, public subsidies and 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 education in independent or Catholic schools on achievement

Across all countries (Table 2.8 of Hanushek and Woessman (2015a)), independent school management tends to be positively associated with student achievement, corresponding to a difference, relative to publicly operated schools, of 16–20 percent of an international standard deviation in the three subjects in PISA 2000 (Fuchs and Woessmann, 2007). Similar results are found in PISA 2003 (Woessmann, 2007).

In the United States, several studies have attempted to measure the effect of independent (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 in the United States (Elder and Jepsen, 2014) and Australia (Nghien et al., 2015). Australian students' PISA scores have fallen steadily since their relatively high performance the first time the test was applied, in 2000. The results in Morsya, Khavensonb, and Carnoy (2018) indicate that attending a Catholic or independent school rather than a government school had no significant relationship with a student's performance on either the PISA math or reading test when student and school SES are controlled for in the analysis.

In Canada, Card, Dolley, and Payne (2010) estimate positive significant effects of Catholic school attendance on the governmental test scores of elementary school students from the Province of Ontario where parents have the choice between two fully funded public systems. One is open to all and the other is restricted to students with a Catholic ancestry (although school boards do admit non-Catholic students if there is an adequate number of spaces). Furthermore, using longitudinal administrative data from British Columbia's elementary school system in Canada, Azimil, Friesen and Woodcock (2015) find that independent 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 settings where students hail from lower socioeconomic 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 (see Vandenberghe and Robin (2004); references in Lefebvre (2018b)) do not find significant effects of independent schools on standardized scores. Canada, in these studies, is sometimes classified as a country with low independent sector attendance (8%). This is certainly not the case for the province of Québec, where from administrative data we observe that the percentage of students in independent high schools is around 20% in the mid-2000s (see Table A2).

There are few studies on the effect of independent schools on students in Québec, even though its independent sector enrollment is the highest of all Canadian provinces at the high school level. Economic studies focusing on this matter find statistically significant positive average treatment on the treated (ATT) effects of independent secondary school attendance on student test scores (Lefebvre (2015, 2018b), Lapierre (2016) using five PISA surveys and similar statistical frameworks as used in this paper). Lefebvre, Merrigan and Verstraete (2011) find statistically significant positive (ATT) effects of independent school attendance on math scores, with panel data, controlling for individual and parental characteristics as well as student fixed effects.[3]

Cognitive and behavioral abilities acquired during secondary education are important factors for ulterior educational success (Anderson and Bergman, 2011). Furthermore, differences in postsecondary enrollment, university attendance and graduation may be linked to differences in the academic achievement of students based

[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, postsecondary 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 an independent high school.

on their socioeconomic status in high school (Jerrim and Vignoles, 2015; Ermish and Bono, 2012; Lefebvre and Merrigan, 2010; Chowdry et al., 2013). 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 socioeconomic status is transmitted between generations. Because of the evidence that independent schools in Québec increase test scores, it is reasonable to ask whether they causally improve educational attainment.

In a recent important article closely related to ours, Laliberté (2019) uses administrative panel data from the city of Montreal (the largest in the province of Québec) which has the highest concentration of independent schools to estimate contextual (neighborhood and school quality) effects on student achievement. He finds strong effects of quality on outcomes. Given the evidence he provides that independent schools are of a much higher quality than public schools, we should obtain strong independent school effects on achievement. We return to his results when we discuss our estimates of independent schooling effects on postsecondary education.

3. The unique character of Québec's independent schools

In 1961, a Ministry of Education was created in the province of Québec. It adopted in the following years many significant changes: a kindergarten level, a K-11 system, the creation of public community colleges (CEGEP degree, see note 10) leading to university programs or technical occupations, and finally a new network of public universities. Hereafter, the education system functioned with a secular linguistic structure.

In 1982, to preserve schooling options for parents, Québec adopted a new subsidy program for independent 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, CEGEP).

Table A2 presents, for selected years, the evolution of student enrollment in both public and independent sectors by level. Demographic statistics (not shown) demonstrate that the decreasing enrollment in public schools is explained by a large decline in the fertility rate over the years (with a small increase at the end of the nineties). At the opposite, for independent schools, there is a modest positive trend at the primary level and a substantial increase at the secondary level which contains 70 percent of independent sector students. There are 128 independent schools at the primary level, 124 at the secondary level, and 68 offer school services at both levels. In general, independent schools offering only the primary level of schooling are much smaller than those offering a secondary level of education.

Table A3 presents the subsidies in Canadian dollars (approximately 1CAN$ exchanged for US$ 0.70–0.90 over this period) for selected years, in particular for the early 2000s, the period of our analysis. A government regulation requires that the fees of subsidized independent schools not exceed their public subsidy per student. Table A3 shows the authorized maximum fee according to provincial regulations and the actual maximum fee charged by independent schools by schooling level. Very few independent schools charge the allowed maximum. On average, the independent school admission fee is 68.3 percent 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. These low prices provide a strong incentive for middle-class families who prefer independent schooling for their children. For public schools, 90 percent of revenues are obtained by direct transfers

from the provincial government (74%), property school taxes (16%), and the rest by related activities.

