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Open Enrolment and Student Achievement

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ABSTRACT

Open Enrolment and Student Achievement*

We investigate the effects of public school open enrolment, which allows students to enroll in any public school with available space, on fourth grade test scores. We find a small, positive effect on the average student; this benefit appears to stem from increased competition among schools, rather than directly through expanded choice opportunities. Among students whose catchment school is locally top-ranked according to test scores, greater choice is of no direct benefit; however, students whose catchment school is locally lowest-ranked earn higher scores when they have access to better local schools. Students in both groups benefit from increased school competition.

JEL Classification: I21, I28

Keywords: open enrolment, school choice, school competition

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1 INTRODUCTION

Policies that offer parents greater scope for school choice are increasingly popular among governments aiming to improve educational outcomes. By far the most prevalent form of school choice policy is "open enrolment", which allows students to attend public schools outside their neighborhood catchment area. Open enrolment is intended to improve student outcomes through two primary channels: by allowing families to enroll their children in schools that are higher quality or better matches; and by creating incentives for school managers to increase effort in order to attract or retain students when faced with increasing competition. Student outcomes may also be affected indirectly through peer effects if increased scope for school choice alters the distribution of student characteristics across schools. As of 2010, thirty-three U.S. states had passed laws requiring school districts to implement some form of open enrolment (Education Commission of the States 2011). Various forms of open enrolment policies have been implemented in a range of jurisdictions, including Chile in 1981, Sweden in 1992, England in 1998, and British Columbia, Canada in 2002.

To date, relatively few studies have assessed the overall impact of open enrolment policies on student outcomes, and the results of these evaluations are mixed. Gibbons et al. (2008) exploit local variation in the spatial density of English public schools to estimate the overall effect of open enrolment on student achievement, using restrictions on inter-district enrolment and instruments based on distance from district boundaries to account for the potential endogeneity of residential sorting. They find little evidence that greater density of public schools is associated with higher levels of student achievement under intra-district open enrolment. Lavy (2010) uses various differencing strategies to compare outcomes of affected and unaffected cohorts from treated and untreated areas before and after the introduction of full inter- and intra-district open enrolment in Tel Aviv; he finds substantial positive effects on a variety of high school outcomes.

We extend this literature in the context of open enrolment in British Columbia, Canada. We use a large administrative data set that includes the universe of fourth grade students who reside within fourteen public school districts to estimate the effect of open enrolment on student achievement. Like Gibbons et al. (2008), our approach exploits spatial variation in the local density of public schools. While they rely on instrumental variables to address potentially confounding cross-sectional variation in unobserved student characteristics across neighborhoods, we rely instead on the introduction of an open enrolment policy that relaxed restrictions on public school enrolment as an additional source of identifying variation. For students who live in areas where public schools are very distant from one another, the substantial travel costs associated with opting out of their catchment school make it unlikely that the new policy would have meaningful effects. However, for students who live in densely populated urban areas that are served by large numbers of proximate public schools, full open enrolment may substantially increase local opportunities to opt in to public school alternatives, and intensify competition among schools. We identify the effects of open enrolment on student achievement via this variation in treatment intensity, before versus after the policy change, by comparing the difference in fourth grade test scores of pre- and post-treatment cohorts of students who reside in catchment areas where there are a larger number of proximate public schools to the difference in test scores of pre- and post-treatment cohorts who reside in catchment areas where there are fewer. Our empirical framework differences out any unobserved time-invariant factors at the catchment area level that influence achievement and are correlated with the spatial concentration of public schools.

Our key identifying assumption is that any within-catchment area changes in the unobserved characteristics of public school students that affect achievement, before versus after the introduction of open enrolment, are not systematically related to local public school density. The main challenge to identification arises if families' residential location decisions respond endogenously to open enrolment, as predicted by some general equilibrium models of school choice and residential location (e.g. Epple and Romano 2003; Calabrese et al. 2006) and supported by recent empirical evidence (Brunner et al. 2012). Families in our data may respond to open enrolment by moving to neighborhoods that are closer to preferred public schools but fall outside the catchment areas of those schools. This behaviour will bias our estimates if it changes the relationship between the number of proximate public schools and relevant student characteristics. We address this challenge by including a set of time-varying covariates to control for these characteristics, and investigate whether our results differ across sub-samples of students where this selection process might be expected to be different.

A second kind of selection bias will arise if students who would otherwise enroll in other types of choice schools (e.g. magnet or private schools) respond to open enrolment by enrolling in a regular public school instead. All else equal, such a response is more likely among students who gain access to a larger number of public schools that are close to their homes. Hence it may change the relationship between the number of proximate public schools and relevant characteristics of *public* school students within a catchment area following the introduction of open enrolment. Unlike previous studies of the effects of open enrolment, we address this issue directly by controlling for the number of private and magnet schools that are proximate to a student's residence, and by investigating the robustness of our results to the inclusion of private school students in our estimation sample.

Following Gibbons et al. (2008), we employ two key measures of the intensity of treatment under open enrolment: the number of public schools that are proximate to a student's home (a measure of the scope for choice) and the average number of public schools proximate to students who reside near the student's guaranteed "catchment" school (a measure of competition facing the catchment school).[1] Our baseline results show that, regardless of which measure we use, open enrolment led to small, precisely estimated improvements in the average reading and numeracy scores of fourth grade students. We then try to disentangle the effects of choice versus competition by including both measures in our model of student achievement. We find clear evidence that the primary mechanism through which open enrolment improves student achievement is by increasing competition between schools. This result differs somewhat from Gibbons et al. (2008), who only find a positive benefit from competition at a subset of schools that are relatively autonomous with respect to governance and admissions practices. Our finding complements a growing body of evidence that other sources of competition have positive

[1] Our measure of competition refers to the number of competitors faced by the catchment school, rather than the attendance school used in Gibbons et al. (2008), in order to avoid issues related to the endogeneity of school choice conditional on residential location.

effects in schooling markets, including choice between secular and Catholic school boards (Card et al. 2010), threats of voucher sanctions under accountability frameworks (Chiang 2009; Rockoff et al. 2010; Rouse et al. 2007), and private school tax credits for low income students (Figlio and Hart 2010).[2]

In contrast, we find that the direct effect of increased *choice* under open enrolment is negligible. Again, this result is consistent with previous evidence that the average student who opts out of their local public school does not benefit from doing so (Betts et al. 2006; Clark 2010; Cullen et al. 2005, 2006; Deming et al. 2011; Hastings et al. 2006, 2009, 2012; Park et al. 2008; Jackson 2010). These and other studies of the direct effects of choice also tend to find that those students who attend certain types of magnet or charter schools, who gain access to relatively high achieving schools (Pop-Eleches and Urquiola 2013), or whose parents place a strong weight on academic quality when choosing schools, may experience academic benefits from opting out. Our approach allows us to directly investigate the role that heterogeneity in the *relative* quality of local school choice options plays in shaping the effects of open enrolment on achievement. This dimension of the school choice environment turns out to be important: we find that students whose catchment school is ranked lowest among proximate public schools (according to mean standardized test scores) gain the most from open enrolment, while students who already had access to the highest-ranked proximate public school do not benefit, and may even perform worse academically after open enrolment is introduced.

2 INSTITUTIONAL CONTEXT

We study an open enrolment policy that was introduced in British Columbia (B.C.) in July 2002. Students in B.C. are guaranteed access to the public school in whose catchment area they reside. They may also choose to enroll in a regular public school other than their catchment area school. Before July 2002, the provincial education authority (the Ministry of Education) mandated that out-of-catchment enrollment in a

[2] Several earlier studies find that competition from private schools has mixed and generally small effects of on public school performance (Hoxby 1994; Hsieh and Urquiola 2006; Jepsen 2003). Hoxby (2000) finds that a greater concentration of districts in metropolitan areas contributes to higher test scores through 'Tiebout choice'; however, re-analysis of these data by Rothstein (2006) produced smaller estimates that were mostly insignificant.

regular (non-magnet) public school required permission of the principals of both the catchment area school and the preferred school. Since July 2002, students have been free to enroll in any public school in the province that has space and facilities available after students who reside in the catchment area have enrolled. Transportation to choice schools is not provided. When public schools are over-subscribed, provincial legislation requires that school boards give priority to students who reside within the district. Boards may elect to give priority to siblings of children who are already enrolled. Within these enrolment categories, principals of regular public schools have discretion over which students to enroll.

Parents in B.C. may also choose to enroll their children in “independent” schools that charge tuition (commonly referred to as private schools) or in a public magnet program. The most popular form of magnet program is French Immersion, which enrolls about 10 percent of Kindergarten students in the province (BC Ministry of Education 2011). Entry into French Immersion programs is restricted to students entering Kindergarten or grade 1, and is often allocated by lottery.

The B.C. Ministry of Education provides operating and capital funding directly to districts. Operating funds are provided in proportion to total district enrolment, with supplementary funding for each student who is Aboriginal, is gifted or disabled, or who qualifies for English as a Second Language (ESL) instruction. Districts and schools are not authorized to raise any additional revenue. Private schools that conform to provincial curriculum standards and meet various administrative requirements are entitled to provincial operating grants that range from 35 to 50 percent of the public school grant depending on their operating costs (B.C. Ministry of Education 2005).

3 DATA

Our estimates are based on extracts from two administrative databases collected and maintained by the B.C. Ministry of Education. The first is an enrolment database that records the school at which each Grade 4 student is enrolled on September 30 of each year. Our extract from this database spans the 1999/2000 through 2006/2007 school years for the fourteen school districts in the Lower Mainland of B.C.[3] It includes indicators for the language spoken in the student's home (English, Chinese, Punjabi, and other), whether the student self-identified as Aboriginal in any year, whether the student was registered in ESL or special education (i.e., a gifted or disabled program), whether the student was enrolled in French Immersion, whether the school is public or private, and the student's sex. In addition, the extract provides the student's residential postal code and unique student, school, and district identifiers. We attach average family income in the student's Census neighborhood (enumeration or dissemination area, depending on year), based on a postal code match.[4] The data appendix includes a detailed description of our procedures for locating residential postal codes within school catchment area boundaries.

The second database provides student-level data on participation and scores on standardized tests administered in Grade 4 for the 1999/2000-2006/2007 school years. These tests, known as the Foundation Skills Assessments (FSAs), measure students' performance in reading and numeracy. All public and provincially funded private schools in British Columbia are required to administer the FSAs to students in Grades 4 and 7 in May of each year. The FSAs do not contribute to students' academic records and play no role in grade completion, and there are no financial incentives for teachers or schools related to student performance. We merge students' FSA scores with the enrolment database via the unique student identifier provided in both files.

We restrict our sample to students enrolled in Grade 4 in a non-Francophone public or private school. In addition, we keep only those students who attend a school that enrolls at least five students in the relevant grade, and who have non-missing values for all relevant variables.

4 OPEN ENROLMENT AND SCHOOL QUALITY

[3] The Lower Mainland consists of the city of Vancouver and its suburbs. It is geographically isolated by the Canada/U.S. border to the south, rugged mountains to the east and north, and the Salish Sea to the west.
[4] An enumeration/dissemination area is the smallest geographic area for which public-use Census data are produced, and typically comprises several hundred households; see the data appendix for details.

In this section, we develop a model that makes predictions about the effects of open enrolment on academic achievement via parents' decisions about school choice and school managers' decisions about effort (which influences school quality). Our model predicts that open enrolment will have the greatest effect on academic achievement in regions where schools are spatially dense. This result operates through two channels: expanded school choice, and increased competition between schools. We show that the greater is the spatial density of schools, the greater is the expansion of parents' school choice options under open enrolment, and the greater is the sensitivity of school choice decisions to school quality (which is assumed to affect achievement). Moreover, a large number of nearby competitors gives school managers strong incentives to increase effort, thereby improving school quality.

We assume that student i's academic achievement, y_i, depends on her ability, a_i, and the quality of the school she attends, $q_{s(i)}$, according to:

$$y_i = f\left(a_i, q_{s(i)}\right) \tag{1}$$

where f is increasing in both arguments. Open enrolment may directly affect the quality of the school that a student attends by affecting the choice of school, $s(i)$. It may also affect the quality of that school, $q_{s(i)}$, by inducing greater effort from the school manager in response to increasing public school competition, and by changing the composition of peers within the school. We discuss each of these channels in turn.

4.1 School choice decisions

For tractability, we treat residential location as given and examine the effects of open enrolment on school choice, conditional on residential choice. We discuss the implications of this assumption below. Families who reside in neighborhood k choose a school for their child from a set of S_k schools. Family i in neighborhood k has preferences over schools represented by the utility function:

$$U_{is} = \beta q_s - \gamma d_{sk} + \varepsilon_{is} \tag{2}$$

where q_s is the quality of school $s \in S_k$, d_{sk} is the travel distance to school s (assumed to be the same for all families in neighborhood k), $\beta > 0$ and $\gamma > 0$ are utility parameters, and ε_{is} is a random preference parameter.

Before open enrolment, the set of schools that families in neighborhood k may choose from, S_k^0, includes the catchment school, and may include some private, public magnet or alternative public schools. Families evaluate the utility of all schools in the choice set and choose school s if and only if:

$$\beta \Delta q_{sr} - \gamma \Delta d_{sr,k} \geq \varepsilon_{ir} - \varepsilon_{is} \tag{3}$$

for all $r = 1, 2, 3 \ldots n_k^0$, where $\Delta q_{sr} \equiv q_s - q_r$ and $\Delta d_{sr,k} \equiv d_{sk} - d_{rk}$. Denote the school $s \in S_k^0$ that maximizes the utility of family i as s_i^*.

Open enrolment can be thought of as expanding the family's choice set to include an additional set of schools, S_k^1. The probability that family i chooses school $p \neq s_i^*$ is:

$$F\left[\beta \Delta q_{s_i^* p} - \gamma \Delta d_{s_i^* p,k}\right] \tag{4}$$

where $F[\cdot]$ is the distribution function of the random variable $\varepsilon_{ip} - \varepsilon_{is_i^*}$, normalized to have mean zero. All else equal, the probability that a family will choose a school that is not s_i^* is increasing in the number of schools they gain access to under open enrolment and in the quality of these schools relative to the quality of s_i^*. It is decreasing in the travel distance to these schools relative to the travel distance to s_i^*.

Differentiating (4) gives us:

$$\frac{\partial F}{\partial \Delta q_{s_i^* p}} = \beta f\left[\beta \Delta q_{s_i^* p} - \gamma \Delta d_{s_i^* p,k}\right] \tag{5}$$

where f is the density of $\varepsilon_{ip} - \varepsilon_{is_i^*}$. This derivative is a decreasing function of the *difference* in travel distances between the two schools ($\Delta d_{s_i^* p,k}$). This result implies that, all else equal, school choice decisions under open enrolment will be more sensitive to school quality when the travel distances to the schools that families are choosing between are relatively similar. On average, the differences in travel distances to schools will be smaller in areas where schools are located more closely together.

4.2 Competition and managerial effort

We now consider how the expansion of school choice opportunities affects school quality via the effort by school managers. Following Card et al. (2010), we assume that school quality is an increasing concave function of the level of effort exerted by school managers, *e*:

$$q_s = q(e_s) \tag{6}$$

The preferences of school managers depend on effort and the number of students who wish to attend their school:

$$V_s(E_s, e_s) = \theta E_s - e_s \tag{7}$$

where $\theta > 0$ reflects the relative weight on market demand, E_s.

Before open enrolment, the market share of school *s* among parents residing in neighborhood *k* is:

$$m_{sk}(\Delta Q_s, \Delta D_{s,k}) \tag{8}$$

where ΔQ_s is a vector of length n_k^0 whose elements are the differences in quality between school *s* and each school in S_k^0, and $\Delta D_{s,k}$ is a vector whose elements are the differences in travel distance to school *s* and each school in S_k^0. Let K_s^0 denote the subset of neighborhoods in which school *s* is an element of S_k^0. The school-age population in each neighborhood is given by M_k. Prior to open enrolment, the total number of students wishing to enroll in school *s* is:

$$E_s = \sum_{k \in K_s^0} M_k m_{sk}(\Delta Q_s, \Delta D_{s,k}) \tag{9}$$

School managers choose effort levels to maximize their utility via (7). The first-order condition for the utility maximization problem before open enrolment is:

$$\theta \sum_{k \in K_s^0} M_k \frac{\partial m_{sk}}{\partial \Delta q_s} \left(\Delta Q_s, \Delta D_{sk} \right) \frac{\partial q_s}{\partial e_s} - 1 = 0 \tag{10}$$

In equilibrium, the manager's effort satisfies:

$$\frac{\partial q_s}{\partial e_s^*} = \frac{1}{\theta \sum_{k \in K_s^0} M_k \frac{\partial m_{sk}}{\partial \Delta q_s} (\Delta Q_s^*, \Delta D_{sk})} \tag{11}$$

Equation (11) shows that open enrolment has two effects on managerial effort. First, open enrolment expands the scope for public schools to attract students from a larger set of neighborhoods (increasing the number of terms in the weighted sum in the denominator of this expression). Second, it increases the number of choices that students have in each neighborhood (increasing the length of the vectors ΔQ_{sk} and ΔD_{sk}), thereby increasing the number of competitors that schools face within each neighborhood. By increasing the returns to managerial effort through both channels, open enrolment will lead managers to choose a higher level of effort, increasing school quality. These direct effects of open enrolment on managerial effort will be reinforced in equilibrium as each school manager responds to the change in behavior of her competitors.

From (5), we know that school quality will play a greater role in school choice decisions under open enrolment when families are choosing between schools that are similarly proximate. All else equal, therefore, the increase in managerial effort will be greater under open enrolment in schools that are located in closer proximity to a greater number of public competitors.

4.3 Peers

Changes in school enrolment outcomes under open enrolment may affect the distribution of student characteristics across schools. To the extent that these characteristics generate spillovers for classmates or schoolmates, students who attend schools that attract high-performing peers or lose low-performing peers under open enrolment may experience an improvement in school quality, while those who attend schools that lose high-performing peers or attract low-performing peers may experience a decline. From (4), we know that families' school choice decisions are more likely to be altered by open enrolment when they gain access to a larger number of proximate public schools. The potential that the characteristics of peers at a given school will change under open enrolment therefore will be greater when that school faces a larger number of proximate competitors.

5 METHODOLOGY

5.1 Empirical model

Our model of student achievement (1) depends on student ability and the quality of the school attended. School quality in turn depends on managerial effort, which varies with the competition that schools face, and on peer composition. Our empirical model is as follows:

$$\begin{aligned} y_i &= \beta_1 X_i + \beta_2 \bar{X}_{\sim ic(i),t} + \beta_3 PrivComp_{c(i),t} + \beta_4 FrenchComp_{c(i),t} \\ &+ \phi_1 Choice_{it} + \phi_2 OE_t Choice_{it} + \phi_3 PubComp_{c(i),t} + \phi_4 OE_t PubComp_{c(i),t} \\ &+ \tau_t + \kappa_{c(i)} + \varepsilon_i \end{aligned} \tag{12}$$

where y_i is student i's test score, X_i is a vector of student characteristics, $\bar{X}_{\sim ic(i),t}$ is a vector of characteristic of same-grade peers residing in the travel zone of student i's catchment school in year t, $PrivComp_{c(i),t}$, $FrenchComp_{c(i),t}$ and $PubComp_{c(i),t}$ are the number of proximate private, French immersion magnet and regular public school competitors facing student i's catchment school in year t, $Choice_{it}$ is the number of public schools that are proximate to student i's postal code in year t, OE_t is an indicator for whether open enrolment is in effect, τ_t and $\kappa_{c(i)}$ are fixed year and catchment area effects respectively, ϕ_1-ϕ_4, β_3 and β_4 are scalar parameters and β_1 and β_2 are vectors of parameters to be estimated, and ε_i is a stochastic error.

When constructing our measures of school choice and competition we define a public school to be proximate to a student's neighborhood if it is located within a distance equal to the 75th percentile of distance travelled to public schools in our sample in the year preceding the introduction of open enrolment.[5] Our measure of public school choice is the number of public schools that are proximate to a student's residential neighborhood (their postal code).[6] Our measure of the amount of public competition facing a catchment school is the average value of the choice variable over all students whose residences are proximate to the school. Our measures of private school and French magnet competition facing the catchment school are constructed in the same way, using the 75th percentile of travel distance to each type of school respectively in the year before the introduction of open enrolment.