All independent 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 under an approved curriculum. Their students must pass the same final state-wide exams in French or English, History, Mathematics and Sciences as those in public schools in grades 10 and 11, the last two years of high school in the province. It is necessary to obtain a passing grade in these exams to graduate from high school. Therefore, the requirements to graduate from high school are the same for both independent and public systems.

At the primary and secondary levels, almost 90 percent of independent schools are subsidized, while a small number of students in independent schools are enrolled in "elite" schools with no subsidies. Most of these are English-speaking with bilingual teaching, some with students of the same gender, very high pedagogical supervision, lower class size, and located in Montreal (the largest city in Québec). These schools charge much higher fees than the average subsidized independent school. Finally, 12 schools are specialized for handicapped youths, and 20 schools offer trade or vocational training.

It is also important in the context of this paper to provide a proper description of the admission process in independent schools. In a 2006 document on admissions, the Federation of Independent 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" (page 3). Therefore, very few are turned away because of a lack of basic skills. Even those turned away can end up in an independent school as they can apply to several schools. Selection is used when applications are higher than available spaces, a rare case.

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%), students are admitted and enrolled after he or she 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 located in the two largest cities (Québec and Montreal), where there is an excess demand for spaces in schools considered excellent in most unofficial rankings. Because very few students applying to independent schools are not admitted in the system, bias from selection because of admission tests should not be of great concern in our analysis. Finally, it must be stressed that Québec's educational system is non-confessional and that independent schools admit individuals from all backgrounds. Therefore, we do not believe that controls for religion, either faith or intensity of worship, can impact the results we present later in the paper.

4. Analytical framework

This study aims to estimate the ATT of independent schooling on high school graduation rates and postsecondary trajectories which are: 1) enrollment in CEGEPs, these are two- and three-year colleges leading to university degrees, two-year programs are geared for admission in universities, while three-year programs lead to a technical degree, many students stop schooling once they have received a three-year technical degree (e.g. police officers, lab technicians, nursing auxiliaries) ; 2) university attendance and university attendance in programs regulated by professional orders. Estimation and modeling rest on a cohort of Québec youths aged 15 in 2000, 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 in Canada focused

on measuring 15-year-old-student abilities in mathematics, reading and sciences for a large cross-section of countries.[4]

Our goal is to estimate the long-run effects of attending an independent school on educational attainment. Clearly, treatment assignment is not random. The decision to send a child to an independent school is without a doubt conditioned by both observable and unobservable characteristics of the student and his or her 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 under a more general approach based on a reweighting of the untreated (for ATT effects).

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 the 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 nonparametric and use propensity scores in a matching procedure. Other types of nonparametric estimators directly employ X to determine the weight assigned to each untreated observation without estimating propensity scores.

[4] A second cohort (Cohort B) was selected in the YITS, targeting slightly older respondents (aged 18-20 in 1999 for the 2000 cycle 1). Information was gathered on the type of high school these individuals attended and age at graduation, along with enrollment and degrees. However, no cognitive tests and little parental information for respondents in Cohort B are available, in particular household income and parental expectations are not observed for this cohort of individuals. Therefore, they were not considered for our empirical analysis.

This paper employs entropy balancing (EB) to construct the counterfactual mean outcome of the treated if untreated, proposed by Hainmueller (2012), and Hainmueller and Xu (2013). This method seeks to balance covariates between groups with a maximal entropy weighting scheme.[5] When successful, 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 the estimator could have a large variance when a few observations receive large weights. The same can be said of estimators based on inverse propensity score weighting. These extreme weights could be 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,

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

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-

[5] Frölich, Hubert, and Wiesenfarth (2017) analyze the performance of a large group of treatment effect 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.

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 $\omega_1,...,\omega_{iN_0}$ 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 - 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 is balanced. For family income, equality of the second moments is also 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). The sample used for the estimations was restricted to individuals residing in Québec in cycle 1 and students who are in grades 9 or 10. The second restriction is imposed because almost no student in independent schools repeated a grade, and because we are estimating the ATT effect of independent schooling (students repeating a grade are poor matches for independent school students and are in less than the ninth grade).

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 nonresponse in later waves. Sample and replicate weights used are those provided by Statistics Canada, adjusted for nonresponse in each cycle.

Probit estimations were performed to ascertain which factors are susceptible to affect nonresponse probabilities. Results show that the only available variable that is statistically significant is family income which positively affects 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 cycle 1. Given the strong correlation between income and educational attainment, the results obtained from the study's estimates are very likely to be conservative. Individuals from lower socioeconomic 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 time span in years since entering high school (5,6 or 7), gender, type of school (independent and public) and language of instruction (French/English). For each cohort (2001 to 2007), graduation by the number of years since entering high school is computed by the Ministry of Education, for 5, 6, and 7 years (5 and 6 years respectively for the 2008 and 2009 cohorts). These administrative statistics indicate very important differences between independent and public system graduation rates, showing much larger rates in the independent system.

Table 1 presents, both for an unrestricted and a restricted sample (the latter for estimation), descriptive statistics on high school graduation rates. The computed rates with YITS data sets in the unrestricted sample are consistent with population data of the later cohorts 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 province-wide 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. Significant gaps between independent and public-school students in favor of independent school students are also observed for postsecondary enrollment.

5.2 Empirical models and covariates

The Cohort A respondents are aged 15 in cycle 1 (2000) of the YITS-PISA survey. Four outcomes of interest are identified for estimation: 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 ages 19 and 21 respectively (at cycles 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. Enrolled in a program leading to an occupation regulated by professional orders in Québec (medicine, law, engineering, etc.) in cycle 4 (for a sample of students attending 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.

For each of these outcomes, the models are estimated with the same set of covariates with cycle 1 values. The following covariates are used in the analysis: the student's gender, his or her age in months, the presence in the household 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 the child's socio-economic status is the parents' highest international socioeconomic index (ISEI) as measured by PISA analysts. This measure, frequently used in sociological analysis, attributes a score of between 11 and 90 to different occupations based on professional characteristics, such as the required level of education and associated income. The index's creators (Ganzeboom et al., 1992) aimed to improve the measure of socioeconomic status for research purposes. The index has been intensively used in the literature on socioeconomic 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 physicians, judges, or CEOs. Values are grouped by quintiles for our empirical analysis. We add household 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) and finally parental expectations about the educational attainment of their child.

Table 3 presents means and percentages for the variables used in the EB procedure. There are striking differences between independent and public-school samples. First, students from independent schools are from wealthier families. The majority are in upper quintiles of the ISEI index. Their households contain many more books. The percentage of mothers with a university-level education is more than twice the one for public school students. A much larger percentage of parents expect their child to obtain a university diploma. Finally, the percentage of children in immigrant households is also much larger for students in independent schools. Not surprisingly, independent school children are from privileged households and this, as we shall see, explains a large proportion of the gaps in high school graduation rates and postsecondary enrollment.

6. Results and robustness checks

6.1 Methods and samples

First, we can state that the EB algorithm functioned extremely well. 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.[6]

We present the estimated causal ATT effects for the full sample and by sex. Estimations with the later outcomes related to postsecondary schooling are performed

[6] Results can be obtained by addressing a query to the corresponding author.

with a smaller number of observations than for secondary school graduation because of attrition. However, as mentioned earlier, 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 4.1–4.2 present the estimation results for all samples and outcomes. The first column (EB-NC, NC for no covariates) 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 mean outcome of the treated minus the EB weighted mean outcome of the non-treated (a weighted regression of the outcome on an independent 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, WC for with covariates) 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 showing the almost perfect balance between samples. Second, we perform the regressions excluding the observations where the assigned entropy weight is over the 99th percentile of the weight distribution (EB-99). Again, the results are very similar to those with all observations. Third, we estimate the ATT effects with a kernel propensity score matching procedure. And then again, results are generally similar.

Finally, we perform a simulation where the sensitivity of estimates 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 independent school attendance while not depending on the treatment is omitted from the model. In this case, the conditional independence assumption (CIA) is violated. The simulation of a confounding variable 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 assignment and to the variable of interest. The ATT is then re-estimated for each simulation of the confounder. A comparison between the estimates without the confounder and the ones obtained with the simulation provides a measure of 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,* and Y_0, Y_1, the potential outcomes. So,

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

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_{ij} 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_{ij} in a way that drives the ATT down to zero, and then assess the plausibility of their distribution. This exercise seeks to determine the likelihood of killer unobserved confounders. These correspond to a simulated omitted variable that will render our treatment effect insignificant statistically. Once a killer confounder is found, odd ratios for the outcome

and treatment equations for this confounder are estimated with a matching method. When very high odd ratios are necessary to "kill" the significant treatment effect, we conclude that the estimated treatment effect is robust. Lastly, the SENSATT method can be employed regardless of the algorithm used to match the observations, when matching methods are used for estimation.

What are the unobserved variables that may cause our estimation method to produce a biased estimate of independent 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 postsecondary institution and the probability he or she attends an independent 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 or she is academically gifted. In addition, parents who send their child to an independent 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 independent schooling and the outcome. The simulated variable is calibrated using the observed correlation between income, independent 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 for the EB estimates.