When open enrolment became law in July 2002, registration for the 2002/03 school year was effectively complete. Parents who wished to enroll their child in a different school would have had to contact the school's principal in early September to inquire about space. We therefore code our open enrolment variable as an indicator that the school year is 2003/04 or later. This assumption is supported by aggregate patterns in enrolment behavior, discussed below.

5.2 Identification

Students who live in areas that are served by a larger number of proximate public schools experience a greater increase in meaningful school choice options under open enrolment than those who live in sparsely populated areas where public schools are widely dispersed. Symmetrically, open enrolment also leads to a greater increase in competition between schools in areas where schools are more spatially dense. Our identification strategy exploits this variation in the intensity of treatment under the new open enrolment

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[5] Our results are not sensitive to the specific percentile of distance that we choose as our definition of proximity.

[6] B.C.'s open enrolment policy gives priority to within-district over cross-district transfers. However, cross-district transfers were not uncommon. Between 2002 and 2005, the proportion of Kindergarten students attending a regular public school in a different district grew from 3.8% to 4.8%. For this reason, we define schools to be proximate if they lie within the specified travel distance from the student's home even if they are in a neighboring district. Our results are not sensitive to whether we include or exclude these out-of-district schools.

policy to identify the effects of interest. The key parameters in (12) are ϕ_2 and ϕ_4. We specify $\kappa_{c(i)}$ as catchment area fixed effects to difference out any time-invariant factors at the catchment area level that influence achievement and are correlated with the local density of public schools. Our estimator of ϕ_2 measures differences in test scores between students in pre- and post-treatment cohorts whose postal code is proximate to a larger number of public schools, compared to students whose postal code is proximate to fewer public schools. Our estimator of ϕ_4 measures differences in test scores between pre- and post-treatment cohorts whose catchment school faces a large number of public school competitors, compared to students whose catchment school faces less competition.

Our key identifying assumption is that there are no unobserved factors that affect changes in pre- and post-treatment student achievement and vary systematically with the spatial concentration of public schools. The main threat to identification arises if open enrolment results in changes in the relationship between the characteristics of public school students who reside within a catchment area and the local density of public schools, either because of residential mobility or substitution between the private and public school sectors. We reduce the risk of any resultant bias by controlling for time-varying characteristics measured at the individual level (gender, home language, Aboriginal identity), at the postal code level (number of proximate French Immersion schools, number of proximate public schools), at the Census Enumeration/Dissemination Area level (mean family income), and at the catchment school travel zone level (the proportion of peers who speak Chinese, Punjabi or another non-English language at home, who are Aboriginal, and who are female). We also undertake a large number of robustness checks in Section 6.3 to address these and other possible identification concerns.

As discussed earlier, peer characteristics are more likely to change when schools face a larger number of public competitors. While peer quality may improve at some schools and decline at others, we would expect that, on average, the change in peer quality would be zero. To the extent that peer quality changes in ways that are systematically related to the local density of public schools, our estimates can be interpreted as the combined effect of competition/choice and peer composition.

6 RESULTS

Table 1 reports mean characteristics for our main estimation sample. The two largest non-English linguistic groups are Chinese-speakers (12 percent of our sample) and Punjabi-speakers (7 percent of our sample); other non-English languages are spoken by 15 percent of students. Aboriginal students, most of whom are English speakers, make up 6 percent of the sample. Under our definition of proximity, the average student lives in a postal code that is proximate to 3.3 public schools (including the catchment school), 1.2 French Immersion schools, and 9.7 private schools. The relatively large number of private schools reflects the longer distances travelled by private school students.

6.1 School enrolment trends

We begin our empirical investigation by examining patterns of school enrolment during the period of study. As predicted by our model, Figure 1 demonstrates that the introduction of open enrolment coincided with an increase in the share of students attending an out of catchment regular public school. Emerging trends in enrolment patterns tend to be most pronounced in Kindergarten, at the time of school entry. After being flat over the previous five years, out of catchment public school Kindergarten enrolment grew by 5.5 percentage points between 2003 and 2006, to 27 percent. The increase in out-of-catchment enrolment in grade 4 was slightly lower, at 4.4 percentage points.[7] Table 2 shows that the average student who goes out of catchment opts out of a catchment school that is slightly below average. This gap is slightly larger after 2002, primarily because students going out of catchment are drawn from somewhat lower achieving schools on average under open enrolment. Out of catchment students enroll in schools where mean test scores are slightly above average overall, and are about .1 standard deviations higher then their catchment school.

[7] The magnitude of this increase is strikingly similar to the 5% increase in out-of-catchment public school enrolment in "non-transition" grades following the introduction of open enrolment in Pinnelas County, Florida (Ozek 2009) and the 6.6% participation rate in San Diego's open enrolment program (Betts et al. 2006).

The overall context during this period was one of increasing competition both within the public school sector and between public and private schools. Whereas the Grade 4 population increased by 11 percent between 1996 and 2006, the number of private schools increased by 21 percent to 104, the number of French Immersion schools increased by 14 percent to 41, while the number of regular catchment schools grew by only 5 percent to 449. Returning to Figure 1, we see that private and French Immersion schools attracted a growing share of students, especially before 2002. Private school Kindergarten enrolment grew by 3.6 percentage points to 14.1 percent of students over the period, and French Immersion enrolment grew by 4.3 percentage points to 10.1 percent. Meanwhile, the proportion of Kindergarten students attending their catchment area school fell by 13.3 percentage points to 54.2 percent. Again, Grade 4 enrolment shows similar patterns, but slightly less pronounced.

Figure 2 provides a sense of the variation in the number of proximate public schools, which we exploit in our identification strategy. Over the full sample period (1999-2006), 17 percent of students had only one proximate public school (their catchment school) and 20 percent had only two proximate public schools, i.e. their catchment school and one public alternative. The maximum number of proximate public schools was sixteen.

6.2 Main regression results

We present results for our main sample in Table 3. Standard errors are clustered at the catchment school-by-year level. The first two columns correspond to a specification that includes our measure of local choice and its interaction with open enrolment, but excludes our measure of local competition and its interaction. We find that both reading and numeracy test scores improve modestly after the introduction of open enrolment. For the average student in our sample, who lives in proximity to 3.3 public schools, reading and numeracy scores increase by 0.03 and 0.02 standard deviations respectively after the introduction of open enrolment.

The specification reported in columns 3 and 4 replaces the choice variable with the competition measure. The point estimates are somewhat larger in this case, but essentially the same. The similarity of these results is not surprising given the high degree of correlation between the choice and competition measures (about .9). Nevertheless, when we include both variables in the model in the final two columns of Table 3, the magnitudes of the competition effects are similar to the previous specification and the estimated effect for reading remains statistically significant, while the effects of the choice variable are zero. These results are consistent with the existing literature, which finds no average effect of public school choice on those who opt out. They also provide direct evidence that increased competition among public schools under open enrolment contributes to reading achievement, and suggestive evidence that it contributes to numeracy achievement. The implied magnitudes of the estimated effects for the average student, whose catchment school has 3.6 public competitors, are small: .04 standard deviations in reading and .03 standard deviations in numeracy. Among those at the 90th percentile of the distribution of public competition (i.e. whose catchment school competes with 8.5 public schools), the estimated reading and numeracy effects are .09 and .07 standard deviations respectively.

To gain further insight into the relative importance of choice and competition, we evaluate two sub-samples of students for whom we have stronger predictions about the effects of increased choice. While students may choose to opt out to a school that is of higher or lower academic quality, these decisions will be influenced by the quality of proximate public schools. We consider subsamples consisting of students whose catchment school ranked highest (lowest) among public schools proximate to the student's postal code, according to school mean test scores in 1999. The frequency distributions of the number of proximate public schools in each of these sub-samples are reported in Figure 2.[8] Students in these subsamples who opt out of their catchment school under open enrolment are more likely than the average student to choose a school that is lower (higher) quality than their catchment school. Since students who have a larger number of alternatives are more likely to opt out, and school quality is a direct input into

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[8] Sub-samples are defined according to the ranking of a student's catchment school with respect to school mean test scores in 1999, relative to other public schools that are proximate to her postal code. When the postal code is proximate to only one school (the catchment school), the observation is included in both the top-ranked and bottom-ranked sub-samples.

test scores via (1), we expect that the relationship between the number of proximate alternatives and the change in test scores under open enrolment to be relatively small or even negative in the first sub-sample and relatively large in the second sub-sample, compared to the effect in the full sample. In both cases, however, the predicted effect of increased competition between schools remains positive and the same.

The first four columns of Table 4 present results from these two subsamples for a specification that includes only the choice variable and its interaction with the open enrolment indicator. Among students whose catchment school is the highest-ranked among proximate public schools, greater choice under open enrolment is associated with *lower* test scores, while among those whose catchment school is locally lowest-ranked, the effect is positive and somewhat larger in magnitude than in the full sample. The remaining columns of Table 4 report results from the specification that includes both the choice and competition measures. Among students with top-ranked catchment schools the estimated effect of increased choice under open enrolment remains negative and statistically significant, while the effect of increased competition under open enrolment is positive and statistically significant. Among students with bottom-ranked catchment schools the estimated effect of choice is zero, while the effect of competition is positive and marginally statistically significant. When evaluated at their respective sub-sample mean number of public competitors, the estimated effects of competition are similar in magnitude to those from the full sample, between .02 and .04 standard deviations.

6.3 Specification checks/robustness

Residential sorting. The results in Table 4 also serve as a form of robustness check against the concern that non-random responses to open enrolment through residential sorting may be influencing our results. As described earlier, family relocation decisions will bias our estimates if they alter the relationship between unobserved student characteristics that affect test scores and local school density measures. Under open enrolment, neighborhoods that are close to but fall outside of the catchment areas of desirable schools become more attractive to parents seeking access to those schools from out of catchment. Since these schools are more likely to be locally lower ranked schools, we expect that this type of selection bias would be greatest among the sub-sample of students who reside in the catchment areas of locally lowest ranked schools, and smallest among those who reside in the catchment areas of locally highest ranked schools. Our results for locally top-ranked catchment schools reassure us that the positive effects of competition that we find in our full sample are not driven by non-random residential sorting in response to open enrolment.