6.2 Estimated effects of independent school attendance

Tables 4.1–4.2 present the estimated ATT (multiplied by 100 gives the estimated difference in percentage points) by outcome, cycle, sample (all observations, males, females). Most estimated effects are large and statistically significant ($p<0.01$). The

first two panels of Table 4.1 show the results for high school graduation in five and seven years after entry in cycles 2 and 3 respectively. Large and statistically significant ($p<0.01$) effects are estimated for graduating in 5 years. The ATT is estimated at 7.8 percentage points (pp) for the whole sample. Restrictions on gender provide estimates of 9 pp for male and 6.6 pp for female students. The kernel estimate is slightly higher, the effect of the simulated regressor on the estimate is relatively strong, but the ATT remains large and significant at 7.1 pp for this case. The effect on high school graduation is also estimated in cycle 3 when the respondents are 19 years old, so 7 years after they started high school. The coefficients are much smaller, as the estimated gap between treatment and counterfactual narrows substantially as compared to graduation after 5 years. Estimates are 3.6 pp for the whole sample and are practically the same for males and females. For the kernel estimate, the effect is very small and statistically not significant. Therefore, we can surmise that the overall high school graduation rate of the treated is not greatly changed by independent school attendance.

The second outcome evaluated in cycle 3 is attending a community college (CEGEP) or university enrollment. All results present in the last panel of Table 4.1 are significant at the 1% level. The estimated ATT is 7.9 pp for the whole sample, 7.5 pp for males and 9.1 pp for females. The kernel estimate is smaller but robust to omitted variable simulation.

The first outcome (Table 4.2) evaluated in cycle 4 is attending a community college (CEGEP) or university enrollment (same as the last in Table 1, but 2 years later). The whole-sample estimate is 10.3 pp, while it is the same for males and 10.7 pp for females. The kernel estimate is smaller and less robust to the simulated omitted variable. However, even with the omitted variable, the effect is rather large at 6.9 pp.

The next outcome is university enrollment. Once again, the estimated coefficients (last panel of Table 4.2) are significant at the 1 percent level in all cases. The estimated effects are 14 pp for the whole sample, 15.2 pp for males and 13.2 pp for females. In

this case, the kernel estimate is slightly higher but the introduction of the cofounder has a very strong effect on the estimate. However, even for this latter case, the effect is very high, close to 10 pp.

The last outcome analyzed in cycle 4 is professional program enrollment among university students, with results presented in the last panel of Table 4.2. In the case of the base model, the ATT for the whole sample is 9.4 pp; for males it is 16.6 pp and 3.5 pp for females. They are statistically significant at 1% for the first two cases, but not significant for females. The kernel estimate is in the same range, robust to omitted variable bias but not significant.

This last result is certainly intriguing: independent school has a large and significant effect on enrollment 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.

We end this section by discussing killer confounders. Our simulations for graduation in 5 years and university enrollment demonstrate that for all cases, the killer confounder must, *ceteris paribus*, almost double the probability of both the outcome and the treatment to render the treatment effects not significant.[7] Given the number of crucial covariates in the set of controls (income, social class, parental education, parental expectations), we feel quite confident that independent schooling matters for educational achievement. Therefore, the evidence that independent school attendance has a strong effect on graduating high school in the required amount of time and on postsecondary enrollment is a strong and robust result.

[7] We do not perform the killer confounder simulations for the outcome of graduating in 7 years from high school. The effect in this case seems to be much weaker and less robust.

7. Interpretation and public policy implications

7.1 Discussion

The magnitude of the estimated effects of independent school attendance on various educational outcomes is large in many cases. The effect of independent schooling on the probability of graduating in 5 years is large and rather robust at 7.8 points. The role of observables is extremely important as the raw difference between independent and public-school attendees for graduating in 5 years is over 25 points and the same is true for university attendance. However, the effect on the overall high school graduation rate is very small. This is an interesting result, as the effect on postsecondary attendance is robust at close to 8 points in cycle 3 and goes up to 10 points in cycle 4. Graduating in 5 years is therefore a key indicator for postsecondary studies. The increase in cycle 4 is partly due to a lower postsecondary 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 postsecondary 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 independent school students' graduate faster? Obvious reasons are assiduous work patterns, a better understanding of testing material, more discipline, etc. These qualities are crucial for postsecondary studies: once the student experiences success with a pattern of work, he or she might feel more confident in the pursuit of postsecondary degrees. Therefore, the important ATT effect of independent schooling is on postsecondary attendance as the impact on high-school graduation, once a respondent is 19 years old, is very small and possibly not significant.

Graduating high school on time, i.e. within a five-year span, might also play a more important role in the province of Québec than elsewhere. To be admitted in a university, a student must graduate with a CEGEP degree, which takes a minimum of 2 years. Therefore, if a student graduates from high school at age19, he or she will start university at age 21, which could be experienced as very late for students with high

discount rates. The CEGEP, in this case, becomes some kind of obstacle for students who ultimately seek a university degree.