Missing test scores. As an alternative to increasing effort and improving the quality of school inputs or organization, school managers could respond to competitive pressures under open enrolment by attempting to raise the *perceived* quality of their school. As discussed below, school-average test scores are reported to the public and may provide parents with information about school quality. Consequently, school managers might attempt to increase the perceived quality of their school by excluding low-achieving students from standardized tests. If school managers respond to open enrolment in this way, estimated improvements in test scores may be driven by a composition effect rather than by increased achievement. We investigate this issue by estimating the relationship between increased school choice and competition under open enrolment and the probability that a student has a missing test score. The estimated year effects (shown in Appendix Table A5) show that the number of missing reading and numeracy test scores increased throughout the period. However, as shown in Table 5, this increase was smaller under open enrolment among students with a larger number of proximate public schools compared to those with fewer. Again, when both the choice and competition measures are included in the specification, the reduction in missing test scores seems to come about through increased competition under open enrolment, rather than through greater options for individual choice. This growth in test participation may reflect an increase in school attendance rates,[9] or an increase in the number of students who are deemed able to respond meaningfully to the test. Either channel could be interpreted as a further evidence of improvements in school outcomes under open enrolment. Moreover, to the extent that these marginal test writers are drawn disproportionately from the lower tail of the

[9] Hastings et al. (2012) find that truancy rates of school enrolment lottery winners decline as soon as they are notified that they have won, and before they enroll in their chosen school.

achievement distribution, their increased participation would lead us to underestimate any positive effects of open enrolment on achievement, and overestimate any negative ones.

Information. Following the introduction of standardized testing in 1999, B.C. slowly began to release information about test scores to the public. The increasing public scrutiny of school performance during this period may have provided an additional motivation for school managers to improve quality, and this information has been shown to influence school choice decisions (Friesen et al. 2011). In the 2000/01 school year, the provincial Ministry of Education provided information about individual, provincial, district and school-level test results to schools, and instructed them to share the information with parents upon request (B.C. Ministry of Education 2000). Beginning in 2003, schools were required to share individual students' exam results with parents before September 30 of each school year. An independent organization (the Fraser Institute) began issuing annual "school report cards" based on these results in June 2003 (Cowley and Easton 2003), which are widely reported in the local media.[10] Tests written in May of school year *t* are released in the fall of $t + 1$; their influence on managerial effort therefore may be reflected in the test scores of students who write the FSA exams in May of $t + 1$. Information from year t test scores released in fall of $t + 1$may influence school choice decisions recorded in the enrolment data recorded on September 30 of year $t + 2$. In order to control for the potential effects of the major information shock associated with the Fraser Institute's report cards, we include one- and two-year lags of the catchment school's mean test scores in our specification; we interact the first lag with an indicator that the year is 2003 or later (the first year it could affect managerial effort) and we interact the second lag with an indicator that the year is 2004 or later (the first year it could affect school choice).

Table 6 reports the results from this specification. The lag structure requires that we drop the first two years of data, leaving us with only two years of data before open enrolment was introduced. While somewhat weaker, the estimates nevertheless continue to provide strong evidence that increased competition under open enrolment led to improved test

[10] None of the authors are affiliated with the Fraser Institute.

scores, particularly in reading. We are more inclined to conclude that these weaker results reflect challenges in separately identifying the effects of information and open enrolment in this much richer specification and shorter panel, rather than evidence against our baseline results.

Mean reversion. The results in Table 4 show that, among the sub-sample of students whose catchment school was locally top-ranked, increased choice under open enrolment causes test scores to fall; among the sub-sample of those whose catchment school was locally bottom-ranked, it caused test scores to increase. Assignment to these sub-samples is based on the relative ranking of school-mean test scores for the 1999 cohort. To the extent that this ranking reflects idiosyncratic shocks in 1999, mean test scores in top-ranked schools might be expected to be lower in subsequent years as a result of mean reversion, and those in bottom-ranked schools to be higher. The magnitude of the shock associated with a school that is ranked highest (lowest) will be larger (smaller) when it is ranked against a larger number of competitors. As a result, our estimates in Table 4, which are based on data that include the 1999 cohort, may be influenced by this pattern of mean reversion.

We address this concern by re-estimating our baseline specification on sub-samples that exclude data from the 1999 cohort. So long as school-level shocks are not serially correlated, this approach will eliminate any systematic bias introduced by our method of defining sub-samples based on school performance. The results presented in Table 7 show that our conclusions are robust to the exclusion of these data.

Public/private substitution. As discussed in the introduction, families may substitute away from private schools towards out-of-catchment public schools under open enrolment; as with substitution between catchment and non-catchment public schools, they are more likely to do so when they reside in close proximity to larger number of proximate public schools. This behavior could alter the relationship between unobserved *public school* student characteristics that affect achievement and our measures of choice and competition under open enrolment. We address this potential source of bias by including all students who attend both private and public school in our sample; the composition of this sample will be unaffected by any changes in the composition of students attending private or public schools. The estimated effects of open enrolment for this sample, reported in the second column of Table 8 may differ from our baseline estimates (reported in the first column) both because they address this potential source of bias and because they represent the average effect of open enrolment on students in both public and private schools. The estimated effect of competition on reading scores, shown in the top panel, is slightly smaller for this sample compared to the sample of public school students only, and essentially the same for numeracy.

Other robustness checks. Table 8 reports results from two additional specifications. The specification in the third column models the effect of open enrolment in terms of years since open enrolment was introduced, rather than a zero-one indicator for the open enrolment policy. This specification allows for gradual adjustment to the new policy. Results from this specification are not substantially different from our baseline estimates.

In the final column we measure competition as the average amount faced by all proximate public schools, rather than the competition facing the catchment school. The true effect of competition on the average quality of school attended by students in a given catchment area will be a weighted (by catchment enrolment share) average of the effect on the quality of each attendance school. Our baseline measures of competition avoid the problem that these weights are endogenous to school choice decisions by using the competition faced by the catchment school as a proxy. Our alternative measure of competition weights all proximate public schools equally. Results for reading show that our estimates are essentially unchanged under this alternative. Results for numeracy further support the general conclusion that open enrolment improved test scores through greater competition.

7. Conclusion

Our results have important implications for the debate on public school choice policies. Most importantly, we find clear, consistent evidence that greater competition among public schools under B.C.'s open enrolment policy created a tide that lifted most, if not all, boats. While these effects are very small for the average student, they are of some consequence for those who live in neighborhoods that are served by a larger number of proximate public schools – in the range of .07 to .09 standard deviations. These results serve as a reminder that while school choice policies may be an effective strategy for improving outcomes in densely populated areas, they are less likely to be effective in less densely populated areas or rural districts.

We also find that the *quality* of local public alternatives strongly influences how student achievement responds to open enrolment. After accounting for the effects of competition, we find that students who had unrestricted access only to the locally lowest ranked public school before open enrolment gain no additional benefit from greater access to alternative public schools. For students who already had unrestricted access to the locally highest ranked public school before open enrolment, gaining freer access to alternative public schools has an adverse effect on test scores on average. This adverse effect neutralizes the benefit of competition with respect to both reading and numeracy scores, so that the test scores of these students are unchanged on average under open enrolment.

Our approach does not separately identify the effects of changes in school peer composition that may arise in response to open enrolment from the direct effects of increased choice and competition. Students who remain in schools that experience a decline in peer quality may be made worse off by open enrolment. Our research demonstrates that any possible adverse effects of open enrolment that operate via increased choice and peer effects may be offset by academic improvements arising from increased competition between schools.

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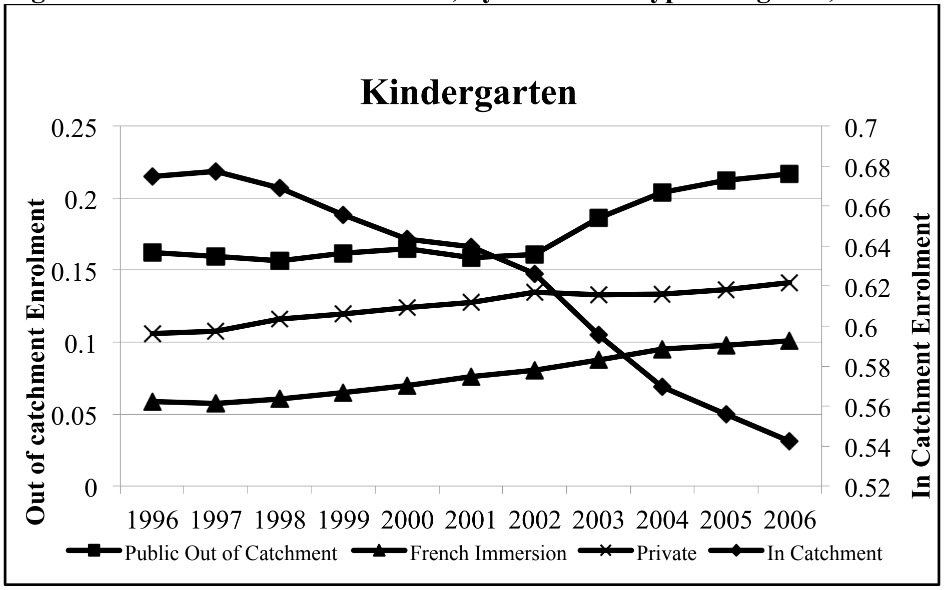
FIGURES

Figure 1. Enrolment in B.C. schools, by enrolment type and grade, 1996-2006



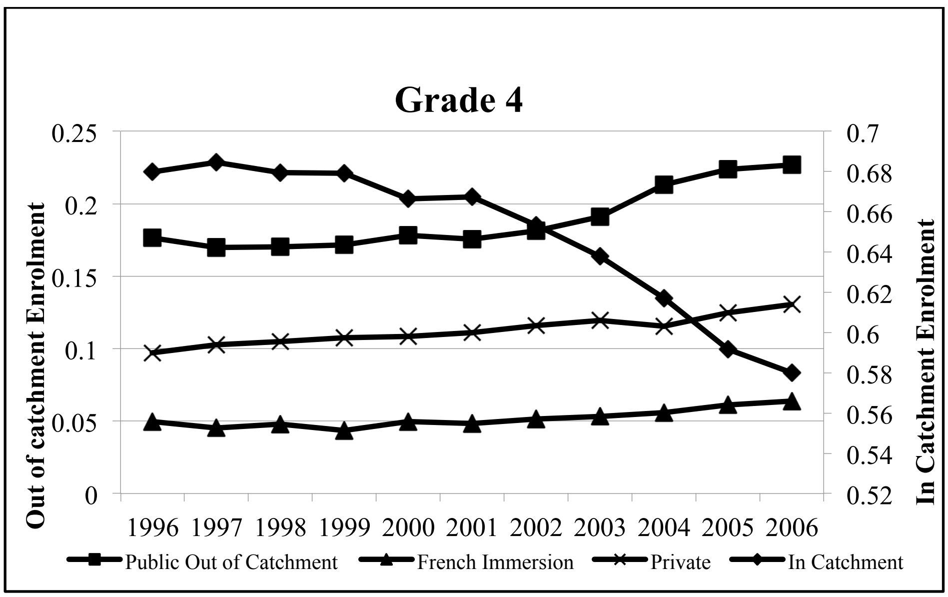
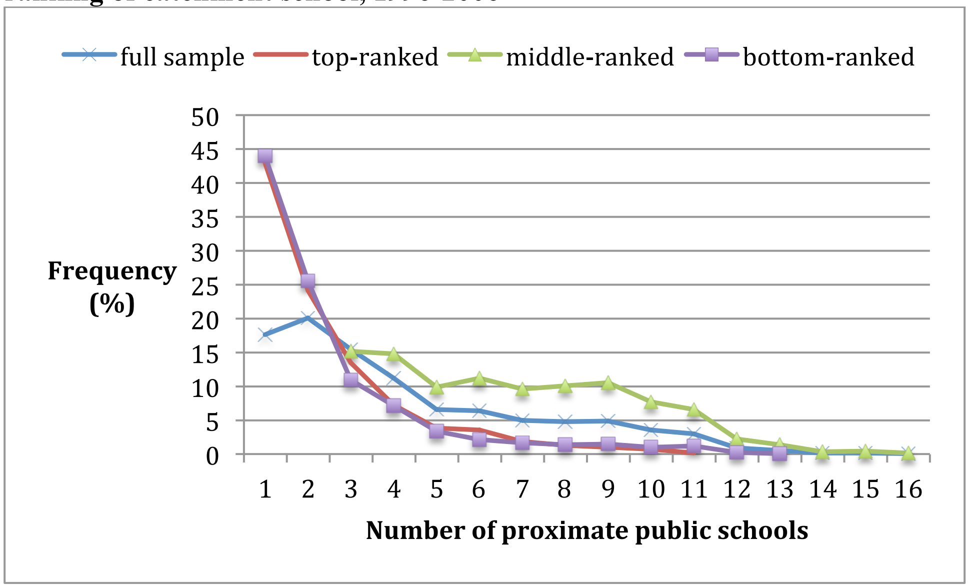


Figure 2. Number of public schools proximate to student's residential postal code, by ranking of catchment school, 1996-2006



Notes: Sub-samples are defined according to ranking of student's catchment school with respect to school mean test scores in 1999, relative to other public schools that are proximate to a student's postal code. When a student's postal code is proximate to only one school (the catchment school), the observation is included in both the top-ranked and bottom-ranked sub-samples.

TABLES

Table 1: Sample characteristics

	Mean	Std. Dev.
Student characteristics		
Chinese home language	0.12	0.33
Punjabi home language	0.07	0.26
Other non-English home language	0.15	0.36
Aboriginal	0.06	0.24
Female	0.48	0.50
FSA Reading Score	-0.05	0.99
FSA Numeracy Score	-0.04	0.99
Missing FSA Reading Score	0.11	0.31
Missing FSA Numeracy Score	0.12	0.32
Postal code characteristics		
Neighborhood family income	$68,000	$28,000
Number of proximate French Immersion schools	1.22	0.98
Number of proximate private schools	9.71	5.57
Number of proximate public schools	3.34	3.07
Catchment school characteristics		
Public school competition measure	3.62	2.82

Notes: see text and Data Appendix for details of sample selection and construction, and for variable definitions.

Table 2: School mean test scores, students attending public out of catchment schools

	Reading		Numeracy	
	Catchment School	Enrolment School	Catchment School	Enrolment school
Before Open Enrolment	-0.11	-0.04	-0.09	-0.03
After Open Enrolment	-0.12	-0.03	-0.11	-0.03

Table 3: Regression results, student achievement in Reading and Numeracy, full sample

KEY VARIABLES	(1) Reading	(2) Numeracy	(3) Reading	(4) Numeracy	(5) Reading	(6) Numeracy
Number of proximate public schools	-0.012***	-0.006**			-0.007**	-0.003
	(0.003)	(0.003)			(0.003)	(0.004)
Number of proximate public schools*Open Enrolment	0.009***	0.007***			0.000	0.001
	(0.002)	(0.002)			(0.004)	(0.005)
Public school competition			-0.022*	-0.008	-0.015	-0.005
			(0.011)	(0.013)	(0.012)	(0.014)
Public school competition*Open Enrolment			0.012***	0.009***	0.011**	0.008
			(0.002)	(0.003)	(0.005)	(0.005)
Constant	-0.105***	0.002	-0.068	-0.002	-0.073	-0.004
	(0.038)	(0.043)	(0.056)	(0.064)	(0.057)	(0.064)
Number of observations	152676	151803	148485	147626	148485	147626
R-squared	0.031	0.032	0.031	0.032	0.031	0.032
# of catchment schools	470	470	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. Additional control variables in all specifications include indicators for gender, home language (Chinese, Punjabi, other non-English), and Aboriginal identity; the proportion of peers in the catchment school's travel zone who speak Chinese, Punjabi, or another non-English language at home, who are Aboriginal, and who are female; mean family income in the student's Census Enumeration/Dissemination area, the number of proximate private and French Immersion school competitors facing the catchment school, and year and catchment area fixed effects.

Table 4: Regression results, student achievement in Reading and Numeracy, students residing in catchment areas of locally top- and bottom-ranked schools

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Top-ranked		Bottom-ranked		Top-ranked		Bottom-ranked	
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
# proximate public schools	-0.004	0.003	-0.003	-0.004	-0.001	0.010	0.001	-0.001
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.008)	(0.008)
# proximate public schools*Open Enrolment	-0.005	-0.014***	0.012***	0.012***	-0.013*	-0.030***	0.000	-0.002
	(0.005)	(0.005)	(0.004)	(0.004)	(0.007)	(0.008)	(0.007)	(0.009)
Public school competition					-0.024	-0.038	0.016	0.043*
					(0.023)	(0.026)	(0.021)	(0.023)
Public school competition*Open Enrolment					0.013*	0.020**	0.014*	0.017*
					(0.008)	(0.009)	(0.008)	(0.010)
Constant	0.016	0.098	-0.108*	0.014	0.052	0.136*	-0.149**	-0.102
	(0.056)	(0.064)	(0.058)	(0.064)	(0.072)	(0.082)	(0.076)	(0.082)
Observations	60070	59770	58098	57735	58506	58216	56552	56196
R-squared	0.031	0.033	0.031	0.032	0.031	0.033	0.031	0.032
Number of catchment schools	341	341	370	371	330	330	356	356

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. Additional control variables in all specifications include indicators for gender, home language (Chinese, Punjabi, other non-English), and Aboriginal identity; the proportion of peers in the catchment school's travel zone who speak Chinese, Punjabi, or another non-English language at home, who are Aboriginal, and who are female; mean family income in the student's Census Enumeration/Dissemination area, the number of proximate private and French Immersion school competitors facing the catchment school, and year and catchment area fixed effects.

Table 5: Regression results, participation in Reading and Numeracy exam, full sample

	(1)	(2)	(3)	(4)	(5)	(6)
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
Number of proximate public	0.002***	0.003***			-0.000	0.000
schools	(0.001)	(0.001)			(0.001)	(0.001)
Number of proximate public	-0.004***	-0.004***			0.000	-0.000
schools*Open Enrolment	(0.001)	(0.001)			(0.001)	(0.001)
Public school competition			0.010***	0.017***	0.010***	0.017***
			(0.004)	(0.004)	(0.004)	(0.004)
Public school competition*Open			-0.004***	-0.005***	-0.005***	-0.005***
Enrolment			(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.108***	0.113***	0.082***	0.066***	0.082***	0.066***
	(0.013)	(0.014)	(0.019)	(0.019)	(0.019)	(0.019)
Observations	171302	171302	166576	166576	166576	166576
R-squared	0.018	0.016	0.018	0.016	0.018	0.016
# of catchment schools	470	470	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is a binary indicator for whether the student participated in the FSA test. Additional control variables in all specifications include indicators for gender, home language (Chinese, Punjabi, other non-English), and Aboriginal identity; the proportion of peers in the catchment school's travel zone who speak Chinese, Punjabi, or another non-English language at home, who are Aboriginal, and who are female; mean family income in the student's Census Enumeration/Dissemination area, the number of proximate private and French Immersion school competitors facing the catchment school, and year and catchment area fixed effects.