As a final robustness test, we estimate the effects for the full sample adding test scores at age 15 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 as covariates in the estimation as the first 2000 PISA wave focuses on one particular subject, in this case reading. Math and science test 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. The estimates of independent schooling are no longer causal, because test scores depend on type of schooling, but the exercise can partly reveal the role of test scores as a mediator of independent school effects.

The results appear in Tables 5.1 and 5.2. As expected, the estimate of the independent schooling effect was reduced for all outcomes and in most cases by between 25 and 30 percent. The largest impact on the independent 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 independent schooling coefficient by 40 percent, but for girls it reduces it only by 9 percent. Therefore, the impact of independent schooling on math scores for boys is crucial for their future. This relationship between independent schooling, math scores and university attendance for boys is certainly intriguing. Although attendance in technical or hard sciences programs is rapidly increasing for women, they were male-dominated fields in the early millennium years. According to our computations from YITS data, 25.3% of male university students are enrolled in such programs, while the same statistic is only 3.8% for female university students.[8] These programs are in general costly, as they require labs and equipment spaces. Most universities are therefore forced to highly

[8] 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.

constrain the number of spaces in these areas (Fortin, 2005). This link between math and university attendance through independent schooling is an important result as university attendance is crucial for a well-paid job and long-term success in the labor market. Thus, the mechanisms that are driving the effects of independent 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, usually, one must be disciplined and do homework regularly. Therefore, by offering support to perform better in math, independent schools 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 independent schooling may have an effect through that channel as well. Clearly, our results demonstrate that test scores mediate the impact of independent schooling on educational attainment, and more precisely for males than females at the university level.

Although math scores cannot be considered as a confounding variable like the others as they are impacted by the treatment, they may also be considered as being (partially) a confounding variable. Math abilities are, in part, predetermined before high school. If one assumes that the level of PISA scores is entirely selection driven, it is logical to control for that hypothetical selection by including them into the EB algorithm. Then, if one still obtains positive and statistically significant independent school effect on educational attainment, our main results concerning the effects of independent schools are even stronger.

Of course, other mechanisms could be driving the effects. Although it is difficult to provide strong evidence for this, independent schools may attract good teachers and principals who prefer working in a more disciplined, “zero tolerance” environment with better students. Second, the large number of independent schools in Québec, coupled with the public system, may cause independent 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 data set cannot be used to provide evidence for such a mechanism.

As mentioned in Section 2, it is instructive to compare our results with those of Laliberté (2019). Using administrative data on almost all schools and five cohorts of students entering first grade chosen between 1995 and 2001 in the city of Montreal, for which the full-education history is known up until university enrollment (and for earlier cohorts, graduation from the university), Laliberté manages to separate quality of school effects from neighborhood effects. To identify this decomposition, he uses the open enrollment policy in place as well as the default option which guarantees a student a space in their neighborhood public school. Very briefly, after constructing a quality measure of a school based on its propensity to enroll students in a university program, he finds using a RD-IV design, that quality has a very strong impact on the probability of enrolling in a university program. He computes the difference in mean quality value (all quality values are constrained to be between 0 and 1) between independent and public schools to be .31. This difference is estimated to have an effect of between .19 and .26 on the probability of enrolling in a university. [9] His lower bound is higher than our estimates which range between .10 and .17. However, it is important to note that his estimates provide evidence that independent schools are of higher quality than public schools on average and that quality has substantial effects on university enrollment.

We provide some explanations as to why our estimates are lower. First our sample is different as we use students from all regions in Québec rather than strictly from the island of Montreal. Second and most importantly we are estimating ATT effects. Hence, our control group students possibly attend better public schools than the average public school as our matched public-school sample comes from higher income

[9] Although these estimates are not included in his paper, Laliberté graciously computed them for us. We are very grateful for his time and trouble.

and better educated families than the average public-school family. These two factors could explain why our estimates are lower than Laliberté's. However, we feel that the numbers from the Laliberté paper add considerably to the credibility of our estimates.

7.2 Public policy implications

The evidence in this paper and indirectly from Laliberté (2019) shows that independent high school education has a strong positive effect on the educational attainment of those who attend independent schools. The strategy of subsidizing independent 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.

Independent sector teachers are not particularly different from their public-school counterparts; they graduate from the same university programs, they 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 high school students and their results, shows that teacher quality is probably a school's most valuable asset (including good principals) (Dhuey and Smith, 2011; Hanushek, 2011).

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 independent school subsidies, as suggested by proponents of public education, would only cause a decline in abilities and competencies for students that attend independent schools. A voucher system

increasing enrollment in independent schools for the less advantaged should be seriously considered given the effects found in this paper.