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Regression results, student achievement in Reading and Numeracy, full sample, with controls for public information about school mean test scores

KEY VARIABLES	(1) Reading	(2) Numeracy	(3) Reading	(4) Numeracy	(5) Reading	(6) Numeracy
Number of proximate public	-0.011***	-0.002			-0.005	0.003
schools	(0.003)	(0.004)			(0.004)	(0.005)
Number of proximate public	0.007***	0.003			-0.002	-0.004
schools*Open Enrolment	(0.003)	(0.003)			(0.005)	(0.006)
Public school competition			-0.022	-0.019	-0.017	-0.021
			(0.015)	(0.017)	(0.016)	(0.018)
Public school			0.010***	0.006*	0.012**	0.010
competition*Open Enrolment			(0.003)	(0.003)	(0.006)	(0.007)
Constant	-0.089*	0.021	-0.046	0.065	-0.051	0.065
	(0.046)	(0.051)	(0.071)	(0.080)	(0.071)	(0.080)
Observations	114208	113624	111475	110896	111475	110896
R-squared	0.032	0.033	0.032	0.032	0.032	0.032
# of catchment schools	470	470	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. Additional control variables in all specifications include indicators for gender, home language (Chinese, Punjabi, other non-English), and Aboriginal identity; the proportion of peers in the catchment school's travel zone who speak Chinese, Punjabi, or another non-English language at home, who are Aboriginal, and who are female; mean family income in the student's Census Enumeration/Dissemination area, the number of proximate private and French Immersion school competitors facing the catchment school; one- and two-year lags of the catchment school's mean test score, first lag of mean test score interacted with an indicator for 2003 or later, second lag of mean test score interacted with an indicator for 2004 or later, and year and catchment area fixed effects.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7: Regression results, student achievement in Reading and Numeracy, with data from 1999 excluded, full sample and students residing in catchment areas of locally top- and bottom-ranked schools

	Full Sample		Top-ranked		Bottom-ranked	
	(1)	(2)	(3)	(4)	(5)	(6)
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
Number of proximate public	-0.005	-0.000	-0.003	0.011	0.006	0.003
schools	(0.004)	(0.004)	(0.007)	(0.008)	(0.009)	(0.010)
Number of proximate public	-0.001	-0.001	-0.010	-0.029***	-0.005	-0.009
schools*Open Enrolment	(0.004)	(0.005)	(0.008)	(0.009)	(0.008)	(0.009)
Public school competition	-0.021*	-0.013	-0.048*	-0.057**	0.007	0.019
	(0.013)	(0.015)	(0.025)	(0.028)	(0.023)	(0.025)
Public school	0.014***	0.010*	0.014*	0.024**	0.018**	0.017*
competition*Open Enrolment	(0.005)	(0.006)	(0.008)	(0.009)	(0.008)	(0.010)
Constant	-0.027	0.034	0.118	0.173*	-0.072	-0.047
	(0.060)	(0.068)	(0.082)	(0.091)	(0.085)	(0.089)
Observations	130091	129514	50995	50789	49289	49037
R-squared	0.031	0.031	0.031	0.033	0.030	0.031
# of catchment schools	455	455	328	328	350	350

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. Additional control variables in all specifications include indicators for gender, home language (Chinese, Punjabi, other non-English), and Aboriginal identity; the proportion of peers in the catchment school's travel zone who speak Chinese, Punjabi, or another non-English language at home, who are Aboriginal, and who are female; mean family income in the student's Census Enumeration/Dissemination area, the number of proximate private and French Immersion school competitors facing the catchment school, and year and catchment area fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Robustness checks, student achievement in Reading and Numeracy

	(1)[a]	(2)[b]	(3)[c]	(4)[d]
READING				
Number of proximate public schools	-0.007**	-0.009***	-0.007**	-0.007**
	(0.003)	(0.003)	(0.003)	(0.003)
Number of proximate public schools*Open Enrolment	0.000	0.003	-0.000	0.001
	(0.004)	(0.004)	(0.001)	(0.004)
Public school competition	-0.015	-0.004	-0.015	-0.015*
	(0.012)	(0.011)	(0.012)	(0.008)
Public school competition*Open Enrolment	0.011**	0.008*	0.004**	0.012**
	(0.005)	(0.004)	(0.002)	(0.005)
Observations	148485	169460	148485	148485
R-squared	0.031	0.029	0.031	0.031
# of catchment schools	455	455	455	455
NUMERACY				
Number of proximate public schools	-0.003	-0.004	-0.002	-0.001
	(0.004)	(0.003)	(0.003)	(0.004)
Number of proximate public schools*Open Enrolment	0.001	0.001	-0.000	-0.001
	(0.005)	(0.004)	(0.002)	(0.004)
Public school competition	-0.005	0.003	-0.006	-0.015*
	(0.014)	(0.013)	(0.014)	(0.009)
Public school competition*Open Enrolment	0.008	0.009*	0.003*	0.012**
	(0.005)	(0.005)	(0.002)	(0.006)
Observations	147626	168517	147626	147626
R-squared	0.032	0.026	0.032	0.032
# of catchment schools	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. Additional control variables in all specifications include indicators for gender, home language (Chinese, Punjabi, other non-English), and Aboriginal identity; the proportion of peers in the catchment school's travel zone who speak Chinese, Punjabi, or another non-English language at home, who are Aboriginal, and who are female; mean family income in the student's Census Enumeration/Dissemination area, the number of proximate private and French Immersion school competitors facing the catchment school, and year and catchment area fixed effects.

*** p<0.01, ** p<0.05, * p<0.1

[a] Baseline specification (from Table 3).

[b] Private school students included in estimation sample.

[c] With 'years since open enrolment' instead of open enrolment indicator

[d] With average competition facing all public schools in student's choice set, rather than competition facing student's catchment school.

Data Appendix

Control variables

Controls for individual characteristics include indicators for gender, Aboriginal identity and language spoken at home (English, Chinese, Punjabi or other). We also control for mean household income in the Census Enumeration or Dissemination Area (EA or DA, respectively) in which the student resides, as a proxy for unobserved student background characteristics. Postal code level controls include the number of proximate French Immersion schools, number of proximate public schools. Details of the construction of these variables are provided below. Catchment school level controls include the proportion of peers who reside in the catchment school's travel zone who speak Chinese, Punjabi or other non-English home languages, who are Aboriginal and who are female. Details of the construction of these variables are provided below.

Coding of Neighborhood Family Income

To proxy for the student's socioeconomic status, we match their residential postal code to the most recent public-use estimates of neighborhood average income from the 1996, 2001, and 2006 Census long-form. Statistics Canada publishes average income at the Enumeration Area (EA) or the Dissemination Area (DA) level, depending on Census year. 1996 Census estimates were published at the EA level, where an Enumeration Areas typically included 125 to 440 dwellings (in rural and urban areas, respectively). Since the 2001 Census, Statistics Canada has replaced EA-level estimates with estimates at the DA level. A Dissemination Area comprises 400 to 700 persons, so EAs and DAs are comparable in size.

We link postal codes are to an EA/DA using Statistics Canada's Postal Code Conversion File (PCCF), which contains the longitudinal history of each postal code (postal codes are routinely retired and reused elsewhere). Postal codes are smaller than EAs/DAs, although they sometimes straddle multiple EAs or DAs. In these cases, we link the postal code to the best EA/DA using Statistics Canada's single link indicator, which identifies the EA/DA with the majority of dwellings assigned to that postal code. The PCCF also includes the latitude and longitude of the postal code's centroid, which we use to compute the great circle distance between each student's residence and nearby schools. We use these distances to define and code our measures of proximate schools; see below.

Assignment of Postal Codes to School Catchment Areas

We identify students' catchment school by locating residential postal codes within school catchment area boundaries as defined in 2007. Historical information about catchment area boundaries prior to 2007 was not available. To minimize measurement error associated with changes in catchment area boundaries between 1999 and 2007, we use detailed information about school openings and closings to identify all students in our sample whose catchment area school may have been affected by such an event. All such cases were assigned a missing value for their catchment area school in the relevant years.

Coding of Proximate School Alternatives

We obtained postal codes from public sources (most notably, school and district websites) for all schools attended by grade 4 students who met our sample restrictions. We used the PCCF to assign a latitude and longitude to each postal code in each year, and calculated the great circle distance (in km) between the student's residence and all schools in our data set. For each residential postal code in each year, we then calculated the number of active public catchment, French Immersion and private schools within a circle centered on the residential postal code and with radius equal to the 75th percentile of in-sample travel distance to public, French Immersion and private schools, respectively, in the year preceding the introduction of open enrolment.

Coding School Competition

We measure the amount of public, private and French Immersion competition facing a catchment school by first identifying all students for whom that school is proximate, i.e. all students who reside within the 75th percentile of the relevant in-sample travel distance to that school. We then compute the average number of proximate public, private and French alternatives available to those students.

APPENDIX TABLES

Table A3: Regression results, student achievement in Reading and Numeracy, full sample

	(1)	(2)	(3)	(4)	(5)	(6)
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
Number of proximate public schools	-0.012***	-0.006**			-0.007**	-0.003
	(0.003)	(0.003)			(0.003)	(0.004)
Number of proximate public schools*Open Enrolment	0.009***	0.007***			0.000	0.001
	(0.002)	(0.002)			(0.004)	(0.005)
Public school competition			-0.022*	-0.008	-0.015	-0.005
			(0.011)	(0.013)	(0.012)	(0.014)
Public school competition*Open Enrolment			0.012***	0.009***	0.011**	0.008
			(0.002)	(0.003)	(0.005)	(0.005)
CONTROLS						
Chinese home language	0.041***	0.389***	0.040***	0.387***	0.040***	0.387***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
Punjabi home language	-0.415***	-0.261***	-0.413***	-0.260***	-0.412***	-0.260***
	(0.012)	(0.011)	(0.012)	(0.011)	(0.012)	(0.011)
Other home language (not English)	-0.265***	-0.109***	-0.265***	-0.111***	-0.265***	-0.111***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Aboriginal	-0.363***	-0.331***	-0.361***	-0.326***	-0.361***	-0.326***
	(0.012)	(0.011)	(0.012)	(0.011)	(0.012)	(0.011)
Female	0.195***	-0.125***	0.194***	-0.125***	0.194***	-0.125***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Neighborhood family income	0.011***	0.008***	0.012***	0.008***	0.011***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Chinese peers	-0.007	0.125	-0.003	0.138	-0.003	0.138
	(0.073)	(0.089)	(0.074)	(0.089)	(0.074)	(0.089)
Punjabi peers	-0.068	-0.177	-0.078	-0.191*	-0.078	-0.191*
	(0.094)	(0.109)	(0.096)	(0.110)	(0.096)	(0.110)
Other peers	-0.047	-0.039	-0.044	-0.006	-0.042	-0.006
	(0.065)	(0.076)	(0.066)	(0.078)	(0.066)	(0.078)
Aboriginal peers	-0.028	-0.167	-0.021	-0.148	-0.021	-0.148
	(0.099)	(0.116)	(0.101)	(0.117)	(0.101)	(0.117)
Female peers	0.017	0.037	0.023	0.049	0.022	0.049
	(0.045)	(0.051)	(0.046)	(0.052)	(0.046)	(0.052)
#ProximateFrenchSchools	-0.022***	-0.019***	-0.024***	-0.019***	-0.022***	-0.019***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
#ProximatePrivateSchools	0.004*	0.002	0.004*	0.002	0.004*	0.002
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
YEAR = 2000	0.013	0.005	0.015	0.006	0.015	0.006
	(0.012)	(0.014)	(0.012)	(0.015)	(0.012)	(0.015)
YEAR = 2001	-0.001	0.003	0.001	0.004	0.002	0.004

	(0.012)	(0.015)	(0.012)	(0.015)	(0.012)	(0.015)
YEAR = 2002	0.013	0.011	0.015	0.011	0.016	0.011
	(0.012)	(0.015)	(0.012)	(0.015)	(0.012)	(0.015)
YEAR = 2003	-0.035**	-0.047***	-0.044***	-0.054***	-0.045***	-0.054***
	(0.014)	(0.017)	(0.015)	(0.018)	(0.015)	(0.018)
YEAR = 2004	-0.026*	-0.039**	-0.034**	-0.045**	-0.034**	-0.045**
	(0.014)	(0.017)	(0.015)	(0.018)	(0.015)	(0.018)
YEAR = 2005	-0.033**	-0.050***	-0.044***	-0.055***	-0.044***	-0.055***
	(0.014)	(0.017)	(0.014)	(0.018)	(0.015)	(0.018)
YEAR = 2006	-0.051***	-0.066***	-0.064***	-0.072***	-0.064***	-0.072***
	(0.015)	(0.019)	(0.016)	(0.020)	(0.016)	(0.020)
Constant	-0.105***	0.002	-0.068	-0.002	-0.073	-0.004
	(0.038)	(0.043)	(0.056)	(0.064)	(0.057)	(0.064)
Observations	152676	151803	148485	147626	148485	147626
R-squared	0.031	0.032	0.031	0.032	0.031	0.032
# of catchment schools	470	470	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. All specifications include catchment area fixed effects.
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered by catchment area and year.
*** p<0.01, ** p<0.05, * p<0.1

Table A4: Regression results, student achievement in Reading and Numeracy, students residing in catchment areas of locally top- and bottom-ranked schools

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Top-ranked		Bottom-ranked		Top-ranked		Bottom-ranked	
	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
# of proximate public schools	-0.004	0.003	-0.003	-0.004	-0.001	0.010	0.001	-0.001
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.008)	(0.008)
# of proximate public schools*Open Enrolment	-0.005	-0.014***	0.012***	0.012***	-0.013*	-0.030***	0.000	-0.002
	(0.005)	(0.005)	(0.004)	(0.004)	(0.007)	(0.008)	(0.007)	(0.009)
Public school competition					-0.024	-0.038	0.016	0.043*
					(0.023)	(0.026)	(0.021)	(0.023)
Public school competition*Open Enrolment					0.013*	0.020**	0.014*	0.017*
					(0.008)	(0.009)	(0.008)	(0.010)
Chinese	-0.009	0.345***	0.025*	0.372***	-0.008	0.345***	0.027*	0.372***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Punjabi	-0.455***	-0.302***	-0.435***	-0.287***	-0.456***	-0.308***	-0.429***	-0.282***
	(0.022)	(0.022)	(0.025)	(0.023)	(0.022)	(0.022)	(0.025)	(0.023)
Other home language	-0.295***	-0.136***	-0.260***	-0.098***	-0.292***	-0.133***	-0.260***	-0.101***
	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)	(0.015)
Aboriginal	-0.360***	-0.358***	-0.402***	-0.345***	-0.357***	-0.352***	-0.398***	-0.337***
	(0.021)	(0.020)	(0.020)	(0.019)	(0.021)	(0.020)	(0.021)	(0.020)
Female	0.202***	-0.124***	0.212***	-0.121***	0.202***	-0.123***	0.211***	-0.120***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)

Neighborhood family income	0.010***	0.006***	0.008***	0.005**	0.011***	0.005**	0.008***	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Chinese peers	0.100	0.250**	-0.063	0.016	0.105	0.254**	-0.070	0.024
	(0.097)	(0.123)	(0.107)	(0.123)	(0.098)	(0.123)	(0.108)	(0.123)
Punjabi peers	0.100	0.207	0.168	0.068	0.065	0.199	0.169	0.055
	(0.198)	(0.230)	(0.207)	(0.211)	(0.203)	(0.233)	(0.210)	(0.213)
Other peers	0.165	0.129	-0.098	-0.010	0.183*	0.169	-0.084	0.011
	(0.101)	(0.120)	(0.096)	(0.111)	(0.101)	(0.121)	(0.099)	(0.112)
Aboriginal peers	-0.092	-0.391**	-0.130	-0.391**	-0.060	-0.356*	-0.152	-0.391**
	(0.178)	(0.196)	(0.160)	(0.179)	(0.184)	(0.204)	(0.165)	(0.182)
Female peers	-0.092	0.027	0.020	0.048	-0.101	0.031	0.008	0.067
	(0.069)	(0.078)	(0.070)	(0.073)	(0.071)	(0.080)	(0.073)	(0.075)
#ProximateFrench	-0.012	-0.008	-0.018*	-0.006	-0.013	-0.009	-0.017*	-0.007
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
#ProximatePrivate	0.003	0.003	0.002	-0.002	0.003	0.005	0.002	-0.001
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
2000	-0.016	-0.038*	0.061***	0.042*	-0.015	-0.040*	0.058***	0.038*
	(0.018)	(0.022)	(0.018)	(0.022)	(0.018)	(0.023)	(0.018)	(0.022)
2001	-0.032*	-0.045**	0.046***	0.055**	-0.026	-0.048**	0.049***	0.051**
	(0.017)	(0.022)	(0.017)	(0.022)	(0.017)	(0.022)	(0.018)	(0.022)
2002	-0.023	-0.053**	0.075***	0.069***	-0.017	-0.057**	0.078***	0.066***
	(0.019)	(0.023)	(0.018)	(0.021)	(0.019)	(0.023)	(0.018)	(0.021)
2003	-0.064***	-0.091***	0.036*	0.028	-0.075***	-0.114***	0.022	0.006
	(0.020)	(0.023)	(0.020)	(0.024)	(0.022)	(0.025)	(0.021)	(0.026)
2004	-0.061***	-0.103***	0.045**	0.024	-0.069***	-0.121***	0.033	0.007
	(0.019)	(0.024)	(0.019)	(0.025)	(0.021)	(0.027)	(0.021)	(0.027)
2005	-0.070***	-0.109***	0.018	0.016	-0.081***	-0.127***	0.006	-0.000
	(0.019)	(0.024)	(0.020)	(0.024)	(0.021)	(0.026)	(0.021)	(0.027)

2006	-0.074***	-0.116***	0.012	-0.014	-0.091***	-0.137***	-0.005	-0.028
	(0.022)	(0.027)	(0.023)	(0.027)	(0.024)	(0.029)	(0.025)	(0.029)
Constant	0.016	0.098	-0.108*	0.014	0.052	0.136*	-0.149**	-0.102
	(0.056)	(0.064)	(0.058)	(0.064)	(0.072)	(0.082)	(0.076)	(0.082)
Observations	60070	59770	58098	57735	58506	58216	56552	56196
R-squared	0.031	0.033	0.031	0.032	0.031	0.033	0.031	0.032
Number of catchment schools	341	341	370	371	330	330	356	356

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. All specifications include catchment area fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Regression results, participation in Reading and Numeracy exam, full sample

	(1)	(2)	(3)	(4)	(5)	(6)
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
Number of proximate public schools	0.002***	0.003***			-0.000	0.000
	(0.001)	(0.001)			(0.001)	(0.001)
Number of proximate public schools*Open Enrolment	-0.004***	-0.004***			0.000	-0.000
	(0.001)	(0.001)			(0.001)	(0.001)
Public school competition			0.010***	0.017***	0.010***	0.017***
			(0.004)	(0.004)	(0.004)	(0.004)
Public school competition*Open Enrolment			-0.004***	-0.005***	-0.005***	-0.005***
			(0.001)	(0.001)	(0.001)	(0.001)
CONTROLS	0.002***	0.003***			-0.000	0.000
Chinese home language	0.018***	0.003	0.018***	0.003	0.018***	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Punjabi home language	0.005	0.004	0.005	0.004	0.005	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Other home language (not English)	0.067***	0.059***	0.066***	0.058***	0.066***	0.058***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Aboriginal	0.087***	0.093***	0.087***	0.093***	0.087***	0.093***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Female	-0.028***	-0.022***	-0.029***	-0.023***	-0.029***	-0.023***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
Neighborhood family income	-0.003***	-0.004***	-0.003***	-0.004***	-0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Chinese peers	-0.088**	-0.062	-0.088**	-0.061	-0.088**	-0.061
	(0.041)	(0.042)	(0.041)	(0.042)	(0.041)	(0.042)
Punjabi peers	-0.128***	-0.120***	-0.127***	-0.119***	-0.128***	-0.119***
	(0.036)	(0.037)	(0.036)	(0.037)	(0.037)	(0.037)
Other peers	-0.039*	-0.026	-0.037	-0.024	-0.037	-0.024
	(0.023)	(0.024)	(0.023)	(0.024)	(0.023)	(0.024)
Aboriginal peers	-0.030	-0.021	-0.026	-0.019	-0.026	-0.019
	(0.031)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
Female peers	0.007	0.003	0.007	0.002	0.007	0.002
	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
#ProximateFrenchSchools	0.003	0.004*	0.003	0.004*	0.003	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
#ProximatePrivateSchools	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
YEAR = 2000	0.010***	-0.004	0.010***	-0.004	0.010***	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
YEAR = 2001	0.023***	0.011***	0.022***	0.010**	0.022***	0.010**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
YEAR = 2002	0.020***	0.008**	0.019***	0.006	0.019***	0.006