To summarize, the foundation of Québec's educational policy is about offering parents the choice of high school for their children at a reasonable cost. Another policy pursued in British Columbia and Québec is the introduction of "open enrollment", 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 the province of Ontario's progress on key educational indicators (e.g. high school graduation, PISA test scores) can be attributed to a more recently established set of publicly sponsored choices available in Ontario's secondary schools. 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's cultural support for universal high achievement. Similarly, public schools in Québec have expanded so-called options programs in public schools, concentrating in specific areas such as music, sports, or opening an 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 independent schools, which have been offering such programs for over a decade.

8. Conclusion

Recent studies seek to establish a causal link between high school establishment type, independent or public, and students' educational performance focused on pupils' performances on standardized tests. These studies include those pursued with the National Longitudinal Study of Children and Youth (NLSCY) led by Statistics Canada from 1994 to1995 through 2008 to 2009 (Lefebvre, Merrigan and Verstraete, 2011; Haeck et al., 2014), or produced with international surveys such as PISA (Lefebvre, 2015; Lapierre, 2016 or administrative data (Azimil, Friesen, and Woodcock, 2015). Results from these estimates lead to a common conclusion: the average treatment effect on the treated of independent schools is positive and significant.

This study focuses on the independent school ATT effect on educational attainment, such as high school graduation in the "expected" number of years, but especially on attendance in postsecondary establishments. We find large and robust positive effects on enrollment in post-secondary institutions in particular universities. The results potentially imply development in independent schools of cognitive abilities or working habits facilitating access to and success in postsecondary education. They also demonstrate that promotion of school choice by way of subsidizing high-quality independent schools can be an efficient mechanism for increasing a nation's human capital and therefore it's economic growth.

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Table 1: High school graduation rate by sex and type of school (independent, public), cohort A of the YITS

	All			Male			Female		
	All	Ind.	Public	All	Ind.	Public	All	Ind.	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	3,270	629	2,641	1,639	346	1,293	1,630	293	1,337

Notes: The restriction excludes students who have repeated grades during their studies; S-D: standard deviation. Source: Authors' computations 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, percentages and number of observations.

	All			Public			Independent			Independent - 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
				Cohort A cycle 3 (19 years old)								
Enrollment CEGEP/university	71	65	77	67	61	73	88	82	95	21	21	22
Enrollment prof. program	14	24	10	12	21	9	19	29	12	7	8	3
				Cohort A cycle 4 (21 years old)								
Enrollment CEGEP/university	72	66	78	68	61	74	91	85	97	23	24	23
Enrollment university	33	25	40	28	20	35	54	46	65	26	26	30
Enrollment prof. program	17	26	12	13	17	12	25	41	13	12	24	1

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

Table 3: Mean characteristics of respondents by type of high school, cohort A cycles 1-2

High school type	All 100%	Public 80.1%	Independent 19.9%
Family income			
Mean	$64,999	$61,031	$82,941
S-D	$52,263	$48,594	$63,384
Male %	49.7	48.6	54.6
Age in months	186	186	186
S-D	3	3	3
Immigrant %	15.8	12.2	33.0
English %	11	9	15
French %	84	86	73
Two-parent %	72	71	77
Quintiles ISEI%			
1	20	22,4	8,5
2	20	21,3	11,9
3	20	21,2	14,9
4	20	19,0	27,7
5	20	16,2	37,0
Siblings%			
0	10.7	8.1	10.7
1	47.1	46.0	47.1
2 or more	42.3	45.9	42.3
Number of books at home%			
Books 1 (0-10)	9.6	10.1	7.3
Books 2 (11-50)	23.2	24.8	16.0
Books 3 (51-100)	22.6	23.5	18.3
Books 4 (101-250)	22.0	21.3	25.2
Books 5 (>250)	22.6	20.3	33.3
Mother's education level%			
Less than high school	17.3	19.3	8.3
High school	33.2	35.2	23.9
>High school and <University	27.4	27.2	28.5
University diploma or more	22.0	18.3	39.4
Parental education expectation%			
High school diploma	9.7	11.1	3.2
Postsecondary studies	26.4	29.0	14.7
University diploma or more	63.9	59.9	82.0
N	3,270	2,641	629

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

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

Level of studies	C	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Graduation high school	2	All	Coef.	0,078	0,080	0,070	0.099	0.071	-28.3
			St. Err.	0,018	0,018	0,017	0.026	0.033	
			N	3,270	3,270	3,251	3,270	3,270	
Graduation high school	2	M	Coef.	0,090	0,093	0,078			
			St. err.	0,028	0,028	0,024			
			N	1,644	1,644	1,634			
Graduation high school	2	F	Coef.	0,066	0,071	0,077			
			St. err.	0,021	0,021	0,023			
			N	1,626	1,626	1,615			
Graduation high school	3	All	Coef.	0,036	0,036	0,033	0,019	0,023	+21.1
			St. err.	0,012	0,011	0,011	0,017	0,019	
			N	2,817	2,817	2,792	2,817	2,817	
Graduation high school	3	M	Coef.	0,038	0,039	0,032			
			St. err.	0,020	0,019	0,018			
			N	1,400	1,400	1,386			
Graduation high school	3	F	Coef.	0,037	0,037	0,039			
			St. err.	0,007	0,008	0,009			
			N	1,417	1,417	1,403			
Enrollment CEGEP/university	3	All	Coef.	0,079	0,084	0,075	0,057	0,056	-1.75
			St. err.	0,020	0,020	0,021	0,026	0,032	
			N	2,817	2,817	2,792	2,817	2,817	
Enrollment CEGEP/university	3	M	Coef.	0,075	0,078	0,057			
			St. err.	0,030	0,029	0,027			
			N	1,400	1,400	1,386			
Enrollment CEGEP/university	3	F	Coef.	0,091	0,096	0,095			
			St. err.	0,023	0,023	0,023			
			N	1,417	1,417	1,403			

Notes: C: cycles 2 (17 year-olds), 3 (19 year-olds); M: male; F: female; Param.: Estimated parameter; EB-NC: Entropy balancing no controls; EB-WC: Entropy balancing with controls; 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 with simulation of confounding variable; Δ%: difference in percentage between coefficient estimated by kernel matching and Sensatt.

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

Level of studies	C	Sex	Param.	EB-NC	EB-WC	EB-99	Kernel	Sensatt	Δ%
Enrollment CEGEP/Univ.	4	All	Coef.	0.103	0.107	0.095	0.083	0.069	-16.9
			St. err.	0.020	0.020	0.021	0.026	0.032	
			N	2,388	2,388	2,366	2,388	2,388	
Enrollment CEGEP/Univ.	4	M	Coef.	0.103	0.104	0.081			
			St. err.	0.033	0.033	0.030			
			N	1,185	1,185	1,174			
Enrollment CEGEP/Univ.	4	F	Coef.	0.107	0.113	0.114			
			St. err.	0.017	0.017	0.017			
			N	1,203	1,203	1,191			
Enrollment Univ.	4	All	Coef.	0.140	0.146	0.137	0.175	0.116	-33.7
			St. err.	0.030	0.031	0.031	0.037	0.046	
			N	2,388	2,388	2,366	2,388	2,388	
Enrollment Univ.	4	M	Coef.	0.152	0.151	0.134			
			St. err.	0.042	0.042	0.038			
			N	1,185	1,185	1,174			
Enrollment Univ.	4	F	Coef.	0.132	0.146	0.140			
			St. err.	0.058	0.062	0.050			
			N	1,203	1,203	1,152			
Enrollment prof. program	4	All	Coef.	0.094	0.093	0.103	0.099	0.105	+6.1
			St. err.	0.053	0.054	0.055	0.068	0.061	
			N	327	327	324	327	327	
Enrollment prof. program	4	M	Coef.	0.166	0.171	0.134			
			St. err.	0.099	0.098	0.134			
			N	118	118	117			
Enrollment prof. program	4	F	Coef.	0.035	0.029	0.030			
			St. err.	0.045	0.048	0.048			
			N	209	209	207			

Notes: C: cycle 4 (21 year-olds); M: male; F: female; Param.: Estimated parameter; EB-NC: Entropy balancing no controls; EB-WC: Entropy balancing with controls; 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 with simulation of confounding variable; Δ%: difference in percentage between coefficient estimated by kernel matching and Sensatt.

Table 5.1: Estimated effects of independent high school on academic outcomes by sex and PISA scores as additional matchi 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 high school	2	A	Coef.	0.069	0.051	-26.1%	0.078	0.053	-32.1%	0.100	0.071	-29.0%
			St. err.	0.021	0.019		0.018	0.017		0.026	0.024	
			N	1,826	1,826		3,27	3,27		1,801	1,801	
		M	Coef.	0.084	0.057	-32.1%	0.089	0.065	-27.0%	0.113	0.087	-23.0%
			St. err.	0.033	0.029		0.028	0.023		0.042	0.037	
			N	937	937		1,644	1,664		919	919	
		F	Coef.	0.069	0.059	-14.5%	0.066	0.042	-36.4%	0.093	0.060	-23.0%
			St. err.	0.026	0.029		0.021	0.020		0.023	0.022	
			N	889	889		1,626	1,626		882	882	
Graduation high school	3	A	Coef.	0.031	0.022	-29.0%	0.035	0.026	-25.7%	0.027	0.017	-37.0%
			St. err.	0.017	0.016		0.011	0.010		0.016	0.015	
			N	1,575	1,575		2,817	2,817		1,551	1,551	
		M	Coef.	0.036	0.020	-44.0%	0.038	0.028	-26.3%	0.026	0.018	-30.7%
			St. err.	0.031	0.029		0.020	0.017		0.029	0.025	
			N	791	791		1,400	1,400		786	786	
		F	Coef.	0.032	0.029	-9.4%	0.037	0.029	-21.6%	0.041	0.033	-19.5%
			S-D	0.012	0.011		0.007	0.007		0.010	0.010	
			N	784	7844		1,417	1,417		765	765	
Enrollment CEGEP / university	3	A	Coef.	0.072	0.055	-23.6%	0.081	0.062	-23.4%	0.077	0.055	-28.5%
			St. err.	0.024	0.024		0.020	0.020		0.023	0.021	
			N	1,575	1,575		2,817	2,817		1,551	1,551	
		M	Coef.	0.061	0.028	-54.1%	0.075	0.055	-26.6%	0.069	0.054	-21.7%
			St. err.	0.034	0.034		0.030	0.028		0.041	0.034	
			N	791	791		1,4	1,4		786	786	
		F	Coef.	0.081	0.076	-6.2%	0.091	0.077	-15.4%	0.095	0.069 †††)	-27.4%
			St. err.	0.031	0.028		0.023	0.021		0.028	0.029	
			N	784	784		1,417	1,417		765	765	