	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
YEAR = 2003	0.037***	0.037***	0.040***	0.041***	0.040***	0.041***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
YEAR = 2004	0.045***	0.036***	0.048***	0.039***	0.049***	0.039***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
YEAR = 2005	0.072***	0.065***	0.075***	0.068***	0.075***	0.068***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
YEAR = 2006	0.102***	0.094***	0.107***	0.099***	0.107***	0.099***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Constant	0.108***	0.113***	0.082***	0.066***	0.082***	0.066***
	(0.013)	(0.014)	(0.019)	(0.019)	(0.019)	(0.019)
Observations	171302	171302	166576	166576	166576	166576
R-squared	0.018	0.016	0.018	0.016	0.018	0.016
# of catchment schools	470	470	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. All specifications include catchment area fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table A6: Regression results, student achievement in Reading and Numeracy, full sample, with controls for public information about school mean test scores

	(1)	(2)	(3)	(4)	(5)	(6)
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
Number of proximate public schools	-0.011***	-0.002			-0.005	0.003
	(0.003)	(0.004)			(0.004)	(0.005)
Number of proximate public schools*Open Enrolment	0.007***	0.003			-0.002	-0.004
	(0.003)	(0.003)			(0.005)	(0.006)
Public school competition			-0.022	-0.019	-0.017	-0.021
			(0.015)	(0.017)	(0.016)	(0.018)
Public school competition*Open Enrolment			0.010***	0.006*	0.012**	0.010
			(0.003)	(0.003)	(0.006)	(0.007)
CONTROLS						
Chinese home language	0.036***	0.406***	0.034***	0.403***	0.034***	0.404***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Punjabi home language	-0.415***	-0.240***	-0.415***	-0.240***	-0.414***	-0.240***
	(0.014)	(0.013)	(0.014)	(0.013)	(0.014)	(0.013)
Other home language (not English)	-0.265***	-0.082***	-0.266***	-0.083***	-0.266***	-0.083***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Aboriginal	-0.346***	-0.317***	-0.344***	-0.313***	-0.344***	-0.313***
	(0.014)	(0.013)	(0.015)	(0.013)	(0.015)	(0.013)
Female	0.195***	-0.138***	0.196***	-0.138***	0.196***	-0.138***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Neighborhood family	0.010***	0.008***	0.010***	0.008***	0.010***	0.008***

income						
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Chinese peers	-0.059	0.118	-0.062	0.121	-0.061	0.122
	(0.086)	(0.103)	(0.087)	(0.104)	(0.087)	(0.104)
Punjabi peers	0.140	-0.052	0.109	-0.093	0.111	-0.093
	(0.126)	(0.142)	(0.126)	(0.141)	(0.126)	(0.141)
Other peers	0.049	0.060	0.066	0.107	0.067	0.107
	(0.073)	(0.087)	(0.074)	(0.089)	(0.074)	(0.089)
Aboriginal peers	0.121	-0.004	0.138	0.034	0.138	0.035
	(0.114)	(0.131)	(0.116)	(0.132)	(0.116)	(0.132)
Female peers	0.040	0.057	0.045	0.066	0.044	0.065
	(0.052)	(0.059)	(0.053)	(0.061)	(0.053)	(0.061)
#ProximateFrenchSchools	-0.026***	-0.023***	-0.027***	-0.023***	-0.025***	-0.023***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
#ProximatePrivateSchools	-0.001	-0.005	-0.001	-0.004	-0.001	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
T-1 Catchment School Mean Test Score	-0.013	0.055*	-0.031	0.031	-0.031	0.031
	(0.025)	(0.029)	(0.026)	(0.030)	(0.026)	(0.030)
T-1 Catchment School Mean Test Score *OE	-0.026	-0.046	-0.011	-0.026	-0.010	-0.027
	(0.024)	(0.029)	(0.025)	(0.030)	(0.025)	(0.030)
T-2 Catchment School Mean Test Score	0.014	0.008	0.011	0.007	0.011	0.008
	(0.020)	(0.023)	(0.021)	(0.023)	(0.021)	(0.023)
T-2 Catchment School Mean Test Score*OE	-0.095***	-0.091***	-0.101***	-0.097***	-0.101***	-0.097***
	(0.022)	(0.026)	(0.022)	(0.026)	(0.022)	(0.026)
YEAR = 2002	0.013	0.007	0.013	0.007	0.013	0.007
	(0.012)	(0.014)	(0.012)	(0.014)	(0.012)	(0.014)
YEAR = 2003	-0.022	-0.032**	-0.035**	-0.042**	-0.036**	-0.043**
	(0.014)	(0.016)	(0.015)	(0.017)	(0.015)	(0.017)
YEAR = 2004	-0.024*	-0.035**	-0.037**	-0.044**	-0.037**	-0.045**
	(0.014)	(0.016)	(0.015)	(0.018)	(0.015)	(0.018)
YEAR = 2005	-0.035**	-0.049***	-0.050***	-0.059***	-0.050***	-0.060***
	(0.014)	(0.016)	(0.015)	(0.018)	(0.015)	(0.018)
YEAR = 2006	-0.047***	-0.061***	-0.063***	-0.069***	-0.064***	-0.070***
	(0.015)	(0.018)	(0.016)	(0.019)	(0.016)	(0.019)
Constant	-0.089*	0.021	-0.046	0.065	-0.051	0.065
	(0.046)	(0.051)	(0.071)	(0.080)	(0.071)	(0.080)
Observations	114208	113624	111475	110896	111475	110896
R-squared	0.032	0.033	0.032	0.032	0.032	0.032
# of catchment schools	470	470	455	455	455	455

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. All specifications include catchment area fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Regression results, student achievement in Reading and Numeracy, with data from 1999 excluded

	(1)	(2)	(3)	(4)	(5)	(6)
KEY VARIABLES	Reading	Numeracy	Reading	Numeracy	Reading	Numeracy
Number of proximate public schools	-0.005	-0.000	-0.003	0.011	0.006	0.003
	(0.004)	(0.004)	(0.007)	(0.008)	(0.009)	(0.010)
Number of proximate public schools*Open Enrolment	-0.001	-0.001	-0.010	-0.029***	-0.005	-0.009
	(0.004)	(0.005)	(0.008)	(0.009)	(0.008)	(0.009)
Public school competition	-0.021*	-0.013	-0.048*	-0.057**	0.007	0.019
	(0.013)	(0.015)	(0.025)	(0.028)	(0.023)	(0.025)
Public school competition*Open Enrolment	0.014***	0.010*	0.014*	0.024**	0.018**	0.017*
	(0.005)	(0.006)	(0.008)	(0.009)	(0.008)	(0.010)
CONTROLS						
Chinese home language	0.040***	0.393***	-0.010	0.349***	0.021	0.374***
	(0.011)	(0.011)	(0.016)	(0.016)	(0.016)	(0.017)
Punjabi home language	-0.412***	-0.249***	-0.460***	-0.302***	-0.436***	-0.282***
	(0.013)	(0.012)	(0.024)	(0.023)	(0.027)	(0.024)
Other home language (not English)	-0.265***	-0.099***	-0.300***	-0.128***	-0.259***	-0.088***
	(0.009)	(0.010)	(0.015)	(0.016)	(0.015)	(0.016)
Aboriginal	-0.350***	-0.318***	-0.351***	-0.350***	-0.390***	-0.330***
	(0.013)	(0.012)	(0.023)	(0.021)	(0.023)	(0.022)
Female	0.192***	-0.130***	0.197***	-0.131***	0.205***	-0.128***
	(0.006)	(0.005)	(0.009)	(0.009)	(0.009)	(0.009)
Neighborhood family income	0.010***	0.008***	0.009***	0.006***	0.007***	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Chinese peers	-0.044	0.103	0.076	0.192	-0.163	-0.074
	(0.079)	(0.095)	(0.105)	(0.132)	(0.118)	(0.132)
Punjabi peers	0.003	-0.168	0.027	0.090	0.247	0.000
	(0.106)	(0.123)	(0.224)	(0.249)	(0.231)	(0.221)
Other peers	0.007	0.051	0.162	0.129	-0.079	0.012
	(0.070)	(0.084)	(0.108)	(0.131)	(0.105)	(0.118)
Aboriginal peers	0.118	-0.062	-0.066	-0.389*	-0.078	-0.275
	(0.107)	(0.124)	(0.196)	(0.219)	(0.180)	(0.195)
Female peers	0.027	0.052	-0.113	-0.022	-0.003	0.060
	(0.049)	(0.055)	(0.076)	(0.085)	(0.079)	(0.079)
#ProximateFrenchSchools	-0.024***	-0.020***	-0.012	-0.010	-0.020*	-0.005
	(0.007)	(0.007)	(0.011)	(0.011)	(0.010)	(0.011)
#ProximatePrivateSchools	0.002	-0.000	0.003	0.006	0.004	0.002
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
YEAR = 2001	-0.014	-0.003	-0.011	-0.011	-0.010	0.012
	(0.012)	(0.014)	(0.017)	(0.022)	(0.019)	(0.021)
YEAR = 2002	0.000	0.004	-0.001	-0.018	0.020	0.029
	(0.012)	(0.014)	(0.019)	(0.023)	(0.019)	(0.020)
YEAR = 2003	-0.061***	-0.058***	-0.062***	-0.082***	-0.038*	-0.023
	(0.015)	(0.017)	(0.021)	(0.025)	(0.022)	(0.024)

YEAR = 2004	-0.053***	-0.051***	-0.058***	-0.088***	-0.026	-0.021
	(0.015)	(0.018)	(0.021)	(0.026)	(0.022)	(0.025)
YEAR = 2005	-0.063***	-0.063***	-0.070***	-0.094***	-0.052**	-0.027
	(0.015)	(0.017)	(0.021)	(0.026)	(0.023)	(0.024)
YEAR = 2006	-0.079***	-0.077***	-0.079***	-0.105***	-0.062**	-0.059**
	(0.016)	(0.019)	(0.024)	(0.028)	(0.026)	(0.027)
Constant	-0.027	0.034	0.118	0.173*	-0.072	-0.047
	(0.060)	(0.068)	(0.082)	(0.091)	(0.085)	(0.089)
Observations	130091	129514	50995	50789	49289	49037
R-squared	0.031	0.031	0.031	0.033	0.030	0.031
# of catchment schools	455	455	328	328	350	350

Notes: Standard errors clustered by catchment area and year. Dependent variable is the student's FSA test score. All specifications include catchment area fixed effects.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$