Notes: : Cycle ; Para.: 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 percentage between original estimate and estimate with PISA score as control in percent.

Table 5.2: Estimated effects of independent 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.	0.133	0.095	-28.6%	0.145	0.114	-21.4%	0.158	0.120	-24.1%
university			St. err.	0.038	0.040		0.031	0.031		0.052	0.053	
			N	1,344	1,344		2,388	2,388		1,309	1,309	
		M	Coef.	0.101	0.048	-52.5%	0.152	0.125	-17.8%	0.143	0.126	-13.5%
			St. err.	0.041	0.042		0.042	0.037		0.069	0.063	
			N	672	672		1,185	1,185		666	666	
		F	Coef.	0.145	0.131	-9.7%	0.131	0.099	-24.4%	0.170	0.136	-20.0%
			St. err.	0.067	0.070		0.058	0.057		0.023	0.027	
			N	672	672		1,203	1,203		643	643	
Enrollment	4	A	Coef.	0.096	0.070	-27.1%	0.105	0.081	-22.8%	0.107	0.082	-23.4%
CEGEP/			St. err.	0.024	0.019		0.020	0.018		0.027	0.023	
university			N	1,344	1,344		2,388	2,388		1,309	1,309	
		M	Coef.	0.103	0.059	-42.7%	0.102	0.078	-23.5%	0.082	0.069	-15.9%
			St. err.	0.035	0.031		0.033	0.029		0.053	0.043	
			N	672	672		1,185	1,185		666	666	
		F	Coef.	0.069	0.059	-14.5%	0.107	0.086	-19.6%	0.138	0.099	-28.3%
			St. err.	0.028	0.022		0.017	0.015		0.017	0.018	
			N	672	672		1,203	1,203		643	643	

Notes: C: cycle; Para.: 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 percentage between original estimate and estimate with PISA score as control.

Statistical Annex

Table A1 Top Ten Mean country scores – PISA 2018 – Reading

Country or Province	Mean score	95% confidence interval
BSJZ - China	555	550-561
Singapour	549	546-553
Alberta - Canada	532	523-540
Macao-China	525	523-528
Hong Kong - China	524	519-530
Ontario - Canada	524	517-531
Estonia	523	516-525
Canada	520	517-524
Finland	520	516-525
Québec - Canada	519	513-526

Top Ten Mean country scores – PISA 2018 – Math

Country or Province	Mean score	95% confidence interval
BSJZ - China	591	586-596
Singapour	569	566-572
Macao - China	558	555-561
Hong Kong - China	551	545-557
Québec - Canada	532	525-539
Taipei	531	525-537
Japan	527	522-532
Korea	526	520-532
Estonia	523	520-527
Netherlands	519	514-524

Top ten mean country scores – PISA 2018 – Science

Country or Province	Mean score	95% confidence interval
BSJZ - China	590	585-596
Singapour	551	548-554
Macao - China	544	541-546
Alberta- Canada	534	525-542
Estonia	530	526-534
Japan	529	524-534
Finland	522	517-527
Québec - Canada	522	514-529
Korea	519	514-525
Ontario	519	511-526

Source: O'Grady et al. (2019).

Table A2: Number of students by school level and type, selected years 1994-1995 to 2013-2014, Québec

School	Public schools			Independent schools (ratio independent/public)		
year	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 A3: Public subsidy per student to Québec's independent 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 personnel, as well as 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 independent 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 Independent 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 in years	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
Independent schools	83	88	89	86	93	84	89	90	87	94	85	89	91	88	94	85	90	91	88	94
Independent-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
Independent schools	86	90	92	89	95	87	91	92	90	95	87	91	93	90	95	87	92	89	94	88
Independent-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 in years measures the number of years since the cohort entered in secondary school. Independent-Public: Independent 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, Québec.